International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 29-10-2019; Accepted: 30-11-2019
www.medicalsciencejournal.com
Volume 5; Issue 12; December 2019; Page No. 160-164

Prevention and control of communicable diseases by hands: Microbial flora of the sanitary surfaces of the toilets of the felix houphouët: Boigny University (Abidjan: Ivory Coast)

N'gbesso Jean-paul N'gbesso[1*], Félicité Beudje[2], Nicaise N'guessan A. épse Okoubo[3], Serge Mambey[4], Juli landry A ARRA[5], Mariana Traore épse Aka[6], Doumbia Mariamou Cisse[7], Allou Aime Constantin Ahoua[8]

[1, 3] Université Félix Houphouët-Boigny ; URF Environment, Vectors et parasites, 22 B.P. 582, Abidjan 22, Ivory Coast, Côte d'Ivoire
[2, 6] Central and Veterinary Laboratory of Bingerville (CVL), Bacteriology Service, BP 206 Bingerville, Côte d'Ivoire
[4] Department of Public Hygiene and Health Environment (DPHHE) BP V 4 Abidjan, Ivory Coast, Côte d'Ivoire
[5] Félix Houphouët-Boigny University; University Center for Research and Application in Remote Sensing, Abidjan, Ivory Coast, Côte d'Ivoire
[7] MSHP/DGS/Deputy General Direction of Public Hygiene, 14 BP Abidjan, Côte d'Ivoire
[8] Félix Houphouët-Boigny University, Institute of Tropical Geography Abidjan, Ivory Coast, Côte d'Ivoire

Abstract
Communicable diseases by hands constitute a real problem in public health, especially in sub-Saharan Africa where hygiene conditions are precarious.
The study took place at the Félix HOUPHOUËT-BOIGNY University from April to August 2018. The samples were taken from toilet surfaces such as door handles, tap heads, toilet flush buttons and WC seats.
A total of three hundred and sixty-eight (368) surface swab samples were examined. The results revealed the presence of total coliforms, *Escherichia* spp, and *Salmonella* spp. However, no *Pseudomonas* spp. Has not been observed. The overall proportions are 36.68% for total coliforms, 36.68% for *Escherichia* spp and 2.98% for *Salmonella* spp. The presence of enteric bacteria in the sanitary surfaces of the toilets of the Félix Houphouët-Boigny university represents a health risk for the university population.

Keywords: communicable diseases, hygiene, enterobacteriaceae, toilet, University

1. Introduction
Communicable diseases by hands such as gastrointestinal pathologies constitute a real public health problem worldwide. They represent a major public health problem in sub-Saharan Africa, mainly in areas with poor hygienic conditions [1]. Today, it is estimated at more than 2.5 billion people worldwide, including 550 million in sub-Saharan Africa who do not have minimum hygiene conditions, according to the recent report of the joint WHO / UNICEF program on water, Hygiene and Sanitation (WASH) [2, 3,4]. Human health risks are undoubtedly the most serious and widespread problem. Each year, around 3.5 million people die from manual diseases, especially in developing countries [5, 6]. The organization of several forums on Water, Hygiene and Sanitation (WASH) (Marrakech in 1997, The Hague in 2000, Kyoto in 2003, Mexico in 2006 and Senegal in 2012) testifies to the magnitude of this problem in developing countries [7]. In these countries, poor hygiene and a lack of basic sanitation are the foundations of these communicable diseases by hands [2, 4, 8, 9]. The latter are themselves the causes of absenteeism from school and work, and therefore from a low level of education and significant economic and income losses across a developing country [2, 10]. They represent a huge burden for these countries [11, 12]. Indeed, the physical environment and the degree of cleanliness of WASH sanitation infrastructures have an impact on the health and well-being of learners. In the event that this environment does not have acceptable sanitation and hygiene conditions such as hand washing facilities and toilets in good condition, the diseases develop and spread quickly. It becomes a high-risk space for the latter by accentuating their vulnerability to manual illnesses, especially gastrointestinal [13]. However, the provision of hygiene and sanitation facilities could reduce these manual diseases by almost 90% [14, 15, 16].
In Ivory Coast, the level of hygiene and sanitation is still low despite the establishment of a policy to improve the living conditions and well-being of the populations [17]**.** This low level of hygiene recorded among students at the Félix Houphouet-Boigny University of Ivory Coast [18, 19] and the promiscuity observed were the reasons for this study, the objective of which was to determine the microbial ecology of germs present in the sanitary surfaces of university toilets.

2. Materials and Methods
2.1 Presentation of the study area
The study area is represented by the Félix HOUPHOUËT-Boigny University of Cocody (Abidjan- Ivory Coast). It was selected because of the low level of hygiene recorded by Alloka and his collaborators. [18]. It is located in West Africa precisely in Ivory Coast in the city of Abidjan (Fig. 1), the economic capital in the south of the country, in the Lagunes region at 5 ° 20 '44' 'Latitude North and 3 ° 59' 10 " Longitude West in the boreal hemisphere [20].

2.1.1. Human aspect
The University has a capacity to accommodate 30,000

students. It is largely overstaffed in relation to the number of amphitheater and the number of rooms available. The number of students is estimated at over 65,000 under the supervision of 1,638 teacher-researchers and 91 researchers [20].

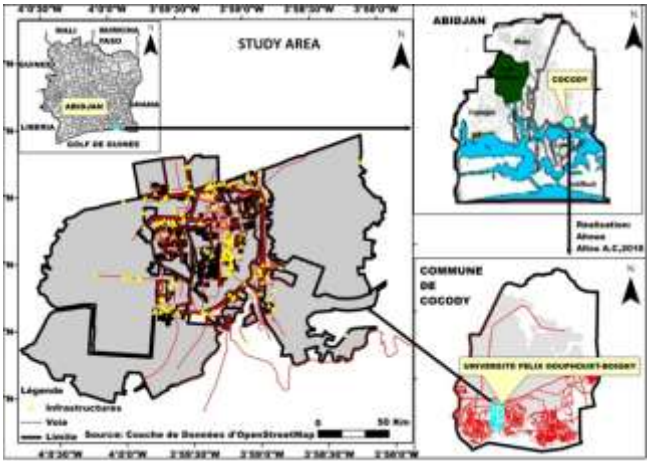

Fig 1: Presentation of the study area

2.1.2. Physical appearance

The Félix HOUPOUET-BOIGNY University is located on a plateau with an area of 200 hectares. It is bounded by two valleys, to the east by the valley of the Higher Normal School and to the west by that of the University Hospital Center (CHU). These two valleys are drained to the drunken lagoon to the south of the university [20].

2.2. Data collection methodology

A qualitative and quantitative microbiological control study was carried out from April to August 2018 at the Félix HOUPHOUËT-BOIGNY University. The swab method [21] has been used in areas such as toilet door handles, tap heads, toilet flush buttons and WC seats. Sterile swabs were previously moistened in sterile peptone water in a tube.
For a given surface, the swab is passed over zones defined in close parallel streaks by rotating them slightly, then over the same zones in perpendicular streaks. The swab is then placed in the tube containing sterile peptone water. The tube is identified and placed in a cooler containing cooling packs to maintain a temperature of 4°C during transport to the laboratory.

2.3. Sample Collection and Analysis

A total of 368 samples were taken. The content of each labeled tube is homogenized by gentle manual agitation. The broth obtained was seeded on several agars, including Doxycholate Citrate Lactose agar incubated at 42°C for 48 hours for the search for total Coliforms. The search for *Salmonella* spp was carried out according to ISO 6579 [22]. The search and identification of total coliforms, *Escherichia* spp, *Salmonella* spp and *Pseudomonas* spp were carried out according to classical microbiology.

2.4. Data processing and analysis

Data entry was carried out with Excel software. The KHI-TWO test (X^2) was used to compare values of the proportions of the germs. Interpretations are based on the p-value in a 95% confidence interval (CI). The digital locality map was produced with ArcGIS software.

3. Results

The microbiological analysis was carried out on 368 samples made up of 80 [17.63 - 26.30] door handles swabs, 84 [18.63 - 27.45] tap head swabs, 90 [20, 15 - 29.17] swabs of toilet flush buttons and 114 [26.28 - 35.97] WC seats swabs. The overall proportions are 36.68% for total coliforms, the same for *Escherichia* spp, 2.98% for *Salmonella* spp. No *Pseudomonas* spp has been identified.

3.1. Microbiological results of swabs from door handles

A set of 80 door handles swabs examined, 09 were positive for *Escherichia* spp a raté of 11.25. This same proportion was obtained for total coliforms. No *Pseudomonas* spp and *Salmonella* spp were obtained (Table 1).

Table 1: Proportion of germs from door handles

Indications	Total coliforms (n=80)	*Escherichia* spp (n=80)	*Salmonella* spp (n) (n=80)	*Pseudomonas* spp (n=80)	Total
Positive door handles swabs (n)	9	9	0	0	18
Proportion of door handles swabs Positive (%)	11.25	11.25	0	0	05.62

3.2. Microbiological results of swabs from tap heads

Of the 84 tap heads swabs examined, 31 were positive for *Escherichia* spp, representing 36.90% (Table 2). No *Pseudomonas* spp and *Salmonella* spp were obtained.

Table 2 : Proportion of germs from tap heads

Indications	Total coliforms (n=84)	*Escherichia* spp (n=84)	*Salmonella* spp (n) (n=84)	*Pseudomonas* spp (n=84)	Total
Positive tap heads swabs (n)	31	31	0	0	62
Proportion of Positive tap heads swabs (%)	36.90	36.90	0	0	18.45

3.3. Microbiological results of swabs from toilet flush buttons

A total of 35 push button swabs are positive for *Escherichia* spp out of a total of 90 swabs. No *Pseudomonas* spp and *Salmonella* spp were obtained (Table 3).

Table 3 : Proportion of germs from from toilet flush buttons

Indications	Total coliforms (n=90)	Escherichia spp (n=90)	Salmonella spp (n=90)	Pseudomonas spp (n=90)	Total
Positive toilet flush buttons swabs (n)	35	35	0	0	70
Proportion of positive toilet flush buttons swabs (%)	38.88	38.88	0	0	19.44

3.3. Microbiological results of swabs from WC seats

Table 4 shows the proportions of germs on the toilet seats. 63 positive swabs were obtained out of 114, a proportion of 55.24%. 11 swabs were positive for *Salmonella* spp. However, a significant difference was observed between the proportion of swabs positive for *Salmonella* spp and that for *Escherichia* spp ($X^2 = 25.46$, $p = 0.0000$).

Table 4: Proportion of germs from WC seats

Indications	Total coliform (n=114)	Escherichia ssp (n=114)	Salmonella ssp (n=114)	Pseudomonas ssp(n=114)	Total
Swabs of positive WC seats (n)	63	63	11	0	137
Proportion of positive WC seats (%)	55.24	55.24	9.64	0	30.04

3.5 Comparative study of the germs obtained as a function of the curved surfaces

Fig 2 shows that the highest number of germs is found in the WC seats.

There are two kinds of bacteria on the toilet seats such as *Escherichia* spp and *Salmonella* spp

At the level of the analyzed surfaces, the seats of WC present more germs with very high proportions.

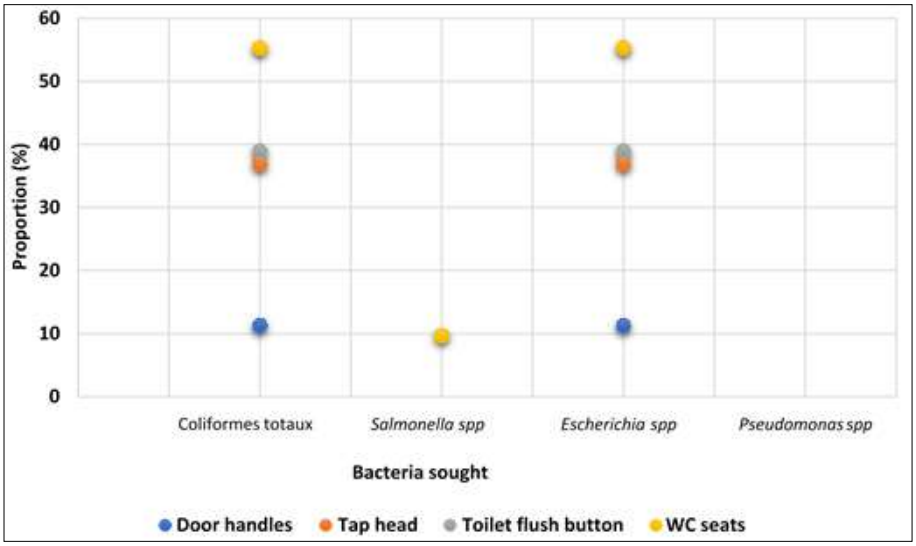

Fig 2: Variation in the number of germs depending on the surfaces examined

It was obtained from a total of 368, 17.11% samples positive for *Escherichia* spp, 2.98% cases positive for *Salmonella* spp, and an absence of *Pseudomonas* spp (Table V). A significant difference was between the proportion of *Escherichia* spp on door handles and that of toilet seats ($X^2 = 35.57$, $p = 0.0000$). Statistical analysis shows a significant difference between the proportion of *Escherichia* spp on the tap heads and that of the toilet seats ($X^2 = 9.00$, $p = 0.0027$).

Table 5: Summary table of the germs sought according to the surfaces analyzed

	Surfaces examined n (%)				
Indication	**Door handles 80 (21,73)**	**Tap heads 84 (22,82)**	**toilet flush buttons 90 (24,45)**	**WC seats 114 (30,97)**	**Total**
Salmonella spp positive swabs	0 (0)	0 (0)	0 (0)	11 (2.98)	11
Escherichia spp positive swabs	9 (2.44)	31 (8.42)	35 (9.51)	63 (17.11)	129
Pseudomonas spp positive swabs	0 (0)	0 (0)	0 (0)	0 (0)	0
Total coliform positive swabs	9 (2.44)	31 (8.42)	35 (9.51)	63 (17.11)	129

4. Discussion

This study highlighted the presence of total coliforms, *Escherichia* spp and *Salmonella* spp at the Félix Houphouët-Boigny University. The overall proportions are 36.68% for *Escherichia* spp, and 2.98% for *Salmonella* spp. However, the absence of *Pseudomonas* spp has been reported.

The results showed that the academic environment of toilets has potentially pathogenic microorganisms such as *Salmonella* spp. These results are corroborated with the studies of Rutala and collaborators on the one hand, and of Weber and collaborators on the other hand. Indeed, according to these authors, the human environment is largely contaminated by specifically environmental microorganisms [22, 23]. This contamination varies qualitatively and quantitatively over time. They also demonstrated that the capacity to create an infection results from a combination of factors associating the level of expression of the virulence factors of the microorganism, its

quantity or its concentration, the mode of contamination and the receptivity of the host.

The contact surfaces of the hands in the toilets presented a bacterial flora in particular enterobacteria. These results are in agreement with that of Munoz and collaborators who have demonstrated the presence of bacteria at the contact surfaces of door handles in a university health center [24].

According to our results, the microbial flora detected at our study site consists of the genera *Escherichia* and *Salmonella*. It should be noted that this flora found on surfaces depends on several factors such as human activity which leads to an intake of microorganisms. Without effective bio-cleaning, the survival of these microorganisms on surfaces can be very prolonged. *Escherichia* spp bacteria can survive for 1.5 hours to 16 months on dry, inert surfaces [25]. In addition to the quality of the bio-cleaning, surface contamination depends on many factors linked to the microorganism: its life on an inert support (which varies depending on the material, temperature, drying), its adhesion to the surface, its ability to produce a biofilm and its ability to withstand adverse conditions [26, 27].

In our study, the genus *Escherichia* occupied the first place of enterobacteria. This abundance could be explained by their predominance in the optional aerobic-anaerobic flora of the digestive tract in humans and in many animal species on the one hand, and on the other hand by their undemanding living conditions [28, 29]. It has been noted that *Escherichia* spp is responsible for the most frequent infection, especially nosocomial infections, and is much less resistant to desiccation [30, 31]. The absence of the genus *Pseudomonas* could be due to the method of analysis which is likely to be poorly suited to these. The microorganisms of human origin or specifically environmental present in the environment belong to opportunistic species and to pathogenic species for humans. It should be noted that most of the infections linked to environmental contamination are still poorly documented, with the exception of those linked to some microorganisms of environmental origin [32, 33, 34, 35]. Controlled epidemiological studies show an association between infection and exposure to a contaminated environment is still rare [36].

5. Conclusion

The genera *Escherichia* spp and *Salmonella* spp are bacteria present on contact surfaces of university surfaces. this study produced overall rates of 36.68% for *Escherichia* spp and 2.98% for *Salmonella* spp.

The most contaminated areas in order of abundance are the toilet seats, toilet flush buttons; tap heads and door handles.

The presence of enterobacteria in the sanitary surfaces of the toilets of the Félix Houphouët-Boigny University represent a health risk for the university population.

Hand hygiene devices must be installed to limit the risks of faecal-oral contamination and the identification of the species of germs found and their resistance to different antibiotics.

6. Remerciements

Our thanks go to the heads of the training and research units, the heads of the cleaning service staff and the cleaning service staff of the Félix HOUPHOUËT-BOIGNY university. We also thank the managers and the technicians of the central and veterinary laboratory of Bingerville (LCVB) especially sir Eloua ADJE.

7. Conflict of Interest

Authors declare no conflict of interest

8. References

1. Rindra R. Environmental impacts on childhood diarrhea in Madagascar: Campylobacter risk analysis, Doctoral thesis in Medicine presented by the University of Grenoble, France, 2012, 164.
2. White water, for a better dissemination of sanitation works in rural Sahel 80 concrete proposals - Synthesis of the study, 2010, 20.
3. Freeman M, Clasen T, Dreibelbis R. The impact of a school-based water supply and treatment, hygiene, and sanitation program on pupil diarrhoea: a clusterrandomized trial. Epidemiology and Infection. 2014; 142(4):340-351.
4. WHO. Water-related diseases, 2017. http://www. who.int/water_sanitation_health/diseases-risks/ diseases/en. 2017.
5. WHO. Global Water Supply and Sanitation Assessment 2000 Report: WHO, 2000.
6. WHO. Water, sanitation and hygiene to accelerate and sustain progress in the fight against Neglected Tropical Diseases GLOBAL Strategy, 2015. – 2020, 2015, 50.
7. ANSD. National Agency for Statistics and Demography Senegal: Demographic and Continuous Health Survey (EDS-Continue), 2014, 263.
8. IFRCS, International Federation of Red Cross and Red Crescent Societies. The International Federation software tools for long-term water and sanitation programming, 2007, 52.
9. Briscoe J, Feachem RG, Mujibur Rahaman M. Health Effect Assessment: Water Supply, Sanitation and Hygiene. UNICEF, ICDDR_B, CRDI (Center for Research for International Development), Ottawa, Canada, 1987, 86.
10. Diallo AC. Evaluation of hygienic hand washing practices by sampling, sampling and microbiological analyzes: case of students and staff of the University of Moncton, Moncton campus. Master thesis in nutrition-food sciences, Université de Moncton, Canada, 2015, 118.
11. Water, Sanitation and Hygiene (WASH) in schools. Manual for child-friendly schools. UNICEF, 2011, 50.
12. The PLoS medicine editors. Clean water should be recognized as a human right. PLoS Med. 2009; 6(3):2-4.
13. Anonymous. Access to water and sanitation in schools in the Saint Louis Region / Senegal. UNICEF, 2013, 33.
14. Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. Lancet Infect Dis. 2005; 5(4):42-52.
15. Gruber JS, Reygadas F, Arnold BF, Ray I, Nelson K. A stepped wedge, cluster-randomized trial of a household UV-disinfection and safe storage drinking water intervention in rural Baja California Sur, Mexico. Am J Trop Med Hyg. 2013; 89(1):238-245.
16. Strunz EC, Addiss DG, Stocks ME, Ogden S, Utzinger J. Water, Sanitation, Hygiene, and Soil-Transmitted Helminth Infection: A Systematic Review and Meta-Analysis. PLoS Med. 2014; 11(3):e1001620.

17. MSHP. Diagnostic study: National strategy for hygiene promotion in Côte d'Ivoire 2016 - 2020, 2015, 187.
18. Alloka Romaric. Evaluation of hygienic hand washing practices for students of UFR Biosciencse, Félix Houphouet-Boigny University, Abidjan, 2016, 52.
19. N'gbesso Jean-Paul N'GBESSO, Nicaise Aya N'GUESSAN, Alexis Loukou BROU, Jean-Romaric ALLOKA, Félix Kouamé N'DRI, Guy Roger GNAZALE (2017) Evaluation of knowledge, Attitude and practices in hand hygiene of students in biological sciences from Felix Houphouët-Boigny University of Cocody (Abidjan-Côte d'Ivoire) International Journal of Environmental & Agriculture Research. 2017; 3(8):49-55.
20. University service: http:/www.univ-fhb.edu.ci, 2016.
21. ISO/DIS 14698-1(norme ISO/DIS 14698-1 International Standard, Clean room and related environment under control _ Control of bio-contamination, 2003, 11.
22. ISO – 6578, International Organization for standardization Amended ISO 6578: 2002 / DAM. Microbiology of food and animal feeding stuffs – Horizontal method for detection of Salmonella spp, 2002.
23. Rutala WA, Weber DJ. Water as a reservoir of nosocomial pathogens. Infect Control Hosp Epidemiol. 1997; 18(1):609-16.
24. Weber DJ, Rutala WA. Environmental issues and nosocomial infections. In: Wenzel RP. Prevention and control of nosocomial infections, Williams &Wilkins, Baltimore. 1997; 3(1):491-514.
25. Munoz-Price LS, Birnbach DJ, Lubarsky DA, *et al*. decreasing operating room environmental pathogen contamination through improved cleaning practice. Infect Control Hosp Epidemiol. 2012; 33(1):897-899.
26. Kramer A, Schwebke I, Kampf G. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. BMC Infectious Diseases, 2006, 6.
27. Oie S, Kamiya A. Survival of methicillin-resistant Staphylococcus aureus (MRSA) on naturally contaminated dry mops. J Hosp Infect. 1996; 34(1):145-9.
28. Wendt C, Wiesenthal B, Dietz E, Ruden H. Survival of vancomycin-resistant and vancomycin-susceptible enterococci on dry surfaces. J Clin Microbiol. 1998; 36(1):3734-6.
29. Nataro JP, Kaper JB. Diarrheagenic Escherichia coli. Clin Microbiol Rev. 1998; 11(1):142-201.
30. Kaper JB, Nataro JP, Mobley HL. Pathogenic Escherichia coli. Nat Rev Microbiol. 2004; 2(1):123-40.
31. Jawad A, Heritage J, Snelling AM, Gascoyne-Binzi DM, Hawkey PM, *et al*. Influence of Relativehumidity and suspend in gmenstrua on survival of *Acinetobacter* spp. ondry surfaces. J Clin Microbiol. 1996; 34(1):2881-7.
32. Alberti C, Bouakline A, Ribaud P, Lacroix C, Rousselot P, Leblanc T, *et al*. Aspergillus Study Group. Relationship between environmental fungal contamination and the incidence of invasive aspergillosis in haematology patients. J Hosp Infect. 2001; 48(1):198-206.
33. Phillips MS, Fordhamvon Reyn C. Nosocomial infections due to non-tuberculous mycobacteria. Clin Infect Dis. 2001; 33(1):1363-74.
34. Stout JE, Yu VL. Legionellosis. N Engl J Med. 1997; 337(1):682-7.
35. Yu VL. Resolving the controversy on environmental cultures for Legionella: aModestproposal. Infect Control Hosp Epidemiol. 1998; 19(1):893-7.
36. Rhame F. The inanimate environment. In: Benett J, Brachman P. Hospital infections. Lippincot-Raven, Philadelphia. 1998; 4(1):299-324.