International Science and Technology Journal
المجلة الدولية للعلوم والتقنية
Volume 34 العدد
Part 2 المجلد
July 2024 يوليو
المجلة الدولية للعلوم والتقنية
ISTJ
تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

Microbial Contamination Assessment of Some Primary Schools in Wadi Jaref-Sirte, Libya.

www.doi.org/10.62341/afrm3429

Aisha F. Rahell
Faculty of Science-Botany Department, Faculty of Science, Sirte University, Sirte, Libya

botchy_33@su.edu.ly

Abstract

Pathogenic bacteria pose a serious risk in schools, where students come into contact with a variety of microbes on a daily basis. Classrooms are thought to be ideal environments for young children to harbor germs. The current study sought to determine the extent of the spread of bacteria in different places in primary schools, as well as to determine whether the schools are sterile and clean for children or whether they are the real cause of their illness. Samples were taken from the primary schools. The schools are located in Wadi Jaref ,Sirte. 30 samples were collected from different classrooms and from places the student comes into contact with, such as door handles, desk, and children's hands. The organisms isolated in this study, based on colonial morphological, and biochemical characteristics the results showed the presence of bacteria Staphylococci epidermidis(35%), Staphylococcus aureus (22%), Esherichia coli (13%), klebsiella pp, micrococcus and Streptococcus (9%), bacillus(4%). The study showed that the largest number of bacterial colonies (Colony Forming Units) (CFU) found on the hands (75 CFU), Desks(26 CFU) and Door handles (22 CFU). This study emphasized the wide range of possible diseases and demonstrated the presence of harmful bacteria in primary schools. This is related to the increasing number of students in primary schools which lack proper hygiene conditions and due to the failure to carry out routine cleaning and sterilization of schools and the lack of facilities.

Keywords: Primary schools, Bacteria, Contamination, Microorganisms, Children, Colony, Wadi Jaref, Sirte.

International Science and Technology Journal
المجلة الدولية للعلوم والتقنية
Volume 34 العدد
Part 2 المجلد
July 2024 يوليو
المجلة الدولية للعلوم والتقنية
ISTJ
تم استلام الورقة بتاريخ: 30/ 2024/6م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

تقيم التلوث الميكروبي في بعض المدارس الابتدائية في وادي جارف– سرت، ليبيا.

عائشة فرج رحيل[1]

قسم النبات ،كليه العلوم، جامعه سرت، سرت، ليبيا

الملخص

تشكل البكتيريا المسببة للأمراض خطرًا شديدًا في المدارس، حيث يتعرض الطلاب لمجموعة متنوعة من الميكروبات بشكل يومي. ويُعتقد أن الفصول الدراسية هي بيئات مثالية لانتقال الجراثيم للأطفال الصغار. وسعت الدراسة الحالية إلى تحديد مدى انتشار البكتيريا في أماكن مختلفة في المدارس الابتدائية، وكذلك تحديد ما إذا كانت المدارس معقمة ونظيفة للأطفال أم أنها السبب الحقيقي لمرضهم. تم أخذ العينات من المدرسة الابتدائية بوادي جارف بمدينه سرت. تم جمع 30 عينه سطحية من فصول دراسية مختلفة ومن اماكن يتواصل معها الطالب مثل مقابض الأبواب، المكتب، وأيدي الأطفال. تم عزل الكائنات الحيه في هدة الدراسة، بناء على الخصائص المور فولوجيه والبيوكيميائيه واظهرت النتائج وجود بكتيريا Staphylococcus epidermidis (35%)، (22%) Staphylococcus aureus، E.coli (13%)، Micrococcus ,Klebsiella spp Streptococcus, (9%)، Bacillus spp(4%). وأظهرت الدراسة أن أكبر عدد من المستعمرات البكتيرية وجد على الأيدي (75 مستعمره)، المكتب (26 مستعمره)، ومقابض الأبواب (22مستعمره). أكدت هذه الدراسة على المجموعة الواسعة من الأمراض المحتملة وأظهرت وجود البكتيريا الضارة في المدارس الابتدائية ، ويرتبط ذلك بتزايد عدد الطلاب في المدارس الابتدائية الذين يفتقرون إلى شروط النظافة المناسبة وبسبب عدم القيام بعمليات التنظيف والتعقيم الروتينية للمدارس ونقص الإمكانيات.

الكلمات المفتاحية: المدارس الابتدائية، البكتيريا، التلوث، الكائنات الحية الدقيقة، الأطفال، مستعمر، وادى جارف ، سرت.

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

Introduction

Pathogenic bacteria pose a significant risk in schools, as pupils come into contact with a diverse range of microbes on a daily basis. Many microorganisms live in the human body, but they are harmless and can only cause harm if they change their position (Maori et al., 2013). Bacterial infections can also occur when there are too many germs in the body, and as a result, these bacteria can multiply rapidly, which can interfere with the function of the heart, lungs, or other organs. Many studies have found that hands contaminated with bacteria can harbor a wide range of microbes causing disease, and that hands play an important role in the transmission and spread of bacterial diseases through indirect contact with feces to the mouth. (Best& Neuhauser., 2004). Hand cleaning is supposed to prevent infection transmission by eliminating germs and dirt, whereas dirt may contain microorganisms and allow them to survive for extended periods of time.(Lanata.,1994). Many studies have proven the effectiveness of hand washing in reducing the two main causes of child death, such as diarrhea and acute respiratory infections. Despite its effectiveness, washing hands with soap is not a common practice among children. (Cairncross, 2003). Several studies have found that hand washing techniques resulted in the isolation of disease causing bacteria from children's hands. A Greek investigation on hand swab samples from 1956 found that 52.9% of children's hands were contaminated with faecal Streptococcus. (Kyriacou, 2009). They discovered the presence of bacterial infections in all hand swabs collected after a study conducted by researchers on 400 students. (Tambekar et al,.2009) Gram-negative enterobacteria of Klebsiella, Escherichia coli, Citrobacter species, and Gram-positive Staphylococcus aureus has been found present on contact surfaces including door handles, tables, windows, chairs, and many other common household furniture. (Tambekar et al,.2009). School classrooms have an environment conducive to the efficient spread of germs, such as prolonged interaction between students, a large number of shared surfaces that are frequently touched, and separate cleaning. Because school buildings often contain large populations, maintaining high-quality indoor settings

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

is particularly challenging. (Karwowska, 2003).In the modern world, people spend most of their time indoors. While indoors, we encounter microorganisms on almost every surface we touch. This frequent contact with internal microbes holds the potential for disease transmission as well as interactions with our own microbes. (Pessoa et al,.2004&Davis et al,.2012) Unhygienic toilet use and improper hand washing after using the toilet may cause bacteria to be transferred to the surrounding area. Bacteria will easily settle on doorknobs, desks, water taps, etc., and spread to others who come into contact with these objects, such as students, teachers, and cleaner (Ramakrishna,.2007). Studies have confirmed that hand washing is an essential element in controlling diarrheal diseases in day care centers. Most staff used a bacterial indicator of fecal contamination rather than pathogen detection to investigate the spread of fecal contamination in the environment and on hands (Feachem et al,. 1983). Increasing evidence indicates that infants are more susceptible to bacterial infections transmitted in their environments than adults who are exposed to the same contaminated environment. (Nwachuku & Gerba ,.2004). In addition, feces are thought to be the main reservoir for human pathogens that can cause serious diseases such as shigellosis. (Ramakrishna,.2007). A prominent human pathogen in children worldwide, Staphylococcus aureus accounts for more than 90% of skin and soft tissue infections, especially cellulitis, abscesses and folliculitis. It can cause staph infections, which are common in children and cause musculoskeletal diseases. (Kaplan et al,. 2005). Each year, children in kindergarten through 12th grade in the United States miss more than 164 million school days due to the spread of diseases. (Leder et al,. 2003). Most cases of infection in children are caused by one of three pathogens viruses, bacteria, or fungi. It is certain that streptococcal and staphylococcal bacteria lead to diseases of the respiratory system, digestive system, and skin diseases.(Rusin,. 2002). High rates of bacterial diseases, in addition to the presence of large numbers of school children, and the possibility that children may not acquire healthy habits, make it important to understand the most important sources of disease transmission and pollution that

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

pose a danger to children.(Oleiwi,.2017)The aim of the current study was to assess the Bacteria contamination in primary schools in wadi jaref sirte - libya and to show whether schools are sanitized and clean for children or it is just the core reason for their illness.

Materials and methods

Samples collection:

Sampling was done from primary school , which located in wadi jaref sirte in Figure (1). Wadi Jaref extends from longitude “16º 12' 00" E to 16º 23' 00" E and latitude 31º 12' 00" N to 30º 59' 00" N. The length of this valley is approximately 31 km . In each school, collection of surface samples were performed from different classes surface (door handles, desks, children's hands) collected samples from different surfaces 30 samples are in Table 1.

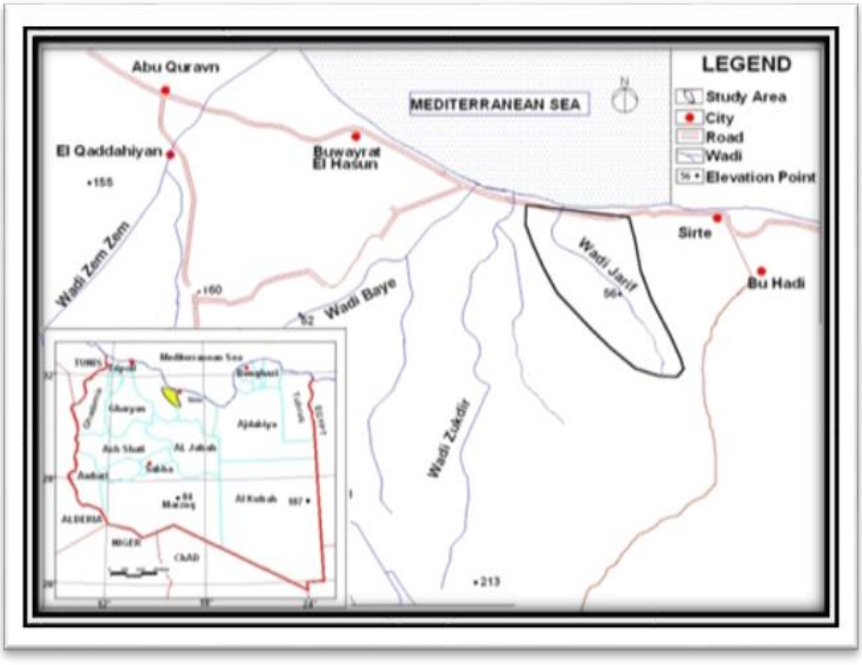

Figure (1): site of Wadi Jaref in the city of Sirte (Latitude. 2017)

تم استلام الورقة بتاريخ: 30/ 2024/6م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

Table 1 - Collected samples from different surfaces

Surfaces School type	Number of samples
Desk	**8**
Hands	**14**
Door handles	**8**
Total	**30**

The swabs are moistened with peptone water to allow bacteria to adhere, then wipe the required surface several times, and immerse the swabs in 10 ml of peptone water to transfer the samples to laboratory in a sterile manner and avoid any contamination. Once samples are collected, they are directly cultured and a series of isolation procedures are performed to determine the types of bacteria present in each sample. (El-Kased & Gamaleldin,.2020). In Petri dishes, the nutrient agar medium was prepared under sterile conditions, and the agar was harden and inoculated by the diffusion method. The dishes were placed in the incubator at 37°C and growth was monitored for 48 h. Bacteria were cultured using a MacConkey culture needle and blood agar media for identification. of bacteria in terms of the shape and arrangement of cells. (ATSDR ,2012).

Isolation and Identification:

After 24 hours, the bacterial colonies were examined, and transferred to a nutrient medium at 37°C for 24 hours. The average number of bacterial colony-forming units (CFU) in each dish was calculated, and bacterial colonies were examined for their type. Using Gram stain to identify the external appearance of all bacterial colonies and biochemical tests were performed to identify bacterial species.(El-Kased & Gamaleldin,2020).

RESULTS

This research was conducted for the study the spread of bacteria in primary schools in Wadi Jarif .Three places were targeted
From each school to represent the places it communicates children. 30 samples were collected from children's hands, desks and door handles (Table 1). The total number of different colonies produced

تم استلام الورقة بتاريخ: 30/ 2024/6م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

amounted to 123 (Table 2). The highest different bacteria counts were in the Hands ,Desk while the least sites were the Door handles. as shown in (Table 2)

Table 2: Mean of bacterial CFU/ml of different surfaces in primary schools.

Surfaces School type	CFU/ml primary schools
Desk	26
Hands	75
Door handles	22
Total	123

The organisms sequentially isolated in this study, based on colonial morphological, and biochemical characteristics the results showed the presence of bacteria Staphylococci epidermidis(35%), Staphylococcus aureus (22%), Esherichia coli (13%), klebsiella pp,micrococcus and Streptococcus (9%), bacillus(4%).

Table 3 -Bacterial isolates and it's proportions.

Bacterial genus or species	No. isolates (%)
Staphylococcus epidermidis.	8(35%)
Staphylococcus aureus	5(22%)
E .coli	3(13 %)
Klebsiella spp	2(9 %)
Micrococcus	2(9%)
Streptocoocus spp.	2(9%)
Bacillus spp	(4%)1

Discussion

Many studies have proven that contaminated hands can harbor a variety of harmful bacteria, and that hands play an important role in the transmission and spread of fecal and oral diseases. (Best & Neuhauser, 2004). We investigated the presence of microorganisms on everyday objects in primary schools, such as doorknobs, desks and children's hands. Most bacterial colonies were found on children's hands, at a rate of 75%. Parental education is significantly associated with children's hand contamination, which is consistent

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

with the findings of (Kyriacou et al., 2009 and Lubna et al., 2016). A mixed flora of Gram-negative and Gram-positive bacteria was also found, which were potentially pathogenic or non-pathogenic. The results of this work confirmed that 35% of primary schools Wadi Jaref examined were contaminated by Staphylococcus epidermis's. Staphylococcus epidermis's is a physiological microorganism commensal on the skin and mucous membranes, such as epiphytes and bacteria. (Pal et al., 2015). Staphylococcus epidermis's are present normally on skin and can rarely cause infections (Miltiadous &Elisaf, 2011). *Staphylococcus aureus* is a major bacterial human pathogen that causes a wide variety of clinical manifestations.(Lowy,1989) Staphylococcus aureus is usually transmitted by direct contact. But some types of infections are transmitted by other methods of transmission.(Rasigade & Vandenesch ,2014). A previous study conducted in 2017 Written by Oleiwi Species of Staphylococcus aureus are found in primary schools.(Oleiwi,2017).The results of the study in Wadi Jarif showed the presence of Staphylococcus aureus by 22%. Staphylococcus aureus is a commensal bacterium that causes disease in humans; Approximately 30% of humans are colonized by S. aureus. (Wertheim et al., 2005). The results of this study included the presence of Escherichia coli bacteria at a rate of 13%. Pathogenic E. coli spread from infected human or animal feces to susceptible humans via environmental media such as hands, water, and soil. Commensal E. coli, which includes non-pathogenic E. coli strains, are widely used as an indicator of fecal bacteria, and its presence is associated with an increased likelihood of infection with enteric pathogens or diarrheal diseases.(Tala et al,2018). Infectious of E. coli strains can cause many diseases, such as gastroenteritis, neonatal meningitis, and urinary tract infections, A previous study by (Meadow et al ,2014). reported that Streptococcus species were found on children's desks.(Meadow et al., 2014). The results also confirmed the presence of bacteria Klebsiella spp , Micrococcus and Streptococcus spp at a percentage of 9%. This study highlights a wide range of potential diseases and shows the presence of harmful bacteria in primary schools. The presence of microbial flora, such

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

as Staphylococcus aureus, Klebsiella sp., Escherichia coli, Streptococcus spp., and some yeast on the hands in school children are common findings.(Carrie et al., 2011). Bacteria of the genus Klebsiella are widely distributed in nature, both in soil and in water. It has a strong relationship with many disease processes in humans and animals, and therefore can enter the food chain. Klebsiella is not a pathogen of intestinal diseases and is not transmitted through food, but its role in intestinal diseases cannot be ruled out. (Neslihan,2014). Streptococci found in the samples are the main cause of skin, respiratory, and ear infections, especially in children. (Marks et al., 2014).Micrococci species, which belong to the Mycobacterium family, are certainly contaminants of the skin and mucous membranes. However, it has been confirmed as the bacterium causing bacteremia, endocarditis, ventriculitis, peritonitis, pneumonia, endophthalmitis, keratolysis, and septic arthritis (Whartonet al.,1986; Adang et al.,1992). Klebsiella spp bacteria were found in primary schools in wadi jaraf at a rate of 4%. Bacillus species bear spores that are highly resistant, hence cannot be easily destroyed and are common environmental contaminants, a study has shown that it is a micro flora of the human hand and surfaces due to its ability to form spores, Bacillus spp has also been implicated in human pathogenesis(Collins & Lyne ,2009).

Conclusions

Most bacterial colonies are found on children's hands, playing an important role in the transmission and spread of fecal-oral diseases. A mixed flora of Gram-negative and Gram-positive bacteria, potentially pathogenic or non-pathogenic, has also been found. The risk of diarrhea is from contaminated hands in places such as desks and other classroom tools. The bacterial counts recorded showed high surface contaminants encountered in the primary schools. This is linked to the high number of students in primary schools who lack proper hygiene attitudes due to schools not being cleaned and sterilized routinely and not washing hands well. Ways to reduce these contaminations should be explored, including greater emphasis on health education and monitoring of hand washing.

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

References

Adang RP, Schouten HC, van Tiel FH, Blijham GH.(1992) Pneumonia due to Micrococcus spp. in a patient with acute myeloid leukaemia. Leukemia. 1992 Mar;6(3):224-6.

Agency for Toxic Substances and Disease Registry (ATSDR). (2012). Toxicological Profile for Cadmium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Best M, Neuhauser D. Ignaz Semmelweis and the birth of infection control (2004). BMJ Qual Saf Health Care .2004 jun 13(3):233-234. doi: 10.1136/qshc.2004.010918.

Cabral, J. P. (2010). Water microbiology. Bacterial pathogens and water. International journal of environmental research and public health, 7(10), 3657-3703

Cairncross S. (2003).Hand washing with soap - A new way to prevent ARIs. Trop Med Int Health. 2003;8(8):677-679. doi: 10.1046/j.1365-3156.2003.01096.x.

Carrie A zapka, Esther J Campbell, Sheri L Maxwell,Charles p Gerba,Michael J.dolan,James W.Arbogast and David R.Macinga (2011) Bacterial Hand Contamination and Transfer after Use of Contaminated Bulk- Soap Refillable Dispensers. Appl Environ Microbiol. 2011;77(9);2898-2904. doi: 10.1128/AEM.02632-10.

Collins CH, Lyne PM (2009) Microbiological methods, 4th Edition. Biutterworths, London.

Danshmand T.N , Friedrich N. D, Gachter M, Montealegre M. C, Mlambo L. S, Nhiwatiwa .T, Mosler H. J, and Julian T. R. (2018) Escherichia coli Contamination across Multiple Environmental Compartments (Soil, Hands, Drinking Water, and Handwashing Water) in Urban Harare: Correlations and Risk Factors Am J Trop Med Hyg .2018 Mar; 98(3): 803–813.Published online 2018 Jan 22. doi: 10.4269/ajtmh.17-0521.

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

Davis MF, Iverson SA, Baron P, Vasse A, Silbergeld EK, Lautenbach E, Morris DO.(2012): Household transmission of meticillin-resistant Staphylococcus aureus and other staphylococci. Lancet Infect Dis. 2012, 12: 703-716. 10.1016/S1473-3099(12)70156-1 Published:September, 2012.

El-Kased F. Reham and Gamaleldin M. Noha(2020) Prevalence of Bacteria in Primary Schools. Pure Appl Microbiol - 14(4):2627-2636 / December 2020 / https://doi.org/10.22207/JPAM.14.4.39

Feachem, R.G., Bradley D.J., Garelick, H., Mara, D. (1983). Sanitation and disease: health aspects of Excreta and wastewater management. Publishedfor the World Bank by John Wiley & Sons Chichester New York Brisbane Toronto Singapore.

Harley P John(2004). Laboratory Exercises in icrobiology Spiral-bound – Import, 1 April 2004 the laboratory manual provides a balanced introduction to laboratory techniques and principles that are important in each area of microbiology .

John, G. Holt; Neel, R. Krieg; Peter; H.A. Sneath; James, T. Stalew; and Stanley, T. Williams (1994). Bergeys Manuol of determinative Bacteriology, (9th) Edition, Philadelphia Lippincott Williams & Wilkins.

Kaplan SL, Hulten KG, Gonzalez BE, et al.(2005) Three-year surveillance of community-acquired Staphylococcus ureus infections in children. Clin Infect Dis. 2005.15;40(12):1785-1791. PMID: 15909267. doi: 10.1086/430312.

Karwowska, E.(2003). Microbiological air contamination in some educational settings. Polish Journal of Environmental Studies, 12: 181-185.

Kyriacou A, Drakopoulou S, Georgaki I, et al.(2009) Screening for faecal contamination in primary schools in Crete, Greece.Child Care Health Dev. 2009;35(2):159-163. doi: 10.1111/j.1365-2214.2008.00911.x Source Pub Med.

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

Lanata CF.(1994) Problems in measuring the impact of hygiene practices on diarrhoea in a hygiene intervention study. In: K.V. Cairncross S, ed. Studying hygiene behavior methods, issues and experiences. New Delhi: SAGE, 1994;127-134.

Latitude.to2017.Availablefrom:http://latitude.to/map/ly/libya/cities /sirte (Accessed 03/11/2017)

Leder K, Sinclair MI, Mitakakis TZ, Hellard ME, Forbes A(2003) Acommunity-based study of respiratory episodes in Melbourne, Australia. Aust N Z J Public Health. 2003;27(4):399-404. doi: 10.1111/j.1467-842X.2003. tb00416.x

Lowy FD. Staphylococcus aureus infections. N Engl J Med. 1998 Aug 20;339(8):520-32.

Lubna A. M., Hoda Y. and Zakia O., (2016). Detection of Microbial Contamination in Some Lebanese Schools, Int.J.Curr.Microbiol. App. Sci(2016)., 5(1): 612-623.

Maori L, Okemena VA, Wasa AA.(2013) The prevalence of bacterial organisms on toilet door handles in Secondary Schools in Bokkos L.G.A., Jos, Plateau Sate, Nigeria. Int J Pharm Biol Sci. 2013;8(4):85-91.doi: 10.9790/3008-0848591.

Marks LR, Reddingera RM, Hakansson AP.(2014) Biofilm Formation Enhances Fomite Survival of Streptococcus pneumoniae and Streptococcus pyogenes. Infect Immun. 2014;82(3):1141-1146. doi: 10.1128/ IAI.01310-13.

Meadow JF, Altrichter AE, Kembel SW, et al.(2014) Bacterial communities on classroom surfaces vary with human contact. Microbiome. 2014;2-7. doi: 10.1186/2049- 2618-2-7

Miltiadous G, Elisaf M.(2011) Native valve endocarditis due to Micrococcus luteus: a case report and review of the literature. J Med Case Rep. 2011;5:251. doi: 10.1186/1752-1947-5-251

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

Monica, C. (1984). Medical laboratory Manual for Tropical countries. Vol.(2) :Microbiology, Doddington (14 Bevills Close, Doddington, Cambs. PE15 0TT):M. Cheesbrough.

Neslihan, G(2014).,Encyclopedia of Food Microbiology (Second Edition).2014, Pages 383-388

Nwachuku, N. and Gerba, C.P. 2004. Microbial risk assessment: don't forget the children. Curr Opin Microbiol, 7(3): 206. doi: 10.1016/j.mib.2004.04.011.

Oleiwi R, Sanaa. (2017) Investigation of Microbial Contamination of Primary Schools in Baghdad City: Iraqi Journal of Science, 2017, Vol. 58, No.2B, pp: 797-802 DOI:10.24996.ijs.2017.58.2B.3

Pal, S.; Juyal, D.; Adekhandi, S.; Sharma, M.; Prakash, R.; Sharma, N.; Rana, A.; Parihar, A.(2015). Mobile phones: Reservoirs for the transmission of nosocomial pathogens. Adv. Biomed. Res. 2015, 4, 144–149.

Pessoa-Silva CL, Dharan S, Hugonnet S, Touveneau S, Posfay-Barbe K, Pfister R, Pittet D.(2004): Dynamics of bacterial hand contamination during routine neonatal care. Infect Control Hosp Epidemiol. 2004, 25: 192-197. 10.1086/502376

Ramakrishna BS. (2007) The Normal Bacterial Flora of the Human Intestine and Its Regulation. J.clinical gastroenterology.41(Suppl. 1):S2-S6 © 2007 Lippincott Williams & Wilkins, Inc. doi: 10.1097/ MCG.0b013e31802fba68.

Rasigade JP, Vandenesch F. Staphylococcus aureus: a pathogen with still unresolved issues. Infect Genet Evol. 2014 Jan;21:510-4.

Rusin P, Maxwell S, Gerba C. (2002).Comparative surfaceto-hand and fingertip-to-mouth transfer efficiency of gram-positive

تم استلام الورقة بتاريخ: 30/ 6/2024م وتم نشرها على الموقع بتاريخ: 30/ 7/2024م

bacteria, gram-negative bacteria, and phage. J Appl Microbiol. 2002;93(4):585-592. doi: 10.1046/j.1365-2672.2002.01734.x.

Tambekar D.H, Shirsat S.D. Hand washing : A cornerstone to prevent the transmission of Diarrhoeal Infection(2009). Asian Journal of Medical Sciences 1(3): 100-103, 2009

Wertheim H.F, Melles D.C, Vos MC, Leeuwen W.V, Belkum A.V, Verbrugh H.A, Nouwen J.L(2005). The role of nasal carriage in Staphylococcus aureus infections. Lancet Infect Dis 5:751–762.doi: 10.1016/S1473-3099(05)70295.

Wharton M, Rice J.R, McCallum R.J, Gallis H.A. Septic arthritis due to Micrococcus luteus. J Rheumatol 1986;13:659-60.