

# Used Restraint Devices: Potential Infection-Hazards On Handcuffs In Ghana

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**Abstract:** The incidence of unknown routes of infectious diseases has become a major public health concern. Restraint devices such as handcuffs used by selected security agency from three (3) Police Stations in Accra were investigated for bacterial contamination. Five (5) handcuffs including two (2) slightly used ones, two (2) frequently used ones and one (1) sealed unused handcuff was purposely selected for the study. The presence and quantity of *Staphylococcus aureus*, *Escherichia coli* and total coliforms on the handcuffs were measured. The *Staphylococcus aureus*, *Escherichia coli* and coliforms showed positive on all the four (4) used handcuffs but were not found on the sealed, unused handcuff. There was more contamination on frequently used handcuffs than slightly used ones. The presence and quantity of bacterial contaminants indicated *Staphylococcus aureus* (64%), *Escherichia coli* (8%) and total coliforms (28%). This shows that, used handcuffs harbour pathogenic bacteria, and could serve as potential routes of infectious diseases among users. This requires sensitization of the public on the cleaning of handcuffs between uses with disinfectants. Education on the use and cleaning of handcuff to users and security agencies could enhance environmental hygiene of restraint devices.

**Keywords:** Handcuffs, Risks, infectious diseases, public health, restraint devices

## 1 INTRODUCTION

Handcuffs are ring shaped devices that can be locked around a person's wrist, usually one of a pair, connected by a short chain or linked bar. Handcuffs could be two metal or plastic rings joined by a short chain that lock around a prisoner's wrist (Cambridge Dictionary). They may be manufactured from various metals including carbon steel, stainless steel and aluminium or from synthetic polymers and comprise two parts linked together by a chain, a hinge or rigid bar. Each half has a rotating arm which engages with a ratchet that prevents it from being opened once closed around a person's wrist. Without the key, the handcuffs cannot back out or be removed and so the handcuffed person is quite unable to move the wrists certain centimetres or inches apart. Handcuffs are standard law enforcement and security industry tools used for restraining and controlling dangerous or unreasonable people. For many years handcuffs have been the most widely and popular type of restraint device used by Police officers, Jail and Correction officers worldwide.

### 1.2 The use of handcuffs

The use of handcuffs cannot be avoided by the security industry for its variety of purposes such as restraining individuals associated with criminal activities, transporting prison inmates and moving active criminals daily. Handcuffs evolved from leather to hard metal mechanism, and in 1862, W.V Adams revolutionized the device, and peerless cuffs were patented in 1912 as standard for the handcuffs industry. This became the model for modern handcuffs. It is not unusual to have apprehended individuals struggling and causing restraint device (handcuffs) to be applied under violent circumstances. This behaviour could lead to over-tightening of handcuffs and could subsequently inflict and create trauma around the wrist causing bleeding which in turn contaminate the handcuffs. In addition, handcuffs may be placed on a person who was already injured or the person could initiate self inflicted injury. Either way, any blood producing injury or body fluid can contaminate the handcuffs. If the contaminated handcuffs are not sterilized between uses the infectious pathogens could contact an open wound of the next handcuffs wearer.

### 1.3 The spread of pathogens and community infections

Besides the day to day interactions of people which constitute one way of spreading disease, the major source and spread of

infections in communities are fomites [1]. This is because, in community interactions, toys, books, doorknob, skin cells, hair, clothing and bedding are all capable of carrying infectious organisms, such as germs or parasites and hence transferring them from one individual to another, as common sources of contamination. Several cases of infectious diseases among humans such as, the transmission of Hepatitis through unknown acquisition routes have been suspected in the use of contaminated handcuffs [2]. Public concern is that, some individuals or suspects could carry variety of dangerous diseases such as Methicillin resisted *Staphylococcus aureus* (MRSA) herpes, influenza, hepatitis, HIV/AIDS and other contagious skin diseases. For instance, fomites when in constant contact with humans or natural habitats of pathogenic organisms constitute major sources of spread of infectious diseases. Scott and Bloomfield [3] emphasize that, even when contaminated surfaces containing relatively low numbers of organisms come into contact with the fingers and other surfaces, organisms may be transferred in sufficient numbers to represent potential infection hazards.

### 1.4 THE MODE OF SPREAD OF INFECTIOUS DISEASES

Some microorganisms can be pathogenic at low concentrations and survive on non-porous surfaces such as telephones, taps, doorknobs and toilet bowls [4]. Pathogenic microorganisms can be spread through direct physical contact among people or through contact with contaminated inanimate objects and surfaces. Studies demonstrate that contaminated fomites contribute to spread of infectious diseases. Scott and Bloomfield [3] for example, noted that, whenever contaminated surfaces come into even relatively brief contact with fingers or an inanimate surface, a significant number of organisms can be transferred which can be recoverable onto an agar surface. Inanimate objects and surfaces have been described as the source for outbreaks of nosocomial infections in healthcare institutions [1]. Additionally, blood, vomit and body fluids from inmates of criminal cells and congested prisons, and on suspected individuals as well as handlers of handcuffs, can permeate the porous material and mechanism of handcuffs, rendering the handlers and suspected individuals at risk of infections. Kramer et al [1] found that, most viruses from the respiratory tract, such as *corona*, *coxsackie*, *influenza*, *SARS* or *rhino* virus, can persist on surfaces for a few days. Viruses from the gastrointestinal tract, such as *astrovirus*, *HAV*, *polio*-

or *rota* virus, persist for approximately 2 months. The authors report that, blood-borne viruses, such as HBV or HIV, can persist for more than one week. Herpes viruses, such as CMV or HSV type 1 and 2, have been shown to persist from only a few hours up to 7 days [1]. The paper examines sources and levels of microbial contaminations on handcuffs and the propensity of handcuffs as possible route of infections due to direct and indirect contacts with humans. The contributions of handcuffs to the transmission of diseases in humans when handcuffs are re-used were also considered in the analysis.

### 1.5 Control of microbial infections

Within the global infection control community, there is an ongoing controversy about the appropriate treatment for inanimate surfaces and objects. For instance, several debates have taken place in hospitals in order to prevent transmission of nosocomial pathogens. Allerberger et al [5] show that, cleaning of surfaces and an object with non antimicrobial detergents is in general sufficient. In the view of [6], preferences are given to cleaning of surfaces and objects with microbial agents based on data on the risk of infections due to microbial contaminations and potential transmission of nosocomial pathogens. Whenever contaminated handcuffs are not sterilized between uses potential infectious particles could contact open wounds of the next handcuffs wearer. This suggests that the major source and spread of community infections are fomites [6, 7]. The paper examines handcuffs used by the police as potential infection sources, the types of microbial contaminants that occur on unused, used and re-used handcuffs and the current methods used by the police in cleaning handcuffs.

### 1.6 THE NEED FOR CLEANING USED HANDCUFFS BEFORE RE-USE

Among restraint devices, handcuffs are most widely and popularly used by the police to restrain suspected individuals associated with criminal activities and also for transporting inmates of criminal cells. Handcuffs can easily become contaminated with blood when suspects are apprehended. This may be due to the frequent struggles that result when handcuffs are applied under violence, and this may lead to over-tightening of handcuffs which could inflict trauma and wounds on victims. Mostly, the struggles result in bleeding at the wrist of victims. Any blood producing injury can contaminate the handcuffs. In this study, the presence or reasonably anticipated presence of blood or other potentially infectious material on items or surfaces is deemed contaminated. Microbial contamination refers to non-intended or accidental introduction of infectious material like bacteria, yeast, mould, fungi, virus, and protozoa or their toxins and by-products into a surface or food etc [8, 9]. There have been instances of obvious microbial infections on the skins of some restrained individuals. Such infections could carry variety of dangerous diseases such as Methicillin resisted *Staphylococcus aureus* (MRSA), Hepatitis, influenza and other contagious skin diseases. Kramer et al [1] found that, most gram-positive bacteria, such as *Enterococcus* spp. (including VRE), *Staphylococcus aureus* (including MRSA), or *Streptococcus pyogenes*, survive for months on dry surfaces. The authors noted that, many gram-negative species, such as *Acinetobacter* spp., *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, *Serratia marcescens*, or *Shigella* spp., can also survive for months, while a few others, such as *Bordetella pertussis*, *Haemophilus influenzae*, *Proteus*

*vulgaris*, or *Vibrio cholerae*, however, persist only for days. Mycobacteria, including *Mycobacterium tuberculosis*, and spore-forming bacteria, including *Clostridium difficile*, can also survive for months on surfaces [1]. Kramer and colleagues reported that, *Candida albicans*, as the most important nosocomial fungal pathogen, can survive up to 4 months on surfaces. Persistence of other yeasts, such as *Torulopsis glabrata*, was described by the authors to be similar (5 months) or shorter (*Candida parapsilosis*, 14 days). The paper investigates and determines the sources and levels of microbial contamination of handcuffs used by the police and the propensity as a route of indirect transmission of infectious diseases.

### 1.7 SOURCES OF MICROBIAL CONTAMINANTS ON HANDCUFFS

Inanimate surfaces have often been described as the source for outbreaks of nosocomial infections [1]. Microorganisms are found everywhere and constitute a major part of every ecosystem. In this environment they live either freely or as parasites [10]. In some cases they live as transient contaminants on fomites and hands where they constitute a major health hazard as sources of community and hospital acquired infections [6, 11]. From the experiences of Cuff Cleaner [12], a company that cleans handcuffs, the unique design and usage of restraint devices provide microorganisms with ideal breeding grounds allowing contaminants such as blood, vomit and other fluids from inmates and suspected individuals to persist. The Centre for Disease Control and Prevention (CDCP) [13], indicated that Hepatitis B virus can survive outside the body for at least seven days, whilst the Hepatitis C virus can survive outside the body at room temperature for up to four days. For instance, the Centre noted that infections caused by Hepatitis B virus and Hepatitis C virus are common due to their life span on inanimate objects [13]. In view of this, inanimate objects like the restraint devices such as used handcuffs could harbour and transmit microorganisms among apprehended individuals who fall victim to the use of handcuffs. It is not unusual to have apprehended individuals struggling with the police, causing restraint devices to be applied under violent circumstances, such as apprehension of suspects during mob attacks or clash between two groups. Other instances include recapturing of suspected individuals and inmates who escape from lawful custody and robbery cases which mostly result in struggles between the police and the victims. These instances usually lead to behaviours which cause over-tightening of handcuffs and subsequently create and inflict trauma around the wrist of victims causing bleeding, which in turn contaminates the handcuffs. Individuals that are already injured and bloodied or individuals with self-inflicted injuries, appear to be the most common sources of contamination. Additionally, vomit and other body fluids from inmates of police cells could permeate parts of handcuffs.

### 1.8 SPREADING CONTAMINANTS THROUGH USED HANDCUFFS

The day to day interactions of people constitute one major source and spread of community acquired infections [7, 14]. Fomites when in constant contact with humans or natural habitats of pathogenic organisms constitute a major source of spread of infectious diseases [15]. Pathogenic microorganisms present on fomites can survive for a long period of time depending on microbial characteristics, fomites characteristics and environmental factors such as relative air humidity and

temperature [4, 16]. Numerous studies have demonstrated that, contaminated fomites play active role in the spread of infectious diseases [3, 17, 19, and 20]. A study by [21] reported that bacterial isolates were highest in emergency areas. Since handcuffs are non-disposable equipment, infectious pathogens could be transferred to the next handcuffs wearer through open wounds and sweat if the handcuffs are not decontaminated or sterilized. In a research conducted by [22], to determine the bacteria contaminants on door handles/knobs of public toilets and bathrooms in selected public places in Abuja metropolis, the capital of Nigeria, for example, out of the one hundred and eighty (180) samples cultured from swabs from public toilet and bathrooms door handles/knobs consisting of one hundred and forty (140) toilet handles/knobs and forty (40) bathrooms handles, one hundred and fifty-six (156) representing 86.7% showed bacterial contamination. Nworie et al [22] reported that bacterial isolates were highest in female toilet handles/knobs (41.7%) and bathroom door handles/knobs (11.5%) than males. Among the contaminants isolated by the authors included *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Escherichia coli*. Nicole [2] suspected the use of contaminated handcuffs as the acquisition route for viral hepatitis, following the speculation about routes of transmission of hepatitis B and C viruses which are yet to be unidentified, and has become a critical public health concern in the United States. Nicole [2] referred to a recent Canadian Police conference on the capability of dirty handcuffs in transmitting viral hepatitis. Hence, people can be infected due to unidentified routes of transmission, and items containing blood or bodily fluids can be suspected sources of spread of diseases.

## 2.0 METHODOLOGY

The study was conducted in Accra in the La Nkwantanang Madina Municipal Assembly (LANMMA). Due to the high crime rate and dense population of inhabitants and economic activities in the area, handcuffs are in constant and daily use in order to apprehend diverse suspected individuals and police cells inmates. Five (5) pieces of handcuffs Five (5) handcuffs including two (2) slightly used ones, two (2) frequently used ones and one (1) sealed unused handcuff was purposely selected for the study. The handcuffs were collected with hands covered with sterile plastic gloves and placed in sterile and labelled polythene bags. The samples were then taken to the Microbiology Section of the Water Research Institute, Accra for bacteriological analysis.

### 2.1 DETERMINATION AND IDENTIFICATION OF MICROBIAL CONTAMINATION ON FIVE (5) HANDCUFFS

Used and unused handcuffs were sampled for bacterial contamination. Five (5) swab samples of washed water specimens, one (1) from sealed unused handcuff and four (4) from used handcuffs. Three parameters were examined, including the presence, quantity and the pathogenic organism on the handcuffs. Pathogenic organisms targeted included *Staphylococcus aureus*, *Escherichia coli* and total coliforms. Isolations were made for the selected bacteria contaminants in the samples. The Membrane Filtration Technique was used in extracting the samples. The method employed materials including, Filtration manifold, Inoculation chamber, Vacuum pump, Filtration funnel, Membrane filters (cellulose nitrate, 47mm diameter, 0.4um pore size), Sterile Petri plates, Incubator, Autoclave, Forceps and Bunsen burner.

### 2.2 Media preparation

Twenty-seven grams (27g) of dehydrated media was suspended in IL distilled water. It was heated to boil to dissolve the medium completely and the dissolved liquid was sterilised by autoclaving at 121 (Degrees Celsius) for 15minutes. The autoclaved liquid was cooled to 50 (Degrees Celsius) and poured into sterile Petri plates and allowed to cool.

### 2.3 PROCEDURE FOR ISOLATING CONTAMINANTS ON THE HANDCUFFS

Using the direct surface agar plate laboratory methods for quantitatively detecting bacterial contamination on non-porous surfaces by [23], the handcuffs were placed in a sterilised whirl-Pac bag. 200ml of sterilised distilled water was added and shaken vigorously. It was left to stand for about 20minutes and the water from the handcuffs was filtered through a membrane filter which was fixed firmly on the filtration manifold using the filtration funnel. With the aid of forceps which had been sterilised using the Bunsen flame, the filtrates were transferred onto Petri plates of Hicrome™ coliform agar. The plates were incubated at 37± 0.5 (Degrees Celsius) for 24hours. All plates were examined for the presence and quantity of *Staphylococcus aureus*, *Escherichia coli* and total coliform. Data was compiled in a spread sheet and analyzed using descriptive statistics.

## 3.0 RESULTS AND DISCUSION

### 3.1 DETERMINATION AND IDENTIFICATION OF MICROBIAL CONTAMINATION ON FIVE (5) HANDCUFFS

Five (5) samples of used and unused handcuffs were examined for bacterial contamination, one (1) sealed, unused handcuff and four (4) used handcuffs. Out of the five (5) samples examined, four (4) showed positive for bacterial contamination (Table 1). Among the bacteria contaminants isolated were *Staphylococcus aureus*, *Escherichia coli* and total coliform. The unused handcuffs did not show any bacterial contamination. Bacteria, Fungal, and Viral contaminations with fomites on door handles and knobs are well documented by several authors, as these inanimate objects are known to serve as vehicles for cross-infections and re-contamination of washed hands [24]. Some contaminants are known to be pathogenic and can be transferred from one person to another or may result in auto inoculation [14]. In Table 1, the study shows different levels of contamination on four (4) used handcuffs and this may be attributed to frequency of usage without cleaning. Table 1 shows that, older handcuffs carried relatively more contaminants than slightly used ones. The most common bacterial contaminants present on Handcuffs were *Staphylococcus aureus* (68%), followed by total coliforms (28%) and *Escherichia coli* (8%).

### 3.2 Levels of contamination among used handcuffs

Comparing levels of contamination among older handcuffs, slightly used ones and unused the one (sealed), there was no bacterial contaminant on the sealed, unused handcuff. Contaminants on the slightly used handcuffs were less than older ones (Table 1). Differences in the level of contamination of new and slightly used handcuffs, unused and sealed as well as old handcuffs may be attributed to the frequency and duration of exposure to the environment. Previous works have shown that frequently or heavily used fomites are most likely contaminated and therefore carry high heterotrophic bacterial

loads [24]. It is common knowledge in Ghana that, among the restraint devices, handcuff is the most and popularly used device by security agencies. The contaminants on the handcuffs might be attributed to poor or no cleaning of handcuffs between uses. Such conditions can create good habitats for living organisms as a result of bruises sustained in the course of apprehension of suspects. Sweat and sometimes blood on suspects and convicts who are transported under restraints devices such as handcuffs by police officers become obvious contaminants of handcuffs.

**Table 1.** Analytical report on bacterial contaminants on five (5) handcuffs

Sample Identity	Total Coliform (TC)	E.coli
Staphylococcus	(cfu/100ml)	
(cfu/100ml)	Sapp.	
	Method: APHA 9222A	Method: APHA 9260F
	Method: APHA 9213B	
1. Unused sealed (New in a Box)	0	0
2. Slightly used	6	0
3. No. 32515 (Older/Used)	20	3
4. No. 18657 (Older/Used)	1	1
5. No. 35410 (Older/Used)	6	5
Ghana Standard GS 175-1	0	0
WHO Guidelines/Standard	0	0

**SOURCE:** LABORATORY ANALYSIS 2015

## CONCLUSION

Older handcuffs carry relatively more contaminants than slightly used ones. The most common bacterial contaminants present on examined Handcuffs are Staphylococcus aureus, followed by total coliforms and Escherichia aureus. Comparing levels of contamination among older handcuffs, slightly used ones and the unused sealed one, there was no bacterial contaminant on the sealed, unused handcuff. Contaminants on slightly used handcuffs were less than older and frequently used Handcuffs.

## 5.3 RECOMMENDATION

Though the level of contaminants identified on the samples appears low it is important for the security industry that uses restraint devices, especially handcuffs, to sterilize them between uses. In handling handcuffs, sweat and sometimes blood contaminate the handcuffs which can serve as a medium for transmission of infectious diseases, hence, there is the need to clean used handcuffs with disinfectants so as to reduce health risks associated with the use of handcuffs. Only sealed and unused handcuffs should be allowed to be used in restraining humans so as to prevent cross-infections. Security personnel should be trained in Environmental health education and the practice of hand washing to reduce Escherichia coli contamination on handcuffs.

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