Journal of Health, Medicine and Nursing
ISSN 2422-8419 An International Peer-reviewed Journal
Vol.85, 2021

Disinfection Practices and Knowledge of Hair Care Professional Barbers in the City of Dschang, Cameroon

Georges Ful Kuh[1*] Ousenu Karimo[1] Polycarp Ndikvu Chia[2] Terence A. Agbor[3]
Kenneth Yongabi Anchang[4] Jules-Roger Kuiate[1]
1. Department of Biochemistry, Faculty of science, University of Dschang, P.O.BOX 67, Dschang, Cameroon
2. Department of Biochemistry, Faculty of science, Catholic University of Cameroon (CATUC) Bamenda, P.O.BOX 782, Bamenda, Cameroon
3. Laboratory Medicine & Pathology Department, Faculty of Medicine & Dentistry, University of Alberta, 8440 112 St. NW. Edmonton, Alberta, Canada T6G 2B7
4. Faculty of Health Science, College of Medicine, Imo State University, Owerri, 460222 Owerri, Nigeria

Abstract
Background: Disinfection and sterilization are key processes required to ensure the safety of clients when they visit a barber for a haircut. Barbering practices differ across barbershops depending on the knowledge and economic status of the barber. Several studies have reported on disinfection methods and disinfectants used in barbershops but the manner in which these methods are implemented were not revealed as well as the working concentrations of the disinfectants they used. This study aimed to uncover knowledge on decontamination practices and disinfectants used in barbershops in Dschang and also to assess barbers' knowledge on these practices and disinfectant substances.**Methods:** A randomized cross-sectional and observational study approach was conducted amongst 57 consented barbers in the city of Dschang. An interview was held with each barber after observing at least a single haircut and a questionnaire filled during the process by the investigator. Collected data was analysed using GraphPad Prism 5, SPSS21 and Microsoft Excel 2013 and the outcome presented as descriptive statistics.**Results:** Barbers in Dschang employed flaming (53%), UV light exposure (23%) and alcohol treatment (14%) as their main disinfection methods but performed no sterilization (100%). Disinfectants commonly used were alcohol by 96.5% barbers and sodium or calcium hypochlorite (eau de Javel) by 86% users. Knowledge on the use of these disinfectants and decontamination processes was poor amongst barbers with 94.74% alcohol and 86% sodium hypochlorite poor users.**Conclusion:** Barbers' awareness of disinfection in their practice was very impressive but their entire decontamination processes were poor and depicting a contamination risk.
Keywords: Disinfection, Sterilization, Decontamination, barber, barbering.
DOI: 10.7176/JHMN/85-0
Publication date: January 31st 2021

1. Introduction

Hair cutting or shaving is a process of cutting the hair on the head and face or modifying the height of the hair by trimming it to a desired level and shape as instructed by the client. The goal is to look neat. It is a very common phenomenon practiced daily by professional barbers as a form of employment and source of income. The shaving process is associated with risks. Accidental cuts and abrasions with the clipper or blade are not unusual and have been reported [1][2] through which transmission of blood-borne pathogens may occur. The risk of non-sexual transmission of blood-borne pathogens in the barbering profession and activity has been documented [1][3][2][4]. Amodio and coworkers[3] reported that the reuse of razors/blades and towels by hairdressers may cause the transmission of blood-borne and body fluid-borne viruses such as Human Immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) as well as localized cutaneous bacterial and fungal infections. Transmission of blood borne disease such as HIV occurs through cuts, abrasions and micro injuries which are much neglected and/unnoticed at barbershops [5].This demands for appropriate treatment of barbering instruments and tools in this profession.

Barbering or shaving risk has also been due to barbers' unsafe practices such as poor disinfection and sterilization of their professional instruments and tools or the non-decontamination of used tools between clients[1][2]. The development of cutaneous plaques or lesions, known as Acne Keloidalis Nuchae (AKN), characterized by exuberant scars on the face or occiput has been attributed to poor disinfection and/or sterilization of electric shaving clippers [6]. Disinfection is the use of an anti-microbial substance or antiseptic to remove as much microbes as possible from a surface or material to an insignificant residual level to survive[7]–[9][10] and therefore minimize possible transmission. Sterilization is the destruction of all microbial forms or microbes plus bacterial spores (endospores) from a material [7], [9][10]. These two processes are different [9]. Both disinfection and sterilization, which are decontamination processes, are crucial in the professional practice of a barber to protect him/herself as well as the clients from cross contamination.

Dschang is a cosmopolitan university city in the West of Cameroon. In such university cities, professional barbers usually take advantage of the student population to set up their barbershops. We do not know yet the

practices of hair care professional barbers in Dschang, however, AKN is on a rise in Dschang and other Cameroonian communities. We hypothesized that poor disinfection and sterilization methods, inappropriate use of disinfectant substances and knowledge deficiency in disinfection and sterilization amongst professional barbers in the university city of Dschang may put its inhabitants at moderate risk of infections. The aim of this study was to determine the disinfection and sterilization methods, and identify disinfectant substances used along with their associated knowledge amongst professional barbers in Dschang. We could only find one study [11] which has reported on professional barbering salons in Cameroon suggesting the paucity of information regarding the practice of this profession in this country. Given the importance of disinfection and instrument sterilization by professional barbers in minimizing transmission of blood borne pathogens and skin diseases, we hope that this work will call for greater attention of the public and public health to implement and promote public health control measures and necessary education for effective practice in barbering salons which has so far been neglected.

2. Materials and Methods

2.1. Study design and setting

A random, cross-sectional and observational study in male barbering salons (target population) in the University City of Dschang was conducted from June to September 2020. A pretested number-coded structured questionnaire with open-ended and closed-ended questions was used during an interview session. Number coding of interview questionnaire was aimed at avoiding bias during data analysis. Investigators went out and sought for barbershops to sample barbers.

2.2. Study location

Dschang is the capital of Menoua Division, the head quarter of Dschang Sub-Division, in the West Region of Cameroon. It is in the grass field areas and has a mean altitude of 1400m above sea level. Longitudinal and latitudinal positions of the city are described in [12]. The city is dominated by a youthful population of students from secondary and high schools and the university.

2.3. Recruitment criteria

We contacted and explained our research purpose and protocol to 74 barbers with 57 of them successfully sampled who orally consented to this research work. Only barbers who had completed their training and were in full professional practice and who consented were sampled for the study. Part time barbers and apprentice trainees were excluded from the study. Consented barbers who thought otherwise during the sampling process and felt like quitting were non-included from the study. Only one barber was sampled from a barbering salon with many barbers.

2.4. Sampling technique and data collection

The questionnaire was pretested and adjusted where necessary. Male barbershops were visited uninformed by the investigators, who presented the research authorization from the authorities concerned, the purpose of the research explained verbally to the barber or barbershop owner to obtain informed verbal consent. The investigators observed the disinfection practices and how barbers shaved at least one client after which an interview was held with the barber. Data was collected during interview as the investigator asked part of the questions from his structured questionnaire and filled in the responses himself. Closed-ended questions were filled based on his observation on clients shaved.

2.5. Ethical consideration

Research authorizations were obtained from the Senior Divisional Officer and Chief District Medical Officer's offices to conduct this research. These were presented to barbers before explaining the research purpose and obtaining informed verbal consent.

2.6. Statistical analysis

Data was analyzed using GraphPad Prism 5, Microsoft Excel 2013 and SPSS version 21 software package. Raw data was entered into Excel, Graphpad 5 and SPSS data spread sheets and analyzed with respect to the set of variables. Results are presented using simple descriptive statistics such as frequencies, percentages, means and Standard deviations (Mean ± SD) as well as in bar charts and graphs.

3. Results

3.1. Demographic data of barbers.

This study sampled 57 barbers in professional practice in the city of Dschang. We observed a gender difference in this hair care professional sector, dominated by males 55 (96.5%) while the female participants constituted 2 (3.5%). Most of our participants 33 (57.9%) were single, and 21 (36.8%) were married while 3 (5.3%) lived in concubinage. These barbers were relatively youthful in age. 20 (35.1%) fell within the age range 17-25yrs, majority

26 (45.6%) dwelled within 26-35yrs, 9 (15.8%) constituted the range 36-45yrs and the oldest barbers 2 (3.5%) settled within 46-55yrs. The mean age of these barbers was 29.5±7.9 (mean ± SD) years. All the barbers had gone to school. The least, 8 (14%) got to elementary school, 13 (22.8%) reached high school while the majority 18 (31.6%) each got to secondary school and university respectively (Table 1). Most of the barbers 28 (49%) had a work experience of <5yrs. 16 (28%) had been in service for 5-10yrs; 6 (11%) had accumulated between 11-15yrs experience; 4 (7%) had attained the range 16-20yrs of professional practice and the least of the barbers 3 (5%) had gained more than 20yrs of work experience (Figure 1a). The mean work experience of the barbers was 6.9 ± 6 (mean ± SD) years. In addition to their general educational level, all the barbers had undergone some kind of professional barbering training. Almost all the barbers 50 (88%) were trained by another barber through apprenticeship; 3 (5%) acquired training sequentially via apprenticeship as well as in a professional academy; 2 (4%) of the barbers indicated to have self-trained themselves at home; 1 (2%) barber mentioned to have acquired his skill as a natural talent. Another barber 1(2%) unsuccessfully tried apprenticeship for a short while but mostly trained himself by watching online barbering videos (Figure 1b). We also obtained an estimate number of clients shaved per day by each barber (Figure 1c). The least and maximum number of clients shaved per day were 3 and 50 respectively. The median number was 15 clients and the modal number 20. The mean client number shaved per day was 15 ± 8.95 (mean ± SD) persons.

Table 1: Demographic information of sampled barbers.

Demographic data of barbers (N = 57)		
Variable	**Frequency (n)**	**Percentage (%)**
Gender		
Male	55	96.5
Female	2	3.5
Marital status		
Married	21	36.8
Single	33	57.9
Concubinage	3	5.3
Age group (years)		
17-25	20	35.1
26-35	26	45.6
36-45	9	15.8
46-55	2	3.5
Educational level		
Primary	8	14
Secondary	18	31.6
High school	13	22.8
University	18	31.5

This table shows barbers who participated in this study were dominantly male (95.5%) and most participants were unmarried. It also reveals the youthfulness of barbers, the youngest age range of participants constituted (45.6%). All barbers left school at different levels with a great number having attained university.

3.2. Methods of clipper disinfection

We observed during this study that barbers employed various methods and techniques to disinfect their clippers before shaving. We identified 3 main techniques they used for clipper disinfection and decontamination: Flaming, UV light exposure and the use of alcohol. Majority of the barbers 30 (53%) used hand-held flaming by exposing a flame via the aid of a gas lighter to the clipper's trimming teeth. The second most used technique was exposing the clipper to ultra violet (UV) light in an enclosed chamber by 13 (23%) barbers. The third main method was the application of alcohol to the blade at the cutting areas observed in 8 (14%) of the barbers. Other less common disinfection methods were the use of disinfectant solutions such as eau de Cologne (EC) by 1 (2%) barber; diluted eau de Javel (EJ) by 2 (4%) barbers; a mixture of alcohol and EJ solutions by 2 (4%) of barbers and lastly, 1 barber (2%) used an undisclosed solution mixture for his clipper disinfection (Figure 1d). All solutions were applied or poured on the clipper teeth for a while to disinfect.

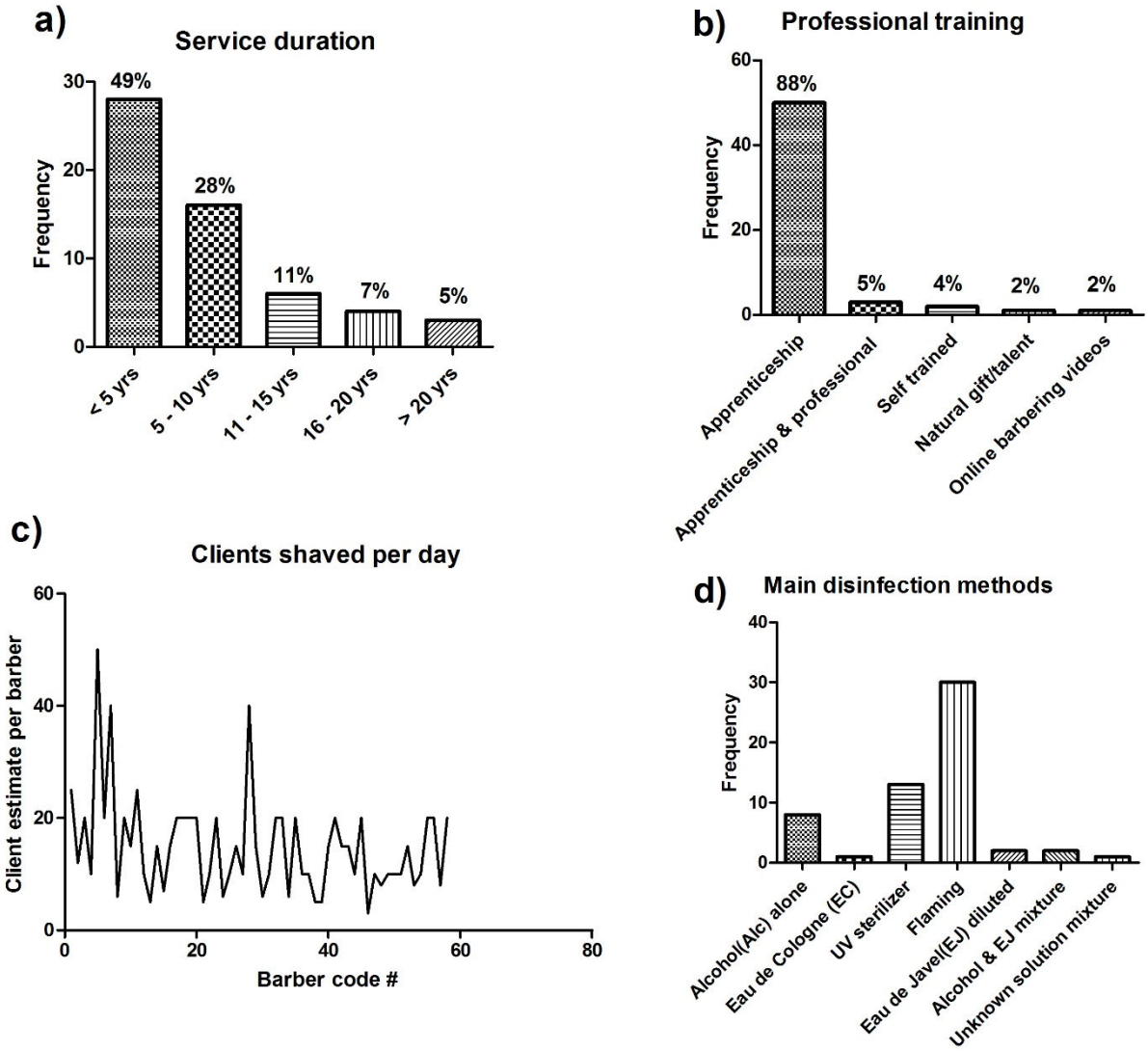

Figure 1. Demonstration of disinfection and training methods and experience of barbers. a) Length of stay of barbers in service. Majority of barbers 28(49%) had <5yrs of practice, followed by 16 (28%) with 5-10 yrs of work experience. Mean service duration years was 6.9±6 (mean ± SD). b) Methods through which barbers were trained as professionals. Most of our sampled barbers 50 (88%) learned the art via another barber in a barbershop. c) Illustration of clients shaved per day by each barber. The highest estimate number of clients shaved by a barber was 50 while the lowest was 3. Mean number of clients shaved per day was 15 ± 8.95 (mean ± SD). d) Main disinfection methods used by barbers. Majority 30 (53%) of barbers used flaming, 13 (23%) used UV sterilizers and 8 (14%) employed alcohol.

3.3. Flaming coupled with other disinfection methods

Hand-held direct flaming was uncovered in this study as the dominant and most common method of clipper disinfection amongst the sampled barbers. As shown in figure 2a, only 2 barbers (4%) disinfected their clippers solely with the flame. Other barbers were observed to associate or couple the flaming method with disinfectant solutions or mixture of these solutions or with UV light exposure. The commonest coupling disinfection method observed was the application of alcohol (mostly 95% concentration) on the clipper's blade and then subjecting the blade to a flame for a short while. The size of the flame increased with this high alcohol (Alc) grade used. Majority of the barbers 17 (30%) associated alcohol with flaming in this study.

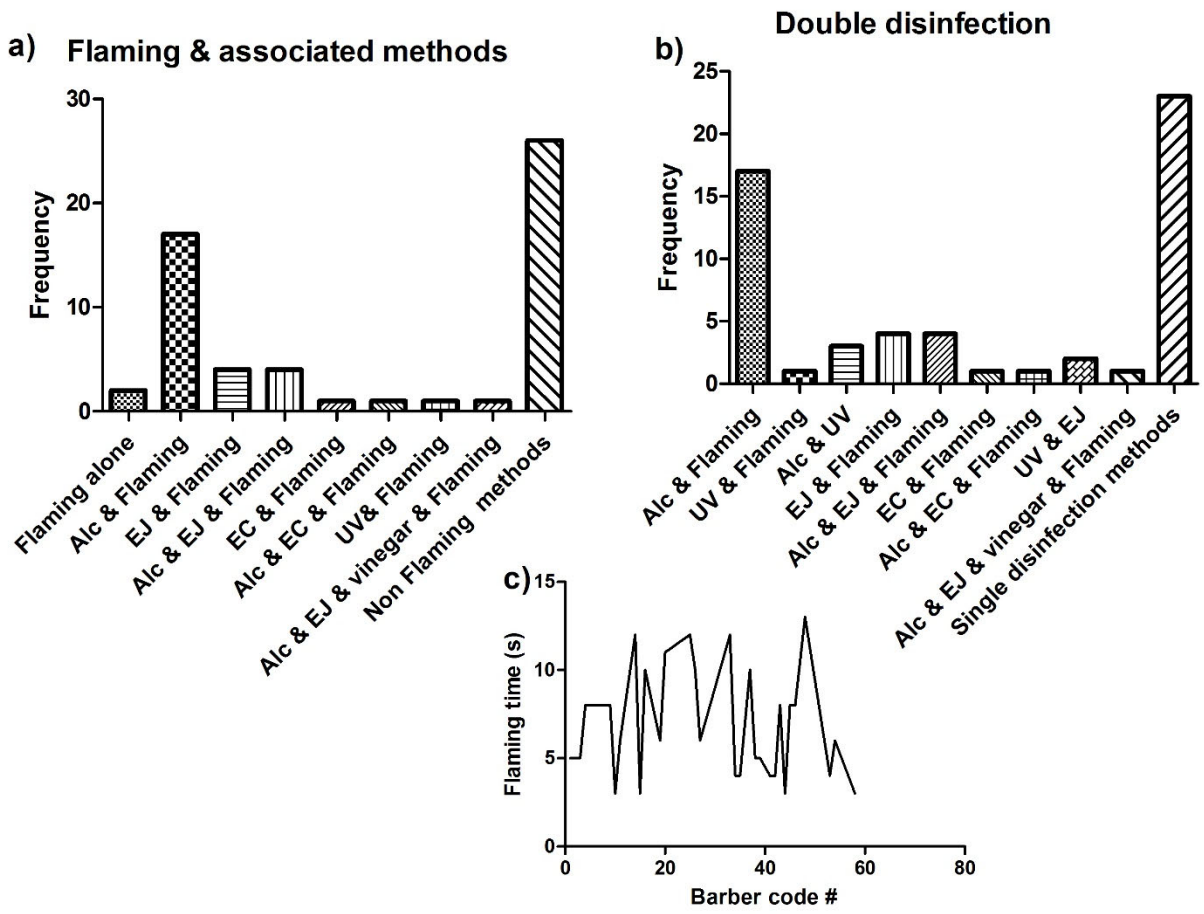

Figure 2. Illustration of flaming-coupled and double disinfections methods barbers employed. a) Flaming coupled with other disinfection methods and solutions. Majority of barbers 17 (30%) employed flaming along with alcohol (Alc). b) Different double disinfections of shaving clippers. Majority 17 (30%) of barbers applied an alcoholic solution on clipper and then proceeded with flaming. c) Demonstration of flaming time of barbers who disinfected with the flame. 3 and 13 seconds were the shortest and highest disinfection flaming time respectively. The mean disinfection flaming time was 6.8 ± 3.1 (Mean ±SD) seconds.

The next frequently used disinfection coupling process by 4 (7%) barbers was the use of a disinfectant bleaching substance (calcium or sodium hypochlorite) commonly known as *eau de Javel* (EJ) along with flaming. Another 7% of barbers applied a mixture of alcohol and EJ solutions prior to flaming. 1 barber (2%) removed his clipper from the UV sterilizer and flamed the blade before proceeding to shaving a client. Another 2% of barbers associated *eau de Cologne* (EC) with flaming, and 2% again coupled alcohol and EC solution mixture to flaming. The last 2% of barbers employed a three solution mixture of alcohol, EJ and vinegar before flaming. The other proportion represented non flaming disinfection methods (Figure 2a). Most of these solution mixtures were not prepared daily. Figure 2b represents double disinfection methods used by barbers in Dschang. 34 (59.6%) barbers altogether performed double disinfection of clipper compared to 23 (40.4%) who practiced single disinfection on clipper before shaving (Figure 2b). All the disinfectant solutions, single or combined, were applied on clipper for less than 60 seconds.

3.4. Flaming time for disinfection

Finding flaming as a very common disinfection method used singly or associated briefly with disinfectant solutions or with UV exposure, we timed the entire flaming process for all barbers employing this practice and documented this. More than half of the barbers 31 (54.4%) practiced this method. Figure 2c illustrates a graph of flaming time for each of the 31 barbers. The median flaming time was 6 seconds and the modal flaming time 4 seconds. The least flaming time was 3 seconds while the maximum flaming time was 13 seconds. The mean flaming time was 6.8 ± 3.1 (mean ± SD) seconds.

3.5. Alcohol concentration or grade (v/v) used by barbers for clipper disinfection

Alcohol, an antiseptic solution was commonly used by the sampled barbers. 55 (96.5%) barbers overall used alcohol relative to 2 (3.5%) non users (Figure 3a). It was used either singly or in combination with other disinfectant solutions to disinfect clippers and mostly utilized as an aftershave antiseptic. Majority of the barbers 46 (80.7%) used 95% v/v alcohol, followed by 6 (10.53%) who used 90% v/v grade. One barber (1.75%) indicated he used 70% and 2 barbers (3.5%) mentioned using 50% v/v alcohol concentration. Two barbers (3.5%) did not use alcohol at all (Figure 3a). Most of the barbers 52 (91%) used 95% and 90% v/v higher grades on clipper and shaved areas undiluted. Even when mixed or diluted with other disinfectant solutions, they were unable to tell the overall alcohol concentration in the mixture.

3.6. Knowledge on the appropriate utilization of alcohol

Barbers' knowledge on the use of alcohol for a proper disinfection process was tested by asking each of them why they used the indicated concentration or grade. Some of the barbers did not know by heart what grade they used until after verification from the container label. 54 (94.74%) of barbers demonstrated poor knowledge on the appropriate use of alcohol as a disinfectant. They provided answers such as higher grades (95% & 90%) were pure, effective, highest quality, kill microbes more and faster, disinfects clipper at maximum, etc. Only one barber expressed good knowledge on the appropriate use of alcohol as a disinfectant (Figure 3b). He bought a stock concentration of 90% v/v and diluted it to 70% v/v explaining that "it evaporates slowly and increases the contact time with the microbes to destroy them". One non user stated that alcohol did not kill microbes but only stabilized them.

3.7. Disinfection using UV sterilizer devices

The second common method employed by barbers to disinfect their clippers was the use of ultra violet (UV) sterilizer cabinets. 13 (23%) barbers practised this method (Figure 3c). Some of these UV light users 6 (11%) also performed double disinfection of their clippers. When taking out the clipper from the cabinet to shave, some barbers 3(5%) sprayed or poured alcohol on the blade, 1 (2%) barber flamed after removal and 2 (4%) applied EJ (Figure 3c). Only 7 barbers (12%) solely used UV light for clipper disinfection (Figure 3c).We observed brief periods of clipper exposure to UV light by some barbers, especially those who had limited hair trimmers when their customer queue was long. Some of them had their UV cabinets on use with doors wide open. Some forgot closing the cabinet door when used clippers were placed inside. A couple of the UV chambers had their doors bad or broken and virtually had to be left open. Two complained their UV bulbs were bad and needed replacement.

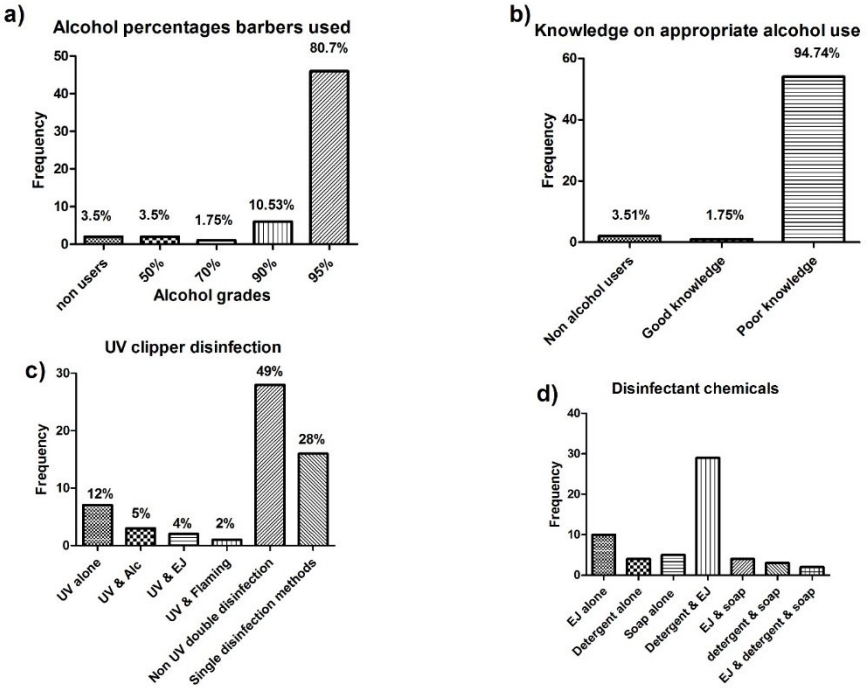

Figure 3. Barbers' alcohol knowledge and chemical disinfectants used for cloth washing.a) Demonstration of the different alcohol percentages (%) used by barbers to disinfect their clippers. The majority 46 (80.7%) used 95% while only 1 barber (1.75%) used 70%. b) Illustration of barbers based on the knowledge of grade of alcohol for disinfection. Majority of the barbers 54 (94.7%) showed poor knowledge on the appropriate percentage for

disinfection. c) Barbers' UV light clipper disinfection. 13 (23%) barbers used UV light. 7 (12%) barbers used only UV light for disinfection while 6 (11%) barbers combined UV and other disinfection applications. d) Disinfectants barbers use in their practice to wash towels and other cloth-like materials used on clients during barbering. 29 (51%) barbers mostly used a detergent along with EJ.

3.8. Disinfectant chemical substances used by barbers to disinfect towels, face towels, protective covers, etc used during practice.

Barbers recycle the use of face towels & towels and protective covers amongst clients during shaving which they use to wash the hair, clean clients' faces and prevent cut hair from dropping upon clients' clothes respectively. These require constant disinfection. Barbers used various disinfectant substances to protect clients from cross contamination. Our study reveals that 10 barbers (18%) used EJ alone, 4 barbers (7%) used solely detergent (either Omo, Madar, Ozil, etc); 5 (9%) used soap (savon) alone, majority 29 (51%) used detergent and EJ combined, 4 (7%) used soap and EJ; 3 (5%) used soap and detergent and the last category of barbers 2 (4%) used a combination of soap, detergent and EJ to clean and disinfect these barbering cloth materials (Figure 3d). Those barbers with a UV warmer placed the face towels and short towels inside this device for disinfection following washing.

3.9. Disinfectants used by barbers after a hair cut

All the barbers (100%) applied a disinfectant substance shortly after to the shaved areas and traced hair line. These aftershave substances were either single solutions or a mixture of solutions or pomade. Most of the barbers 34 (60%) used alcohol alone, followed by 11 (19%) who used EC solely too. Two barbers (4%) used sivoderm. One barber (2%) used an antiseptic powder. Disinfectant mixtures such as Alc and EJ were used by 4 barbers (7%), Alc and EC by 4 (7%) barbers as well and one barber (2%) applied an Alc and vinegar mixture (Figure 4a). According to them, this aftershave treatment was to get rid of microbes from the blade in case it was not well disinfected, to treat clipper created wounds (micro and visible) and to avoid eruption of rashes on the cheek and chin.

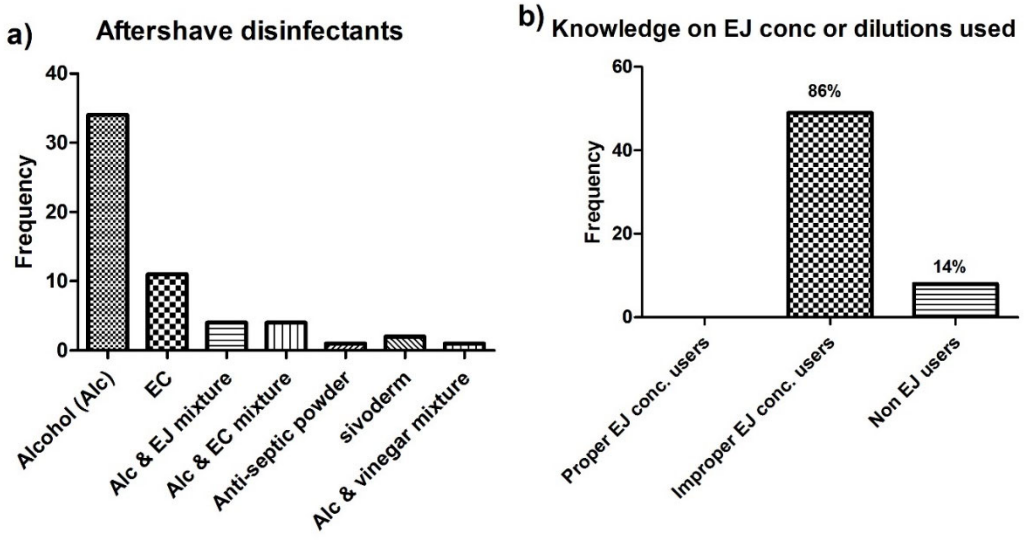

Figure 4. Barbers' knowledge on bleach dilutions and aftershave substances employed. a) Disinfectant solutions used to treat shaved areas. Most of the barbers 34 (60%) used alcohol (Alc) as aftershave, second by eau de Cologne (EC) (19%). b) Proportion of barbers using incorrect dilutions of Sodium or calcium hypochlorite (EJ) in their practice. None of the barbers used the recommended dilution. 49 (86%) barbers used the wrong dilution.

3.10. Barbers' Knowledge on the appropriate concentration or dilution of eau de Javel for disinfection.

Eau de Javel (2.5%) is a bleaching agent mostly used domestically to eliminate microbes with main component either calcium or sodium hypochlorite. We identified that 45 (78.9%) barbers used EJ solely or combined with other substances (soap and detergent) for washing and disinfecting textile materials. We asked them what final dilution they prepared with EJ to clean barbering clothes or disinfect their clippers. We discovered that given the volume proportion of EJ to water (ratio) which they used for disinfection, none of the barbers 49 (86%) did use or prepare the recommended dilution as instructed by EJ manufacturer for effective disinfection. 8 barbers (14%) did not use EJ at all (Figure 4b). EJ dilutions barbers commonly used were 1:50, 1:100, 1:167, 1:200, 1:250, 1:300, 1:333, 1:500, 1:1000, 1:1500, 1:2000, 1:16000 to disinfect blades and textile materials.

3.11. Barbers' knowledge on disinfection

Barbers were interrogated on why they disinfected their clippers before shaving a client. Without any hesitation and blinking, all the barbers (100%) in their individual oral responses, in one way or the other, brought out the notion to prevent disease transmission and contamination between clients; and to kill, eliminate and neutralize microbes. All the barbers were aware of the existence of blood-borne diseases as well as skin diseases and were obliged by this to disinfect their clippers. The barbers' awareness on disease prevention and their knowledge on the importance of disinfection was overwhelming.

3.12. Barbers' knowledge on sterilization

We also investigated whether the barbers did sterilize their clippers' blades and metallic scissors for a "Yes" or "No" response. All the barbers (100%) responded with an affirmative "Yes". When asked how, most verbally described the same procedure we observed them perform on their clipper disinfection. Some responded with "I answered that question previously" referring to the question on how they disinfected their clippers earlier asked. None of the barbers employed any of the sterilization methods in their practice such as autoclaving, using a gas or an electric oven, boiling for > 1 hour and using the appropriate chemicals for immersing their blades for at least 30 minutes. One barber described her sterilization by dipping a clean sponge in undiluted 2.5% EJ and cleaning the clipper's blades with and placing the clipper in a UV sterilizer chamber. Another claimed to sterilize by immersing blades, combs and small brushes in a mixture of alcohol and EJ overnight.

4. Discussion

The need of infection control in all hair care professional barbershops globally to break or eradicate the transmission of diseases (blood-borne and skin) is highly desired and of paramount importance. This can be partly achieved via proper implementation of disinfection and sterilization measures of barbering instruments such as clippers and razors. Our study identified three main methods used by barbers in Dschang to disinfect their clippers: flaming, UV light exposure and alcohol treatment (Figure 1d). The use of these methods has also been reported in other studies [1][2], [4], [13]. As observed by Biadgelegn and coworkers [2], flaming was the dominant method used by barbers in this study. It was mostly associated with other disinfection techniques including use of alcohol and/or UV light exposure (Figure 2a and b; Figure 3c). We conceived this as doing the disinfection twice. A combination of disinfectant solutions was also used by some of these barbers to treat their clippers prior to flame application. We consider this phenomenon a double disinfection process given that some of these solutions or mixtures are solely used by some shaving practitioners to disinfect their clippers. The application of disinfectant solution and flaming was aimed at reinforcing the overall disinfection process and reassured the barber of a safe shave on the client. Mixing or combining two or more solutions could give a resultant solution whose antimicrobial activity is either neutralized, reduced or enhanced. Thus, we are uncertain about the antimicrobial strength and activity of this mixed resultant solution that is coupled to flaming. Furthermore, based on our observation, we estimate the contact time of all disinfectant solutions applied on clipper teeth to be less than 30 seconds which may not be enough time for effective disinfection.

Moreover, we recorded the duration time of flaming the clipper (Figure 2c) not observed in any study. The mean flaming time was 6.8 ± 3.1 (mean $\pm$ SD) seconds. We consider 6 seconds too short a time to properly disinfect the clipper. Thus, bringing these three factors together: the uncertain disinfectant status of the combined resultant solution, its brief contact time with the clipper and short flaming time of the clipper does not make the double disinfection process satisfactory and convincing. The practice of using a combination of disinfectants, as observed in our study, has also been documented in [2], [11]. The proportion of barbers using a combination of disinfectant solutions is higher in our study (11%) unlike in the former. This may be driven by a strong desire to find a resultant solution which decontaminates better than the individual solutions.

The second main technique employed by our study participants (23%) was UV light exposure (Figure 3c). Other studies with a larger number of barbers using UV light devices have been reported [2], [14], [15][4]. Its use amongst barbers is getting so popular due to its user-friendly operation [15] and it can effectively disinfect many barbering instruments and tools if used appropriately. Most of the barbers we investigated using UV light devices demonstrated poor knowledge on the use of this device. A few were observed to have combs, brushes and scissors along with clippers in these cabinets. These implements were uncleaned prior to putting in the chamber. Cabinet doors were left open by some and others had broken doors. UV exposure time to these implements were less especially when a good number of customers waited in a queue. Under such condition and practice, the disinfection efficiency could not be satisfactory. These unsafe practices were also observed amongst a far larger number of UV device users in an Ethiopian study [4]. Our study did not check on the effectiveness of these UV devices like other studies [14], [15] which observed growth of bacteria and fungi from cultures of swabs from implements placed in UV chambers in barbershops. These studies suggested that inappropriate use of these devices diminished their antimicrobial efficacy and vice versa.

Some of our participants applied disinfectant solutions briefly to the clipper or flamed it following UV

exposure before shaving (double disinfection). We do not know whether they did this because of our presence or because of their awareness of their unsafe and inappropriate use of these devices. UV light is an effective method for eliminating microbes when correctly handled and used [10]. A most recent study of Adebiyi and colleagues has demonstrated that at least one hour UV exposure to shaving implements is required to effectively get rid of bacteria and fungi [14]. An Indian study had demonstrated 30 minutes was the minimum UV exposure time to kill 100% microbes [16].Thus, the disinfection practice of the UV users in our study is unsure especially at peak workload.

The use of alcohol for clipper disinfection was third in our study (Figure 1d). An alcohol is a water-soluble chemical compound with germicidal and disinfectant properties. Two alcohols are commonly used: ethanol (ethyl alcohol) and 2-propanol (isopropanol). After a few minutes of contact, these alcohols are bactericidal against vegetative forms of bacteria; they are also tuberculocidal, fungicidal and virucidal but unable to kill spores [7], [10]. Ethanol is used as an antiseptic in the concentration range of 60 - 80% [9]. To achieve highest effectiveness, alcohols are used in a concentration of approximately 70%; and lower and higher concentrations to this are less effective [7]. Alcohol possesses anti-mycobacterial activity at 70% concentration [9]. Many studies have reported the use of alcohol by barbers [1], [2], [4], [11] but some did not have the used concentration mentioned. However, the use of 70% by some barbers has been mentioned in some African studies [2], [13]. Almost all our participants used the wrong percentage of alcohol (ethanol): 46 (80.7%) used 95% and 6 (10.53%) used 90% grade (Figure 3a). They all thought the higher percentage was best and effective. Only one barber indicated using 70% and managed to give his own explanation (Figure 3a and 3b). We do not know whether this lone appropriate user accurately prepared this effective alcohol percentage. The alcohol concentration in a combined mixture of disinfectants could not be determined by the barbers. Therefore, the use of alcohol was thus poor and the alcohol disinfection method and process was non satisfactory. A large proportion of barbers (61.7%) in another study did not know the concentrations of the disinfectants they used [4].

Sodium or calcium hypochlorite, commonly known as “household bleach” in North America and eau de Javel (EJ)/Camel water in Cameroon, is another frequently used disinfectant utilized at homes and by barbers in a bid to practise safely. Sodium hypochlorite is effective against a wide range of microorganisms [17] or demonstrates a broad spectrum of antimicrobial activity with bactericidal, fungicidal, mycobactericidal and sporicidal effects [10].This germicide is sold at a concentration of at least 5% sodium hypochlorite in USA [9], [10] and from 3-8% in Canada [17]. Its concentration or dilution for use is from 1:10 to 1:100 [9], [10] and fresh dilutions of bleach and water are to be prepared daily [17] for use. It is sold in Cameroon at a concentration of 2.5% or 2.74%.

Several studies have reported the use of household bleach by barbers [1], [2], [4], [11] but the used concentrations or dilutions were not assessed. The manufacturer of eau de Javel sold in Cameroon has indicated the various proportions for different uses on its container or container label. These dilutions are 1:4, 1:44, 1:89 and 1:200 for dustbin, hard surfaces, cotton materials and synthetic fibers respectively. For disinfecting the clipper’s metallic blade, 1:44 dilution would be suitable for 10 minutes. None of the barbers used this dilution for disinfecting their clippers and the contact time was less than 30 seconds. EJ dilutions commonly used were 1:50, 1:100, 1:167, 1:200,1:250, 1:300, 1:333, 1:500, 1:1000, 1:1500, 1:2000, 1:16000 to disinfect blades and textile materials. These high dilutions could probably be used to avoid the corrosive action of EJ on the metallic blade and to extend its duration of use. This could also be to avoid bleaching textile materials (towels, protective covers, etc) which they frequently used. This observation also demonstrates poor knowledge on the proper use or dilutions of EJ or bleach by hair-cut service providers (Figure 4b).

Our participant barbers, all of them (100%), applied disinfectant substances as aftershave to the shaved area and carved hair line (Figure 4a). The aim was to eliminate microbes brought on to this area by the clipper blade in case it was not properly disinfected. It was also targeted to created wounds and to prevent the appearance of rashes. This is one of the last touches on a customer that brings the shaving process to a halt. Only 11(19%) of sampled barbers used eau de Cologne solely on clipper-shaved areas (Figure 4a). This is commendable owing to the fact that EC was manufactured purposely as an aftershave treatment and the liquid product mainly has alcohol with a concentration of 60-80% in it. This concentration range is good to disinfect. Unlike the previous group, 60% of our participants, the majority, applied alcohol alone as aftershave treatment. This alcohol was mostly 95% v/v concentrated and its antimicrobial activity is less [7]. 80% v/v alcohol or higher concentration largely coagulates bacterial cell wall and the disinfectant cannot enter the cell [9] to destroy it. The poor use of alcohol amongst these barbers was evident. Some used a disinfectant mixture of alcohol and EJ. These two disinfectant solutions were not properly prepared because of the non-respect of correct dilutions and concentrations. The resultant mixture’s germicidal activity is unknown. Mixing or diluting bleach must be done with water alone; same thing applies for alcohols if its purpose is for disinfection. And mixing sodium hypochlorite bleach with other disinfectants and not water can be dangerous [9]. Besides, EJ is not an antiseptic like alcohol or EC to be used on the skin. A mixture of alcohol and EC was also used. Mixing these two solutions would lead to increased alcohol concentration and thus less germicidal effect. Furthermore, a combination of alcohol and vinegar was also used as an aftershave. We do not know the antimicrobial strength of the final solution. Apart from EC being used solely, the disinfectant

ability of the others are doubtful and at the moment undetermined.

We also evaluated barbers on their knowledge of disinfection asking why they have to perform it on the clipper. All the barbers (100%) gave good responses on the importance of this process; briefly, to eliminate microbes and avoid contamination between clients. They were so devoted to must disinfect their clippers before beginning to shave. Some disinfected their clippers after a shave and kept if there was no client waiting. And when a client came, the barber had to disinfect this clipper again in front of him or her. This consciousness and awareness on disinfection was so impressively overwhelming. However, the effectiveness of the practice by these barbers was unsure and a problem. The inappropriate use of alcohol and eau de Javel concentrations, and the poor use of UV devices made their disinfection skills and knowledge incomplete. This can be enhanced by organized seminars and workshops in this regard. Some studies have reported on knowledge of barbers on disease transmission and occupational hazard risks [1]–[4], [11], [13], [18], [19]. Our study focused on evaluating their knowledge on the effectiveness of disinfection. These barbers showed good intention and consciousness to disinfection but fell short of its effectiveness in their practice. The average client number shaved per day was 15 ± 8.95 (mean ± SD). This implies a minimum of 411 clients and a maximum of 420 clients are exposed to this practice per month.

Our study also sought to know whether the barbers understood the concepts of disinfection and sterilization in their practice. These two concepts are well defined and differentiated in some published works [7], [9], [10], [17]. Disinfection and sterilization terms are used interchangeably in daily life and by some authors, giving the impression they mean the same. This is not true. We were interested to validate this too in this work. Though we did not ask the barbers a verbal definition of both terms, we asked them whether they performed disinfection and sterilization in their practice and how. Intriguingly, all the barbers (100%) agreed with a “yes” to performing sterilization. And to the how question, they all described what they did for disinfection and which the investigators had observed earlier. Thus, the mix-up was clear. They did not know there was a categorical difference between the two terms. Besides, none of the barbers had or used an autoclave, an oven, recommended chemical sterilants or boiled blades for more than one hour. Biadgelegn and coworkers [2] indicated the use of some sterilization techniques amongst some barbers. These authors reported that 48% of the barbers had correct knowledge of what sterilization meant [2]. According to this same study, disinfection and sterilization procedures of the barbers were risky and they showed a poor level of knowledge on them. This was unlike our study where none had such good knowledge on sterilization and did not practice it. Similar to this study, the disinfection knowledge of barbers in our study was poor.

5. Conclusion

Based on our analyses and observations, our study identified flaming, UV light exposure and alcohol treatment in descending order of frequency as the main disinfection methods employed by barbers in Dschang. These barbers did not practise sterilization. Their knowledge on disinfection was poor but their awareness overwhelming. Their knowledge on sterilization was poor and they could not distinguish between disinfection and sterilization. Alcohol and eau de Javel (sodium & calcium hypochlorite) were the main disinfectants used by these barbers. Their knowledge on the utilization of these disinfectant substances was also poor. Overall, their practices fell short of the desired effectiveness and the risk of contamination is quite eminent. This work brings to light poor disinfection practices and knowledge deficiency in the appropriate use of disinfectants amongst barbers which poses the risk of an emergence of resistant strains which could cause great public health threats if such strains become virulent. This study was limited by its nature of being observational, without any sample collection for laboratory determination of the effectiveness of the observed decontamination practices. This aspect of the work will be our next follow-up project. We recommend periodic seminars or workshops on effective decontamination processes with the barbers would rescue this situation. Moreover, the government should ensure that more professional training schools are created and that trainers or these professional barbering schools must include in their curriculum courses on disinfection and sterilization techniques.

Conflict of interests

The authors declare that they have no competing conflict of interests.

Authors’ contributions

GFK: conceived idea, wrote proposal, designed project, collected and analyzed data, interpreted data and drafted manuscript. OK: approved proposal, collected data, co-analyzed data. PNC: reviewed and approved proposal with some revision, designed project. TAA: reviewed proposal, revised and approved proposal and manuscript. KYA: reviewed, revised & approved proposal and manuscript. JRK: reviewed, revised and approved proposal and manuscript; oversaw execution of project. All authors contributed in data interpretation. All authors also read and approved the manuscript for publication.

Acknowledgements
We vehemently and specially thank the consented professional barbers in Dschang for their participation and collaboration in this study. We are also grateful to Dr Ghislain T. Maffo for providing the analytical software used in this work. This research work had no funding or financial support from any organization.

List of Abbreviations
UV Ultra violet
HIV Human Immunodeficiency virus
HBV Hepatitis B virus
HCV Hepatitis C virus
AKN Acne Keloidalis Nuchae
EC Eau de Cologne
EJ Eau de Javel
Alc Alcohol

References
[1] Arulogun O. S and Adesoro M. O., (2009). "Potential risk of HIV transmission in barbering practice among professional barbers in Ibadan, Nigeria," *Afr. Health Sci.*, 9(1):19–25.
[2] Biadgelegn F. *et al.*, (2012). "Potential risk of HIV transmission in barbering practice in Ethiopia: From public health and microbiological perspectives," *BMC Public Health*, 12(1):1 doi: 10.1186/1471-2458-12-707.
[3] Amodio M., Di Benedetto M. A., Gennaro L., Maida C. M., and N., (2010). Romano, "Knowledge, attitudes and risk of HIV, HBV and HCV infections in hairdressers of Palermo city (South Italy)," *Eur. J. Public Health*, vol. 20(4):433–437, doi: 10.1093/eurpub/ckp178.
[4] Deresse D., (2017). "Barbers knowledge and practice of biological hazards in relation to their occupation: A case of Hawassa Town, Southern Ethiopia," *J. Public Heal. Epidemiol.*, 9(8):219–225, doi: 10.5897/jphe2017.0919.
[5] Krishanani M. K., Ali F. A., Khuwaja A. K., Qidwai W., and Ali B. S., (2014). "Educational intervention among barbers to improve their knowledge regarding HIV/AIDS: A pilot study from a South Asian country," *J. Heal. Popul. Nutr.*, 32(3):386–390, doi: 10.3329/jhpn.v32i3.2820.
[6] Salami T., Omeife H., and Samuel S., (2007). "Prevalence of acne keloidalis nuchae in Nigerians," *Int. J. Dermatol.*, 46(5):482–484, doi: 10.1111/j.1365-4632.2007.03069.x.
[7] WHO (1988)."Guidelines on sterilization and high-level disinfection methods effective against human immunodeficiency virus (HIV)," *Bulletin of the International Union Against Tuberculosis and Lung Disease*, 63(2):7–11.
[8] Cronquist A. B., Jakob K., Lai L., Della Latta P., and Larson E. L., (2001). "Relationship between skin microbial counts and surgical site infection after neurosurgery," *Clin. Infect. Dis.*, 33(8):1302–1308, doi: 10.1086/322661.
[9] Yoo J. H., (2018). "Review of disinfection and sterilization - Back to the basics," *Infect. Chemother.*, 50(2):101–109, doi: 10.3947/ic.2018.50.2.101.
[10] Rutala W. A. and Weber D. J., (2009). "Control of Hospital Waste," *Mand. Mand. Douglas, Bennett's Princ. Pract. Infect. Dis. 7th ed.*, pp 3677–3695, doi: 10.1016/B978-0-443-06839-3.00301-5.
[11] Abia W. A., Fomboh R., Ntungwe E., Abia E. A., Serika W. A., and Ageh M. T., (2016). "Occupational Health Hazards Awareness and Common Practices amongst Barbers and Hairdressers in Cameroon," *J Public Heal. Dev Ctries*, 2(1): 94–101.
[12] Emile T., Honorine N., Thomas N., and Marie-Anne S., (2012). "Vegetable production systems of swamp zone in urban environment in West Cameroon: case of Dschang city," *Univers. J. Environ. Res. Technol.*, 2(2):83–92.
[13] Mutocheluh M. and Kwarteng K., (2015). "Knowledge and occupational hazards of barbers in the transmission of hepatitis B and C was low in Kumasi, Ghana," *Pan Afr. Med. J.*, 20; p. 260, doi: 10.11604/pamj.2015.20.260.4138.
[14] Salem A., (2020). "Qualitative evaluation of the antimicrobial efficacy of UV sterilization chambers employed by barbershops in Benin City , Nigeria Original Article Open Access Qualitative evaluation of the antimicrobial efficacy of UV sterilization chambers employed by ba," no. May, doi: 10.4314/ajcem.v21i3.9.
[15] Addo R., (2014). "Effectiveness of UV Sterilisation Chambers in Barbering Shops and Salons," *J. Nat. Sci. Res. www.iiste.org ISSN*, 4(20): 67–75
[16] Mehraj I. and Latha C. N., (2010). "Effect of UV rays (265nm) to determine the minimum amount of exposure required to effect a 100% kill of the organism. Bacillus cereus, an endospore-former, and

Staphylococcus aureus, a non-endospore-former will be used to provide a comparison of the relat," *Biomed. Pharmacol. J.*, 3(2):431–434.

[17] P. H. Ontario (2019). "Guide to Infection Prevention and Control in Personal Service Settings , 3 rd edition," no. July.

[18] Beyen T. K., Tulu K. T., Abdo A. A., and Tulu A. S., (2012). "Barbers' knowledge and practice about occupational biological hazards was low in Gondar town, North West Ethiopia," *BMC Public Health*, 12(1): 1, doi: 10.1186/1471-2458-12-942.

[19] Mandiracioglu A., Kose S., Gozaydin A., Turken M., and Kuzucu L., (2009). "Occupational health risks of barbers and coiffeurs in Izmir," *Indian J. Occup. Environ. Med.*, 13 (2): 92–96 doi: 10.4103/0019-5278.55128.