



OBSERVANCE OF GUIDELINES TOWARDS MITIGATING THE RISK OF HOSPITAL ACQUIRED INFECTIONS IN A UNIVERSITY TEACHING HOSPITAL: PRELIMINARY FINDINGS FROM A PILOT STUDY TOWARDS HEALTHCARE QUALITY IMPROVEMENT

Serge Honoré Tchoukoua^{1,2}, Pierre René Fotsing Kwetché*^{1,2,4}, Fernande Njonga Tchami^{1,2}, Sandrine Gamwo Dongmo^{1,2}, William Lelorel Nankam Nguekap^{2,4}, Anselme Michel Yawat Djogang^{1,2}, Josué Simo Louokdom^{1,2,3}, Jonas Kouamouo^{1,2} and Kourouma Kaba^{1,2}

¹School of Pharmacy, Higher Institute of Health Sciences, Université des Montagnes; Bangangté, Cameroon.

²Laboratory of Microbiology, Université des Montagnes Teaching Hospital; Bangangté, Cameroon.

³Faculty of Science, University of Dschang; Dschang, Cameroon.

⁴School of Medical biology, Higher Institute of Health Sciences, Université des Montagnes; Bangangté, Cameroon.

Received date: 30 May 2018

Revised date: 20 June 2018

Accepted date: 11 July 2018

Corresponding Author: Pierre René Fotsing Kwetché

School of Pharmacy, Higher Institute of Health Sciences, Université des Montagnes; Bangangté, Cameroon.

ABSTRACT

The present study was conducted to address a few parameters that are recognized to contribute to hospital hygiene improvement in the framework of policies enforced to prevent hospital acquired infections (HAIs) at the Université des Montagnes' Teaching Hospital. These included amongst others hand hygiene, waste and reusable material management and cleaning. The necessary pieces of information were collected with questionnaires, interviews and observations. To assess the quality of the patient' environment, products from swabbing performed on surrounding commodities were submitted to microbial investigations. Culture, isolation, identification of bacteria as well as susceptibility tests for 15 common antibiotics were conducted according to standard guidelines (REMIC, 2014; CA-SFM, EUCAST, 2014). Significant findings revealed that 44 - 48% of healthcare workers always wash their hands between two procedures; 77% were aware of the danger that might accompany blood exposure accident and 65% knew where they could have information for better practices. Moreover, 33% did not change gloves between two activities on the same patient though glove availability was 100%; 20 - 42% recapped soiled needles; 70% work indiscriminately in all hospital wards. Most bacterial isolates were *Bacillus* spp., 50%. They were least frequently isolated from specimens collected in the maternity, consistent with the policy enforced to prevent contamination at that level. Resistance rates were high and multiple-drug resistance frequent but could not serve to rule out reliable conclusion because the number of isolates tested was reduced. Overall, many amongst the workers knew what they normally had to do. Why implementation did not follow remained to be addressed, though material resource availability could be pointed out. Relocating institution's priorities would be essential for safer healthcare in the hospital. This requires contribution of all stakeholders, in line with the current One Health concept's paradigm.

KEYWORDS: Hospital acquired infection, Standard precautions, bacterial contamination.

INTRODUCTION

Patient's safety is one of the biggest challenges for all health institutions across the globe and depends on the ecosystems which might confer conducive environment for growth and dissemination of infectious disease agents. In general, potential infections risks associated with microorganisms in healthcare facilities include nosocomial infections, epidemic and occupational infectious diseases.^[1] This is the reason why the quality

of care in hospital is firmly related to the level of hygiene that is in turn based on periodical reports and improvements of workers' attitudes and practices in their daily activities. Better encompassed in the global terms of healthcare-associated infections (HAI), hospital acquired infections are infectious diseases that are contracted either by the healthcare worker or by the patient throughout care administration procedure.^[2] For hospitalized patients, an infection is regarded as nosocomial when first symptoms are recorded 48 h after

admission.^[2] HAI represent a crucial health challenge worldwide for the high morbidity and mortality rates associated with infectious diseases and, moreover, infectious diseases caused by drug-resistant microorganisms (DRM). In fact, health facilities are recognized as one of the most conducive environments for selection and dissemination of DRM because in those places, selection of resistance genotypes and phenotypes is favored in both professional and opportunistic pathogens. According to the WHO, 1.4 million people worldwide experience IDs complications in connection with resistant bacteria causing hospital disaffection in many cases as consequence of longer hospitalization and elevated healthcare cost.^[3] In that connection, many high-income countries in Europe and America have encouraged and developed microbial resistance control policies at national and international levels. In the health facilities of these countries, this control is also performed and assessed on regular basis.^[4] In Africa, controlling infectious risk in hospitals remains a crucial cause of concern due to the low living standards that come along with low education, unregulated drug trade and drug utilization in human medicine, animal husbandry (for disease control, disease prevention and grow supplementation) and crop production. In these areas, nosocomial infections are also largely ignored because they are insufficiently investigated then, poorly reported. Standard precautions (SP) were put in place in the 1980s with the advent of AIDS pandemic to protect healthcare professionals from potential contaminations in case of exposure to bodily fluids during care administration. These SP rely on the principle that the infectious status of patients is unknown; and aims to secure (if applied with strict compliance) health professionals against contaminations by mitigating patient-to-patient and patient-healthcare professional-patient germ transmission^[5], then expected to be systematically observed during healthcare procedures. In addition to these SP, hospital hygiene covers a large number of concepts known to play relevant roles in the prevention of nosocomial infections namely the treatment of reusable biomedical equipment and hospital linen, the management of healthcare wastes and blood exposure accidents.^[6,7]

Through decision N°0178 / D / MSP / SESP / SG / DPS / SDHA / SHM / BPHE by the Ministry in charge of health in Cameroon, putting in place a hospital hygiene unit was encouraged in all healthcare facilities.^[8] Data analysis based on rates of nosocomial infections in a few surveys indicated that these recommendations were not observed.^[9,10] Investigations to address hygiene issues are also rarely conducted in Cameroon hospitals. It is in this line and in the continuation of a previous work (Nunkam Youmbi, unpublished doctorate degree dissertation) that the present study was carried out.^[11] It will generate current holistic data on a few aspects in connection with hygiene, healthcare givers attitude and profile of bacteria flora in the Université des Montagnes' Teaching Hospital for sustainable policy and decision

making by the Managing Comity in the short run. Intermediate and long-term expectations are to have involved all stakeholders in hygiene and sanitation for improved healthcare offers in the hospital. This also represent a unique opportunity to advocate implementation of an AMR stewardship program in this hospital and in other facilities in West Cameroon.

MATERIAL AND METHODS

Sampling, culture, identification and susceptibility testing

Sampling and culture

To continue the study conducted in 2014 with authorization Ref: 2015/074/UdM/PR/CAB/CIE and with participants' consent, the present descriptive cross-sectional survey on the working environment was conducted from October 5th to December 15th 2015 at the Université des Montagnes' Teaching Hospital in five health units, in public toilets, on hospital equipment and, caregivers' attitude and practices. The selected toilet items included among others doorknobs, hand washbasin and toilet seats. After all necessary ethical and administrative requirements were fulfilled, a humidified sterile swab was used to rub approximately 2.5x4 cm² surface areas on inanimate surfaces and hospital devices. A questionnaire and an observation sheet on knowledge and practices of care givers were filled thereafter.

Culture and isolation were conducted according to Tchapdie Ngassam *et al.*^[12] on MacConkey agar (Liofichem®) for *Enterobacteriaceae*, Columbia agar (Liofichem®) with 5% fresh sheep blood and chocolate agar for fastidious bacteria like *Streptococcus*; and Mannitol-salt agar (Liofichem®) for *Staphylococcus*. For non-fastidious bacteria, incubation was performed aerobically at 37 °C for 18-24 h. Fastidious bacteria incubation was done under 5% CO₂ for 24-48 h at the same temperature.

Identification and antibacterial susceptibility testing

When incubation was complete, the morphology of bacterial colonies was used for presumptive identification. A culture was regarded as positive (for high bacterial density on the item) when a total count of at least 8 CFU/cm² of a pure bacterial culture was obtained (modified Vandini *et al.*, 2014).^[13] Then, all suspected colonies underwent tests for specific biochemical and enzymatic properties, according to standard guidelines (REMIC, 2014).^[14]

Susceptibility tests were carried out by disk diffusion (Kirby-Bauer) with 15 conventional antibacterial agents that are commonly used in Cameroon. This was done with a 18-24 h bacterial pure culture grown on Nutrient Agar. For this, bacteria suspension prepared at opacity 0.5 McFarland in 0.9% saline was adjusted to the final density recommended for susceptibility tests by agar diffusion technique on Mueller Hinton agar or chocolate agar. Test procedures and interpretations were done according to the standard guidelines recommended by

the Comité de l'Antibiogramme de la Société Française de Microbiologie, CA-SFM, EUCAST, 2014".^[15] The antibiotic disks tested included: Penicillin (10 µg), Amoxicillin/clavulanic acid (20/10 µg), Amoxicillin (30 µg), Cefazidime (30 µg), Ceftriaxone (30 µg), Cefalotin (30 µg), Nitrofurantoin (300 µg), Cefoxitin (30 µg), Cefuroxime (30 µg), Gentamicin (120 µg), Vancomycin (30 µg), Ciprofloxacin (30 µg), Nalidixic acid (30 µg), Trimethoprim/sulfamethoxazole (1.25/23.75 µg), Oxacillin (1 µg). For identification and susceptibility tests, reference bacterial strains used for quality control included *S. aureus*: ATCC 29213, *S. aureus*: QC 1625, *E. faecalis*: ATCC 29212 and *E. coli*: ATCC 25922.

RESULTS

Distribution of responders according to specialty

The overall distribution of the personnel working in the hospital was pictured and presented as shown in figure 1.

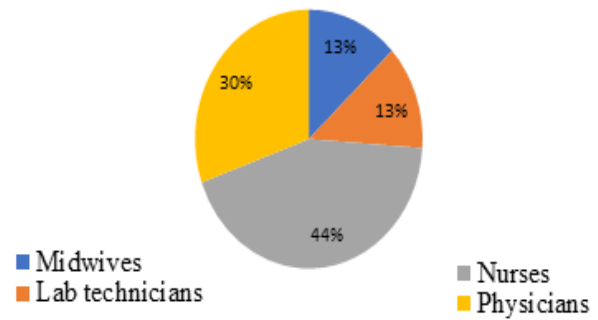


Figure 1: Distribution by occupational category.

This figure revealed that the number of nurses and physicians represented 74% of the study population. In addition, 54% of nurses operated indiscriminately throughout the internal medicine and pediatric wards while 23% worked exclusively for the maternity and 24% for the surgery. About 70% of all personnel, including physicians and laboratory technicians also operated everywhere within the institution.

Hospital beds, Bathroom and sink availability

The total number of hospital beds visited was 24. Their distribution per care unit was done as presented in table I.

Table I: Distribution of hospital beds and cleaning facilities per care unit.

Units of care	Number of hospital beds	% of bed per care unit	Number of rooms equipped with Sinks
Surgery	6	25	1
Maternity	6	25	2
Pediatrics	3	12.5	1
Male Internal medicine	6	25	2
Female Internal medicine	3	12.5	1
Total	24	100	7

This table shows that each medical unit was equipped with at least a sink and a running water device. Reporting the number of sink per room to all beds, the ratio was estimated at close to 1:3.4. Other patient service locations such as consultation sites and laboratory sampling rooms were also equipped with washbasins.

Washbasin equipment in hospital rooms

None of the 7 washbasins identified in the hospital wards was equipped with solid soap or disposable towels at the time of the study. Data analysis further indicated that soap was provided by the patient family for personal purposes. No other fabric or devices were available for hand drying. Hands were then self-dried or dried on the coat. All of the washbasins listed could be used by caregivers, visitors and patient's parents.

Availability of hydro-alcoholic solution, medical gloves and advertising posters

Out of the 5 care units investigated during the study, hydro-alcoholic solution could be found only in the maternity. None of the professionals had a pocket bottle

of hydro-alcoholic solution at the time of data collection. In the external surgery premises, red betadine was always present and used instead of the hydro-alcoholic solution.

Concerning the gloves, they were permanently available in all settings within the hospital including the sampling and dressing rooms. Poster on hand hygiene promotion (handwashing) and indication in case of accidental blood exposure could be found in the emergency room, in all care units, at the specimen collection site and in the laboratory.

Training on standard precautions

Overall, 96% of the participants reported that they underwent training on standard precautions in general. More detailed pieces of information indicated that 60% underwent the training less than 5 years ago and the remaining (36%) did it more than 5 years back (from the date of data collection). Further, 65% knew where they could find a procedure or poster about what to do if they were victims of accidental blood exposure.

Implementation of standard precautions

Indicators aiming at addressing knowledge and practices related to hospital hygiene were taken into consideration

for 23 participants out of the total 28 health professionals (82.14%). The results of that survey were brought together, compiled and displayed as shown in table IV.

Table IV: Observance of standard precaution guidelines.

Attitudes	Observance /Frequency of practices (%)			
	NC	Never	Often	Always
Hand disinfection with a hydro-alcoholic product or hand washing				
Between 2 patients	5	0	47	48
Between 2 activities	0	4	48	48
After removing the gloves	0	8	48	44
Wearing disposable gloves				
If there is a risk of contact with blood or other biological products	0	0	9	91
If there is a risk of contact with mucous membranes	0	0	28	73
If there is a risk of contact with the injured skin of the patient	0	0	21	79
When a dirty dressing is removed	28	0	19	53
When handling contaminated material	4	0	13	83
Change of gloves for single use				
Between 2 patients	0	0	13	87
Between 2 activities (example: 2 different treatments in the same patient)	4	0	63	33
Wearing a disposable mask				
If there is a risk of spraying or aerosolization of blood or any other product of human origin	13	0	44	43
In case of suspicion of respiratory infection (colds, coughs) while caring for a patient	13	20	32	35
Hand disinfection with a hydro-alcoholic product or hand washing				
Between 2 patients	5	0	47	48
Between 2 activities	0	4	48	48
After removing the gloves	0	8	48	44

NC: not concerned.

This table indicates that 48-53% of all medical personnel disinfected or washed their hands from time to time after gloves were removed; at the end of an intervention; between two activities or between two patients while 4-8% did not.

Regarding the simultaneous protection of the staff and the patient, 73-79% of all personnel always wear gloves when there was a risk of contact with patient’s lesion.

About 91% always wear gloves when there was a risk of contact with blood or any other biological product. Also, 33% systematically change gloves between two activities. Overall, and for a variety of reasons (patient confidence, availability), 20% never wear disposable masks when a patient was suspected of developing a respiratory infection. Further details recorded on hazards in connection with accidents were presented as shown in table V.

Table V: Frequency of practices in connection with accidental exposure.

Attitudes	Frequency of practices (%)			
	NC	Never	Often	Always
Use of Sharp devices				
I sometimes recap the dirty needles	0	38	42	20
I sometimes get the misfit needle by hand	0	27	38	35
I immediately eliminate sharp objects soiled as close to care in a suitable collector	4	4	8	84
Accidental blood exposure (ABE)				
I practice a simple washing of the hands followed by a hydro-alcoholic friction if my skin is stained by blood or biological liquids	10	17	18	55
I practice washing and antiseptis at the level of the wound in case of accident with exposure to the blood	13	0	10	77
I practice an abundant rinsing with water or physiological saline in case of projection of blood or biological fluid on the mucous membranes (eyes)	13	0	0	87

NC: not concerned.

About 20% of participants recapped used needles and 38% did not. More than half (55%) systematically practice a simple hand washing prior to hydro-alcoholic friction when their skin was in contact with blood or any patient bodily fluids. Also, 77% were aware of the danger that might accompany a blood exposure.

Microbiological control of the patient's environment

With regards to the collected specimen origin, table VII displays the distribution of bacteria isolates in three of the surveyed sites for a week (sixteen times).

Table VII: Distribution of bacterial type per sampling site.

Germes	Pediatrics	Maternity	Public toilets	Frequency (%)
<i>Bacillus</i> spp.	5	5	22	50
<i>Streptococcus</i> spp.	2	2	14	28.12
<i>Staphylococcus epidermidis</i>	1	0	1	3.12
<i>Staphylococcus saprophyticus</i>	2	1	9	18.75
Total	10	8	46	100

According to this table, it is at the level of public toilets that more isolates were recovered (in both the total and the types). The maternity toilets were the least

contaminated. Data recorded were furthermore reorganized according to the surface area from which sampling was performed (table VIII).

Table VIII: Frequency of identification of germs on sinks, pots and doorknobs.

Bacteria types	Pediatrics		Maternity		Public toilets	
	Morning	Evening	Morning	Evening	Morning	Evening
Glasses of pots						
<i>Bacillus</i> spp.	2	2	1	1	7	4
<i>Streptococcus</i> spp.	2	0	1	1	7	4
<i>S. epidermidis</i>	1	0	0	0	0	0
<i>S. Saprophyticus</i>	0	1	1	0	6	2
Sinks						
<i>Bacillus</i> spp.	0	0	0	0	2	1
<i>Streptococcus</i> spp.	0	0	0	0	1	0
<i>S. epidermidis</i>	0	0	0	0	0	0
<i>S. Saprophyticus</i>	0	0	0	0	0	0
Door knobs						
<i>Bacillus</i> spp.	0	1	0	0	4	4
<i>Streptococcus</i> spp.	0	0	0	0	2	0
<i>S. epidermidis</i>	0	0	0	0	1	0
<i>S. Saprophyticus</i>	0	1	0	0	0	1

Subtle pieces of information from this table indicated that it was at the level of the glasses of pots that most germs were isolated (72%). The most frequent bacteria types were *Bacillus* spp., at all sampling sites, followed by *Streptococcus* spp. and *Staphylococcus saprophyticus*. The doors knobs were the least contaminated. No significant differences were recorded between the

sampling conducted in the morning and that performed in the evening.

The bacterial types isolated from various sampling sites were then subjected to susceptibility tests. The frequencies recorded in each clinical category (Susceptible, Intermediate, Resistant) were summarized as shown in table IX.

Table IX: Susceptibility profile of isolate representatives (%).

Antibiotics	Susceptibility profiles of isolates											
	<i>Bacillus</i> spp.			<i>S. epidermidis</i>			<i>S. saprophyticus</i>			<i>Streptococcus</i> spp.		
Antibiotics	R	I	S	R	I	S	R	I	S	R	I	S
Ceftriaxone	30	5	65	50	50	0	80	0	20	80	10	10
Amoxicillin/Clavulanic acid	35	5	65	0	50	50	20	40	40	10	40	50
Nitrofurantoin	20	20	60	50	0	50	40	0	60	30	30	40
Nalidixic Acid	25	10	65	50	50	0	20	40	40	50	10	40
Cefuroxim	30	15	55	50	0	50	60	0	40	30	10	50
Cotrimoxazole	30	5	65	50	0	50	20	0	80	10	0	90

Ciprofloxacin	30	0	70	0	0	100	20	0	80	20	0	80
Amoxicillin	30	15	55	0	0	100	20	0	80	30	10	60
Cefoxitine	90	0	10	50	0	50	80	0	20	80	0	20
Ceftazidime	15	20	65	50	50	0	60	20	20	50	50	0
Oxacilline	65	0	35	100	0	0	80	0	20	100	0	0
Cephalotine	35	15	40	50	0	50	40	0	60	30	10	60
Gentamicine	0	20	80	0	0	100	0	0	100	0	0	100
Penicillin	50	15	35	0	0	100	60	20	20	60	10	30
Vancomycin	14	15	71	50	0	50	60	20	20	60	10	30

It appears globally that all the isolates were either susceptible or intermediate to gentamicin (100%) whereas highest resistance rates were recorded with oxacilline, amongst other information.

DISCUSSION

This work conducted in the framework of precautions and practices for infection prevention in the premises of the Université des Montagnes' Teaching Hospital first revealed that each care unit investigated was equipped with at least a sink and running water. The overall sink ratio per hospital bed (1: 3.4) was significantly larger than that of 1:22 reported in a national hospital in Bamako and, well above the required minimum ratio of 1/10 recommended by the WHO.^[16,17] None of the bathroom sink was equipped with soap and disposable toilet paper. The absence of these commodities was explained by the fact that they were not provided by the hospital authorities. The ones used were provided by patients' family members who would keep it in their private sideboard or bag after use. Thought reasonable, this would represent a weak aspect in the infection prevention policy expected to be implemented in such context as healthcare facilities where microbial infections are favored by the immune status of patients and the high degree of exposure through care-providers' hands. Theoretically, the use of private amenities necessary excites exaggerate economy by all users because it is rarely used generously. This attitude eventually compromises cleaning effectiveness. Otherwise, the quantity and the quality expected to be used for efficient work will not be respected because everything would be done in order to mitigate the total cost of health. These conclusions are consistent with the absence of disposable toilet paper and the general living standard of the local population. In such context, reusable pieces of cloth or ordinary towel were used for drying surfaces and material; then kept in privacy like the soap. Unlike the soap, however, these reusable pieces of cloth are potent germ carriers and engines for microorganisms' dissemination from the toilets and/or sinks to hospitalization sites then, throughout the hospital.^[11] Preventing such germ spread would therefore, rely on provision of adapted disinfectant and disposable cleaning and drying tools with posted indications for use. This is essential for patients' parents in their activities and very useful for caregivers who are expected to wash and dry their hands when they pass from one patient to the other in the overall framework

that promotes reduction of the risk of patient-to-patient transmission of infectious agents.

In this context, many amongst caregivers rather wiped theirs on their coats, likely engendering re-contamination for subsequent spread, consistent with findings from previous authors^[18,19] and, at the origin of mixed bacterial populations that represent the substrates for stochastic genetic variations known to develop in the microbial world.^[20] These conclusions also agree with report from the previous survey conducted by Numkam Youmbi the year earlier (2014) on the epidemiology of microbial flora in the same healthcare facility.^[11] Numkam Youmbi's data revealed that the amenities for hand hygiene was inadequate in several hospital's settings. Those from the present study further indicated that the maternity ward was the only one that was equipped with hydro-alcoholic solutions (HAS), most likely due to the fact that the system payed special attention to newborns. In addition to that HAS, other germ-dissemination preventive measures like posters regularizing the in-and-out movements of visitors in that unit premises as well as the restricted care providers who could access it and did not interact with other settings in the hospital were implemented subsequent to Numkam Youmbi's report. These safety indicators, therefore, appeared to had provided positive outcomes, since data recorded from microbiological analysis in the maternity's specimens were also the least contaminated.

These developments on restrictive actions implemented in the maternity subsequent to the above Numkam Youmbi's works are indications that they could also be effective in other units where they are either absent or incompletely put in place. In fact, the study participants were mostly nurses and 70% worked indiscriminately throughout the hospital. The presence of hand hygiene promotion posters in the wards surveyed and, in the nurses' preparation room firmly indicated that the promotion on hand hygiene was well strategized but insufficiently implemented. Moreover, data analysis revealed that there was a failure in communication policy because, for instance, only a little more than half (or 65%) of hospital personnel knew where they could find a poster about precautions to take in case of accidental blood exposure, though it was posted in the nurses' preparation room. It is, however, noteworthy that this 65% represented a unique asset that could be capitalized to improve communication in the entire hospital, since a training in that direction would be facilitated. Arguments

for this facilitated training are further supported by the fact that 96 % declared to have undergone training on standard procedures in the past, while 77% were aware of the danger that might accompany accidental blood exposure. Why they didn't apply the knowledge they had is yet to be investigated, though can be anticipated as due, at least partially to resource limitation. This conclusion is also supported by the example of gloves for which availability was accompanied by optimal use. Overall, the high percentages recorded highlighted that the staff was equip with adequate knowledge, even if implementation did not follow. It further implied that this high potential could be capitalized for future initiatives towards hospital hygiene promotion.

Less than half (44 - 48%) of the staff members surveyed always wash their hands after they have removed the gloves and at the end of interventions between two patients or between two activities. This could be explained by the lack of amenities like soap and disposable towels as discussed above. Though this percentage remained low, it was more than twice higher than the one recorded by Numkam Youmbi (20.7%) and would imply that findings from that previous work impacted the personnel's behaviors but, moreover, that encouraging policies could rapidly help achieve the objective of reducing risk of germs dissemination in the hospital.^[11] Basically, hand hygiene relies on five applications: "before patient", "before an aseptic act", "after patient", "after contact with a biological fluid" and "after the patient's environment".^[21] According to the results from the present study, the "before patient" and "before an aseptic act" would be regarded as the best observed, unlike the three others for which special emphasis by the hospital authorities should be laid through continual training on the advantages provided by the global hospital hygiene (including mitigating the risk of nosocomial infection and that of antimicrobial resistance selection and spread) and the necessary steps to follow in the implementation process.^[22]

In the related frame, 4-8% of respondents did not change gloves until they were worn out. This attitude is not defendable since gloves were used at will in all settings within the institution. This group of people were found amongst those who did not know where to find information on the attitudes to adapt upon accidental exposure to bodily fluids. Once again, this highlighted the necessity for continual training of personnel from all fields of work in the hospital as well as that of indications for patients' parents and visitors. Likewise, up to 73-79% always wear gloves any time there was a risk of contact with the patient's mucous or lesioned skin, while 21-27% believed that it was not necessary to wear gloves in such circumstances and should be trained accordingly.

As far as protection against droplets was concerned, 20% never use a disposable mask for various reasons some of which included patient confidence and mask availability;

13% did not feel concerned about blood exposure accidents (BEA) and 20% use their hands to recovers soiled needles. Still 42% often recapped used needles. Though high than what is expected, this percentage was very low compared with the one reported by other authors.^[23,24] These results could also be explained, at least in part, by the fact that the collectors for sharp objects were not permanently available in the units surveyed and could, from time to time be replaced by empty plastic bottles of 1.5 L. During this work the specimen collection site like the laboratory and the blood bank were equipped with safety boxes for sharp objects; indicating that its importance was recognized in the institution. Why they were not found in all settings was due to limited availability and should be strongly addressed to obey the related recommendations.^[25]

Regarding the treatment of reusable material, a centralized system for their sterilization existed with autoclaves and ovens. In particular, the laboratory was equipped with an autoclave and an oven for this purpose. This special provision was put in place by the hospital authorities to prevent the spread of germs by inactivating all potentially contaminated waste prior to disposal. This provision was also reinforced with an organized laundry itinerary within the institution.

The most commonly identified microorganisms belonged to the genus *Bacillus*, a group of ubiquitous spore-forming Gram-positive bacteria. Strains from this genus are common hosts of the environment and surfaces. They were wrongly regarded as having no or little importance in infectious diseases because they are endowed with low virulence.^[26] Consistently, however, evidences are released on the multiple roles they could play in hospital acquired infections: first as opportunistic etiologies of disease in immune-depressed hosts that otherwise are a common category in healthcare facilities.^[27-30] Second, as potent resistance selection engines and vectors for resistance traits dissemination.^[12,19,31-33] Third, they might play both roles and therefore could be useful in assessing cleaning effectiveness for their role in bacterial biofilm development.^[31] Indeed, many other bacterial types could actually be recovered, but *Bacillus* appeared to have advantage over the others probably due to its ability to form resistance spores, to resist action of antibiotics and antiseptic, often in connection with microbial density.^[20,26] Due to reduced number of isolates, the susceptibility profile could not release reliable information during the present survey. But based on recent study in West Cameroon anticipation of an overall high resistance rates would be the likely option. Anyway, compared with those recorded in Numkam Youmbi's study, the data from this work indicated that it was possible to minimize the risk of germ transmission with minimal equipment, tutoring and organization if the follow-up policy is appropriate.^[12,33,34] This policy would typically rely on the involvement of all stakeholders throughout the hospital, in line with the current One Health concept's paradigm.

CONCLUSION

The present investigation revealed human resource potential that could play key roles for effective implementation of good hygiene practices within the premises of the Université des Montagnes' Teaching Hospital. Relocating institution's priorities and services would, however, be essential to drive the expected changes for safer patient's caretaking environment. The policy to enact in that direction should rely on the involvement of all stakeholders throughout the hospital and should be in line with the current One Health concept's paradigm. Moreover, minimal equipment with a smarter organization would help achieve the expected goal.

ACKNOWLEDGEMENTS

The authors are thankful to Professor Lazare Kaptué, Head of the Université des Montagne Teaching Hospital for the invaluable support provided during this survey. They are also highly indebted to the "Association pour l'Education et le Développement" (AED) for the literature resources and laboratory equipment; and to Dr Marie Christine Fonkoua (Centre Pasteur du Cameroun) for providing advices and reference strains. Special tribute to late Sitchepping Kuetche Claude for revising the original manuscript.

REFERENCES

- Eugénie d'Alessandro. Prévenir le risque infectieux à l'hôpital ? *Anthropol Santé*, 2014; 4: 0–18.
- Amiel C. On sait qu'il n ya pas de vrai risques: discours et pratiques des soignants autour des infections nosocomiales. *John Libbery Eurotext*, 2005 sept; 23(3).
- Organisation mondiale de la santé. Prévention des infections nosocomiales guide pratique. 2nd ed. Genève: OMS, 2008.
- Nicole Marty. Hygiène hospitalière. SAURAMPS MEDICAL, editor, 2010; 504.
- Girou E, Girard R, Chémorin C, Simon A. Précautions standard. *Surveill prévenir les Infect Assoc aux soins*, 2002; 257–9.
- Société Française d'Hygiène Hospitalière. Recommandations: Actualisation des précautions standard - Établissements de santé - Établissements médicosociaux - Soins de ville, 2017; XXV: 13–8.
- N. Hygis. *Hygiène hospitalière*, 2010; 513.
- Manga BL. Etude sur les systèmes appropriés de traitement des déchets médicaux dans le cadre du programme national de developpement participatif. yaoundé: Programme national de developpement participatif et Santé environnementale, 2009.
- Njall C, Bitá A, Adiogo D, Ateba N, Tchoua R. Ecologie bactérienne de l'infection nosocomiale au service de réanimation de l'hôpital la quintinie de Douala, Cameroun. *Pan Afr Médical J.*, 2013; 140(14).
- Mfoulou A. Profil bactériologique des infections urinaires nosocomiales dans un service de réanimation: cas de l'hôpital gyneco-obstétrique et pédiatrique de Yaoundé. *J Med Health Sciences*, 2013.
- Numkam Youmbi CM. Epidémiologie de la flore microbiene aux cliniques universitaires des montagnes et étude de leur sensibilité aux antimicrobiens [thesis]. *Medecine. Université des Montagnes*, 2015; 64.
- Tchapdie Ngassam FR, Megne Tantse, Fotsing Kwetche PR, Noukela Noumi DP, Kouamouo J Simo Louokdom J *et al.* Multicenter study on antibiotic susceptibility/resistance trends in the western region of Cameroon. *Int J Biol Chem Sci*, 2017; 11(1): 131–43.
- Vandini A, Temmerman R, Frabetti A, Caselli E, Antonioli P, Balboni PG, et al. Hard surface biocontrol in hospitals using microbial-based cleaning products. *PLoS One*, 2014; 9(9).
- Rémic 2 volumes: Société Française de Microbiologie: Microbiologie . 4ème édit. Societe.
- Microbiologie SFDE. Societe Francaise de Microbiologie. Paris, 2016; 117.
- Organisation Mondiale de la Santé. Résumé des recommandations de l'OMS pour l'hygiène des mains au cours des soins. OMS. Genève, 2010.
- Loseni B. implantation et évolution d'un programme de promotion d'hygiène des mains dans un hôpital national du Mali [thèse]. *Pharmacie. Université de Genève*, 2011; 392.
- Jeurissen A, Weyers L, Cossey V, Muller J, Schuermans A. Dissemination of *Bacillus cereus* in the burn unit due to contaminated non-sterile gloves. *Journal of Hospital Infection*, 2010; 76: 92–3.
- Balm MND, Jureen R, Teo C, Yeoh AEJ, Lin RTP, Dancer SJ, et al. Hot and steamy: Outbreak of *Bacillus cereus* in Singapore associated with construction work and laundry practices. *J Hosp Infect*, 2012; 81(4): 224–30.
- Martínez JL, Baquero F. Emergence and spread of antibiotic resistance: setting a parameter space, *Upsala. J. Med. Sci.*, 2014; 119(2): 68-77.
- Francioli P, Ruef C. Assurance qualité à l'Hôpital (III): missions de l'hygiène hospitalière dans le domaine de la qualité des processus. *Swiss-Noso*, 1997; 4(4): 29- 31.
- Rosenthal VD, Pawar M, Leblebicioglu H, et al. Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach over 13 years in 51 cities of 19 limited-resource countries from Latin America, Asia, the Mid.
- Mbanya D, Ateudjieu J , Tayou Tagny Cl, Kaptue L et al. Risk Factors for Transmission of HIV in a Hospital Environment of Yaoundé, Cameroon. *Int J of Environ Res Public Health*, 2010; 7(5): 2085-2100.
- Kosmann J L. Les collecteurs a objets piquants,coupants: un matériel de sécurité essentiel et un risque paradoxal. *Hygiènes*, 2003; 11:

- 147-150.
25. Binder P, Bruneau C, Deseny J, Pillet A, Thiebaut C, Veyret J, et al. Déchets d'activités des soins a risque - comment les éliminer? Paris: Ministère de la santé et des sports, 2009.
 26. Najim Abdulla Y, Ahmad AM. Incidence and Resistotyping Profiles of *Bacillus subtilis* isolated from Azadi Teaching Hospital in Duhok City, Iraq. *Mater Socio Med Journal*, 2012; 24(3): 194-7.
 27. Bottone EJ. *Bacillus cereus*, a volatile human pathogen. Vol. 23, *Clinical Microbiology Reviews*, 2010; 382-98.
 28. Campbell JR, Hulten K, Baker CJ. Cluster of *Bacillus* species bacteremia cases in neonates during a hospital construction project. *Infect Control Hosp Epidemiol*, 2011; 32(10): 1035-8.
 29. Ting J, Wong SY, Chee YY, Wong KY, Tsoi NS, Lau AY. *Bacillus* bloodstream infections in a tertiary perinatal centre: An 8-year study. *Am J Perinatol*, 2013 Aug 23; 30(4): 309-15.
 30. Ikeda M, Yagihara Y, Tatsuno K, Okazaki M, Okugawa S, Moriya K. Clinical characteristics and antimicrobial susceptibility of *Bacillus cereus* blood stream infections. *Ann Clin Microbiol Antimicrob*, 2015; 14(1): 43.
 31. Bridier A, Sanchez-Vizueté, M del Pila DLC. Biofilms of a *Bacillus subtilis* hospital isolate protect *Staphylococcus aureus* from biocide action. *Plos-ONE*, 2012; 7(9): 1-8.
 32. Dolan SA, Littlehorn C, Glodé MP, Dowell E, Xavier K, Nyquist A-C, et al. Association of *Bacillus cereus* Infection with Contaminated Alcohol Prep Pads. *Infect Control Hosp Epidemiol*, 2012; 33(07): 666-71.
 33. Noukela Noumi DP, Fotsing Kwetche PR, Kouamouo J. *Bacillus* spp. and *Staphylococcus* spp.: Potential Reservoirs of Resistance Traits in a Healthcare Facility?, 2017; 7(1): 37-48.
 34. Simo Louokdom J, Fotsing Kwetche PR, Kengne Toam AL, Gamwo Dongmo S, Kouamouo J. High Antibiotic Resistance in Bacteria from a Healthcare Setting: Case in the surgery Wards of the Regional hospital of Bafoussam, West-Cameroun. *J Chem Bio Sci.*, 2016; 6(4): 1297-307.