بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Graduate Studies

Assessment of Bacterial Contamination on Physicians' White Coats

تقويم التلوث الباكتيري في المعاطف البيضاء للأطباء

A dissertation submitted in partial fulfillment for the requirements of M. Sc. in Medical Laboratory Science (Microbiology)

By:

Alzhow Altayeb Ibrahim Altayeb

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Supervisor:

Prof. Humodi Ahmed Saeed

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الآية

بسم الله الرحمن الرحيم

قَالَ تَعَالَى:

﴿ ٱللَّهُ لَآ إِلَٰهَ إِلَّا هُوَ ٱلْحَىُّ ٱلْقَيُّومُ ۚ لَا تَأْخُذُهُۥ سِنَةٌ وَلَا نَوْمٌ ۚ لَّهُۥ مَا فِى ٱلسَّمَٰوَٰتِ وَمَا فِى ٱلْأَرْضِ ۗ مَن ذَا ٱلَّذِى يَشْفَعُ عِندَهُۥٓ إِلَّا بِإِذْنِهِۦ ۚ يَعْلَمُ مَا بَيْنَ أَيْدِيهِمْ وَمَا خَلْفَهُمْ ۖ وَلَا يُحِيطُونَ بِشَىْءٍ مِّنْ عِلْمِهِۦٓ إِلَّا بِمَا شَآءَ ۚ وَسِعَ كُرْسِيُّهُ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضَ ۖ وَلَا يَـُٔودُهُۥ حِفْظُهُمَا ۚ وَهُوَ ٱلْعَلِىُّ ٱلْعَظِيمُ ﴾

سورة البقرة ﴿٢٥٥﴾

DEDICATION

To my lovely family and best friends

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First of all thanks to ALMIGHTY ALLAH for giving me the power and welling to complete this work.

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ABSTRACT

The white coat is the most recognized and respected dress of a doctor. There has been growing concern that these coats may actually play a role in transmitting pathogenic bacteria in a hospital setting. The objective of this study was to assess the bacterial contamination on physicians white coats. The study was conducted during the period from April to August 2015.

Samples were collected from coats of physicians in three hospitals in Khartoum State. The surfaces of the white coats were sampled using sterile cotton swabs moistened in sterile distilled water. The swabs were kept in 2 ml nutrient broth. Bacterial load was assessed by Miles and Misra method. Isolated bacteria were identified by their colonial morphology, Gram's stain and biochemical characteristics.

The result revealed that out of 100 swabs investigated, 29 (29%) yielded bacterial growth, the rest 71 (71%) exhibited no bacterial growth. The mean of bacterial load in white coats was 57.7×10^4 CFU/coat. The CFU/coat in different hospitals were as follows; hospital A 47.5×10^4, hospital B 61×10^4, and in hospital C 64.7×10^4. Twenty-nine bacterial isolates were identified. These were 15 (51.8%)

Bacillus species, 3 (10.3%) *Pseudomonas aeruginosa*, 4 (13.8%) *Staphylococcus aureus*, 2 (6.9%) *Staphylococcus intermedius*, 5 (17.2%) *Staphylococcus epidermidis*.

It is conducted that the level of bacterial contamination of physicians white coats is moderate. Potentially pathogenic bacteria were isolated. Daily cleaning and disinfection of physicians white coats is highly recommended to minimize the level of bacterial contamination. Further studies are needed to validate these results.

المستخلص

المعطف الأبيض هو اللباس الأكثر شهرة واحتراما للطبيب. هناك قلق متزايد من أن هذه المعاطف قد تلعب بالفعل دورا في نقل الباكتيريا المسببة للأمراض في المستشفيات.

الهدف من هذه الدراسة تقويم التلوث الباكتيري على المعاطف البيضاء للاطباء. وقد أجريت الدراسة خلال الفترة من أبريل حتي أغسطس 2015.

جمعت العينات من معاطف الاطباء في ثلاث مستشفيات في ولاية الخرطوم. وأخذت العينات من سطح المعاطف باستخدام مسحة قطن معقمة مبللة في الماء المقطر المعقم, ثم وضعت في 2 مل من الماء المقطر المعقم. استخدمت طريقة مايلز وميسرا لحساب الحمل الباكتيري وقد تم تحديد الباكتيريا المعزولة عن طريق التشكل الظاهري للمستعمرات، وصبغة غرام والخواص الكيميائية الحيوية.

أظهرت النتائج أن من أصل 100 مسحة، 29 (29٪) أسفرت عن نمو الباكتيريا، والباقي 71 (71٪) لم تظهر أي نموا للباكتيريا. وكان متوسط الحمل الباكتيري في المعاطف 57.7×10^4 خلية / معطف. وكشفت النتائج أن متوسط الحمل الباكتيري وفقا للمستشفيات على النحو التالي؛ مستشفي A 47.5×10^4 ، مستشفى B 61×10^4، وفي مستشفى C 64.7×10^4. حددت هوية تسعة وعشرين باكتيريا معزولة. وكانت هذه 15 (51.8٪) أنواع من العصيات، 3 (10.3٪) الزائفة الزنجارية، 4 (13.8٪) المكورات العنقودية الذهبية، 2 (6.9٪) المكورات المتوسطة، 5 (17.2٪) المكورات العنقودية البشروية.

خلصت الدراسه الي أن مستوي التلوث الباكتيري علي المعاطف البيضاء للاطباء متوسط, وان الباكتيريا الممرضه عزلت من هذه المعاطف. توصي الدراسة بالتعقيم اليومي للمعاطف للتقليل من نسبة التلوث الباكتيري وبمزيد من الدراسات للتحقق من صدقية هذه الدراسة.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION AND OBJECTIVES

CHAPTER TWO

LITERATURE REVIEW

CHAPTER THREE

MATERIALS AND METHODS

CHAPTER FOUR

RESULTS

CHAPTER FIVE

DISCUSSION

LIST OF TABLES

CHAPTER ONE
INTRODUCTION AND OBJECTIVES

CHAPTER ONE
INTRODUCTION AND OBJECTIVES

1.1. Introduction

The physicians' white coat was worn initially for the purpose of protection against cross contamination spills (from reagent) and also because white coat means purity, innocence, goodness (Van Der Weyden, 2001). It is worn by physicians because to make them look smart and more professional as well as to emphasize the humanistic value of medicine (Harnett, 2001).

The high rates of the bacterial contamination of white coats may be associated with the following two facts: Firstly, patients continuously shed infectious bacteria in the hospital environment, and the health care providers are in constant contact with these patients. Secondly, it has been demonstrated that microorganisms can survive between 10 and 98 days on fabrics which are used to make white coats, which include cotton, cotton and polyester, or polyester materials (Chacko *et al.*, 2003).

The most common bacteria that contaminate physicians coat are usually environmental organisms and skin commensals, including *Staphylococcus aureus*, Diphtheroidis, Enterococci, *Pseudomonas aeruginosa* (Nester *et al.*, 2004).

Bacterial contamination occurs within hours after donning newly laundered uniforms. After 8 hours of wear, no difference was observed in the degree of contamination of the new uniforms versus infrequently laundered white coats (Burden *et al.*, 2011).

However, physicians do not all agree with the patients view of wearing a white coat because they consider them an infection risk (Harnett, 2001).

1.2. Rationale

The environment can play a crucial role in the transmission of pathogenic bacteria. Hospital environments are known to be colonized by nosocomial pathogens due to continual shedding by patients. These environmental surfaces can then act as a source of contamination to physicians white coats as they move from patient to patient or from ward to ward. The patient's skin also can be a source of contamination to the physicians white coat (Nester *et al.*, 2004).

Another major source of microbial contamination of white coats is from the hands of physicians. A number of earlier studies have demonstrated that compliance with hand hygiene protocols among all healthcare workers, including physicians is poor (Harris *et al.*, 2000; Pittet, 2000).

However, that would have no bearing on the fact that the coats were contaminated with potentially pathogenic bacteria and that they could function as fomites for the transmission of pathogenic organisms (Treakle *et al.*, 2009).

Reviewing the literature, there seems to be no published study about contamination of physicians white coats in Sudan. This study focuses on determining the presence, quantum and type of bacteria among physicians white coats.

1.3. Objectives

1.3.1. General objective

To assess bacterial contamination on physicians white coats in hospitals in Khartoum State.

1.3.2. Specific objectives

A) To isolate bacteria from physicians' white coats.

B) To determine bacterial load on white coats.

C) To identify isolates to species level.

CHAPTER TWO
LITERATURE REVIEW

CHAPTER TWO
LITERATURE REVIEW

2.1. White coats and hand hygiene

The white coat is one of the most established symbols of the medical profession and is probably the item of clothing worn most by physicians (Kazory, 2008). However, it is recognized to be progressively contaminated during the care provided to patients, making the uniforms potential vehicles for transmission of bacteria, which could contribute to the increase in infections associated with health care (Carvalho *et al.*, 2009).

Also, emphasize that these garments are not only risky for the transmission of pathogenic bacteria to patients, as healthcare professionals, in general, they carry out the cleaning of there clothes in there homes, which potentially creates risks for family and community where are inserted (Higginson, 2011).

Despite their best intentions, healthcare workers (HCWs) may be potential vectors of disease, disseminating virulent micro-organisms among their patients (Saloojee and Steenhoff, 2001).

There has been growing concern, that these coats may actually play a role in transmitting pathogenic bacterium in a hospital setting (Loh and Holton, 2000; Srinivasan *et al.*, 2007; Treakle *et al.*, 2009; Wilson *et al.*, 2007). This concern is yet to be fully appreciated in healthcare settings, particularly in developing countries, despite increasing incidence of health care-associated infections in these parts of the world and the dire need to introduction of effective patient-safety initiatives. In 2005, WHO Patient Safety Initiative launched the first global patient safety challenge to galvanize international focus

and action on the critical issue of health care-associated infections (WHO, 2005).

The prevalence of health care-associated infections is estimated to be about 5-10% in developed and 25% in developing countries (Pittet *et al.*, 2008; Amini *et al.*, 2009). Center for Disease Control and Prevention (CDC) estimated that 1.7 million health care-associated infections occurred in US hospitals in 2002 and were associated with approximately 99,000 deaths (Klevens, *et al.*, 2007). Although difficult, many of these infections (~15-32%) seem to be preventable (Clements *et al.*, 2008).

Hand hygiene is therefore a fundamental action for ensuring patient safety, and it should occur in a timely and effective manner in the process of care. Since most hospital-acquired pathogens are transmitted from patient to patient via the hands of healthcare workers, hand washing is the simplest and most effective proven method to reduce the incidence of nosocomial infections (Pittet, 2000).

A recent WHO survey of more than 2000 healthcare facilities in 69 countries, found that 65% of them are at a good level of progress with regards to hand hygiene promotion, resources and activities, but at least 35% are still at an inadequate or basic level. Promising achievements in promoting hand hygiene through reminders and education of healthcare workers have occurred in more than 90% of health care-associated infections, but improvement is still needed in areas such as monitoring of hand hygiene practices and establishing optimal hand hygiene behavior with in a strong patient safety culture (WHO, 2013).

2.2. Nosocomial infections

A hospital-acquired infection (HAI) is an infection whose development is favoured by a hospital environment, such as one acquired by a patient during a hospital visit or one developing among hospital staff. Such infections include bacterial and fungal infections and are aggravated by the reduced resistance of the patients (Klevens *et al.*, 2007). At any one time, more than 1.4 million people world wide are estimated to suffer from infections acquired in hospitals (Vincent, 2003).

The HAIs are a major public health problem in both developed and developing countries (Pittet, 2005). The impact of HAIs is more severe in resource-poor settings, where the rate of infection is estimated to range from 25% to 40% (WHO, 2005).

Much of health professionals believe that clothes can be nosocomial infection transmission vehicles, which is supported by weak scientific evidence. So to prove them, they must be tested and examined, quantifying and qualifying the bacteria which present in garments (Carvalho, 2009).

In Nigeria microbiological analysis of swabs taken from the cuffs and pocket mouths of physicians white coats in an acute care hospital showed that 91.3% of the coats had bacterial contamination. Specifically Diphtheroids, *Staphylococcus aureus* and Gram-negative bacilli were isolated. In contrast, comparatively lower rates of bacterial contamination were observed on the white coats of visiting physicians, from the medical unit where the coats were laundered daily. Further, the white coats of physicians who wore them only when seeing patients had significantly lower bacterial contamination than white coats of physicians who wore theirs during clinical and non clinical duties. In particular, white coat cuffs had a higher bacterial load than the mouths of the pockets

(Uneke and Ijeoma, 2010).

2.3. Antibiotic resistance

Antibiotic-resistant bacteria are an increasing problem in the United States and world wide. Among infected patients, antibiotic resistance is associated with increases in length of hospital stay, health care costs, and patient morbidity and mortality. Mortality among patients with methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) bacteremia is significantly higher than mortality among patients with susceptible forms of the same bacteria (Cosgrove *et al.*, 2003; DiazGranados *et al.*; 2005).

Viable infectious organisms, such as MRSA, *Clostridium difficile*, and VRE have been recovered from the clothes of healthcare workers, particularly on sleeves, waist areas, and neckties (Nurkin, 2004; Siegel *et al.*, 2007).

White coats of "cardiac surgery ICU" and "surgery ward" had the mean highest number of positive isolates. Studies in a hospital in Iran indicated that emergency and surgery wards had the most contaminated white coats (Akbari *et al.*, 2005).

Studies by Loh and Holton, (2000) and Akbari *et al* (2005) reported that coagulase-negative staphylococci, Diphtheroid species and *Acinetobacter* spp were the most common isolates; these authors found *S. aureus* in only 29 out of 100, 5 out of 100 white coats, respectively.

In study conducted from September 2008 to February 2009 and involved the physicians of Ebonyi State University Teaching Hospital (EBSUTH) Abakaliki, in Southeastern Nigeria, up to 91.3% of the white coats screened were contaminated with bacteria. This is

consistent with other studies in this area that showed white-coat contamination ranging from 23% to 95% (Pilonetto *et al.*, 2004; Srinivasan *et al.*, 2007; Treakle *et al.*, 2009). Diphtheroids, *Staphylococcus aureus*, and Gram-negative bacilli were the most frequently isolated bacteria from the white coats of physicians in this study. This is consistent with the spectrum of bacterial agents isolated in similar investigations (Pilonetto *et al.*, 2004; Srinivasan *et al.*, 2007). These micro-organisms are frequently found in the hospital environment and are mainly skin commensals, but they have also been implicated as causative agents of nosocomial infection (Loh and Holton, 2000; Nester *et al.*, 2004). The white coats of physicians from the Pediatrics and Accident/Emergency specialties were more contaminated than those of physicians from the Medical specialty.

Srinivasan *et al* (2007) reported that *Staphylococcus aureus* was less likely to be isolated from the white coat of a physician in a medical specialty than from a physician in a surgical or other specialty.

Because patients can shed infectious bacteria into the health-care environment by the virtue of their constant contact with patients, health-care workers are also at risk of transmitting pathogens. Thus, both patients and health-care workers can transmit infection through direct contact with patients, as well as through indirect contact with inanimate objects such as white coats (Treakle *et al.*, 2009).

CHAPTER THREE
MATERIALS AND METHODS

CHAPTER THREE
MATERIALS AND METHODS

3.1. Study design

3.1.1. Type of study

This is a cross–sectional study.

3.1.2. Study area

This study was done on three hospitals in Khartoum State (A, B & C). The practical part was carried out in the Research Laboratory, Sudan University of Science and Technology (SUST).

3.1.3. Study duration

This study was carried during the period from April to August 2015.

3.2. Sampling method

Sterile cotton wool swabs moisten by sterile distilled water was used to swab hundred white coats surfaces. Then each swab was immersed in 2ml of sterile nutrient broth and brought it to the laboratory within one hour.

3.3. Bacteriological methods

3.3.1. Bacterial load count

Six test tubes each containing nine ml of sterile nutrient broth were labeled 1-6. The initial dilution was made by transferring 1ml of bacterial suspension (that was prepared by immersed the swab in two ml of sterile nutrient broth and mixed well) to the first tube, this was 1/10 dilution. Immediately after 1/10 dilution has been shaken, uncapped it and 1ml was transferred to a second tube. This second represented 1/100 dilution of the

original sample. The process was repeated 4 times more till having 1/1000000 dilution. Three plates were needed for each dilution series, for statistical reasons an average of at least 3 counts were needed. The surfaces of the plates were sufficiently dried. Plates of nutrient agar were divided into three equal sectors. The sectors were labeled with the dilutions. In each sector, 20µl of the three last tubes (10^4, 10^5 &10^6) was dropped onto the surface of the nutrient agar and the drop was allowed spreading naturally. The plates were left upright on the bench to dry before inversion and incubated at 37°C for 18–24 hours. Each sector was observed for growth at the end of incubation period. Colonies were counted in the sector where the highest number of full-size discrete colonies between 30-300 colonies.

The following equation was used to calculate the number of colony forming units (CFU) per coat from the original aliquot / sample (Hedges, 2002):

CFU per coat = Average number of colonies for a dilution ×dilution factor.

3.3.2. Bacterial isolation

Bacteria that gave significant growth on nutrient agar was sub cultured on MacConkey agar and Blood agar, then incubated over-night aerobically at 37°C. The colonial morphology was studied and further identification was done.

3.4. Identification of bacteria

3.4.1. Gram stain

Bacterial smear was prepared by transferring portion of discrete colony to a drop of normal saline. The smear was covered with crystal violet stain for 30-60 seconds, rapidly washed off the stain with clean water, then the smear was covered with lugol's iodine for

30-60 seconds, washed off the iodine with clean water, decolorized rapidly (few seconds) with acetone-alcohol, washed immediately with clean water, then the smear was covered with safranin 2 minutes, washed off the stain with clean water, wiped back of the slide clean and placed in draining rack for the smear to air dry. The smear was examined microscopically with the oil immersion objective to report bacterial cell shape. Gram positive bacteria; stain dark purple, Gram negative bacteria; stain red.

(Cheesbrough, 2006).

3.4.2. Biochemical tests for identification of Gram-positive cocci

1. Catalase test

Two to three ml of 3% hydrogen peroxide was poured into a test tube. Using a sterile wooden stick, a portion of a good growth of the organism under test was transferred, and then immersed in the hydrogen peroxide solution. Immediate bubbling is positive result (Cheesbrough, 2006).

2. Coagulase test

Coagulase is an enzyme that causes plasma to clot. The test was used to differentiate *Staphylococcus aureus* which produce coagulase enzyme from other staphylococci. 0.5ml of diluted plasma was placed in small test tube. 5 drops of bacterial suspension was added and then mixed gently, incubated at 37°C and examined for clot formation up to 6 hours. (Cheesbrough, 2006).

3. Deoxyribonuclease (DNAse) test

The test organism was cultured on medium which contains DNA and incubated over-night at 37°C. The colonies were tested for DNAse production by flooding the plate with weak hydrochloric acid solution. The Acid precipitates un-hydrolyzed DNA. DNAse producing colonies are therefore surrounded by clear areas indicating DNA hydrolysis (Cheesbrough, 2006).

4. Mannitol fermentation

Test organism was inoculated on mannitol salt agar, incubated at 37°C and examined after 24 hours for mannitol fermentation. It was indicated by formation of yellow color around the growth (Cheesbrough, 2006).

3.4.2. Biochemical tests for identification of Gram-negative rods

1. Indole test

In this test the tested organism produce tryptophanase which breakdown tryptophan and produce indole, which react with Kovac's reagent and give pink ring. The tested organism was inoculated into peptone water and incubated at 37°C for overnight; the Kovac's reagent was added. If there is pink ring, the result is positive. If there is no pink ring in surface, the result is negative (Collee *et al.*, 1996).

2. Citrate utilization test

In this test organism has ability to use citrate as only source of carbon. By straight wire a part of colony was inoculated in Simmons' citrate media and incubates up to 24 hour at 37°C. The positive result shows blue color and in negative result there is no change in medium color (Collee *et al.*, 1996).

3. Urease test

In this test the organism produce urease enzyme which break down urea and produce ammonia, which makes the PH of media alkaline, in the presence of phenol red indicator the tested organism was inoculated in Christensen's urea agar.

The positive result gives pink color and negative result appears as no changing in color (Collee *et al.*, 1996).

4. Fermentation of sugar, H_2S and gas production

A tested organism was inoculated by sterile straight wire by stab on the butt, then blocked the pore and streaked slop medium and incubated for 24 hours at 37°C. Glucose fermentation give yellow butt, lactose fermentation yellow slope, gas production in the end of the tube and H_2S production blacking in the medium (Collee *et al.*, 1996).

5. Oxidase test

A strip of filter paper was soaked with a little freshly made 1% solution of the reagent and then at once used by rubbing a speck of culture on it with a platinum loop. A positive reaction was indicated by an intense deep-purple color appearing within 5-10 seconds (Mackie and McCartny, 1996).

CHAPTER FOUR
RESULTS

CHAPTER FOUR
RESULTS

A total of 100 physicians were participated in this study. They worked at three hospitals in Khartoum State. Forty-three samples were collected from white coats of physicians working in hospital A, thirty-three in hospital B, and twenty-four in hospital C (Table 1). Of the 100 white coats screened 29 (29%) were contaminated with bacteria, while the remaining 71 (71%) specimens yielded no bacterial growth (Table 2). Distribution of bacterial growth according to hospital was 14 (48.3%) from hospital A, 6 (20.7%) from hospital B, 9 (31%) from hospital C (Table 3). The mean of bacterial load was 57.7×10^4 CFU/coat (Table 4).

The Gram-positive and Gram-negative bacteria identified using biochemical tests can be seen in Table (5) and (6).

The various bacterial species isolated were 15 (51.8%) *Bacillus* species, 3 (10.3%) *Pseudomonas aeruginosa*, 4 (13.8%) *Staphylococcus aureus*, 2 (6.9%) *Staphylococcus intermedius*, 5 (17.2%) *Staphylococcus epidermidis* (Table 7).

Table 1. Distribution of physicians enrolled according to hospitals

	Physicians	
	NO	**%**
Hospital A	43	43
Hospital B	33	33
Hospital C	24	24
Total	100	100

Table 2. Bacterial growth after primary cultivation of samples

Result of culture	**NO**	**%**
Positive growth	29	29
Negative growth	71	71
Total	100	100

Table 3. Distribution of bacterial growth according to hospital

Hospitals	**Bacterial growth**	
	No	**%**
A	14	48.3
B	6	20.7
C	9	31
Total	29	100

Table 4. Shows mean of bacterial load (CFU) according to hospital

Hospital	Mean bacterial load (CFU/Coat)
A	47.5×10^4
B	61×10^4
C	64.7×10^4
Mean load	57.7×10^4

Table 5. Identification of Gram-negative bacterial isolates

Isolate code	Biochemical tests								Suggested organism
	S	B	G	H_2S	Urease	Indole	Citrate	Oxidase	
C1	R	R	__	__	negative	negative	positive	positive	*Pseudomonas aeruginosa*
C2	R	R	__	__	negative	negative	positive	positive	*Pseudomonas aeruginosa*
C3	R	R	__	__	negative	negative	positive	positive	*Pseudomonas aeruginosa*

***Key:** S= Slope; B= Butt; G= Gas; H_2S = Hydrogen sulfide; R= Red

Table 6. Identification of Gram-positive bacterial isolates

Isolate code	Biochemical tests				Suggested organism
	Catalase	Mannitol fermentation	DNAse	Coagulase	
C4	positive	Positive	positive	Positive	*S. aureus*
C5	Positive	Negative	positive	Positive	*S. intermedius*
C6	Positive	Negative	negative	Negative	*S. epidermidis*
C7	Positive	positive	positive	Positive	*S. aureus*
C8	Positive	negative	negative	Negative	*S. epidermidis*
C9	Positive	Positive	positive	Positive	*S. aureus*
C10	Positive	Positive	positive	Positive	*S. aureus*
C11	Positive	Negative	negative	Negative	*S. epidermidis*
C12	Positive	Negative	positive	Positive	*S. intermedius*
C13	Positive	Negative	negative	Negative	*S. epidermidis*
C14	Positive	Negative	negative	Negative	*S. epidermidis*

Table 7. Bacterial species isolated from white coats

Isolate	Frequency	%
Bacillus spp	15	51.8
Pseudomonas aeruginosa	3	10.3
Staphylococcus aureus	4	13.8
Staphylococcus intermedius	2	6.9
Staphylococcus epidermidis	5	17.2
Total	29	100

CHAPTER FIVE
DISCUSSION

CHAPTER FIVE
DISCUSSION

5.1. Discussion

Wearing a white coat is an accepted part of medical practice. The actual use of white coats and how often they are changed varies greatly among individual doctors and their specialties. There has always been some concern that white coats may actually play a part in transmitting pathogenic bacteria in a hospital setting.

In this study white coats of doctors from three hospitals in Khartoum State were examined for the presence of bacteria and the rate of contamination was found to be 29%. In contrast, in Nigeria the swabs taken from the cuffs and pocket mouths of physicians white coats in an acute care hospital showed higher frequency of contamination 91.3%. Specifically *Diphtheroids*, *Staphylococcus aureus* and Gram-negative bacilli were isolated (Uneke and Ijeoma, 2010). The present study demonstrated that from 100 white coats screened 29(29%) were contaminated with bacteria, the most frequently isolated bacteria were *Bacillus* spp (No =15) followed by *Staphylococcus* species (No =11) and Pseudomonas aeruginosa (No =3). This variation in results may be due to frequency and period of wearing the coat. Some physicians wear the white coat only when examine patients and other wear coats all day while in duty.

Loh and Holton, (2000) and Akbari *et al*, (2005) reported that coagulase-negative staphylococci, Diphtheroid species and *Acinetobacter* spp were the most common isolates; these authors found *S. aureus* in 29 out of 100, and 5 out of 100 white coats,

respectively. While in the present study 4 (13.8%) of the bacteria isolated were S. aureus. Srinivasan *et al* (2007) reported that *S. aureus* was less likely to be isolated from the white coat of a physician in a medical specialty than from a physician in a surgical or other specialty.

5.2. Conclusion

In conclusion, the bacterial contamination on physicians white coat was moderate.

Potentially pathogenic bacteria were isolated.

5.3. Recommendations

1. Physicians should be encouraged to wash their white coats daily using disinfectant.
2. Further studies with large number of samples involving pocket mouths, sleeves and neckties of coats are highly recommended.

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APPENDICES

APPENDICES

A) Preparation of reagents

1- Gram stain reagents

Safranine stain

Safranine powder	0.5g
Distilled water	100ml

Lugol's iodine solution

Potassium iodide	20g
Iodine	10g
Distilled water	to 1litre

Acetone-alcohol decolorizer

Acetone	500ml
Ethanol or methanol, absolute	475ml
Distilled water	25ml

Crystal violet Gram stain

Crystal violet	20g
Ammonium oxalate	9g
Ethanol or methanol, absolute	95ml
Distilled water	to 1litre

2- Physiological saline (8.5g/l)

Sodium chloride	8.5g

Distilled water	to 1litre

3- Hydrochloric acid, 1mol/l

Hydrochloric acid, concentrated	8.6ml
Distilled water	to 100ml

4- kovac's reagent

Amyle or isoamyle alcohol	150ml
p-Dimethyl-aminobenzaldehyde	10g
Hydrochloric acid, concentrated	50ml

5- Hydrogen peroxide

H_2O_2 solution	10vol

B) Preparation of culture media

1- Nutrient agar and nutrient broth

Lab-Lemco powder	1.0g/l
Yeast extract	2.0g/l
Peptone	5.0g/l
Sodium chloride	5.0g/l
Agar	15.0g/l

Nutrient broth contain the same component except the agar is omitted.

2- MacConkey agar

Peptone	20.0g/l
Lactose	10.0g/l
Bile salts	5.0g/l

Sodium chloride	5.0g/l
Neutral red	0.075g/l
Agar	12.0 g/l

3- Blood agar

To make about 35 blood agar plates:

Nutrient agar	500ml
Sterile defibrinated blood	25ml

4- Kliglar iron agar (KIA)

Lab-Lemco powder	3.0g/l
Yeast extract	3.0g/l
Peptone	20.0g/l
Sodium chloride	5.0g/l
Lactose	10.0g/l
Dextrose (glucose)	1.0g/l
Ferric citrate	0.3g/l
Sodium thiosulphate	0.3g/l
Phenol red	0.05g/l
Agar	12.0g/l

5- DNAse agar

Tryptose	20g/l
Deoxyribonuclic acid	2g/l
Sodium chloride	5g/l

Agar	12g/l

6- Christensen's urea agar

Glucose	5g
Sodium chloride	5g
Potassium dihydrogen phosphate	2g
Peptone	1g
Agar	20g
Distilled water	1litre

7- Simmons' citrate medium

Koser's medium	1litre
Agar	20g
Bromothymol blue, 0.2%	40ml