

AN INSIGHT TO MEDICAL TEXTILES**Dr. Deepti Sharma^{1*} and Dr. Harvinder Popli²**¹BHMS; MHM, Delhi Pharmaceutical Sciences and Research University, Delhi.²Dean, Delhi Pharmaceutical Sciences and Research University, Delhi.Article Received on
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Delhi.**ABSTRACT**

Medical textile is one of the most rapidly expanding markets across the world and variety of textiles with medical industry applications are being consumed in that market. This article classifies the different types of medical textiles currently available in the market and gives an overview of application of different textiles used in healthcare industry and their utility across the world. We highlight on the different aspects related to the choice of different medical textiles. It also gives an insight into the future of medical textiles namely smart medical textiles and use of nanotechnology in the manufacturing of these textiles.

KEYWORDS: Healthcare apparel, Contaminated textiles, Antimicrobial, Active barrier apparel, Personal protective equipment, Occupational exposure.

INTRODUCTION

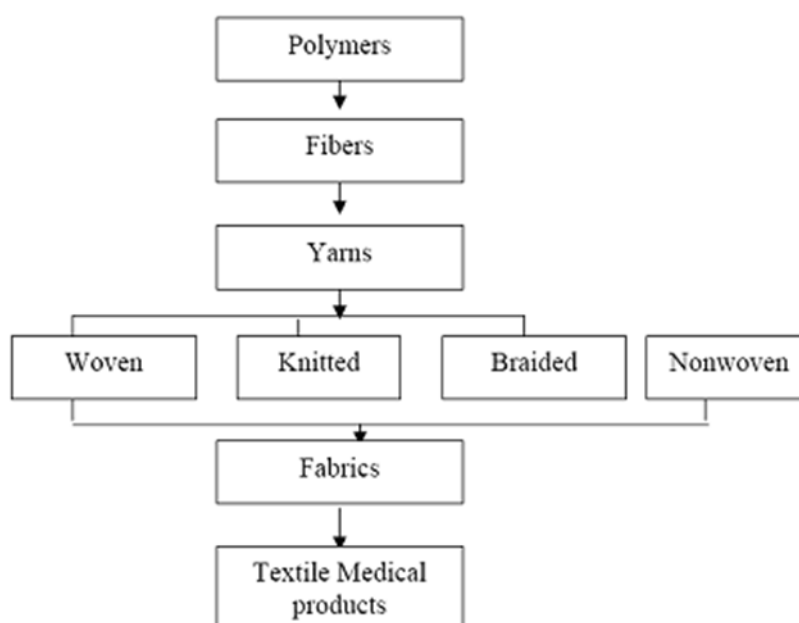
Amalgamation of textile technology and medical sciences has resulted into a new field called medical textiles. Medical textiles are those finished goods which are used in surgical end use and hygiene, healthiness and private care. Based on the area of application, the medical textiles products can be woven, knitted and non-woven structure. Increasingly, synthetic fiber is being utilized in the manufacturing of these products. Development in the field of textiles, both natural and manmade textiles, focusses at how they enhance the comfort to the users. Arena of medical textiles is a boon, which is meant for converting the painful days of patients into the comfortable days. Application of medical textiles has been refined with the development of new fibers and manufacturing technologies for yarns and fabrics. The most basic and vital use of textile in medicine has been wound care and preventing chronic wounds. The most used amongst textiles are bandages and wound dressings which are

affordable and reusable.^[1] The medical textile should have bio-compatibility, flexibility and strength.

BRIEF HISTORY OF MEDICAL TEXTILES

The history of medical textiles goes back to thousands of years ago when the development of wound closures and sutures took place. With the advancement in surgery, the development of wound closures during 5000-3000 BC came into existence. These wound closures used to be made from natural materials such as flax, silk, linen strips, and cotton. To ensure a clean wound closure procedure and to reduce tissue drag the natural materials used were first lubricated in oil and wine. To make wound closures mandibles (jaw/jawbones) of soldier ants were also used. These were utilized for making surgical clips in bowel surgery. In 30 AD, the Roman Cornelius Celsus has described the use of sutures and clips, and Aelius Galen described the use of silk and catgut in 150 AD. Indian plastic surgeon Sushruta has elaborated on suture material made from flax, hemp, and hair. More advancement was recorded in surgical and suture technique finally in the 1800s with the development of sterilization procedures. Synthetic sutures were introduced with the development of synthetic polymers and fibers.

CONSTITUENTS OF MEDICAL TEXTILE PRODUCTS



PROPERTIES OF IDEAL MEDICAL TEXTILE FIBER^[2]

1. Non toxic
2. Non Allergenic

3. Non Carcinogenic
4. Ability to be sterilized without imparting any change in the physical or chemical characteristics.
5. Biocompatibility
6. Flexibility
7. Strength
8. Elasticity

CLASSIFICATION OF MEDICAL TEXTILE FIBER

This refers to the fibers used in to medical application and it can be classified into two groups:

a) Commodity fiber b) Specialty fiber

Commodity Fiber includes natural & regenerated fiber like cotton, silk and viscose i.e. Cellulose based fibers. Whereas synthetic fibers include polyester, polypropylene, PTFE (poly-tetra fluoro ethylene), Polyamide, Carbon, Glass Fiber.

Specialty Fibers are broadly made from following types of materials

1. **Collagen:** Collagen is obtained from cow skin. It is a protein which is available either in hydrogel or fiber form. Collagen fibers when used as suture are as strong as silk and are biodegradable.
2. **Calcium Alginate:** This variety of synthetic fiber is made from brown seaweed. This fiber has healing properties. Calcium alginate fibers have been proven to be of help in improving wound healing. Wound dressing made from such fibers are non- toxic, biodegradable and hemostatic.
3. **Chitin:** This is a polysaccharide that is obtained from crab and shrimp shell. It has excellent antithrombogenic characteristics. It can be absorbed by the body and it promotes healing.
4. **Chitosan:** Treatment of Chitin with alkali produces chitosan. It can be spun into filament and the strength of the fiber is similar to viscose rayon.

According to biological resistance the medical textile can be

Biodegradable fibers include Cotton, Viscose rayon, polyamide, polyurethane, collagen and alginate, polycaprolactone. These are absorbed by the body within 2-3 month time after implantation.

Non-biodegradable fibers are those which are absorbed by the body slowly and take more than six month time to degrade. These include polyester (e.g. Dacron), polypropylene, PTFE and carbon.

CLASSIFICATION OF MEDICAL TEXTILES

The textiles used for medical and surgical purpose is classified as follows

1. Non implantable material: Non implantable materials refer to those used outside the human body to assist the recovery of wounds. These include wound dressing, plaster, and bandages.
1. Wound dressings are materials that provide protection against infection and absorb blood and exudate to promote healing and hence enhance wound healing.^[3]
2. Extra-Corporeal devices: These are used to replace the diseased tissues and organs. These include the artificial organs (artificial kidney, liver and lung). The manufacturing of these devices requires precise design and manufacture. The properties of such devices are vital. E.g. Cervical Collar, Foam Padded Arm Sling.
3. Implantable Materials: Include sutures, vascular grafts, artificial ligaments, artificial joints, scaffolds for tissue growth and so on, each providing suitable properties for the end-use. These textile structures can be used inside the human body for variety of purposes, for example, for closure (sutures) or replacement surgery (vascular grafts, artificial ligaments etc.).
4. Healthcare & hygienic products: An important area of textile is in the healthcare and hygiene sector. Varieties of products are available for healthcare and hygiene, and are typically used either in the operating theatre or in the hospital wards for hygienic, care and safety of the staff and patients. E.g. Surgical Hosiery, Masks and Wipes.

APPLICATIONS OF TEXTILES IN MEDICAL FIELD^[4]

1. Repair or replacement of injured tissue, prostheses of bone, joint or tooth; artificial: heart valve, blood vessel or skin, contact lens
2. Assistance or substitution of psychological functions of a failed organ, artificial heart/lung/kidney/liver or pancreas temporarily
3. Disposable article in a daily medical treatment; tubing, syringe, suture, catheters tube inserted into a body cavity to remove fluid etc.
4. New delivery systems for drugs like plastic release devices can be used.
5. Clinical lab tests tool with quick response, high accuracy and sensitivity for tests

6. Separation of blood components plasma separation, cell separation, removal of virus and bacteria.

SMART MEDICAL FABRIC TECHNOLOGY

Smart medical textiles revolutionize health care. Smart fabric technology has a great deal to offer patient monitoring. Sensors integrated right into the textile provide the least annoying way to monitor vitals.^[5]

Body temperature of patients can be regulated by fabrics which can detect the need of the wearer and ideal body temperature. This fabric was designed by VTT Technical Research Centre of Finland. It works by identifying the patient and measuring the surrounding temperature and then adjusting temperature according to the needs of the patient.

This could be particularly useful for patients in hospital who feel cold after surgery or get too hot during an operation.

Users can gain access to lab-quality analysis by using a biometric “shirt” developed by Hexoskin. Few projects like heart rate measuring clothes, blood vessels developed from textiles and suits for increasing mobility of disabled children are being developed. By using new and smart textiles for medical applications, new opportunities are created in the health care sector.

CHALLENGES FACED BY MEDICAL TEXTILE INDUSTRY

Manufacturing of medical textiles in India is not well developed in presence of existing settings. Market access is quite difficult and complex in India.

Most Medical Textile companies use external distributors to reach the market. But, these results in less control over the customer and market dynamics that poses a challenge to effectively market the product. Also, it is very demanding to meet the specific requirements of the Indian market. There is a requirement for low cost products with high quality that can be used in resource constrained settings. Few studies in this field have found that key barriers to success in the Indian Medical Technology industry for start-ups are access to capital, clinical partners and technical resources, product engineering, development and regulatory expertise, access to labs and equipment, lack of ideas and understanding of clinical needs.^[6]

Opportunities In The Field Of Medical Textiles In India

India is the second most populous country in the world with a huge requirement for healthcare services. The opportunity in the Medical Textile industry is also tremendous. Consumption is increasing rapidly. The healthcare spending from the private sector comprises over 70% of the market which is more than comparable developing countries as well as developed countries.

Bulk of the market is through the in-patient segment of the hospital sector. There are opportunities to cater to the in-patient market. Hence, private hospital sector too is growing rapidly.

The growth in the healthcare market is driven by the higher income of the patients who also have greater healthcare awareness, especially with the increase in non-communicable diseases. The market currently is still open and this creates an opportunity to cater to the needs of such a population.

Increased preventive care and treatment creates an opportunity not only in the diagnostic market but also in the hospital market as increased diagnosis leads to increased hospitalization.

RECOMMENDATIONS

There are ample numbers of opportunities in the Medical Textile industry in India. In order to take realistic advantage of these opportunities, the development of products and solutions should take the aspects of affordability and accessibility into consideration.

One of the most practical ways of capitalizing on the gaps and opportunities in the Indian Medical Textile industry is to undertake a formal process of identifying and analyzing the 'Unmet needs' from a clinical and resource perspective. The formal process addresses the 'voice of customers' and other stakeholders in the ecosystem. Once the unmet needs are identified and analyzed, concepts to address these problems and gaps must be generated.

CONCLUSION

Range and extent of use of textile materials in healthcare is a reflection of their enormous versatility. In reality, however, thorough research is required to manufacture a textile for even the simplest cleaning wipe so as to meet the stringent performance specifications. New developments continue to utilize the range of fibers and fabric-forming techniques which are

available. Innovations in fiber technology have resulted in new types of wound dressing which contribute to the healing process. Advanced composite materials containing combinations of fibers and fabrics have been developed for aiding in situations where biocompatibility and strength are required. It is predicted that composite materials will continue to have a long-lasting and deeper impact in this sector owing to the large number of characteristics and performance criteria required from these materials. Non-woven are being increasingly utilized in every area of medical and surgical textiles because of the various benefits like shorter production cycles, higher flexibility and versatility, and lower production.

BIBLIOGRAPHY

1. Canonico, I. P., Industrial Plasma Treatment for Nonwovens, *Nonwovens Ind. Textiles*, 2000; 3: 36-40.
2. Rajendran S, Anand SC. Developments in medical textiles. *Textile progress*. Dec 1 2002; 32(4): 1-42.
3. Virk RK, Ramaswamy GN, Bourham M, Bures BL. Plasma and antimicrobial treatment of nonwoven fabrics for surgical gowns. *Textile research journal*. Dec 2004; 74(12): 1073-9.
4. Sun G, Worley SD. Chemistry of durable and regenerable biocidal textiles. *Journal of Chemical Education*. Jan 2005; 82(1): 60.
5. Lansdown AB. Silver in health care: antimicrobial effects and safety in use. In *Biofunctional textiles and the skin* Karger Publishers.,. 2006; 33: 17-34.
6. Behera BK, Arora H. Surgical gown: a critical review. *Journal of industrial textiles*. Jan 2009; 38(3): 205-31.
7. Overcash M. A comparison of reusable and disposable perioperative textiles: sustainability state-of-the-art 2012. *Anesthesia & analgesia*. May 1; 2012; 114(5): 1055-66.
8. Sarmadi, M., and Denes, F., Surface Modification of Polymers under Cold Plasma Conditions, *Tappi J*. 1996; 79(8): 184-204.