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ASSESSMENT OF BACTERIA ASSOCIATED WITH FINGER NAILS SOME PRIMARY SCHOOL PUPILS IN DUTSIN MA METROPOLIS, KATSINA STATE, NIGERIA

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Abstract
This study was conducted to access bacteria under the nails of primary school pupils in Dutsin Ma Metropolis, Katsina State, Nigeria. Samples were by means of sterile cotton swabs moistened in 0.85g physiological saline from 200 pupils in four different schools and were identified by culture and biochemically characterized in Biology Laboratory, Federal University Dutsin Ma. The result indicated that 198 samples were found to habour bacteria under the finger nails. Bacterial pathogens isolated from the under nails of the pupils included *Staphylococcu spps which* had the highest prevalence of 74(37%) followed by *Escherichia coli* with prevalence of 61(30%) while *Proteus* spp and *Klebsiella* spp had 21(10.5%) and 16(8%) respectively. *Pseudomonas* spp had 10(5%) and the least was *Salmonella* spp which had a prevalence of 7(3.5%). The highest prevalence of bacteria isolates were seen in male pupils with 31 while the female pupils were 18 isolates more number of bacteria isolates was also observed in pupils of age group 5-7years. Through basic hygiene, these bacteria contamination can be minimized.

***Keywords**: Finger nails, Bacteria, Pupils*

Introduction

The hands are the parts of the human body that are in most contact with the outside world. People use their hands for a variety of activities every day. It is extremely easy to come in contact with different microbes and to transfer them to other objects and maybe even people. The fingernail is an important structure composed of laminated layers of the protein, keratin. Although nails are small, they have two crucial roles. They act as a protective plate and enhance the sensation of the fingertip by acting as a counter-force. Surprisingly, fingernails harbor the most bacteria found on the human hands and they are increasingly being viewed as a major concern in many health related issues because of the capability to harbor many varieties of microorganisms (WHO, 2017). The space under the fingernails, also called the subungual region, was “an important site” for harbouring bacteria. The fingernails harboured the same types of bacteria as the rest of the hand, just a lot more of them (Goldman, 2016). In health care related occupations fingernail etiquette is becoming a strict practice as the bacteria in the nails of health care providers can exacerbate a patient's existing medical conditions (Kurtzweil, 1995).

Microorganisms can be found everywhere and they constitute a major part of every ecosystem. In the environment, they live either freely or as parasites (Sleigh *et al.,* 1998). Human hands usually harbor microorganisms as part of body normal flora as well as transient microbes contacted from the environment (Oranusi *et al*., 2013).Transient bacteria present on the hands can be to contacted with contaminants such as fomites where they constitute major health hazards as well as act as sources of community and hospital acquired infections (Pittet *et al.,* 1999). The hands and fingernails are often affected by bacteria, fungal and yeast infections, such as those caused by species of *Pseudomonas*, *Staphylococcus*, *Acinetobacter*, *Enterobacter*, *Klebsiella, Aeromonas, Serratia, Trichophyton*, *Acremonium*, *Aspergillus*, *Scopulariopsis*, *Cladosporium*, *Candida*, *Trichophyton* and *Rhodotorula*). These bacteria are extremely easy to transfer and may reside on a person’s hand when he/she touches money, food, doorknobs, hair and countless other things. Some transient bacteria may stay on the human hands from minutes to hours or even months. This depends on the type of bacteria that the hand had come in contact with and whether or not they were able to adapt to the physical conditions of the human hands (Larson, 2001)

The hand serves as a major vehicle of transmission of various microbes, including the enteric species in children (Prescott *et al*., 2005). It can cause a variety of community-or hospital-acquired infections, including those of the urinary tract, respiratory tract, wounds and burns, bacteriaemia, neonatal meningoencephalitis, empyema and osteomyelitis. Contaminated hands play a major role in faecal-oral transmission of diseases (Ray *et al*., 2011). The unhygienic habits of most people especially children leads to the various infections via hands and fingernails. 80% of these diseases are associated with the poor domestic and personal hygiene. Faecal contamination of hands is one of the important route by which children are exposed to pathogenic organisms (Langford, 2009). The World Health Organization (WHO) recognizes the spread of diarrhea diseases as a serious global problem and further stated that diarrhea diseases is the second leading cause of death in children under five years old. They estimated that each year diarrhea kills around 525, 000 children under five and nearly 1.7 billion global cases of childhood diarrhea disease every year (WHO, 2017). The majority of these deaths are in children under school age. It has been suggested that hand washing and hygiene may substantially reduce the risk of diarrheal diseases and promote healthy leaving (WHO, 2017 and Patel, *et al*., 2010). The aim of the study is to identify the bacteria associated with fingernails of some primary school pupils in Dutsin Ma Metroplois.

Statement of the Problem

Reports of unhygienic conditions among primary school pupils have necessitates the conduct of this research to isolates and identify the possible bacteria that are resident under their fingers which can pose a serious health hazard among them.

Materials and Methods

Collection of Samples

Swab samples were collected from finger nails of the pupils by means of sterile cotton swabs moistened in 0.85g physiological saline. The swab sticks were rubbed all over the surface of under

nails and transferred immediately to the Biological Sciences laboratory, Federal University Dutsin Ma within one hour of in a cooler containing ice blocks to prevent dryness and proliferation of bacteria. The nutrient and macConkey agar was prepared in 500ml flask and was sterilized by autoclaving a 121ºC at 15 psi for 20 minutes. 20 ml of the media was poured in the petri plates before getting solidified. The swab was immediately streaked on Nutrient and MacConkey agar plates and incubated at 37°C for 24 hours. The plates were then observed for growth and a colonial description of the isolates. Selected colonies were again sub-cultured on nutrient agar in petri-plates to isolate pure culture. After isolating pure cultures, bacterial isolates were further identified and characterized by size and shape and gram staining of colonies and Gram staining reaction as well as appropriate biochemical tests. Colonies on agar plates were carefully examined macroscopically for cultural characteristics such as shape, colour, size and constituency.

Isolation and Identification Methods

Cultural Technique

The nutrient and macConkey agar medium was used in the study for isolation of the bacteria. Each fingernail swab was used to aseptically inoculate nutrient agar and macConkey agar plates using the streak plate method. The plates were incubated aerobically 24 hours for at 37 °C.

The detail information was collected based on age and sex during collection under the nails (long nails) samples. Separate colonies were sub cultured onto nutrient agar to obtain pure culture.

Identification of Bacteria

Morphological characteristics, gram stain tests and biochemical properties of the isolate were identified, evaluated, and compared according to Cheesbrough (2006) and Ekrakene and Igeleke (2007). Several identification methods such as shape, Gram stain, Indole Test, Oxidase test, Catalase test, Urease Test, Coagulase Test and triple sugar iron agar test were conducted to identify the isolated

Results

Table 1 shows the total number of bacteria isolated from the four schools. A total number of 189 bacterial were isolated *Staphylococcus spp* had the highest prevalence of 74(39.15%) followed by *Escherichia coli* which have total percentage prevalence of 61(32.28%) while *Proteus* spp and *Klebsiella* spp had 21(11.11%) and 16(8.47%) prevalence respectively. *Pseudomonas* spp had a prevelence of 10(5.29%) and the least was *Salmonella* spp which had a prevalence of 7(3.7%).

Table 1 Bacteria isolated under the fingernails of pupils in four different primary schools in Dutsin Ma Town

Results of bacteria culture				**LSD (P<0.05)**
Bacteria Isolates	No of pupil sampled	No. of isolates	Prevalence (%)	0.03
Staphylococcus spp	200	74	37	
Escherichia coli	200	61	30	
Proteus spp	200	21	10.5	
Klebsiella spp	200	16	8	
Pseudomonas spp	200	10	5	
Salmonella spp	200	7	3.5	
Total	**200**	**189**	**100**	

Table 2 shows the highest prevalence was recorded in males in NA'Alhaji Primary School with prevalence rate of 114.8% while female rate 78% as shown in table 2

Table 2 Bacteria isolated from under the nail of the Male and Female Pupils in the Schools

	Male (%)			**Female (%)**		
School Sampled	No of samples	No of isolates	Prevalence (%)	No of samples	No of isolates	Prevelence (%)
Damy	24	17	70.8	26	17	65
Yadaka	25	25	100	25	28	112
Na'Alhaji	27	31	114.8	23	18	78
Darawa	26	29	111.5	24	23	95
Total	106	103	97	98	86	87.7

The table 3 shows the prevalence of bacteria in the fingernails of the primary school children according to age groups. The prevalence of 80(98.8%) was recorded among the age group of 5-7years, while 59(92.2%) was recorded for the age group between 8-10years. The least was recorded by the age group of 11.13 at 52(92.9%).

Table 3. Bacteria isolated from the finger nail under considering age groups

	Bacteria Isolates			LSD (P>0.05)
Age Groups	**Total Samples**	**No of Isolates**	**Prevalence (%)**	**0.38**
5-7	**80**	**79**	**98.8**	
8-10	**64**	**59**	**92.2**	
11-13	**56**	**52**	**92.9**	
Total	**200**	**189**	**94.5**	

Figure 1 shows a chart showing bacteria isolated from different class from the schools sampled. The highest numbers of *Staphylococcus spp* were isolated especially from primary 1-4 which incidentally were from the lower classes. The second most abundant bacteria isolate was *E. coli* which parenthetically cut across the whole class.

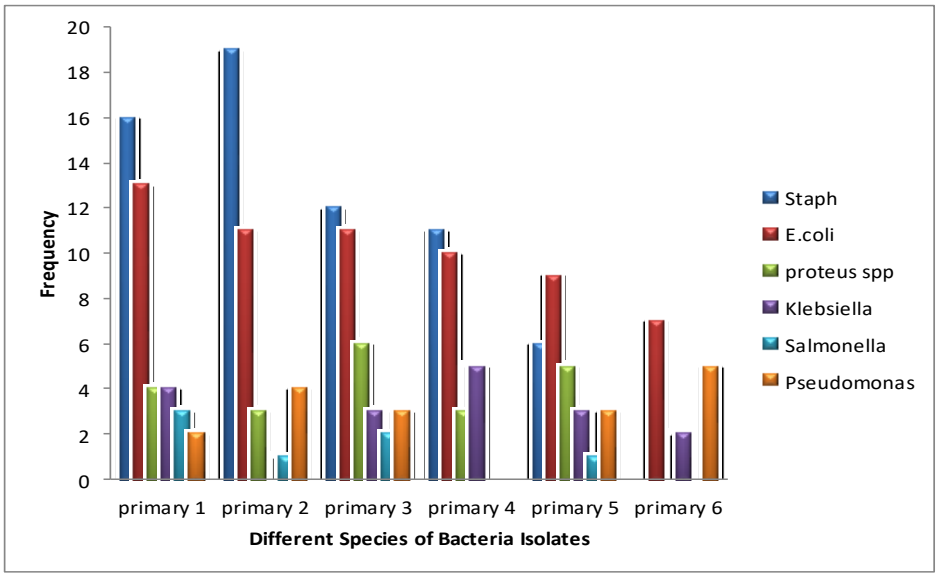

Figure 1 Bacteria Isolates from different Grades in Schools sampled

Figure 2 presents the number of bacteria isolated from the different schools sampled. *Staphylococcus* spp, *Escherichia* spp, *Proteus* spp were found in high number from all the four schools. While *Salmonella* spp was found only from Yadaka model primary school and Darawa primary school.

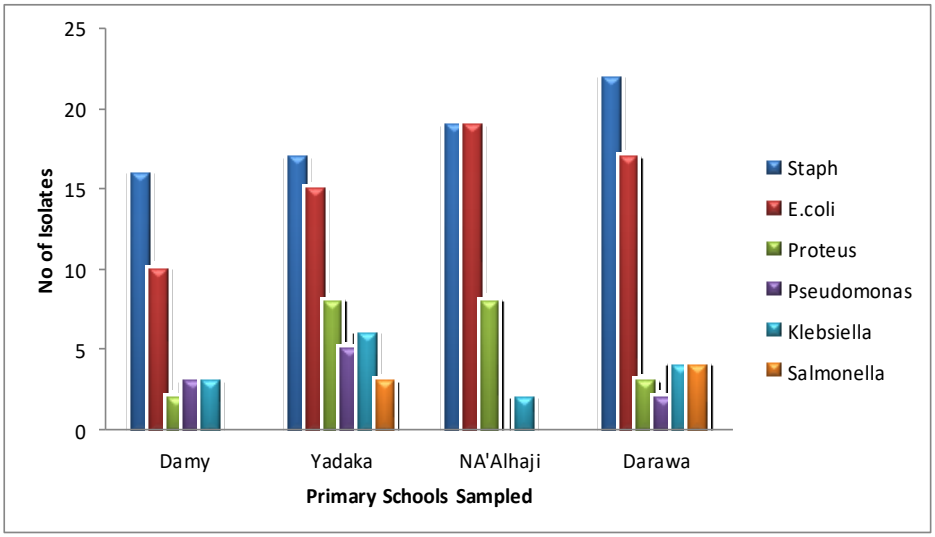

*Figure 2: Bar chart showing the distribution of each bacteria isolated species among the four schools***Discussion**

The result of this study shows that the samples were positive for enteropathogenic bacteria; comprising of genus such as salmonella spp. In addition, other enterobacteriaceae like *Klebsiella sp, E. coli , Proteus spp, Staphylococcus spp* and *Pseudomonas spp* were also isolated from the fingernails of the pupils. Mohsen (2017) recorded similar bacteria including *Staphylococcus aureus, Pseudomonas aeruginosa* and *Klebsiella* spp under fingernail of people sampled at College of Biotechnology, Al-Nahrain University. Nahenthran *et al*., *(2016)* reported the presence of *Klebsiella sp, E. coli , Proteus mirabilli, and Salmonella spp* under the finger nail of canteen workers in Universitas Padjadjaran, Jatinangor. Furthermore, *Wachuku et al.,* (2007) also isolated *Staphylococcus aureus*, *Echerichia coli*, *Proteus* and *Pseudomonas aeruginosa* from the fingernails of health care workers and food handlers in Port Harcourt, Nigeria. However, *Staphylococcus spp* and *E. coli* isolated from the fingernails of the pupils have the highest percentage compared to the other enterobacteriaceae. The reason probably being that *Staphylococcus spp* is classified as the normal body flora. Since the hands are in constant contact with the surrounding surfaces and is use for scratching the body, it is possible that these organisms can lurk under the nails most especially those that have not been trimmed. Many healthy people carry these bacteria on their skin and in their noses without getting sick.

Bacteria isolated from the pupils studied in this work means that kids can carry *Staphylococcus* bacteria from one area to another or they can also pass it to other kids they come in contact with. Since, Kids can carry bacteria from one pupil to another, good hand washing is vital to preventing staph infections. Furthermore, when skin is punctured or broken, staph bacteria can enter the wound and cause infections, which can lead to other health problems. *Staphylococcus aureus* can also cause other kinds of illnesses including bone infections, impetigo (school sores), pneumonia and blood stream infections (septicaemia) (Longo, 2015). Isolation of *E. coli* in the fingernail was recorded in high percentage in this study which in agreement with Nahenthran *et al.* (2016). *E. coli* is a type of bacteria that normally lives in the intestines, where it helps the body break down and digest the food we eat. Therefore, its presence in the fingernail indicated faecal contamination as these bacteria are found in the digestive system. Infections due to *E. coli* (*Escherichia coli*) bacteria in children can cause severe bloody diarrhea, blood infections, respiratory illnesses, and urinary tract infections.

The number of *Klebsiella spp* isolated in the finger nail of the pupil sampled in this study was lower compared to *Staphylococcus spp* in this present work; however, it still poses as a health challenge. *Klebsiella spp* can be found in the respiratory tract and feces of some healthy adults and this bacteria become pathogenic when they extent to tissues outside their normal intestine tracts. *Klebsiella pneumonia* is an opportunistic pathogen frequently associated with nosocomially acquired infections of the respiratory tract such as acute bronchopneumonia, typical lobar pneumonia and urinary tract in compromised individuals. Brooks *et al.* (2007) and Ryan and Ray (2004) reported a higher survival rate of *Klebsiella spp* on the fingertips compared to other enteric bacteria. Most human body bacteria have adopted the ability to exist in dryer condition, *Klebsiella spp* which is a normal human flora has probably adapted to this condition which is perhaps why it was isolated in the finger nail of the pupil sampled. Furthermore, a pathogen's opportunity for infectivity depends upon its ability to survive on surfaces. Most microorganisms that colonize the human intestinal tract have adapted to moist conditions. When found on dry environment, they either die or adapt slowly in the environment (Todd *et al*., 2009). This might explains why *Klebsiella spp, Salmonella paratyphii* were found at a lower percentage under the fingernails of the pupils sampled in Dutsin Ma Metropolis. Ryan, (2004) further reported the high survival rate of a species of *Klebsiella (Klebsiella aerogenes)* on fingertips in some countries. The author concluded that *Klebsiella aerogenes* which are found as a normal flora in many parts of the colon, intestinal and in biliary tracts has adapted to dry conditions.

A study conducted by the Infectious Disease Society of America revealed that nails that are longer than three millimeters beyond the tip of the finger carries harmful bacteria and yeast under them (Hmar, 2015). Rayan and Flournoy (1987) reported heavy bacterial growth under fingernails that were more than 1mm in length. Lin *et al.,* (2002) also acknowledged that long fingernail tends to harbors more microorganisms than short nails. In the year 2000 in Atlanta USA a potentially lethal Bacteria beneath the long fingernails of nurses have been linked to the deaths of babies in an intensive care unit in a hospital in Oklahoma

City (Altman, 2000). Most of the pupil's samples keep long finger nails; it can be attributed to negligence of their parents/guardians. Against this background, control measures like limiting nail length in schools should be put in place; children and their guardians should be educated on the effects of keeping long nails

About 72% of the pupils sampled do not have the habit of hand hygiene. One of the ways of healthy living is hand hygiene (Patelet *et al.,* 2010). Hand washing is among the best means of preventing the spread of germs. In many places, public health laws are in place to ensure that those in the food service industry keep their hands clean. Faecal contamination of hands is one of the important route by which children are exposed to pathogenic organisms (Langford, 2009). Washing hands is believed to reduce infection transmission by washing off potential microorganisms and also by removing the dirt, which could also harbor microorganisms and allow their survival for longer periods of time (Lanata, 1994). A systemic reviews by Curtis and Cairncross (2003) have pointed out the effectiveness of hand washing in reduction of diarrhea and acute respiratory illnesses, the two major childhood killer diseases (Jefferson *et al.,* 2008). Despite being shown to be effective, hand washing with soap is not a common practice. Ray *et al.,* (2009) observed a decrease in colony count following hand washing with soap in 60% of the samples. As the practice of hand washing is poor, isolation of pathogenic microorganisms has been reported in a number of studies done among children. A study from Greece found that 52.9% of children's hand swab samples were contaminated by fecal *streptococci*. A study from Amravati, Maharashtra (India), demonstrated the presence of bacterial pathogens in the hands of all of the 400 students whose hand swabs were examined. The natural habitat of microorganisms like *Staphylococcus* is in the human skin and can therefore be passed from one person to another Dodril *et al*., (2011). On the other hand, no amount of scrubbing can get rid of all the bacteria in the hand. The impossibility of sterilisation is why doctors and nurses so often wear gloves while interacting with patients. Hand washing with soap and water reduces the number of transient bacteria in hand and fingernails; especially in the primary school pupils as discovered in this study.

Conclusion and Recommendation

From the findings of this research work, it is observed that fingernails haboures bacteria and these bacteria can probably spread through hands in contact with hands or other objects, the most bacteria present in the hands of the pupils sampled are enterobacteriaceae such as *E. coli*, *Klebsiella*, the family of pseudomonas (*Pseudomonas spp*) and gram positive bacteria *Staphylococcus spp.* Therefore, the fingernails are able to accumulate different types of bacterial especially in primary school pupils.
Hence, there should be increasing awareness of hand and fingernail hygiene, as healthier fingernails can promote healthier lifestyles. The growth of bacteria within the nails causes unhealthy, thin, and brittle nails. Nails should be kept clean, short, and should not extend past the fingertips especially in children.

Reference

Altman LK, (2000) Study Links Bacteria, Long Nails and Baby Deaths. New york times www. nytimes.com/2000/03/24/us/study-links-bacteria-long-nails-and-baby-deaths.html

Brooks GF, Carroll KC, Butel JS and Morse SA (2007). Medical Microbiology 24th ed. New York: McGraw- Hill Companies. pp 832. Available at http://www.mcgraw-hill.co.uk/html/0071476660.html

Cheesbrough M, (2006). District Laboratory Practice in Tropical Countries, Part 2, Cambridge University Press, United Kingdom, pp 60-64.

Curtis V, and Cairncross S, (2003) Effect of washing hands with soap on diarrhoea risk in the community: A systematic review. *Lancet Infect Diseases*, 3:275-81.

Dodrill L, Schmidt W, Cobb E, Donachie P, Curtis V and de Barra M (2011). Male commuters in North and South England: risk factors for the presence of faecal bacteria on hands. *BMC Public Health,* 11(1): 31. https://doi.org/10.1186/1471-2458-11-31

Ekrakene T and Igeleke CL (2007). Micro-organisms Associated with Public Mobile Phones along Benin-sapele Express Way, Benin City, Edo State of Nigeria. *Journal of Applied Sciences Research,* 3(12):2009-2012.

Goldman JG, (2016) BBC- Future - what lives under your fingernail? www.bbc.com/future/story/20160622-what-live-under-your-fingernails. Accessed November 2017

Hmar R, (2015) Health Problems Associated With Long Nails. Health. https://www.indiatimes.com/health/healthyliving/health-problems-associated-with-long-nails-242261.html

Jefferson T, DelMar C, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, *et al*. (2008) Physical interventions to interrupt or reduce the spread of respiratory viruses: Systematic review. BMJ 336.77. doi https://doi.org/10.1136/bmj.39393.510347

Kurtzweil P, (1995) Fingernails: Looking Good While Playing Safe. FDA Consumer Magazine, December. microbewiki.kenyon.edu/index.php/Human_Hand_and_Fingernails

Lanata CF, (1994). Problems in measuring the impact of hygiene practices on diarrhoea in a hygiene intervention study. In: Cairncross S, Kochar V, editors. Studying hygiene behaviour methods, issues and experiences. New Delhi: SAGE; 127-34.

Langford RM, (2009). Hand-washing and its impact on child health in Kathmandu, Nepal. Doctoral thesis, Durham University. Available at E-Thesis Online. http: //etheses.dur.ac.uk/79/

Larson E, (2001). Hygiene of the Skin: When is Clean Too Clean? *Emerging Infectious Diseases.* 7(2) 225-230.DOI:10.3201/eid0702.700225

Lin C, Wu F, Doyle M, Michaels B and Williams K (2002) Removal *of* Escherichia coli on hands with natural or artificial fingernails. *International Journal of Epidemiology*, 21: 1157-1164.

Mohsen HR (2017) Isolation and Identification of Bacteria from under Fingernails
International Journal of Current Microbiology and Applied Sciences, 6 (8); 3584-3590

Nahenthran NN, Imam M, and Raksanagara AS (2016) Detection of Enteropathogenic Bacteria under Fingernails of Canteen Workers at Universitas Padjadjaran, Jatinangor. *Althea Medical Journal,* 3(2); 309-313

Oranusi S, Dahunsi SO, Owoso O and Olatile T (2013). Microbial profiles of hands, foods, easy contact surfaces and food contact surfaces: A study of university Campus. *Novus International Journal of Biotechnology & Bioscience,* 2 (1):12- 24.

Patel HR, Daniel PS, Anand IS and Patel CN (2010). Role of community pharmacist in assessing the awareness of hand hygiene in rural area. *Journal of Global Pharma Technolog,* 2(5): 59-61.

Pittet D, Dharan S, Touveneau S, Sauvan V and Pernegar TV (1999).Bacterial contamination of the hands of hospital staff during routine patient care .*Arc internal Med*icine, 159(8):821-826.

Prescott LM, Harley JP, Klein DA (2005). Microbiology. 6th ed. Tim McGraw-Hill co. New Delhi. 675.

Ray SK, Amarchand R, Srikanth J and Majumdar KK (2011). A study on prevalence of bacteria in the hands of children and their perception on hand washing in two schools of Bangalore and Kolkata. *Indian Journal of Public Health*, 55 (4):293-297. Ray SK, Dobe M, Lahiri A and Basu SS (2009).Hand washing practices in urban and rural communities in and around Kolkata, West Bengal. Indian J Public Health, 53:1192-1195.

Rayan G and Flournoy D (1987). Microbiologic flora of human fingernails. The *Journal of Hand Surgery,* 12A: 605-607

Ryan KJ and Ray CG (2004). An introduction to infectious diseases. Sherris Medical Microbiology 4th ed. New Yorks: McGraw-Hill medical Publishing Division. New York. Pp 997. DOI: 10.1036/0838585299

Sleigh DJ and Timbury MC (1998). Note on Medical Microbiology, 5th edition. Churchill Livingstone, New York. pp. 173.

Todd EC, Greig JD, Bartleson CA and Michaels BS (2009) Outbreaks where food workers have been implicated in the spread of foodborne disease, Part 6: transmission and survival of pathogens in the food processing and preparation environment. *Journal of Food Protection*, 72(1):202–19

Wachukwu CK, Abbey SD, Ollor AO and Obilor NL (2007). Public Health Implication of Artificial Finger Nails Used by Health Workers and Food Handlers in Port Harcourt, Nigeria. *Journal of Applied Sciences*, 7:3580-3583

WHO (2017) Media Center: Diarrhoel Diseases Fact Sheets Updated May 2017 www.Who.Int/Med center/Factsheets/Fs330/En