Significance of Textiles in Surgical Gowns

Dr.Chinta S.K.* & Veena K.V
D.K.T.E's Textile & Egg. Institute, Ichalkaranji

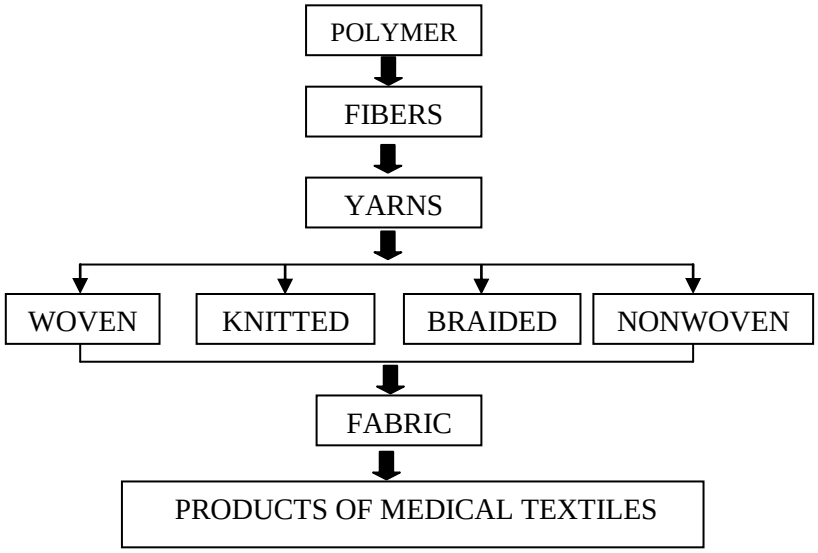
Introduction:

Combination of textile and its application in medical sciences has resulted into a new field called medical textiles. New areas of application for medical textiles have been identified with the development of new fibers and manufacturing technologies for yarns and fabrics. Development in the field of textiles, either natural or manmade textiles, normally aimed at how they enhance the comfort to the users. Development of medical textiles is really meant for converting the painful days of patients and surgeons into the comfortable days.

Consumption of different categories of medical textiles:

SR.NO	Medical Textile Product	Market potential (Rs in Lakhs)	
		2005	2010
1	Sanitary Napkins	4819	8519
2	Incontinence diapers	605	1070
3	Surgical dressing	5828	10302
4	Health care textiles	1491	2635
5	Sutures	3160	5587
6	Medical devices & Implants	1190	2104

Constituent element of Medical Textile products:



Characteristics of materials for medical use:

The major requirements for biomedical polymers

1. Non toxicity
2. Nonallergenic response
3. Mechanical properties
4. Strength
5. Elasticity
6. Durability
7. Biocompatibility
8. The ability to be sterilized as biomedical materials may be contaminated with bacteria, sterilization is very important for biomedical polymers. The sterilization technique can be physical or chemical.

Fibers used for medical and healthcare application:

Textiles materials that are used in medical applications include fibers, yarns, fabrics and composites. Depending upon the application, the major requirements of medical textiles are absorbency, tenacity, flexibility, softness and at times biostability or biodegradability.

Fibers used in medical field may vary from natural fibre such as cotton, silk, regenerated wood fluff (absorbent layer), to, manmade fibers like polyester, polyamide, polyethylene, glass etc.

The various applications of different fibers in medical field are shown as below:

Sr.No.	Fibre	Application in medical field
1	Cotton	Surgical clothing gowns, Beddings, Sheets, Pillow cover, Uniforms, Surgical hosiery
2	Viscose	Caps, Masks, Wipes
3	Polyester	Gowns, Masks, Surgical cover drapes, Blankets, Cover stock
4	Polyamide	Surgical hosiery
5	Polypropylene	Protective clothing
6	Polyethylene	Surgical covers, Drapes
7	Glass	Caps mask
8	Elastomeric	Surgical hosiery

A number of crucial issues regarding medical products in general and healthcare and hygiene products in particular have been identified and debated amongst clinicians, environmentalist, drug companies etc. for a long time. The issues such as

- Natural fibers against chemical or manufactured fibers.

- Disposable against reusable or durable fabrics.
- Antibacterial or antimicrobial fibers against finishes or coatings for infection control
- Methods of disposal of clinical waste i.e. landfills against incineration and other forms of medical and clinical waste disposal.

There is general move towards an increased use of natural polymers that are biocompatible, biodegradable and nontoxic.

History of Surgical Gowns:

The use of surgical gowns and drapes dates back from a century. Their primary purpose was to protect the sterile surgical zones from microbial invasion. Most of the items were made of a loosely woven, readily permeable, reusable fabric generically known as muslin. Surgical gowns with impermeable areas and edges will block the transfer of bacteria, viruses, infections, blood borne pathogens, and other harmful agents and chemicals to and from the patient. Surgical gowns are widely considered to be the foremost item of protective equipment today. Nonetheless, surgical gowns and surgical apparel have not been in standard use for very long. Surgical gowns and apparel did not come into regular use in the surgical profession until the 1800s. During those times, surgeons conducted their operations in auditorium or amphitheater-style rooms where the operation would take place in the center and the audience would sit in the surrounding seats. Surgeons would typically wear their street clothes and occasionally wear something similar to a butcher's apron to protect his clothing from stains. In fact, surgeons typically conducted operations with bare hands and non-sterile surgical instruments and supplies.

It wasn't until the late 1800s that the surgical world took notice of antiseptics, sterile equipment, and protective clothing. This revolution was largely due to the pioneering research of Joseph Lister. Lister used carbolic acid solution to sterilize surgical instruments, surgical incisions, and dressings in an effort to prevent gangrene and other infections. He published numerous articles on the *Antiseptic Principle of the Practice of Surgery* describing these procedures in 1867. He also encouraged surgeons to wear clean gloves and wash their hands before and after operations. His research, articles, and life work led to the rise of sterile surgery.

Nevertheless, surgical gowns and other protective equipment didn't see wide use until much later. During the Spanish flu epidemic of 1918, surgeons began wearing cotton gauze masks and rubber gloves to protect them from the patient's disease. It wasn't until the 1940's that advances in antisepsis and knowledge of infections led to the use of antiseptic drapes and surgical gowns. Originally, medical scrubs and other surgical attire were white, in an effort to emphasize cleanliness. However, the combination of bright lights, white rooms, and white clothing caused eyestrain in surgeons and staff. Additionally, many people found the sight of blood splattered on these white gowns to be a bit distasteful, to say the least. It was not until 1952 that Beck alerted the surgical community to the fact that while the material may have been considered an acceptable bacteriological barrier when dry, it lost its barrier capability once it became wet even

when multiple layers were used. This proved to be the turning point that triggered research into developing more satisfactory materials for this unique application. It was also during this period that another segment of the textile industry made its presence known, namely, nonwoven, disposable material that was intended to be used once and thrown away. Therefore, the use of white surgical gowns and other apparel was abandoned and hospitals began to use various shades of green and blue surgical attire. As surgical procedures progressed throughout the twentieth century, surgical apparel saw greater usage and improvement. But it wasn't until the 1980s when the biggest increase in use of surgical apparel began. The AIDS epidemic has a lot to do with this. Today, different gowns are designed to handle different surgeries. The cost of gowns varies with the amount of protection afforded. To perform a surgery with several risks and a high blood count, a higher barrier, and frequently reusable, gown will be chosen. For less risky surgeries, a lower barrier disposable gown is used. Disposable gowns offer benefits in that hospitals which can dispose of the contaminated textiles quickly, they reduce laundry costs, and they can be doffed quickly in locations such as Emergency Rooms. It is virtually unheard of that a surgical procedure is performed without full protective clothing to prevent infection of both the patient and surgical team. Fortunately, maintaining and increasing that level of safety has become a main concern for a number of companies serving the surgical apparel market. As a result, advancement in protective surgical apparel continues to be made.

Requirements for surgical gowns and drapes

General requirements	General requirements from the perspective of users	Requirements from the perspective of surgeons	Requirements from the perspective of patients
Barrier function (against the penetration of germs)	Protective function	Germ barrier	Protective function
Prevention of germ transmission	Liquid tightness (resistance to liquid penetration)	Protection against injuries to the patient	High cut resistance
Protection of the patient	High cut resistance, tensile strength and tear propagation resistance	High tensile strength	Liquid tightness
Protection of the user and Skin compatibility of the tapes	Well sealed seams	Good adhesiveness of the tapes	High tensile strength and tear propagation resistance
Can be processed without losing quality	High product safety	Liquid tightness including in operations with large quantities of blood	Good stretch ability when dry and wet
Sets can be composed individually	Low flammability limit (when working with electricity, especially in HF surgery)	Absorbency/high liquid absorption with the drapes	Good adhesiveness of the tapes including when drenched
Good drapability	Easy handling and Easy storage and Easy to remove packaging		Easy to remove the tapes
Antistatic properties and Low flammability	Practical composition/correct sequence of the sets		Prevention of cooling and Delay of heat loss
No unpleasant odors	Easy to remove the protective adhesive strip		

Performance Requirements: Surgical gowns are worn by doctors and nurses in the operating theater to perform a dual function of preventing transfer of microorganisms and body fluids from the operating staff to the patient, and also from patient to staff. Many of the performance requirements for surgical gowns are well documented. The desired characteristics of surgical gowns include that they should:

1. be resistant to penetration by blood and other body fluids as necessitated by their intended use (data verifying that the gown materials are protective barriers against the transfer of microorganisms, particulates, and fluids to minimize strike-through and the potential for personnel contamination should be obtained from the manufacturer)
2. maintain their integrity
3. be durable
4. have an acceptable level of quality (i.e., be free of holes and/or defects)
5. be constructed of materials that are appropriate to the method(s) of sterilization (e.g., radiation, steam, and ethylene oxide)
6. resist combustion, i.e., gowns selected for use should be consistent with accepted flammability standards that will provide the safest environment for patients and health care workers
7. be comfortable
8. contribute to maintaining the wearer's desired body temperature, i.e., have the ability to maintain an isothermic environment for the wearer
9. be resistant to tears, punctures, and abrasions
10. be as lint-free as possible
11. be free of toxic ingredients and allergens (patients and/or health care workers may experience untoward reactions to toxic ingredients and/or allergens)
12. be flexible, i.e., the gown conforms loosely to the wearer's body
13. have limited memory
14. be of adequate size to allow for complete closure in the back
15. be of adequate sleeve length to prevent cuff exposure outside the sterile glove
16. have a favorable cost-benefit ratio, i.e., cost should not be the primary consideration in the selection process.
17. surgical gowns must repel diseases and infections yet provide adequate freedom to move.
18. Allow necessary mobility without rubbing and chafing, and must resist tearing and linting.
19. fit closely but not restrict movement. Since there is generally excess fabric, the gowns must withstand constant pulls on the fabric during routine movements.
20. be designed to fit a diversity of body shapes and sizes with a limited range of sizes as hospitals will only stock limited quantities (du Pont, 2001).
21. control the bacteria released into the theater and aid in maintaining the sterile zone required for patient safety.
22. provide for easy donning and doffing without contamination, yet not have openings where the barrier might be breached.
23. be durable enough to last the intended useful life of the garment, be that single or multi-use.

Structural requirements

Structural analysis is undertaken to assess the design features of existing products and to characterize the market. For surgical gowns, comfort issues related to product design are of particular concern as comfort is a critical product requirement. Although comfort is somewhat dependent on the permeability and flexibility of the fabric, there is a design influence (T-PACC, 1997).

Why do doctors wear green or blue scrubs?

Scrubs (or surgical gowns) used to be white—the color of cleanliness. Then in the early twentieth century, one influential doctor switched to green because he thought it would be easier on a surgeon's eyes, according to an article in a 1998 issue of *Today's Surgical Nurse*. Although it is hard to confirm whether green scrubs became popular for this reason, green may be especially well-suited to help doctors see better in the operating room because it is the opposite of red on the color wheel.

Green could help physicians see better for two reasons. First, looking at blue or green can refresh a doctor's vision of red things, including the bloody innards of a patient during surgery. The brain interprets colors relative to each other. If a surgeon stares at something that's red and pink, he becomes desensitized to it. The red signal in the brain actually fades, which could make it harder to see the nuances of the human body.

Types of gowns used in patient care

Surgical gowns:

- Usually packaged as sterile products or designed to be sterilized
- Some are disposable and others are made of fabric that is labeled as washable for multiple use
- Come in various sizes, including one-size-fits-all
- Made of fluid-resistant materials to reduce the transfer of body fluids

Isolation gowns:

- not sold as sterile products
- usually intended to protect the wearer from the transfer of microorganisms and only small amounts of body fluids

Choosing between surgical gowns and isolation gowns

When working in a hospital or other healthcare environment:

- Surgical gown should be chosen when performing surgery or other sterile procedure.
- Isolation gown should be chosen when caring for a patient in isolation.

What should be known before using surgical gowns?

- Select gown materials based on the activity and the amount of body fluid that is expected.
- Remove surgical gowns promptly when they are soiled.
- If blood or body fluids soak through a surgical gown, remove it and any soiled clothing underneath and immediately wash skin.
- Never reuse disposable surgical gowns.
- Never wash or disinfect disposable surgical gowns.
- Never share surgical gowns with other users.

Standard Specification for Surgical Gowns Intended for Use in Healthcare Facilities

ASTM Standards

- D751 Test Methods for Coated Fabrics.
- D1683 Test Method for Failure in Sewn Seams of Woven Apparel Fabrics.
- D1776 Practice for Conditioning and Testing Textiles.
- D5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
- D5587 Test Method for Tearing Strength of Fabrics by Trapezoid Procedure.
- D5733 Test Method for Tearing Strength of Nonwoven Fabrics by the Trapezoid Procedure.
- D6701 Test Method for Determining Water Vapor Transmission Rates Through Nonwoven and Plastic Barriers.
- F1494 Terminology Relating to Protective Clothing.
- F1671 Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System.
- F1868 Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate.

AAMI Documents: AAMI/ANSIBE78:2002 Biological Evaluation of Medical Devices, Part 10: Test for Irritation and Sensitization

AATCC Standards: AATCC127 Water Resistance: Hydrostatic Pressure Test

ANSI/ASQC Standard: ANSI/ASQCZ1.4 Sampling Procedures and Tables for Inspection by Attributes

ISO Standards: ISO13683 Sterilization of healthcare products--Requirements for validation and routine control of moist heat sterilization in healthcare facilities

Federal Standards:29CFRPart1910.1030 Occupational Exposure to Blood-borne Pathogens: Final Rule, Federal Register, Vol. 66, No. 12 / Thursday, January 18, 2001.

References:

1. http://cardinalhealth.com/convertors/documents/pdf/2CON0047-01_AAMI%20PB70-2003%20brochure.pdf

2. Farzana Kishwar, Samina Kalsoom, Filza zafar Khan, Shahzad Alam, Mohd. Tariq Sohail, " *Surgical Apparels Comparison of some physical parameters*" Professional Med J July-Sep 2011, Vol 18(3), P 390-395, http://www.theprofesional.com/article/2011/Vol-18-no-3/010-Prof. 1698.pdf

3. Nathan.L.Belkin, *"Gowns and drapes for the level of exposure anticipate"*. Vol 87, number 5, bulletin of the american college of surgeons http://www.facs.org/fellows_info/bulletin/belkin0502.pdf

4. reusable surgical fabrics, Clinicum the magazines for mangers in the hospitals, http://www.medizinmedien.at/mm/mm024/low_Kons_MehrwegtextilienENGL_cc0911.pdf

5. Fabric technology helps protect patients and healthcare workers, http://www2.dupont.com/Medical_Device_Material/en_US/assets/downloads/medical_fabric_technology.pdf

6. D. Gopalakrishnan & R K Aswini, *Nonwoven for medical textiles*, http://www.fibre2fashion.com/industry-article/pdffiles/Nonwovens-For-Medical-Textiles.pdf

7. Traci May-Plumlee and Amanda Pittman, Surgical gowns requirements capture, JTATM, Vol2, issue 2, spring 2002. http://www.tx.ncsu.edu/jtatm/volume2issue2/articles/mayplumlee/plumlee_full.pdf

* The Author to whom correspondence should be made:
Prof (Dr.) S.K.Chinta
D.K.T.E's Textile & Egg. Institute, Ichalkaranji
Mobile: 07709802270/09422421424
E-mail: chinta.sk@gmail.com