Developments in Health Care and Medical Textiles - A Mini Review-1

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Abstract: This review intends to highlight the developments in medical and Health care textiles, current perspective and key challenges regarding the advancements of non-toxic and eco-friendly solutions for health care. This study provides an appraisal on the innovative, intelligent and smart textile products related to Health care and medical textiles. This review also intends to highlight the current state of the technologies as well as future advances and enhancements potential of new textile materials in antimicrobial, surgical sutures and wound dressings. A discussion on classification of antimicrobial textiles, types of surgical sutures and wounds management make this review interdisciplinary.

Key words: Antimicrobial, surgical sutures, wound dressings, polymer, textile fibres

INTRODUCTION
Textiles are common materials used in all Health care facilities. As the name suggests, a medical textile—usually used interchangeably with "Health care textile" is any textile product that offers a medical advantage. Since medical textiles present a great variety of opportunities for textile manufacturers, numbers of textile materials in the form of knits, woven, nonwoven and composite have been employed in various Health care and medical applications. For a particular purpose, these products must pass the requirements of particular end-use performances (White et al., 2010). Internal applications such as surgical sutures and implants and external applications like gauzes, bandages, gowns, surgical masks, hospital apparel, upholstery fabrics, tampons, adult briefs, nappies, face masks and arm and knee braces, etc. have to achieve utmost standard properties (Harrison, 2002).

New applications of medical textiles are directly related to the innovations in new textile fibres, novel materials and ultra modern manufacturing methods and technologies (Thilagavathi et al., 2007). Developments in medical textiles endeavour to improve the comfort for patient and end-users; consequently, development of all medical textiles is aimed to convert the painful days of patients and surgeons into the comfortable days (Patel and Desai, 2014). Among the important requirements for biomedical products, non toxicity, no allergenic response, strength, mechanical properties, durability, elasticity and biocompatibility are considered vital prerequisites for successful health products (Chinta and Veena, 2013).

Furthermore, the bulk of the products fall in medical and Health care sector is disposable, while the remainder can be reused after appropriate cleaning. Medical textiles utilize all major forms of textiles, i.e., fibre, yarn, roving, woven fabrics and nonwoven. All these can be classified in the following four different groups, non-implantable materials, extracorporeal device, implantable devices and hygiene products (Horrocks and Anand, 2000). Vast applications of Nonwovens are found in the area of non implantable devices and hygiene products. Range of new fibres as well as technologies makes it possible to introduce cheaper, better, compatible, innovative and biodegradable products. Cotton, viscous, polyester, polypropylene, polyamide, polyethylene, hollow, polysaccharides, elastomeric and others fibres are used predominantly in such medical textiles (Horrocks and Anand, 2000; Czajka, 2005).

This review intends to highlight the developments of textiles related to medical and Health care. Moreover, the present status and important challenges to develop non-toxic and eco-friendly solutions for health care are also covered in this write-up.

Antimicrobial textiles: The expression 'antimicrobial' suggests a wide variety of products and technologies that give different degrees of defense for textile materials against germs and microorganisms. Antimicrobials products vary in their actions, chemical properties, impact on environment and people, durability, regulatory compliance, handling characteristics, costs and their interaction with microorganisms (White et al., 2010). Fungi, yeast, bacteria, mold, mildew and virus are part of human lives and they all are either good or bad types of microorganisms (Malek and Speier, 1982). Consumers worldwide has opted towards sanitation, hygiene and

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active lifestyle, which has not only stimulated extensive research and development in medical textiles, but also created a rapidly rising market for a large scope of textile products offered with anti-microbial properties (Borkow and Gabby, 2007; Gao and Cranston, 2008; Ramachandran et al., 2004). Application of antimicrobial finishes is observed in clothing such as undergarments, protective apparels, home-furnishing and sportswear used in areas with high danger of infection and disease by pathogens, for example, operation theaters, medical laboratories and hospitals (Singh et al., 2005; Ziberman and Elsner, 2008).

Variety of antimicrobial compounds for textiles are used, such as ammonium compounds, triclosan, quaternary, polybiquanides, N-halamines and metals like silver and naturally derived antimicrobials such as chitosan being experimented (Gao and Cranston, 2008; Purwar and Joshi, 2004; Simonczc and Tomsic, 2010). Antimicrobial compounds used in textiles must comply vital consumer requirements such as effectiveness against microorganisms, appropriateness for textile processing, stability and a favourable safety and environmental properties (Gao and Cranston, 2008). Ongoing topics of research include the development of novel and improved antimicrobials (Dastjerdi and Montazer, 2010; Bhena et al., 2011) and development of antimicrobial products based on naturally-derived products (Joshi et al., 2009).

The effectiveness of antimicrobial textiles is attained by numerous different methods. The most commonly and widely used product having antimicrobial property today is 2,4,4-trichloro-2'-hydroxydiphenyl ether, also called Triclosan (Harrison, 2002; Orhan et al., 2007). The chemical structure is shown in Fig. 1.

Triclosan inhibits the growth of microbial by affecting fatty acid biosynthesis through stopping lipid biosynthesis and by reacting with the residues of amino acid of the enzyme-active site within a membrane (Orhan et al., 2007).

Quaternary ammonium compounds (QAC), for instance are those having chains of 12 to 18 atoms of carbon, had been extensively tried as disinfectants and anti-septic antimicrobial agents (Gao and Cranston, 2008; Schindler and Hauser, 2004). Chemical structure of QAC is displayed in Fig. 2. QAC’s antimicrobial activity is relied on the number of quaternary ammonium groups and length of the alkyl chain present in the molecules that bear a positive (+ve) charge on the N atom. The antimicrobial action comes from the attractive interactions between the catonic (+ve charged) ammonium group of the QAC and the negatively charged cell membrane of microbes. This creates the disruption of all vital functions of the cell membrane and, as a result, the break of protein activity. QAC also attacks DNA multiplication ability of microbes (Simonczc and Tomsic, 2010).

Another commonly used biocide, Polyhexamethylene biguanide (PHMB), is used in various antimicrobial applications. It has been experimented as a disinfectant for swimming pools, food industry and as an antiseptic agent in hospitals to control wound infections. PHMB is also utilized in cosmetics business as an important preservative, fabric softeners, personal care products, hand-wash detergents and contact lens solutions (Thilagavathi et al., 2007).

**Surgical sutures:** Sutures are foreign body materials which are implanted into human tissues. Although sutures are the most common implants used by doctors and surgeons worldwide, their biological and physical characteristics are usually not fully understood and appreciated (Capperauld, 1989). Sutures are normally grouped according to their physical format, origin of raw material and their capacity to absorb, desorp, or not to absorb (Capperauld, 1989). Common rules for the choice of suture mainly depend on the past experience of the surgeon, surgical method, wound curing rates of the tissue and the size of suture used (Ingle and King, 2010).

An absorbable type suture decomposes in the human body because it degrades as a wound heals. These types of sutures are made from the materials which are broken down in body tissue after a certain period of time, normally from 10 to 30 days, depending on the composition of suture (Martin and Williams, 2003). On the other hand, non-absorbable type sutures are designed to either be left permanently in the human body, or they have to be taken out after a particular healing time (Almarzouq et al., 2014). These permanently placed non-absorbable sutures are usually applied in tissue where curing and healing may take place but the new body tissues may never have the

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**Fig. 1:** Chemical structure of Triclosan

- CH$_3$
- (CH$_2$)$_3$Si
- N
- (CH$_2$)$_n$
- CH$_3$Cl
- CH$_3$

**Fig. 2:** Chemical structure of 3-tri hydroxysilyl propy ldimethyloctadecyl ammonium chloride

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appears in nature and made synthetically using petroleum products, although they are also manufactured from natural materials such as wood pulp. Some important natural fibers include cotton, silk and linen. Man-made or synthetic polymers include polyester, polyamide, nylon, polypropylene, etc. Important natural polymers include proteins and alginites. Furthermore, several non-fibrous materials are also used in wound care (Petruelye, 2008).

Because of the discovery of moist healing concept, alginites are found to be one of the most vital materials used in wound care and management, because they are capable to absorb exudates from wound (Eagstein, 2001; Rajendran and Anand, 2006). Alginites offer several advantages over other counterpart conventional dressings. Products based on Alginate produce a gel on absorption of wound exudates to avoid wound from drying out. On the other hand, traditional viscose or cotton materials can be entangled in the wound and could develop pain and discomfort during the removal of dressing material (Brown and Muri, 2005).

Conclusion: This study reviewed the developments in the field of medical and health care related to textiles. This review provided an appraisal on the innovative, intelligent and smart textile products related to medical textiles, particularly antimicrobial textiles, surgical sutures and wound dressings. This review also highlighted the current state of the technologies as well as future advances and enhancements potential of new textile materials.

REFERENCES