What is real choice for HEALTH AND HYGIENE TEXTILES?
- REUSABLES or DISPOSABLES

It can take more than 400 years for these to decompose...
What’s so disposable about them?
A number of crucial issues regarding medical products in general and health care and hygiene products in particular have been identified and debated amongst clinical, environmentalists, drug companies, etc. for a long time now. The issues such as natural against chemical or manufactured fibres; disposables against reusable or durable fabrics; antibacterial or antimicrobial fibres against such finishes or coatings for infection control; and method of disposal of clinical waste i.e. landfill against incineration and other forms of medical and clinical waste disposal, are constantly being discussed in most relevant forums and conferences across the globe.

There are pros and cons to using disposable nonwovens and reusable textiles infection control products. The decision-making process often becomes more difficult for healthcare facilities that are trying to reduce both disposal costs and high labour costs related to reprocessing. And when it comes to evaluating the safety and infection control abilities of disposable and reusable products, particularly surgical textiles, there is little consensus on which is better, other than the importance of balancing cost considerations relating to infection prevention issues and the environmental effects.

From the discussion we would be able to say that the argument between disposables and durables for healthcare products will continue and one obvious solution of this argument is the increased and universal usage of biodegradable natural and manufactured fibres and products across the whole spectrum of the products. The recycling or disposal of clinical or medical waste materials poses problems of health and safety and availability and cost of landfill sites and incineration. This problem can be also controlled by using the reusable barrier fabrics with an improved laundry facilities and standards. But at last, “The Choice Depends On Customer”.
INTRODUCTION

A number of crucial issues regarding medical products in general and health care and hygiene products in particular have been identified and debated amongst clinical, environmentalists, drug companies, etc. for a long time now. The issues such as natural against chemical or manufactured fibres; disposables against reusable or durable fabrics; antibacterial or antimicrobial fibres against such finishes or coatings for infection control; and method of disposal of clinical waste i.e. landfill against incineration and other forms of medical and clinical waste disposal, are constantly being discussed in most relevant forums and conferences across the globe. Here in this paper we will be mainly concentrating on the issue of “disposables against reusable or durable fabrics for health and hygiene products”.

A BRIEF HISTORY OF REUSABLE AND DISPOSABLE TEXTILES

Up until the late 1800s, there were no surgical gowns, drapes, or wrappers to promote a sterile field. The concept of the germ theory was introduced at that time through the efforts of Louis Pasteur, Joseph Lister and Robert Koch, all of whom endeavoured independently. As a result of these efforts, the germ theory evolved. The idea, obvious today, represented a breakthrough, more than 100 years ago. This was a theory about certain diseases which are caused by microorganisms, too small to be seen except through the microscope. The development of the sterile field, generally credited to Florence Nightingale, was a practical response to the germ theory. The sterile field is an area immediately around a patient that has been prepared for a surgical procedure, and is considered free of microorganisms (Mosby’s, 2002). Today, and in recent years, the combined use of surgical gowns, drapes and wrappers, along with many other products and procedures, are utilized to promote sterility in the Operating Room.

Originally, all textile components used to maintain a sterile procedure were reusable. These were all cotton materials which were laundered and sterilized prior to each use, but they use to loss their barrier properties during each wash. Many new products have been introduced during the last 5 decades which covers the above demerits of cotton reusable. However, the popularity of the single-use products mushroomed dramatically when skewed by the provisions of a reimbursement system that permitted all single-use items to be charged to the patient on a cost-plus basis. In addition, having thus been viewed as revenue generators by hospital administrators, whatever clinical benefit to be derived from their use was totally obscured by their financial and environmental effects. Although improved materials were available in both reusable and single-use qualities, for a decade thereafter most hospitals continued to use products made of the traditional, readily permeable, reusable material. Some health care providers simply incorporated the new, more expensive “barrier” quality materials into their gowning and draping practices with the thought that
they would perhaps protect their patients from another possible portal of entry for exogenous contamination.

**INTRODUCTION TO REUSABLE AND DISPOSABLE TEXTILES**

An important area of textile is the healthcare and hygiene sector among medical applications. The range of products available for healthcare and hygiene is vast, but they are typically used in either in the operating theatre or in hospital wards for hygiene, care and safety of the staff and patients. They could be reusable or disposable. Disposable items are single-use and nonwoven, while reusable items are multiple-use and woven.

The most important criteria for the operation room products are the degree of barrier properties inherent in the item, according to Barbara J. Gruendemann, RN, MS, FAAN, CNOR and Sandra Stonehocker Mangum, RN, MN, CNOR, authors of Infection Prevention in Surgical Settings. These items must meet standards established by the American Society for Testing Materials (ASTM), the Association for the Advancement of Medical Instrumentation (AAMI) and the Association of perioperative Registered Nurses (AORN).
Depending upon the cost involved, protection and comfort offered and the criticality of the operation, a judicious selection of the right type of fabric is very essential. Textile materials used for these fabrics include: Reusable or multiple use fabrics made from cotton, linen or polyester / cotton blends and Single use disposable textile fabrics are constructed from a spun-lace, wet-laid wood pulp and polyester fibre blend, and a spun-bonded, melt blown polyethylene, with both having polyethylene film laminated beneath the nonwoven fabric in critical areas. The modern reusable barrier fabrics are made from the polyester microfilaments with high density of threads per unit area.

**REUSABLE TEXTILES VS DISPOSABLE TEXTILES**

There are pros and cons to using disposable nonwovens and reusable textiles infection control products. The decision-making process often becomes more difficult for healthcare facilities that are trying to reduce both disposal costs and high labour costs related to reprocessing. And when it comes to evaluating the safety and infection control abilities of disposable and reusable products, particularly health and hygiene product, there is little consensus on which is better, other than the importance of balancing cost considerations relating to infection prevention issues and the environment.

The main function of the health and hygiene product is to do *infection control* by providing *maximum comfort*. The principal design features of fabric, weather reusable or disposable, utilized as medical textiles must meet minimum performance standards for *barrier protection, sterilization stability, breath ability & comfort, low linting, economical and environment friendly* to ensure the safety of healthcare workers (HCW)'s and patients.

**INFECTION CONTROL**

One thing is certain that infection control both with in the hospital and in the house hold environments has become an extremely serious concern to everyone, as some *5000 deaths are caused as a direct result of unhygienic hospital environments in UK every year*. The control of micro-organisms, including Ecoli, staoh aureus MRSA, Enterococcus faecium VRE and SARS, etc. have become an international issue of great importance and concern. Hence the *efforts are being carried out to avoid infection in every way*. The world health organization (WHO) has *recommended use of disposable personal protective equipment* i.e. apron, mask, gown, cap, gloves etc. in its practical guidelines for infection control in health care facilities.

Nonwoven disposable products can facilitate and enhance infection prevention and control efforts in the healthcare setting and reduce the opportunity for cross-contamination compared to reusable textiles. International studies have indicated that *single-use nonwoven products reduced infection by 2.5 times compared to reusable woven textiles*. 
International studies have also shown that 56% of reusable textiles had significant defects that could seriously compromise their performance to cause infection.

**BARRIER PROTECTION**

For the infection control the barrier protection is the most important property required in the health and hygiene products. Without this, there would be no reason to wear a gown or drape a patient.

The barrier requirement can be partial (“-resistant”) or total (“-proof”), ranging from particulates and bacteria to fluids and viruses. e.g. “higher efficiency allergenic bedding”, basically an SMS which meets the dust and particle barrier performance. The barrier protection properties of material are usually measured as:

- **BFE (Bacterial Filtration Efficiency)** measures the % efficiency at which the face mask filters bacteria passing through the mask.
- **PFE (Particulate Filtration Efficiency)** measures the % efficiency at which the face mask filters particulate matter passing through the mask.
- **Delta P (AP) (Breathability)** is the pressure drop across a facemask, expressed in mm water/cm². The higher the Delta P, the more difficult the mask is to breathe through.
- **Fluid resistance** is defined as the ability of a facemask’s material construction to minimize fluids from travelling through the material and potentially coming into contact with the user of the facemask. Fluid resistance helps reduce potential exposure to blood and body fluids caused from splashes, spray or spatter.

Reusable and disposable products are more or less comparable in this respect. The quality does not therefore depend on whether a product is simply reusable or disposable. There is well-document information supporting both, disposables and reusable. The American National Standards Institute ANSI and AAMI published a study showing that when laundered properly; reusable garments and drapes are 70% more effective in providing barrier protection, when tested for meeting standards. However, a European study concluded that the microbial-penetration resistance of single-use nonwoven surgical textiles is superior to that of reusable textiles, highlighting that the reusable products showed a lower liquid resistance than required in critical areas. Unlike this Nonwoven disposable fabrics are engineered to have high barrier to blood or body fluids. There was one thing both studies agreed upon: **appropriate processing is of major importance.**

Medical textiles are made sterile and are intended to prevent any possibility of infection being transmitted from the surgeon’s arms or torso to the patient. When designing fabric for sterilization it is essential to understand the impact of sterilization procedures on fabric performance features. **The reusable woven surgical textiles need to be washed and sterilized after each surgery.** Nonwoven disposable products are manufactured in sterilised environment and packed in PP bags and dispenser boxes sterilised before despatch. Hence the nonwoven disposable shows the proven sterilize performance.
Another important point to remember is that gowns protect patients and staff. However, they can also be a mode of pathogen transmission if not used, removed and discarded appropriately. Regardless of whether disposable or re-usable gowns are purchased, they should only be used once, then discarded or reprocessed. **Disposable single use products can also help to remove reservoirs of pathogenic organisms**, namely HCWs medical apparel during patient-care activities.

Non-woven disposables not only have properties to prevent infection but they are also very comfortable for doctors (in the sense they have good breathability and are soft). In the case of reusable surgical gowns as the number of washes increases from 0 to 30, the bacterial filtration efficiency reduces from 92.8% to 69.2% and air permeability increases from $5.8 \text{ m}^3/\text{cm}^2/\text{sec}$ to $6.5 \text{ cm}^3/\text{cm}^2/\text{sec}$. whereas, disposable non-woven surgical gowns have 95-98% bacterial filtration efficiency and 25-30 $\text{ cm}^3/\text{cm}^2/\text{sec}$ air permeability. Hence, disposable non-woven products are much safer and comfortable compared to reusable products.

**COMFORT AND BREATH ABILITY**

Wear comfort is not just a convenience; it is a physiological requirement. It is of particular concern to the OR team, whose efficiency needs to be supported rather than impaired. However, the drape should also offer adequate physiological comfort in order to benefit the patient. If this is not the case, additional help is often given in the form of increased medication or blankets.

The comfort and breathability factor is usually considered as opposing the barrier function. For sterilization wrap, the issue is that the barrier must prevent dust and micro-organisms penetrating a sterilized package during storage and transportation. At the same time it must be porous enough for the sterilant to penetrate the wrapped package and completely sterilize the contents of surgical sets. Nonwoven disposables have good breathability compared to reusable. Another fact of comfort is often described as “Drape-ability” and hand. Fabric flexibility also affects comfort and provides easy moulding over the body and in surgical drapes. For gowns, comfort and stiffness may affect perspiration and movement. Reusable cotton textiles have good drape ability and good absorbency compared to nonwoven disposables due to this they provide sufficient comfort. This can be seen from the following figure:-
Particles including lint are a safety-related concern in the operating room and have been identified as the source of contamination that cause potential infections and pyrogenic affects. **Re-usable cotton fabrics generate lot of lint during washing process hence there are chances of spreading infection.** But, with the advent of **non-woven materials, the lint has virtually been decreased to little or no lint present.** The **modern reusable barrier fabrics** produced from continues filament yarns **have very low propensity** compared to the traditional reusable cotton fabrics. As traditional spun yarns used in cotton fabrics and spun laced disposables are both constructed with “staple fibres”. The ends of each fibre are a potential source of lint. Filament barrier fabrics use continuous filaments that do not have fibre ends. Thus have very low propensity to lint.

**STRENGTH**

The strength of surgical textiles is especially important because they are subjected to high mechanical stress levels when used, e.g. bent arm at elbow. Even the best possible barrier properties are of little use if the material tears or bursts during use. In the standard, strength is measured in two ways: Bursting Strength and Tensile Strength. **Reusable products perform better in both categories.**
**Bursting strength**

Bursting strength describes the strength of the product in all directions of the material. It is measured in a dry and a wet state. Modern Reusable products offer substantially higher bursting strength than disposable products both for minimum and maximum performance levels.

**Tensile strength**

Resistance to tearing describes the strength of the product in the longitudinal (machine or warp) and horizontal direction (weft). For example, as surgeon bends forward, the gown can be stretched in different directions at shoulder and back. It is measured in a dry and a wet state. Even weak reusable products offer considerably higher resistance to tearing than disposable products.

**COST**

In today’s economy, hospitals are beginning to fully appreciate that purchase price is not the only cost of the product – one must also take into account associated costs in the product’s lifecycle. For example, with disposables one must consider the cost of waste removal. According to the 2005 Comparative Operating Revenues and Expense Profile for the Healthcare Textile Maintenance Industry, if a hospital chose to use disposable surgical products rather than reusable, they would incur upward of an additional about 35 cents per pound per year. *It is said that the use of single use nonwoven products will reduce the overall health care cost to the nation by reducing cross infection.*

For surgical gowns, on a cost per use basis, the following estimates were disclosed (American Reusable Textile Association, 2005). Costs of a surgical gown comparisons re: Reusable vs. Disposable impermeable surgical gowns (50 processing cycles vs. single use):

<table>
<thead>
<tr>
<th></th>
<th>Reusable</th>
<th>Disposable</th>
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<tbody>
<tr>
<td>Initial cost</td>
<td>($60.00)</td>
<td>($4.50)</td>
</tr>
<tr>
<td>Cost per use</td>
<td>1.20*</td>
<td>4.50</td>
</tr>
<tr>
<td>Administrative costs</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Packing and sterilization</td>
<td>0.40</td>
<td>----</td>
</tr>
<tr>
<td>Laundering</td>
<td>0.50</td>
<td>----</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>----</td>
<td>0.25</td>
</tr>
<tr>
<td>Total cost per use</td>
<td>$2.25</td>
<td>$4.90</td>
</tr>
</tbody>
</table>
Based on 50 launder and sterilization cycles. The preceding is an estimate, based on long experience. These figures can vary, but the cost saving characteristics of reusable barrier fabrics are expected to be maintained.

**Actual savings with reusable textiles have been reported. A major healthcare facility advises an annual savings (surgical gowns and towels) of $60.00 and at the same time, diminished waste by 50,000 pounds.**

The above point is only sustainable only if the laundry follows the AAMI/ANSI ST65:2000 “Processing of Reusable Surgical Textiles for Use in Health Care Facilities”.

Disposable textiles require more onsite storage as compared with reusable that are delivered daily, potentially, the space currently used for storing disposable products could be converted to revenue-generating uses, such as for medical equipment, operating rooms or more patient beds. However, **while disposable products generate a significant amount of waste, the cleaning and storage of reusable products has its own impact on the environmental and cost management.**

According to the Environmental Protection Agency (EPA)’s Energy Star program, hospitals spend $8.3 billion on energy each year and offer $2.5 billion in potential savings. While **innovations in laundering have cut the amount of water, energy and chemical use by two to three times, a hospital with more than 300 beds typically uses 16 pounds of textiles per patient day, making laundry services one of the top services accounting for most of a hospital’s energy use.** Reusable textile services can create economic benefits for the hospital in this area by taking over or simplifying logistic procedures and transparency of consumption and costs allow effective control.

But when we talk about India as a developing country, the total costs of using single-use fabrics are generally lower cost than re-usable, as disposal cost is not taken into consideration, thus the use of single use nonwoven surgical textiles will reduce the overall health care cost to the nation by reducing cross infection. In India total budgeted expenditure of Ministry of health of Rs 18380 crore inclusive of National Rural Health Mission of Rs 12529 crore can be reduced significantly by adopting/increasing use of nonwoven disposable.

**ENVIRONMENTAL EFFECTS**

The environmental impact of products and their resource consumption are taken very seriously and assessed extensively at both national and international level. The biggest problem involved with the surgical textiles disposable products, weather single use or multiuse, is its disposal. As disposal of medical textiles potentially can pollute water supplies and the air whether sent to a landfill or burned. Also when they are made from the manmade materials they take around 400 years to degrade and in such circumstances, if single use product are utilized it would be a major concern for an environment, as the land required for their disposal would be more and more in growing years. And it is estimated that
if the single use textiles are used at the same rate than, “50% of landfills open today will be filled to capacity within 5 years”. This can be controlled by using the modern laundry facilities and following the laundry, AAMI/ANSI ST65:2000 “Processing of Reusable Surgical Textiles for Use in Health Care Facilities”.

CONCLUSION

When we try to compare the different properties in brief can be stated as follows:

<table>
<thead>
<tr>
<th></th>
<th>Cotton reusable</th>
<th>Disposables</th>
<th>High tech reusable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barrier effect</strong></td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Cleanliness</strong></td>
<td>+</td>
<td>?</td>
<td>+</td>
</tr>
<tr>
<td><strong>Particle emission</strong></td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Comfort and breathability</strong></td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Environmental impact</strong></td>
<td>+/-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Functionality</strong></td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Cost effective</strong></td>
<td>+/-</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>Value for money</strong></td>
<td>-</td>
<td>+/-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Full fill global standards</strong></td>
<td>-</td>
<td>+</td>
<td>+*</td>
</tr>
<tr>
<td><strong>Consistency in use</strong></td>
<td>-</td>
<td>+</td>
<td>+*</td>
</tr>
<tr>
<td><strong>Environmental friendly</strong></td>
<td>+</td>
<td>-</td>
<td>-/+</td>
</tr>
</tbody>
</table>

*(with modern laundry facilities and standards) if not used it may cause pollution in other way e.g., water waste, chemical waste evolved from soaps, etc.

From the above table we can say that the argument between disposables and durables surgical textile products will continue and one obvious solution of this argument is the increased and universal usage of biodegradable natural and manufactured fibres and products across the whole spectrum of the products. The recycling or disposal of clinical or medical waste materials poses problems of health and safety and availability and cost of landfill sites and incineration.

At last, “The choice depends on customer”, the product that would be able to satisfy the customers mind will lead the market and also the effect cased on environment will fully rely on the thinking of an individual personality.

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