

Health Professionals' Hand Hygiene Best Practice on Infection and Resistance Reduction at District Health Facilities, Cameroon

Cécile Ingrid Djuikoue^{1, 2, *}, Yimga Wanda Grace², Meyoupo Penda Audrey Armandine¹, Omer Tchikamgoua Njajou², Alex Stephane Ndjip Ndjock², Venant Tchokonte-Nana¹, Benjamin Longo-Mbenza^{3, 4}, Eugène Ndebia⁴

¹Faculty of Health Sciences, University des Montagnes, Bangangte, Cameroon

²Prevention and Control Foundation, Yaounde, Cameroon

³Faculty of Public Health, LOMO University of Research, Kinshasa, Democratic Republic of Congo

⁴Faculty of Health Sciences, Walter Sisulu University, Mthatha, South of Africa

Email address:

Djuikoe1983@yahoo.fr (C. I. Djuikoue), yimga_grace@yahoo.com (Y. W. Grace), pendaarmandine@yahoo.com (M. P. A. Armandine), njajou@gmail.com (O. T. Njajou), alexndjock@gmail.com (A. S. N. Ndjock), venant.tnana@gmail.com (V. Tchokonte-Nana), longombenza@gmail.com (B. Longo-Mbenza), ndebiaecugene@gmail.com (E. Ndebia)

*Corresponding author

To cite this article:

Cécile Ingrid Djuikoue, Yimga Wanda Grace, Meyoupo Penda Audrey Armandine, Omer Tchikamgoua Njajou, Alex Stephane Ndjip Ndjock, Venant Tchokonte-Nana, Benjamin Longo-Mbenza, Eugène Ndebia. Health Professionals' Hand Hygiene Best Practice on Infection and Resistance Reduction at District Health Facilities, Cameroon. *World Journal of Public Health*. Vol. 6, No. 4, 2021, pp. 181-187. doi: 10.11648/j.wjph.20210604.17

Received: September 29, 2021; **Accepted:** October 21, 2021; **Published:** December 24, 2021

Abstract: Hospital-based hand hygiene measures and best practice have been empirically proven to prevent cross-transmission of infection and resistance spreading. Little is documented on hand hygiene best practices in reducing pathogenic micro-organisms transmission dynamic, infection and resistance spread at district/community health facilities and hospitals in Cameroon. Our study thus, aimed at evaluating health workers hand hygiene measures compliance and best practices against pathogenic infections over a period of seven months at Nylon Health District, Douala, Cameroon. A cross-sectional study using an observation grid analysis based on WHO protocol was used to collect samples from 155 consented health workers from eight Nylon health facilities. A univariate logistic regression was performed to define the compliance rates and assessment of indicators at 95% confidence interval (CI). An overall hand hygiene compliance rate of 7.74% (12/155) was observed. Public and private health facilities had similar hand hygiene compliance rates of 7.69% and 7.84% respectively. Doctors had the most nails within 0.5 cm/ and the nails of the midwives were the most varnished and/or artificial nails. Professional qualifications (state certified nurse/midwives (OR=10.74; 95% CI OR [1.22; 94.43]; p-value=0.03) and doctors (OR=8.38; CI 95% OR [1.67; 41.95]; p-value=0.01)) and the wearing of jewellery and/or artificial nails or varnish, and/or nails of size >5 mm during treatment (OR=0.16; 95% CI OR [0.03; 0.97]; p-value=0.04) were the factors significantly influencing the compliance of hand washing. This study shows that hand hygiene measures best practice amongst health staff at district health facilities was low which calls for urgent awareness and health education to reinforce the hospital's infection prevention and control standards training activities so as to improve quality care delivery and reduce antimicrobial resistance spread in Cameroon.

Keywords: Compliance, Hand Hygiene, Health Personnel, Infection, Resistance, Cameroon

1. Introduction

It has been documented since 1845 that good hand hygiene reduces the risk of transmission of infections [1]. One hundred and seventy years later, this simple and effective concept is still not fully integrated into current clinical practice [1].

The term “hand hygiene” which replaces the more restrictive term “hand washing” is a new concept in health which firstly designates hand washing which consists of eliminating dirt and transient microorganisms present on the hands and therefore rests on the use of soap and water and secondly on hand antisepsis. We speak of hand hygiene compliance when these two main steps are followed [3]. Promoting hand hygiene compliance has an essential role in the prevention of healthcare associated infections (HCAI) [3].

According to the WHO, more than 1.4 million people suffer from hospital-acquired infections worldwide, and the risk of contracting them is 2-20 times higher in developing countries than in countries in Europe and North America [5]. In Africa the prevalence of healthcare associated infections varies between 2.5% and 14.8% [6]. According to the WHO, 5 to 8 million lives will be saved if better practices of hand hygiene are respected, thereby reducing the transmission of pathogens during care by 50% and more. About 61% of healthcare professionals do not practice proper hand hygiene, resulting in a global compliance rate of 40% to 50% [5].

In Cameroon nosocomial infection remains a concern in terms of morbidity and mortality with a prevalence ranging from 10% to 20% [6], including urinary tract infections which are one of the major problems in Public Health in terms of morbidity and funding [7], and several studies have been devoted to it, such as that of Njall *et al* in 2013 which analysed simple aseptic measures to remedy post-operative nosocomial infection [8]. Agbor and Azodo (2010) carried out a study in 91 dental clinics in Cameroon and reported that infection control activities in the clinic were supervised mainly by 31% of dentists and 38.6% of dental therapists with less than half of the respondents reported good hand washing practices [9]. Although hand hygiene is the most cost effective HCAI prevention measure, it is also the least well practiced both qualitatively and quantitatively [4]. It is for this reason that a study on the conformity of hand hygiene and its determinants among the health staff of health facilities of the Nylon Health District was undertaken.

2. Materials and Methods

2.1. Study Area

This is a cross-sectional analytical study conducted in the Littoral region of Cameroon from January 23 to August 30, 2019, on selected health centres at the Nylon district. The sampling method used was non-probabilistic and consecutive. Included in our study were all health personnel from the preselected health facilities present at the time of the study and having given their informed consent.

2.2. Data Collection

An observation grid on hand hygiene was used to collect data according to the WHO 2019 protocol divided into three main stages: pre-enforcement stages which consisted of observing the places and hands of the staff, enforceable stage which consisted of observing the execution of hand hygiene and finally the indications which consisted of verifying the different moments of execution of hand hygiene.

2.3. Data Collection Method

After contacting the administrative manager and obtaining the consents of the health personnel at the district hospitals, we proceeded with an audit of different materials of hand hygiene namely: sink, tap with running water, soaps (solid or liquid), hand towel and hand disinfection solution (hydro-alcoholic or antibacterial); we also looked for the presence of the various protocols relating to handwashing displayed (simple handwashing protocol, protocol for the use of an alcoholic hand rub and protocol on the various indications of hand hygiene).

Subsequently we observed the staff who administered patient care; the compliance of hand hygiene of each of them according to two main stages which are: simple hand washing and hand disinfection with a hydro alcoholic solution as recommended by the WHO was noted [3]. With the aid of a ballpoint pen or an ordinary pencil, each grid on the survey was checked as either a “yes” or a “no”.

2.4. Statistical Analyses

Data were collected and analysed using Epi Info software version 7. Hand hygiene compliance was described using the calculation of proportions; confidence interval and odds ratio. The search for determinants was done by univariate logistic regression. The significance level was set at 95% for 0.05.

2.5. Ethical Considerations

As part of research ethics requirements, the following were obtained:

- 1) An Ethical Clearance issued by the University of Douala;
- 2) A survey authorization issued by the Regional Delegate of Public Health;
- 3) A survey authorization addressed to the District chief and the heads of health facilities;
- 4) Informed consent addressed to health personnel.

3. Results

3.1. Description of the Study Population

One hundred and fifty-five (155) health personnel were recruited from 8 health facilities in the Nylon District. The data were collected in 74 service units distributed as follows: 14 reception service units, 2 surgical service units, 4 antenatal consultation offices (ANC), 9 outpatient offices, 8 hospitalization service units, 11 treatment room units, one

physiotherapy service unit, 6 minor surgery units, 4 vaccination units, 8 laboratory service units, 3 maternity service units (delivery), a neonatal service unit, an emergency unit and 2 paediatric service units.

The sex ratio M/F was 0.94. The majority of staff, 104 (67.10%) were from public structures and 51 (32.90%) from private structures. The recruited staff consisted of 84 nursing assistants, 23 laboratory technicians, 23 doctors and 25 state-

certified nurse/midwives. A third, 60 (38.71%) staff wore jewellery on their hands; 44 (28.39%) had nails of length greater than five mm; 27 (14.42%) wore varnish or artificial nails; 10 (6.52%) had all three characteristics at the same time and 81 (52.26%) had at least one of the three characteristics during the execution of acts. 82 (52.90%) staff wore gloves during the execution of acts and 47.10% did not wear gloves (Figure 1).

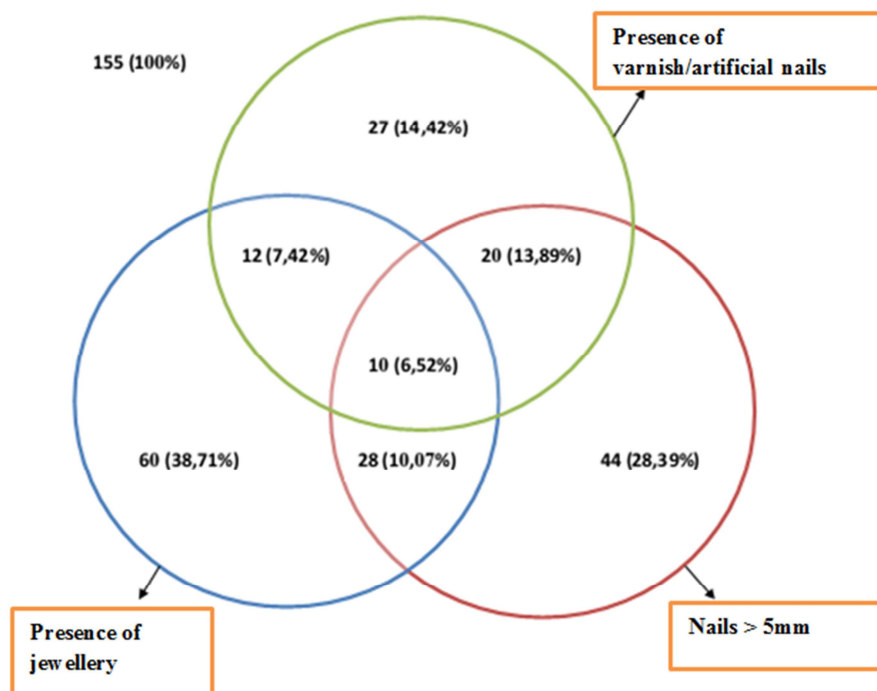


Figure 1. Distribution of hospital staff according to the presence of jewellery and/or artificial nails or varnish and/or nails of size > 5 mm when performing an act.

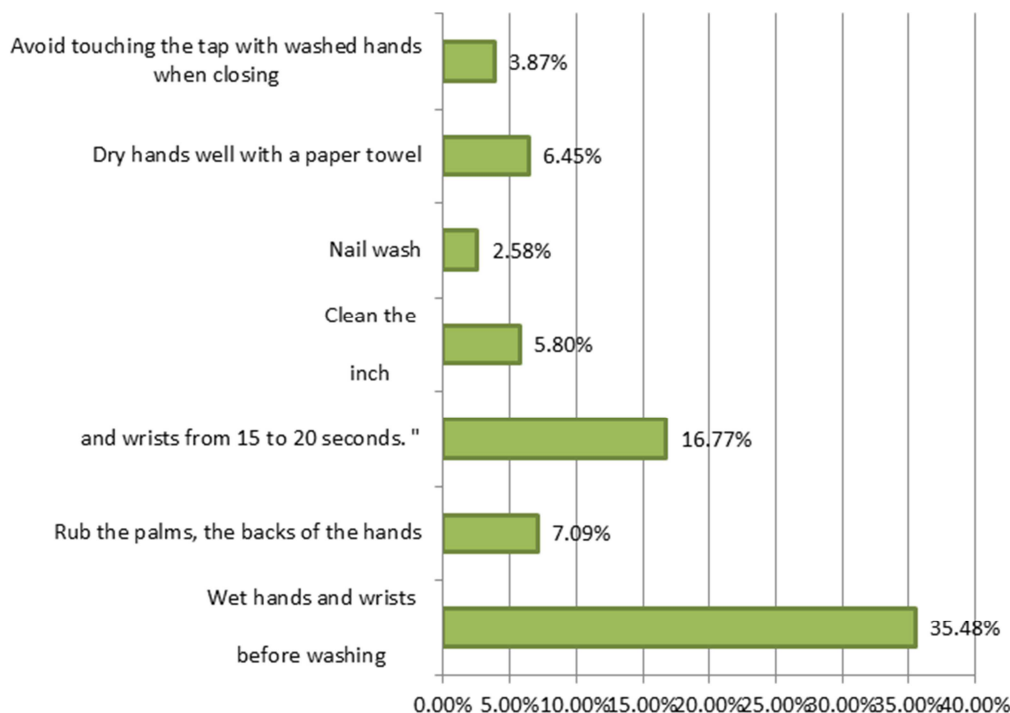


Figure 2. Executory steps for hand washing.

3.2. Description of the Conformity of Hand Washing

Only 12 (7.74%) personnel washed their hands in a compliant way, they followed the 7 binding steps of washing as recommended (Figure 2).

Table 2 shows the 7 binding steps of handwashing, 50 (35.48%) health workers wet their hands and wrists before washing. The proportion of those who rub the palms, back of the hands and wrists for 15 to 20 seconds was 7.09%. The health personnel who clean the interdigital spaces represented 16.77%. Thumb cleaning was 5.80%. The proportion of health personnel who wash the nails was 2.58%. Healthcare workers who dried their hands with a single paper towel after washing represent 6.45%. The proportion of health personnel who avoided closing the tap directly with their washed hands was 3.87% (Table 2).

3.3. Distribution of Personnel, Hand Washing Compliance

According to Table 1, 9.33% of men practiced proper hand washing during treatment, compared to 6.25% of women. In univariate logistic regression, there was no significant association between gender and handwashing compliance (OR=1.54; 95% CI OR [0.47; 5.10]; p-value=0.47).

7.84% of the staff of private health facilities practiced a proper hand washing against 7.69% for public health facilities. In univariate logistic regression, there was no significant association between the type of health facility and the compliance of hand washing (OR=1.54; 95% CI OR [0.47; 5.10]; p-value=0.47).

21.74% of doctors practiced proper hand washing against

12% of nursing staff with state diploma or midwife, 4.35% of laboratory technicians and 3.57% of nursing assistants. Of all these qualifications, only the profession of doctor was significantly associated with the compliance of hand washing in univariate logistic regression (OR=7.25; 95% CI OR [1.64; 34.29]; p-value=0.01).

Only 12.2% of those who wore gloves during treatment had performed a proper hand wash compared to 2.74% for those who did not. In univariate logistic regression, there was a positive association between wearing gloves and hand washing compliance (OR=4.93; 95% CI OR [1.40; 23.31]; p-value=0.04) (Table 1).

Only 3.70% of those who wore jewels and/or artificial nails or varnish, and/or nails of size>5 mm during the treatments had practiced a hand wash in conformity against 12.16% for those who were not. In univariate logistic regression, there was no significant association between the wearing of jewellery and/or artificial nails or varnish, and/or nails of size>5 mm during care and the conformity of hand washing (OR=0.28; 95% CI OR [0.07; 1.07]; p-value=0.06) (Table 1).

3.4. Factors Influencing the Conformity of Hand Washing

The qualification: IDE nurse/midwife (OR=10.74; 95% CI OR [1.22; 94.43]; p-value=0.03), doctor (OR=8.38; 95% CI OR [1.67; 41.95]; p-value=0.01).

The fact of wearing jewellery and/or artificial nails or varnish, and/or nails of size>5 mm during treatment (OR=0.16; 95% CI OR [0.03; 0.97]; p-value=0.04) (Table 2).

Table 1. Distribution of personnel practicing handwashing according to their gender, type of health facility, qualification, wearing of gloves, size of nails and presence of jewellery, varnish or artificial nails.

INDEPENDENT VARIABLES	Total number N=155	Hand washing Compliance		Gross OR	CI 95%OR	P-value
		Yes	No			
Sex						
F	80	5 (6.25%)	75 (93.75%)	Ref.		
M	75	7 (9.33%)	68 (90.67%)	1.54	[0.47; 5.10]	0.47
Type of health facility						
Private	51	4 (7.84%)	47 (92.16%)	Ref.		
Public	104	8 (7.69%)	96 (92.31%)	0.98	[0.28; 3.42]	0.97
Professional qualification						
Caregiver	84	3 (3.57%)	81 (96.43%)	Ref.		
Laboratory technician	23	1 (4.35%)	22 (95.65%)	1.23	[0.12; 12.39]	0.86
State certified nurse/midwife	25	3 (12%)	22 (88%)	3.68	[0.69; 19.53]	0.13
Doctor	23	5 (21.74%)	18 (78.26%)	7.25	[1.64; 34.29]	0.01
Wearing of gloves						
No	73	2 (2.74%)	71 (97.26%)	Ref.		
Yes	82	10 (12.2%)	72 (87.8%)	4.93	[1.40; 23.31]	0.04
Presence of jewellery/varnish/artificial nails/nail size>5 mm						
No	74	9 (12.16%)	65 (87.84%)	Ref.		
Yes	81	3 (3.70%)	78 (96.30%)	0.28	[0.07; 1.07]	0.06

P-value is significant if<0.05.

Table 2. Factors influencing the conformity of hand washing; multivariable logistic regression.

Independent variables	CI 95%OR**	P-value
Professional qualification		
Care-giver	Ref.	
State certified nurse/midwife	10.74 [1.22; 94.43]	0.03

Independent variables		CI 95%OR**	P-value
Doctor	8.38	[1.67; 41.95]	0.01
Laboratory technician	1.28	[0.12; 13.68]	0.84
Wearing of gloves			
No	Ref.		
Yes	3.61	[0.69; 18.89]	0.13
Presence of jewellery/varnish/artificial nails/nail size>5 mm			
No	Ref.		
Yes	0.16	[0.03; 0.97]	0.04
Sex			
F	Ref.		
M	1.49	[0.39; 5.61]	0.56

P-value is significant if <0.05.

According to Table 2, in multivariable logistic regression the following characteristics have been retained as factors significantly influencing the compliance of hand washing.

4. Discussion

Hand hygiene compliance is a preventive, effective measure for infection control in hospitals [9]. Many of these infections are caused by pathogens transmitted from one patient to another by the hands of health workers who have not washed or disinfected between treatments or without the use of gloves [3]. Consequently, this study was designed with the general objective of evaluating the compliance of hand hygiene and its determinants for health personnel of the sanitary district of Nylon health units. The current study demonstrated that at least one material for hand washing is available in the service units in the 74 service units we observed, with the exception of the physiotherapy service. The most available materials were 42% sinks and 38% running water. Hydro-alcoholic solutions are more present in consultation offices, this could be explained by the fact that water and sinks are the basic materials for hand hygiene and hydro-alcoholic solutions are the most practical and rapid cleaning agents for hand hygiene. These findings are different from those of another study who found that the alcohol-based solution is the most common hand cleaning agent in services because according to the WHO the solutions based on alcohol are the most effective hand sanitizers for good hand hygiene [10]. With regard to the hand hygiene protocol, two out of three protocols sought are present in the services visited, namely the simple hand washing protocols and the protocols for using a 5% hydro-alcoholic solution, this could be due to a lack of training and awareness of hand hygiene guidelines in health facilities.

The current study showed that a majority of the participants had jewellery on their hands; some had nails of length greater than five mm, had varnish or artificial nails while at least a third of the respondent characteristics during the execution of acts. More than half of the patients wore gloves during the execution of procedures and 47.10% did not wear gloves. Even though health personnel are trained on the basic rules of hospital hygiene during their training, majority of them tend to ignore them. Also, this would simply be justified by the lack of communication and education on hand hygiene guidelines in relation to WHO

recommendations.

In the current study, only 7.74% were compliant with hand washing rules, that is to say they respected the 7 binding steps of washing as recommended. This rate is low compared to the global compliance rates reported WHO which is 40-51% [2]. It is also lower as compared to a study carried out in Nigeria which reported a 38% hand hygiene compliance rate [9] and in England whose compliance rate among healthcare workers was 74% [16]. The reason for this extreme low hand hygiene compliance rate could be the absence of health educational program on hand hygiene and the absence of guidelines in health facilities.

In the current study, it is noted that 7.09% of health personnel respect the recommended duration for the rubbing of the palms of the hands, thumb and wrists of 15 to 20 seconds which could be justified by a high work overload of the personnel in the health facilities, this finding is similar to that of a study in Austria where the majority of health personnel rubbed their hands in 20 seconds [13]. However, another study [14] had an average duration of hand washing of 10 seconds, which is less than the recommended duration. Note that the duration of hand washing is the most important factor in hand hygiene practice [14]. In a study in the North Western region of Nigeria, 37.0% of staff rubbed their hands for at least 20 seconds and it was noted that staff does not spend enough time washing their hands [12]. This may be due to the large number of patients and relatively few staff over a short period [12].

The current study showed a low level of practice of hand washing in private and public health facilities as 7.84% of the staff of private health facilities practiced proper hand washing against 7.69% for public health facilities. These similar low percentages can be attributed to lack of awareness and low reinforcement of guidelines. This result is contrary to that of the Iranians which found a lower hand hygiene compliance rate in private hospitals than in public hospitals [15].

In the current study, 21.74% of doctors practiced proper hand washing against 12% of nursing staff with state diploma or midwife, 4.35% of laboratory technicians and 3.57% of nursing assistants. Of all these qualifications, only the profession of doctor was significantly associated with the compliance of hand washing in univariate logistic. Garba (2018) which affirms that doctors practiced hand hygiene more than other health personnel [11] while Sharir *et*

al.(2010) showed that doctors and nurses practiced hand washing more than other health workers [12].

Hand hygiene has several determinants that influence its compliance, among which: the length of the nails, the wearing of jewellery, the presence of varnishes and/or artificial nails and the wearing of gloves. Wearing gloves is a major element of contact precaution, which in many cases may be the only method of isolation for patients and healthcare workers [17]. In our study, only 12.2% of those who wore gloves during treatment had performed a proper hand wash compared to 2.74% for those who did not. In univariate logistic regression, there was a positive association between wearing gloves and handwashing compliance which is similar to the results of the study in Bamako [18]. Only 3.70% of those who wore jewels and/or artificial nails or varnish, and/or nails of size >5 mm during the treatments had practiced a hand wash in conformity against 12.16% for those who did not. In univariate logistic regression, there was not a significant association between the wearing of jewellery and/or artificial nails or varnish, and/or nails of size >5 mm during care and the conformity of hand washing.

The factors significantly influencing the compliance of hand washing in our study were: the professional qualifications (state certified nurse/midwife and doctor (and the wearing of jewellery and/or artificial nails or varnish, and/or nails of size >5 mm during treatment). These findings are close to the study in Nigeria where an observational study was carried out in three hospitals and had found a high compliance for hand hygiene among nurses unlike doctors [9]. They also found a variation between the conformity of hand hygiene and professional qualification [9]. Likewise, Vikke reported in his study that the wearing of watches and jewellery has a negative impact on the effectiveness of hand hygiene [19].

In order to improve compliance with hand hygiene; educational programs, distribution of information leaflets and guidelines, workshops and lectures should be promoted both in hospitals, to the public through campaigns and health training schools or universities [20].

5. Conclusion

At the end of our study, it was observed that hand hygiene materials were less available in services and consultation offices as well as protocols relating to hand hygiene. In addition, the compliance rate of hand hygiene was relatively very low. Likewise, we found that public and private health facilities had similar hand hygiene compliance rates. However, findings also showed that, doctors had most nails within 0.5 cm and that the nails of the midwives were the most varnished and/or artificial nails. As suggestion, further studies should be carried out in these health facilities to find out whether this poor conformity of hand hygiene can be a source of infections associated with care.

6. Limitations of the Study

- 1) The refusal to participate of certain personnel who found that our presence during their consultations will frustrate their patients;
- 2) The inaccessibility in certain services like the operating room which are sterile environments and requiring the wearing of special clothing;
- 3) The possibility of bias because some health personnel practiced hand hygiene only because of our presence.

Funding Support

CID is the ASM, Young Ambassador in Cameroon, 2020-2021. Thanks to *Universite des Montagnes* for the enabling research environment.

Consent for Publication

All authors consented for publication.

Availability of Data and Material

All data are available upon request.

Conflict of Interest

The authors declare that they have no competing interests.

Authors' Contributions

CID conceived the project and designed the study. CID and searched relevant literature scrutinized all relevant information and draft the manuscript. CID and conducted and coordinated the field study. CID, YWG, BLB, MPA; OTN, VTN, EN collected and processed the samples and data. CID, VNT and EN analyzed the data. All authors provided additional information. CID further analyzed the data. CID, OTN, and VTN Wrote the first version of the manuscript, CID and EN revised the manuscript. All authors read and approved the final manuscript.

Acknowledgements

Our gratitude goes to all participants of the study as well as the hospitals' authorities who facilitated the study. Moreover, acknowledgement goes to Dr Ikanyeng Dolly Seipone for the proof reading of this paper.

References

- [1] Berche P, Lefrère JJ. Ignaz Semmelweis. *La presse médicale* [The medical press]. 2010; 40 (1): 94-101.
- [2] *Organisation Mondiale de la Santé 2019. journée mondial de l'hygiène des mains* [World Health Organization 2019. Global Hand Hygiene Day]. Disponible sur: http://www.cpias-nouvelle-aquitaine.fr/serious_games [Consulté le 23/04/2019].

- [3] Agence de la santé publique du Canada. *Pratiques en matière d'hygiène des mains dans les milieux de soins* [Public Health Agency of Canada. Hand hygiene practices in health care settings]. Disponible sur: <http://www.phac-aspc.gc.ca>. [consulté le 18/04/19].
- [4] Pitter D. *Hygiène des mains reste la mesure la plus efficace contre les infections* [Hand hygiene remains the most effective measure against infection]. Disponible sur: <http://www.infirmhyier.com/> le grands-dossier /hygiène/hygiène-mains-oms-renouvelle-recommandation.html. [consulté le 18/04/219].
- [5] Organisation Mondiale de la Santé 2018. *l'hygiène des mains, un geste qui sauve* [World Health Organization 2018. Hand hygiene, a life-saving practice]. Disponible sur: C:\Users\x\Documents\L'hygiène des mains, un geste qui sauve des vies.mhtml. [consulté le 27/5/2019].
- [6] Doscoaph AFL, Kisito JM, Quenum, Hessou S, Roch CJ. *État des lieux des infections associées aux soins dans deux hôpitaux publics du sud Bénin (Afrique de l'ouest): Centre Hospitalier Universitaire de Zone d'Abomey Calavi/Sô-Ava et Centre Hospitalier de Zone de Cotonou 5* [Assessment of healthcare associated infections of two public hospitals in southern Benin (West Africa): University Hospital Center of Abomey Calavi/Sô- Ava Zone and University Hospital Center of Cotonou 5 Zone]. *Journal of Applied Biosciences*. 2017; 121: 12192-12201.
- [7] Djuikoue C, Njajou O, Kamga H, Fokunang C, Bongoe A, Ondo E, Bruno, Tadjoung P, Linjouom AA, Kakam C, Ngogang J. Prevalence of CTX-M beta-Lactamases in *Escherichia coli* from community- acquired urinary tract infections and associated risk factors among women in Cameroon. *Journal of Epidemiological Research*. 2017; 3 (1).
- [8] Njall C, Adiogo D, Bitá A, Ateba N, Sume G, Kollo B, Binam F, Tchoua R. *Écologie bactérienne de l'infection nosocomiale au service de réanimation de l'hôpital Laquintinie de Douala, Cameroun* [Bacterial ecology of nosocomial infection in the intensive care unit of Laquintinie Hospital, Douala, Cameroon]. *Panafrikan Medical Journal*. 2013; 4: 140.1818.
- [9] Agbor MA, Azodo CC. Handwashing and Barrier Practices among Cameroonian Dental Professionals. *Tanz Dent J*. 2010, 16 (2): 35-38.
- [10] Wandel D, Maes L, Labeau S, Vereecken C, Blot S. Behavioral determinants of hand hygiene compliance in Intensive Care Units. *Américan Journal Critique Care*. 2010; 19: 230-9.
- [11] Matthew P. Muller M, Eilen C, Naureen S, Larson RN. *Conformité à l'hygiène des mains dans un service d'urgence: les effets de la surpopulation* [Hand hygiene compliance in an emergency department: the effects of overcrowding]. *Academic Emergency Medicine*. 2015; 22 (10): 1218-1221.
- [12] Garba D. Hand hygiene practice among healthcare workers in a public hospital in North-Western Nigeria. *Niger Journal Basic Clinical Science*. 2018; 15: 109-13.
- [13] Sharir R, Teitler N, Lavi I, Raz R. High-level hand washing compliance in a community teaching hospital: a challenge that can be met. *Journal Hospital Infection*. 2010; 49: 55-58.
- [14] Kuzu N, Özer F, Aydemir S, Nevzat Y, Zencir M. Compliance with Hand Hygiene and Glove Use in a University-Affiliated Hospital. *Infection Control and Hospital Epidemiology*. 2014; 26 (4): 312-315.
- [15] Ataeia, Zahraeib SM, Pezeshkib Z, Babakc A, Nokhodianc Z, Mobasherizadehc S, Ghoseinic S. Baseline evaluation of hand hygiene compliance on three major hospital, Isfahan, Iran. *Journal of Hospital Infection*. 2013; 07 (001): 69-72.
- [16] Randle J, Clarke M, Storr J. hand hygiene in healthcare workers. *Journal of Hospital Infection*. 2017, 64: 205-209.
- [17] National Patient Safety Agency (NPSA). *Flowing with the Go: The Complete Year Two Maintenance Handbook for clean your hands Partner Trusts*. London: NPSA, 2009.
- [18] Bengaly L, Fomba S, Keita M, Traoré A S, Harouna Z, Fofana A, Traoré D, Dembélé JP. *Impact de l'usage des gants médicaux sur l'observation de l'hygiène des mains au cours des soins au Centre Hospitalier et Universitaire du pont G de Bamako* [Impact of the use of medical gloves on the observance of hand hygiene during care at the University Hospital Center of Pont G in Bamako]. *Revue Médicale d'Infection et de Microbiologie*. 2016; Tome 7.
- [19] Vikke HS, Vittinghus S, Giebner M, Kolmos HJ, Smith K, Maaret C, Lindström V. *Respect des règles d'hygiène des mains dans les services médicaux d'urgence: étude d'observation internationale* [Hand hygiene compliance in emergency medical services: an international observational study]. *Emergency Medecine Journal*. 2018; 36 (3).
- [20] Pittet D. Improving compliance with hand hygiene in hospitals. *Infect Control Hosp Epidemiol* 2000; 21: 381 386.