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RESEARCH ARTICLE

MICROBIAL FLORA ON WHITE COAT

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ABSTRACT

Dental lab coat is designed to protect the worker's health, for a bio safe work environment and to provide conditions that favor comfort and freedom of movement. Aprons are potential source of cross infection and dissemination of microorganisms in medical and in dental settings. Various studies have been carried out to determine the level and type of bacterial contamination present on the white coats, in order to assess the risk of spread of nosocomial infections by contact with patients. The present article reviews different areas of contamination on white coat, risk factors for the development of infections and methods to avoid cross contamination.

INTRODUCTION

White coat, apron or laboratory coat is a knee-length overcoat or smock worn by professionals in the medical or dental field or by those involved in laboratory work to protect their street clothes. The garment is made from white cotton or linen to allow it to be washed at high temperature and make it easy to see if it is clean.(2) White coat brings about the standard of professionalism and caring and emblem of the trust doctors must earn from patients.(13). It is a symbol of the medical and dental professions; many a times, a doctor is identified in a medical and dental setup with his white coat. Traditionally, it is considered to bring credibility and dignity for medical profession.(13). White coats, nurses' uniforms and other hospital garments, materials and articles may play an important part in transmitting pathogenic bacteria in a hospital and dental setting. (10) Nosocomial/ hospital/ acquired infections are those which are not present or incubated before admission of patient to the hospital but obtained during the patient's stay in hospital. Also, dental personnel's clothing or uniforms (white coat) are spattered by blood, aerosol and saliva and there is a definite risk of infection with various transmissible agents causing Nosocomial infections. (2) Healthcare-associated infections (HAIs), also known as nosocomial infections (NI), constitute a significant hazard for patients and their families visiting a healthcare facility. The World Health Organization (WHO) defines HAI as an infection occurring in a patient in a Health care facility in which the infection was not present or was incubating at the time of admission. This includes infections acquired in the hospital or dental clinic but appearing after discharge or after dental treatment and also occupational infections among staff of the facility (14) specifically in the area of dentistry, health care professionals are routinely exposed to potentially pathogenic microorganisms which are present in the surrounding environment. Most of them originate from the mouths of patients. Contamination may occur from instruments through contamination vectors. These contaminated object infections may be transferred from patient to patient or from patient to professionals through direct or indirect contact with body fluids. (7) White coats have been shown to harbor potential contaminants and may have a role in the nosocomial transmission of pathogenic multi-drug resistant microorganisms. It is well accepted that proper handling of white coats by physicians and other healthcare workers could minimize cross- contamination and improve patient safety by potentially reducing nosocomial infections. It remains important to have a thorough knowledge of the micro-flora harboring these white coats. (11)

Contamination of White Coat

Contamination of skin and clothing by "splashes" or touch is practically unavoidable in hospitals. The white coat worn over personnel clothing, is a personal protection equipment (PPE) from such contamination.(2) The white coat is associated with medicine, science, and the healing, and it is the most recognized and respected dress of a doctor.

Dental health care workers are subjected to all types of infectious agents e.g. blood, respiratory secretion, tissue fluid, mucus membrane & skin. Dental personnel's clothing or uniforms (white coat) are spattered by blood, aerosol and saliva and there is a definite risk of infection with various transmissible agents (2). Dentistry is characterized as a profession where professionals are in contact with various biological agents due to the close proximity to the patient during treatment, which ends up by exposing professional to blood, saliva, mucous, and other body fluids, which makes professionals, staff and patients susceptible to contamination.(7)

Contamination of Different Areas of White Coat

Different cross-sectional studies had been conducted to evaluate presence of bacteria in different areas of the white coat.

Derek Wong, *et al*. (1991) collected sample from, the cuff and the lower front pocket and back of the coat, of 100 doctors and reported that the cuff and the pocket had a significantly higher level of contamination than the back of the white coat.(6)

Harsh Priya *et al*. (2009) did a survey of the 51 white coats of dental students. Sample was taken from chest area of the white coat and the pocket mouth, both on the side of the dominant hand and he found that chest area showed highest contamination followed by the pocket mouth , both on the side of the dominant hand.(2)

Diane Weed, *et al*. (2011) had obtained cultures from the breast pocket and sleeve cuff (long sleeved for the white coats, short-sleeved for the uniforms) and from the skin of the volar surface of the wrist of their dominant hand. Those wearing white coats also had cultures obtained from the mid-biceps level of the sleeve of the dominant hand, as this location closely approximated the location of the cuffs of the short-sleeved uniforms and found that Colony counts were greater in cultures obtained from the sleeve cuffs of the white coats compared with the pockets or mid-biceps area. For the uniforms, no difference in colony count in cultures from the pockets versus sleeve cuffs was observed. (3)

Silvia Munoz-Price MD *et al* (2012) cultured two areas of the white coat; the sleeve of the dominant hand and the front panel at the level of the abdomen (dominant hand side).and found that both were equally contaminated with bacteria.(5)

Zahra Moravvej *et al*.(2013) conducted studies by taking samples from the outer surface of three sites of the white coat; the cuff and pocket mouth of the dominant hand, and the abdominal region and found that the abdominal region was contaminated with a significantly higher number of isolates than the pocket and cuff regions.(15)

Saxena R.K. (2013) in their study, samples were taken from chest area, upper part of pocket and sleeves of aprons. They found that 88% of chest of aprons, 84% of pockets of aprons and 71% of sleeves (16)

Reza Robati *et al*. (2013) conducted cross –sectional study on 50 medical student. Swabs were taken from four different areas of the white coat (collar, pocket, sides and lapels).He found that the sides of the coats were the most highly contaminated areas followed closely by the collar and pockets.(8)

Reis PF, Pagliari BG, *et al* (2015) performed investigation on presence of bacterial contamination on dental clothing. In his study, the points of dental lab coats from which microbial samples collected were: collar, sleeve and pocket. They found sleeves (cuff) and the pockets of the white coat as the sites that were highly contaminated (7)

Sonam Thaore *et al*. (2016) in their study evaluated the type of microbial flora present on the lab coats of the clinicians working in the Dept of Endodontics and their antibiotic sensitivity. Three sites were chosen i.e. chest, pocket, and cuff for determining the type of microbial flora. The mouth of the dominant pocket was more contaminated than the chest and cuffs of the sleeve. (10)

Thus the most common sites of bacterial contamination in dental setting are chest area followed by pocket mouth-both on the side of the dominant hand, sleeves (cuff) collar. In hospital settings, most common site of contaminations are the front panel at the level of the abdomen; the sleeve of the dominant hand followed by chest area, breast pocket, collar and back.

Diagram showing the most common sites of bacterial infections on white coat

1. Chest area
2. Pocket mouth- on the both side of dominant hand
3. sleeves
4. collar

Microorganisms Isolated on White Coat

Staphylococcus aureus was the major pathogen isolated (64.7%), in the studies of Muhadi *et al*. Treakle *et al*., Wong *et al*; (1) and Asima banu *et al*. (2)

The other most common organism was Bacillus species. Gram negative bacilli and other forms of microbes are considered as environmental microorganisms with no clinical significance and skin commensals such as coagulase negative Staphylococci and diphtheroid species (2)

Zahra Moravvej *et al*. in the study demonstrated Gram-positive Bacilli (36.1%) as the most common isolates

followed by Staphylococcus aureus (28%) and coagulase-negative Staphylococci (24.8%) (15)

Trupti *et al*. stated that the various microbial agents isolated from white coats are Coagulase negative Staphylococci (52.45%) followed by Micrococci (24.59%), Gram positive bacilli (14.75%), Acinetobacter species (6.55%) and Staphylococcus aureus (1.63%). No case of mixed contamination was observed.(14)

Reis PF. *et al*. diagnosed microorganisms which were: Klebsiella sp., Staphylococcus saprophyticus, Enterobacter sp., Staphylococcus epidermidis, Staphylococcus aureus. Staphylococcus aureus (50%) and Staphylococcus epidermidis (40%) were the most predominant bacteria found (7)

Adriana Cristina de Oliveira *et al*. in their study reviewed the demonstration of Staphylococcus aureus, Acinetobacter baumannii, Klebsiela pneumoniae, Pseudomonas aureuginosa.(9)

Malini M, Titus K Thomas *et al*. in their study found Gram-positive cocci dominated the colonization on white coats, followed by Gram-negative cocci. 50% cultures showed Gram-positive cocci, as major microbial group contaminating the white coats in the dental operatory. Among the Gram-positive cocci, coagulase- negative staphylococcus was the dominant microbe. Gram-negative coccus (24%), Gram-positive bacilli (15%), and Gram-negative bacilli (11%) constituted the remaining 50% of the white coat microbial contamination. (11)

Micro-organisms	Percentage %
A) Gram positive cocci	50%
1)Catalase –positive Coagulase-negative staphylococci	24%
2) Catalase-negative, coagulase-negative- Streptococcus viridans	2%
3) Catalase-positive, coagulase-negative- Micrococci	10%
4) Pneumococci	2%
5) Enterococcus faecalis	10%
B) Gram-negative cocci	24%
1) Neisseria catarrhalis	24%
C) Gram-positive bacilli	15%
1)Spore bearer bacilli	15%
D) Gram-negative bacilli	11%
1)Escherichia coli	2%
2) Klebsiella pneumonia	4.5.%
3)Pseudomonas aeruginosa	4.5%

Risk Factors Influncing Development of Infections

Patients continuously shed infectious microorganisms in hospital as well as in the dental setting, and the health care providers are in constant contact with these patients. It has been demonstrated that microorganisms can survive between 10 and 98 days on fabrics.

Following are the risk factors for development of infections (4) Patient susceptibility

Important patient factors influencing acquisition of infection include age, immune status, underlying disease, and diagnostic and therapeutic interventions.

The extremes of life - infancy and old age - are associated with a decreased resistance to infection. Patients with chronic disease such as malignant tumours, leukaemia, diabetes mellitus, renal failure, or the acquired immunodeficiency syndrome (AIDS) have an increased susceptibility to infections with opportunistic pathogens. The latter are infections with organisms that are normally innocuous, e.g. part of the normal bacterial flora in the human, but may become pathogenic when the body's immunological defenses are compromised. Immunosuppressive drugs or irradiation may lower resistance to infection. Injuries to skin or mucous membranes bypass natural defense mechanisms. Malnutrition is also a risk. Many modern diagnostic and therapeutic procedures, such as biopsies, increase the risk of infection.

Environmental factors

Patients with infections or carriers of pathogenic microorganisms admitted to hospital are potential sources of infection for patients and staff. Patients who become infected in the hospital are a further source of infection. Crowding in the hospital, concentration of the patients in one area and frequent transfers of patients from one unit to another, these factors are highly susceptible to infections .

Bacterial resistance

Multi-resistant bacteria pose a major health risk and are increasing the cost of healthcare worldwide. Currently, the most problematic health care associated multi-resistant species are methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum blactamase (ESBL)-producing Enterobacteriaceae and carbapenemase-producing gram-negative bacteria.(17) Microorganisms in the normal human flora, sensitive to the given drug are suppressed. The widespread use of antimicrobials for therapy or prophylaxis (including topical) is the major determinant of resistance. Many patients receive antimicrobial drugs. As an antimicrobial agent becomes widely used, bacteria resistant to this drug eventually emerge and may spread in the health care setting. Many strains of pneumococci, staphylococci, enterococci, and tuberculosis are currently resistant to most or all antimicrobials which were once effective. Multi resistant *Klebsiella* and *Pseudomonas aeruginosa* are prevalent in many hospitals. This problem is particularly critical in developing countries where more expensive second-line antibiotics may not be available or affordable.(4)

Antibiotics	1st day		3rd day	
	Sensitive	Resistant	Sensitive	Resistant
AMIKACIN	90%	10%	80%	20%
AMOXYCILLIN	95%	5%	10%	90%
AMOX CLAV	75%	25%	50%	50%
AMPICILLIN	75%	25%	40%	60%
CEFTRIAXONE	50%	50%	50%	50%
CIPROFLOXACIN	95%	5%	85%	15%
COTRIMOXAZOLE	35%	65%	20%	80%
ERYTHROMYCIN	30%	70%	10%	90%
GENTAMYCIN	20%	80%	15%	85%
PENICILLIN G	80%	20%	15%	85%
VANCOMYCIN	100%	0%	100%	0%
TETRACYCLIN	70%	30%	70%	30%

Thus nosocomial infections are widespread. They are important contributors to morbidity and mortality. They will become even more important as a public health problem with increasing economic and human impact because of:

- Increasing numbers and crowding of people.
- More frequent impaired immunity (age, illness, treatments).
- New microorganisms.
- Increasing bacterial resistance to antibiotics

Organisms causing nosocomial infections can be transmitted to the community through discharged patients, staff, and visitors. It was also found that the lab coats of dentists were contaminated by microorganisms considered of clinical importance, contributing to a possible spread of disease-causing microorganisms among dentists, staff and patients. If

organisms are multi-resistant, they may cause significant disease in the community. (4,7)

Suggestions

The lab coats may act as a vector for transmission of cross infection. In order to prevent transmission of cross infection, between doctor and patient, a strict protocol should be set. (10) Basic prevention practices should be adopted by health professionals, from the simplest to the most complex, among which washing hands with soap and water, vaccines should be updated, and especially use of personal protective equipment implicated (7)

1. A yearly purchase of white coats and the possession of two or more white coats at any point of time should be made compulsory. (1, 8)
2. The lab coats should be washed daily or once in 3 days. The wearers of the white coats should be encouraged to wash their white coats at least weekly.(8)
3. Stricter white coat changing and washing regimes should be implemented.
4. The exclusion of white coats from the nonclinical areas of the hospital such as the libraries and the dining rooms. (1)
5. As contamination of the hands is highly likely to occur from organisms present on the cuff, and vice versa. There is a pressing need to promote a scrupulous hand washing among the physicians before and after they attend patients and also to promote alternatives to the white coats, which includes the universal use of protective gowns (6, 12)

CONCLUSION

White coats are contaminated with a variety of pathogenic and resistant bacteria which are potential source of cross infection. Efforts could be directed at encouraging workers to launder their coats daily or more frequently. Efforts should also be made to limit the use of coats outside the working area. Wearing of plastic aprons or altering lab coat material to plastic laminated clothing or closely woven waterproof cotton can reduce the bacterial transfer rate and cross contamination. Further studies should be carried out in the area of materials technology aimed at the development of water proof, disposable and / or durable and inexpensive fabrics, so that in each procedure with several patients during the workday, health workers, physician, dentists can develop their activities with more comfort, health and safety.

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