

# Occupational Health and Safety Administration (OSHA) in the Morgues: Management and Practice of the Universal Precautions in Morgues in Kenya

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## Abstract

**Background:** Morgues provide a risky work environment that requires universal safety precaution since it presents a variety of Occupational Health and Safety (OHS) challenges. Although OHS is a top priority internationally, in sub-Saharan Africa, health institutions are perceived to be 'safe' given that 'health' is their core mandate thus creating numerous hazards like the health worker Ebola related fatalities in Africa. Despite high global OHS-related mortality, there is lack of information on the potential of OHS exposures among mortuary workers in government health facilities in Kenya. As such, the current study investigated the OHS management practices, focusing on the implementation of Universal Safety Precautions (USP) in government-owned mortuaries in Kenya.

**Methodology:** A cross-sectional survey was conducted targeting a randomly selected sample size of 39 (40.2%) respondent facilities spanning seven regions/Provinces of Kenya through which the government administers the health care program via the Kenya Essential Package for Health system (KEPH) - level 2 to 6. A standardized research model instrument, "the Morgue OHS-Hazard Identification Risk Assessment and Control (HIRAC) survey" was used to collect data.

**Results:** A total of 24 (61.5%) of surveyed facilities had "No universal precautions in place"; 10 (25.6%) had partially implemented while only 5 (12.8%) had universal precautions fully in place. The presence of a "documented OHS management plan" influenced the practice of the following individual universal precautions among morgue workers: use of (Standard Operating Procedures (SOP) and best practice OHS principles ( $\rho=0.632$ ;  $P=0.001$ ); protection by vaccination ( $\rho=0.546$ ;  $P=0.0001$ ); latex allergy alternatives ( $\rho=0.356$ ;  $P=0.026$ ); inclusion of OHS on facility performance contract ( $\rho=0.875$ ;  $P=0.0001$ ); appropriate ventilation systems ( $\rho=0.424$ ;  $P=0.007$ ); ventilation of autopsy suite to  $\geq 6$  room air changes/hour with air flow away from operators' breathing zone ( $\rho=0.478$ ;  $P=0.002$ ); local exhaust ventilation provision over bone cutting saws/band-saws for sectioning of tissue ( $\rho=0.474$ ;  $P=0.002$ ); provision of appropriate equipment (power-saws and vacuum systems) ( $\rho=0.331$ ;  $P=0.040$ ); additional personal protective equipment (PPE) ( $\rho=0.793$ ;  $P<0.0001$ ); respiratory protection program ( $\rho=0.744$ ;  $P<0.0001$ ); provision of adjustable cadaver tray/work area ( $\rho=0.401$ ;  $P=0.011$ ).

**Conclusion:** USP are largely not applied in government-owned mortuaries that were studied hence a need for an urgent and significant improvement in OHS administration. A documented OHS management plan as part of daily operations should be preceded by implementation of individual USP measures.

**Keywords:** Occupational safety and health management plan; Practice of universal precautions; Morgue/Mortuary safety; Workers safety; Public health facilities

## Introduction

Mortuary services refer to all procedures involved in the receipt, storage and release of the deceased [1]. Managing this process safely, securely, efficiently, effectively and appropriately is the core business of mortuary services teams [1]. Majority of workers in the morgue, spend much time at work places as compared to the time they spend at home [2], and as such are prone to exposure hazards of use in the

morgue. Most workplaces embody hazards and risks, often resulting in occupational-related injuries and deaths [3]. While studies point to over 2.3 million annual deaths from occupational accidents and work-related diseases [4], the rate of related injuries (both reported and non-reported) is believed to be much higher, especially in the developing countries where Occupational Health and Safety (OHS) administration is minimal and still associated with industries [5]. In sub-Saharan Africa, since health care facilities are meant to deliver 'health'— considered their core objective, the general feeling is that health care facilities are 'safe' [6]. However, reports show that health sector workers are particularly vulnerable to occupationally-acquired infectious diseases as shown by recent experiences with severe acute

respiratory syndrome (SARS) [7]. Despite acknowledgment of risk, the occupational death rate for health care workers remains unknown. While it is estimated that the annual death rate for Health Care Workers (HCWs) from occupational events, including infection is 17–57 per 1 million workers [7], little data exists on the OHS-related issues in the morgues. The morgue is considered a neglected health care department in sub-Saharan Africa [8] despite the growing need for the morgue related services since the priority of HCWs is considered “to save lives” [9]. The growing need for mortuary services in sub-Saharan Africa amid competing priorities poses critical OHS challenges to industry stakeholders [9] as has been witnessed by the Ebola fatalities among HCWs. Health and safety, particularly the prevention of infection, are vital in mortuaries and post-mortem rooms [10], since it is generally accepted that OHS-based management systems reduces accidents and injury rates besides improving productivity [5]. It has been further documented that mortuary workers face hazards at work such as infectious diseases and chemical and psychosocial hazards [11] with studies in Africa indicating that exposure to HCWs like recent Ebola crisis is frequent, rarely reported, and at high risk of conveying occupational infection [12]. Consequently, risks in the morgues should be reduced as much as possible by providing and maintaining a safe working environment and ensuring that staff are personally protected [13]. It is therefore critical that staffs who work in mortuaries are properly trained and are aware of their environmental risks so as to avoid or minimize their exposure. The training should involve good working practices, application of standard operating procedures (SOP), and continuous staff re-training [13]. Efforts have been made to contain the OHS risks in the morgue by prescribing precautions for each category of risks including, formaldehyde exposure (ventilation challenge), blood-borne pathogen exposures, administrative controls for hazard communication and management (e.g. use of SOP) and other early warning systems, engineering controls for safety and ease of work and provision and proper use of Personal Protective Equipment (PPE) [14]. These efforts have resulted into development of minimum standards recommended for autopsies or morgues. The recommendations detail that standard autopsies should be performed in institutions with minimum standards of engineering controls and work practice procedures in place that include; (1) ventilation of the autopsy suite that achieves at least 6 room air changes per hour (vented to the exterior) with the air flow moving away from the operators’ breathing zone, (2) local exhaust ventilation provided over bone-cutting saws or band saws for sectioning of tissue, (3) all personnel in contact with the body or any specimens use impervious aprons and footwear, surgical gloves of latex or a similar synthetic material, eye splash protection and respiratory protection, (4) procedures in place to deal with autopsy “surprises” that may make a case to be re-evaluated in mid-procedure, and re-classified in the high-risk category, (5) clean-up and decontamination procedures domesticated and adhered to, and (6) regular monitoring of the effectiveness of staff and environmental control measures is conducted and documented [15]. While these are confirmed in the “typology of universal precaution” which details procedures to control the risk of infection [15], little evidence exist to show that these procedures are being implemented in sub-Saharan Africa.

With an estimated 2.3 million deaths per year from occupational accidents and diseases, Occupational Safety and Health Administration (OSHA) has become a universal obligation for every workplace as enforced by International Labor Organization (ILO) [16]. Countries like Kenya have domesticated the ILO-OSHA

requirements by enacting OSHA Law 2007, thus setting compliance standards and penalties [17]. Under the OSHA Law 2007, all health care facilities in Kenya are classified as legal entities and compliance to safety standards is a requirement. Despite the gains made so far internationally, the challenges of mainstreaming OHS in the morgues seems to be on the rise in developing countries, especially when the health sector has shown several gains from research [18]. Countries such as Kenya are yet to develop and implement the ILO and WHO model for a hospital OHS Management System (OHSMS) with key elements needed by any hospital or health service center. The delay to develop and implement these critical OHS guidelines signifies absence of a comprehensive approach to managing a nation’s OHS obligations towards a workplace free of risk and continuous improvement of health and safety performance [19]. It is therefore critical to evaluate the culture of government health care sector in Kenya against the universally accepted safety standards. Morgues in sub-Saharan Africa (considered “forgotten areas”), presents a critical part of health care sector with an opportunity for improvement to enable workers participate in activities to safeguard their health, with minimal work-related risks [8]. As such, the current study sought to investigate the OHS management system and the practice of universal safety precautions in government morgues in Kenya.

## Materials and Methods

### Study design and study site

A cross-sectional survey was conducted between February and September 2012 in public health care facilities with morgues across Kenya. The targeted facilities were randomly selected from the master list of medical facilities. The selection spanned seven regions/Provinces of Kenya through which the government administers the health care program via the Kenya Essential Package for Health system (KEPH) - the KEPH level 2 to 6 [20]. The provinces were administrative units through which the Ministry of Health in Kenya rolls out the health care program. They comprised Coast, Nyanza, Rift Valley, Nairobi, Central, Western, Eastern and North Eastern Provinces of Kenya.

### Selection of facilities

Multistage random sampling approach was used to select the facilities for survey. A list of public medical facilities was compiled using a database obtained from the Ministry of Health [20]. This comprised the Provincial General Hospitals (KEPH Level 5), District and Sub-District hospitals (KEPH Level 4), Health Centers (KEPH Level 3) and Dispensaries (KEPH Level 2) that offered mortuary services. KEPH Level 6 (referrals and teaching facilities) were excluded from this study due to their lack of homogeneity in service and administrative structure, with the rest of other levels. Consequently, the health institutions covered were sampled from a total number of 259 facilities classified as KEPH level 2 to KEPH level 5 that offered mortuary services [20]. The simplified formula for calculating sample size proportions by Yamane [21] was used to calculate the required sample size of 39 health facilities. These were proportionately stratified as per Province/regions and then facilities randomly sampled in each province or region. The sample size per region was then proportionately distributed so that in each stratum (Province), a total number of respondent facilities corresponded to the actual population. Finally, the sample size per facility level was distributed in each strata and actual facility picked randomly. Presence of a functional mortuary

in government-owned health facility was used as an inclusion criterion.

### Data collection

Data collection employed a research model instrument, the Morgue OHS-Hazard Identification Risk Assessment and Control (HIRAC) survey comprising 30 dimensions developed from the principles of Universal Mortuary Safety Precautions for standard autopsies or morgues [22] and hierarchy of controls [9]. The tool was administered to test for the presence and implementation of the universal safety precautions for the morgues in Kenya. The following information on five key OHS areas were collected from the facilities: (i) Administrative controls as part of Hazard Identification, Risk Assessment and Control (HIRAC) such as the use of SOPs and other warning systems (7 dimensions), (ii) Appropriate engineering controls for safety and ease of work (6 dimensions), (iii) Provision and proper use of Personal Protective Equipment (PPE) (5 dimensions), (iv) Precautions for Bloodborne Pathogen (BBP) Exposures (7 dimensions), and (v) Precautions for Formaldehyde exposure and ventilation challenges (5 dimensions). The identification of the 5 key areas was followed by ranking of the guidelines on a Likert scale [22] of 0 to 5 showing; 0 =Neutral/Not Applicable (process likely to present risk not undertaken in the facility); 1=Universal Precautions fully in Place (the risk is low/completely mitigated); 2=Universal Precautions Partially (mostly) in Place (Acceptable risks exist in low quantities. Exposures possible but unlikely in large quantities); 3=Certain Elements of universal precautions in Place (the line of acceptable risk has been crossed. Non-acceptable risks exist though in low quantities and exposures certain); 4=Universal Precautions hardly in Place (Non-Compliance, significant risk exists - serious enough to warrant urgent changes in day-to-day operations); 5=No Universal Precautions in Place (Catastrophic: Risk is serious enough to impact the facility's ability to meet commitments without jeopardizing workers' safety). Selected questions were administered on a reverse score basis to blindfold the participants [23] and choice of measures based on validity and reliability as per previous observations [24,25]. Scientific clearance to conduct the study was provided by the Maseno University School of Graduate Studies while the ethical clearance was obtained from Maseno University Ethics Review Committee.

### Data management and statistical analysis

Data collected was checked in the field and at the end of each collection day, cleaned to ensure completeness, consistency, credibility and eligibility. Information captured in the HIRAC questionnaire to test for the presence and application of universal safety precautions for the morgues was coded and entered into Statistical Package for Social Sciences (SPSS) (Version 17) (IBM SPSS Inc., Chicago, IL, USA). For comparison, modes and medians were used for proportionality and Spearman's rho correlation test was used to determine the relationship between the presence of a "Written OHS Management Plan issued by facility's top administration highlighting importance of good OHS management" and the implementation of individual universal safety precautions in the morgues (29 dimensions). Statistical significance was assessed at a  $P \leq 0.05$ .

## Results

### Practice of universal safety precautions in the morgues

**Installation of appropriate engineering controls for safety and ease of work as part of HIRAC:** A total of 39 facilities were included in the current study. When stratified in terms of facility service level [Kenya Essential Package for Health Level (KEPH L)], morgues in KEPH Level 5 were 9(23.1%), KEPH Level 4 were 29(74.4%), while KEPH Level 3 was 1(2.6%) as shown in Table 1. Nine dimensions of appropriate engineering controls for safety and ease of work at the morgue were examined and results stratified in terms of implementation of the precautions. Overall, majority of the facilities 26(66.7%) showed "No Universal Precautions in Place" i.e. Catastrophic: Risks serious enough to impact the facility's ability to meet commitments without jeopardizing workers' safety), while 3(7.7%) showed "Universal Precautions fully in Place i.e. the risk were low/completely mitigated." A total of 10(25.6%) facilities had partially implemented the precautions in various levels namely, 4(10.3%) showed acceptable/low quantity risks levels with exposures possible but unlikely in large quantities, 3(7.7%) showed certain elements of universal precautions in place i.e. the line of acceptable risk had been crossed, and even though risks existed in low quantities, exposures were certain during day-to-day operations. A total of 2(5.1%) recorded significant non-compliance with "Universal Precautions hardly in Place" and risks serious enough to impact on the facility's ability to meet commitments without jeopardizing workers' safety as shown in Table 1.

There were more cases of Catastrophic Risks with facilities posting "No universal precautions in place" (48.7%) and above as compared to a high of 12.8% of the morgues that had universal precautions fully in place in the 5 categories of USPs.

**Implementation of universal precautions for formaldehyde exposure and related ventilation challenges:** In addition, Table 1 presents seven dimensions of implementation of precautions for formaldehyde exposure and related ventilation challenges considered in the study. Results revealed that 27(69.2%) of facilities had "No universal precautions in place" for this precaution as compared to 2(5.1%) of the morgues that had universal precautions fully in place. A total of 10(25.6%) respondent facilities had partially implemented the universal precautions in various levels namely; Universal Precautions Partially in place 4(10.3%) to keep risks at acceptable level; 5(12.8%) showed certain elements of universal precautions in place i.e. the line of acceptable risk had been crossed, and though risks existed in low quantities, exposures were certain during day-to-day operations, while 1(2.6%) facility recorded significant risk level with "Universal Precautions hardly in Place" and risks serious enough to impact the facility's ability to meet commitments without jeopardizing workers' safety

**Precautions for Blood-Borne Pathogens Exposures (BBPEs):** Ten dimensions of precautions against BBPEs at the morgue were examined. The results show that there were more cases of Catastrophic Risks levels within most responding facilities (Table 1). A total of 22(56.4%) facilities returned "No universal precautions in place" as compared to 5(12.8%) of the morgues that had universal precautions for BBPEs fully in place. A total of 12(30.8%) facilities had partially implemented the universal precautions in various levels namely; 4(10.3%) had acceptable risk levels with universal precautions partially in place; 5(12.8%) had implemented certain elements of universal precautions such that even though risks existed in low quantities,

exposures were certain during day-to-day operations and threshold of acceptable risk certainly violated. A total of 3(7.7%) recorded significant risk levels with “Universal Precautions hardly in Place” and

risks serious enough to impact on the facility’s ability to meet commitments without jeopardizing workers’ safety (Table 1).

Facilities/Morgues (N=39)			Installation of Appropriate Engineering Controls for Safety and Ease of Work as part of HIRAC	Implementation of precautions for ventilation challenges and formaldehyde	Implementation of Precautions for Blood-borne Pathogens Exposures (BBPEs)	Use of administrative controls as part of HIRAC	Proper use of Provision and Personal Protective equipment (PPE)
KEPH L3	KEPH L4	KEPH 5					
n=1	n=29	N=9					
USP fully in place (1)			3 (7.7%)	2 (5.1%)	5 (12.8%)	5 (12.8%)	6 (15.4%)
USP Partially in place (2)			4 (10.3%)	4 (10.3%)	4 (10.3%)	4 (10.3%)	4 (10.3%)
Certain Elements of USP in place (3)			3 (7.7%)	5 (12.8%)	5 (12.8%)	6 (15.4%)	5 (12.8%)
USP hardly in place (4)			2 (5.1%)	1 (2.6%)	3 (7.7%)	4 (10.3%)	2 (5.1%)
No USP in place (5)			27 (69.2%)	27 (69.2%)	22 (56.4%)	19(51.2%)	22 (56.4%)
Facilities/Morgues (N=39)			39 (100%)	39 (100%)	39 (100%)	39(100%)	39 (100%)

**Table 1:** Practice of Universal Safety Precautions (USP) in Morgues: Results on Measures for HIRAC. (1) The risk is low/completely mitigated. (2) Acceptable risks exist in low quantities. Exposures possible but unlikely in large quantities. (3) The line of acceptable risk has been crossed. Risks exist though in low quantities and exposures certain. (4) Non-Compliance significant with risks serious enough to warrant urgent changes in day to day operations. (5) Catastrophic: Risks serious enough to impact the facility’s ability to meet commitments without jeopardizing workers’ safety.

**Use of administrative controls as part of HIRAC:** Nine dimensions of application of administrative controls as part of HIRAC for morgues were examined and results presented on Table 1. Overall, majority of the facilities 19(48.7%) showed “No Universal Precautions in Place” i.e. catastrophic risk levels. A total of 5(12.8%) showed “Universal Precautions fully in Place i.e. the risks were low/completely mitigated”, while 14(35.9%) had partially implemented the precautions in various levels namely; 4(10.3%) showed partial implementation with acceptable/low quantity risks levels with exposures possible but unlikely in large quantities, 6(15.4%) showed certain elements of universal precautions in place i.e. the line of acceptable risk had been crossed, and though risks existed in low quantities, exposures were certain during day-to-day operations, while 4(10.3%), recorded significant non-compliance with universal precautions hardly in place and risks serious enough to impact on the facility’s ability to meet commitments without jeopardizing workers’ safety (Table 1).

**Provision and proper use of Personal Protective Equipment (PPE) as part of HIRAC:** In this category, six dimensions were examined namely: Shields in place when significant splash hazards are anticipated; use of PPE in adequate standard for all personnel who are in contact with the body or any specimens; use of additional PPE if blood exposure and/or gross contamination is anticipated during autopsies or orthopedic surgery e.g. surgical caps, hoods, shoe covers or boots; a respiratory protection program for minimization of stench and formaldehyde effects; procedures are in place to deal with autopsy “surprises” that may render a case to be re-evaluated in mid-procedure and re-classified in the high-risk category; and latex allergy alternatives readily accessible to those employees allergic to latex gloves. As shown in Table 1 there were more cases of catastrophic risks with facilities posting “No universal precautions in place” 22(56.4%) as compared to

6(15.4%) of the morgues that had universal precautions fully in place. A total of 11(28.2%) had partially implemented the universal precautions in various levels namely; Universal Precautions partially in place, 4(10.3%); certain elements of universal precautions in place, 5(12.8%) and Universal Precautions hardly in place at 2(5.1%) respondent facilities.

### Factors associated with non-compliance with Universal safety precautions in the Morgues

**Appropriate engineering controls for safety and ease of work as part of HIRAC:** As outlined in Table 2, some of the observations associated with non-compliance and potential exposures were; lack of provision for dry/slip resistant surfaces or wet surfaces covered with non-slip materials; absence of a functioning inbuilt waste management system that allows minimal contact with waste and tissues; non-provision for glass in windows, doors of subject-to-human impact being of sufficient thickness and condition of use; absence of functioning engineering controls in place (e.g. exhaust ventilation), coolers and cadaver storage facility; non-provision of appropriate ventilation systems (e.g. downdraft tables that capture the air around the cadaver); lack of ventilation of the autopsy suite that could achieve at least 6 room air changes per hour (vented to the exterior) with the air flow moving away from the operators’ breathing zone; non-provision of local exhaust ventilation provided over bone-cutting saws or band saws used for sectioning of tissue; lack of vacuum systems for power saws and non-provision for adjustable cadaver tray/holder with supportive comfortable chairs that includes foot-rests for procedures. Most facilities (46.2%) reported “No universal precautions in place” for all the nine variables (Table 2). The highest contributing variables were lack of engineering controls in place such as exhaust ventilation,

coolers and cadaver storage facility at 35(89.7%), and non-provision of ventilation of the autopsy suite that achieves at least 6 room air changes per hour (vented to the exterior) with the air flow moving away from the operators' breathing zone at 31(79.5%). On the other hand, only 1(2.6%), and 5(12.8%) fully implemented these safety

provisions, respectively. As shown in Table 2 the most critical element (catastrophic) was lack of "Engineering controls in place such as exhaust ventilation, coolers and cadaver storage facility" at 35(89.7%).

(N=39)	USP fully in place	USP partially in place	Certain elements of USP in place	USP hardly in place	No USP in place	N (%)
MRG1002	4 (10.3%)	10 (25.6%)	6 (15.4%)	1 (2.6%)	18 (46.2%)	39 (100%)
MRG1006	4 (10.3%)	8 (20.5%)	4 (10.3%)	4 (10.3%)	19 (48.7%)	39 (100%)
MRG1010	5 (12.8%)	6 (15.4%)	6 (15.4%)	1 (2.6%)	21 (53.8%)	39 (100%)
MRG1011	1 (2.6%)	1 (2.6%)	1 (2.6%)	1 (2.6%)	35 (89.7%)	39 (100%)
MRG101a	3 (7.7%)	3 (7.7%)	4 (10.3%)	1 (2.6%)	28 (71.8%)	39 (100%)
MRG1011a1	1 (2.6%)	3 (7.7%)	3 (7.7%)	1 (2.6%)	31 (79.5%)	39 (100%)
MRG1011a2	1 (2.6%)	3 (7.7%)	3 (7.7%)	1 (2.6%)	31 (79.5%)	39 (100%)
MRG1011b	5 (12.8%)	2 (5.1%)	0	3 (7.7%)	29 (74.4%)	39 (100%)
MRG1021	5 (12.8%)	1 (2.6%)	3 (7.7%)	6 (15.4%)	24 (61.5%)	39 (100%)

**Table 2:** Installation of Appropriate Engineering Controls for Safety and Ease of Work as part of HIRAC: Contributing variables.

MRG1002: Surfaces kept dry and slip resistant with wet surfaces covered with non-slip materials.

MRG1006: Functioning in-built waste management system allows minimal contact with waste and tissues.

MRG1010: Glass in windows, doors etc of subject to human impact of sufficient thickness and condition of use.

MRG1011: Engineering controls in place such as exhaust ventilation, coolers and Cadaver Storage facility.

MRG101a: Appropriate ventilation systems (e.g. downdraft tables that capture the air around the cadaver).

MRG1011a1: Ventilation of the autopsy suite that achieves at least 6 room air changes per hour (vented to the exterior) with the air flow moving away from the operators' breathing zone.

MRG1011a2: Local exhaust ventilation is provided over bone cutting saws or band saws used for sectioning of tissue.

MRG1011b: Vacuum systems for power saws in the morgue.

MRG1021: Adjustable cadaver tray available with supportive comfortable chairs that includes foot-rests provided.

For all the nine variables, most facilities (46.2% and above) reported "No universal precautions in place" the highest contributing variables were MRG1011, MRG1011a1, and MRG1011a2 at 89.7%, 79.5% respectively as compared to "Universal Precautions fully in place" at between 2.6%, and 12.8% respectively for the lowest and highest ranking variables. The most critical element (catastrophic) was lack of "Engineering controls in place such as exhaust ventilation, coolers and Cadaver Storage facility" (MRG1011) at 89.7%.

**Formaldehyde exposure and related ventilation challenges:** Table 3 presents the contributing variables/factors to the catastrophic risk levels reported whereby 37(94.9%) respondent-facilities lacked engineering controls in place (e.g. exhaust ventilation, coolers and

cadaver storage facility), 19(48.7%) lacked a functioning inbuilt waste management system that allows minimal contact with waste and tissues complete with cadaver management plan, 20(51.3%) did not have in place a respiratory protection program that would have stench and formaldehyde effects minimized, while 31(79.5%) of facilities did not have a provision for ventilation of the autopsy suite that achieves at least 6 room air changes per hour (vented to the exterior), with the air flow moving away from the operators' breathing zone. Overall, the highest contributing factor was the absence of engineering controls in place (e.g. exhaust ventilation, coolers and cadaver storage facility in the morgues; (Table 3).

**Precautions for Blood-borne Pathogens Exposures (BBPEs):** As shown in Table 4, for the ten dimensions investigated most facilities 17(43.6%) reported "No universal precautions in place" for BBPEs. The highest contributing variables being; work surfaces were littered with potentially infectious materials such as body fluids and tissues at 29(74.4%) facilities, lack of appropriate surgical equipment in place for autopsy and corpse preparation at 23(59.0%), non-provision and use of additional PPE if blood exposure is anticipated during autopsies or orthopedic surgery (such as surgical caps, hoods, shoe-covers or boots when gross contamination anticipated) at 21 (53.8%), lack of SOPs on Universal Precautions as required by the Blood-Borne Pathogens Standards at 22(56.4%), and non-protection of staff by means of vaccination at 29 (74.4%) (Table 4).

**Use of administrative controls as part of HIRAC:** The contributing factors/variables as outlined in Table 5 were; lack of a written safety plan by the facility's top administration explicitly highlighting the importance of good OHS management at 24(61.5%), non-provision in the facility's annual report of a section devoted to its OHS performance on the regulatory framework provisions at 22(56.4%), lack of SOP in place for universal precautions as required by the Blood-Borne Pathogens Standards at 22(56.4%), lack of procedures in place to deal with autopsy "surprises" that may cause mid-procedure case re-evaluation and re-classification to the high-risk category at

18(46.2%), lack of basic housekeeping procedures that would keep aisles and passage ways appropriately clear at 18(46.2%), lack of SOP on housekeeping for clean-up and decontamination procedures to be adhered to at 17(43.6%), lack of maintenance regime that would

ensure repair of holes/cracks in the floor, sidewalks or other surfaces to make safe at 18(46.2%) and lack of domestication of SOPs that would enable the facilities to stick to best practice principles for OHS management (e.g. SOP on handling emergencies) at 11 (28.2%).

(N=39)	USP fully in place	USP partially in place	Certain Elements of USP in place	USP hardly in place	No USP place	N (100%)
MRG1006	4 (10.3%)	8 (20.5%)	4 (10.3%)	4 (10.3%)	19 (48.7%)	39(100%)
MRG1011	1 (2.6%)	0	1 (2.6%)	0	37 (94.9%)	39(100%)
MRG101a	3 (7.7%)	3 (7.7%)	3 (7.7%)	1 (2.6%)	29 (74.4%)	39(100%)
MRG1011a1	1 (2.6%)	3 (7.7%)	3 (7.7%)	1 (2.6%)	31 (79.5%)	39(100%)
MRG1011a2	1 (2.6%)	3 (7.7%)	3 (7.7%)	1 (2.6%)	31 (79.5%)	39(100%)
MRG1014	1 (2.6%)	8 (20.5%)	8 (20.5%)	2 (5.1%)	20 (51.3%)	39(100%)
MRG1013	2 (5.1%)	4 (10.3%)	12 (30.8%)	0	21 (53.8%)	39(100%)

**Table 3:** Implementation of Universal Safety Precautions (USP) for Formaldehyde exposure and related ventilation challenges: Contributing variables.

MRG1006: Functioning inbuilt waste management system that allows minimal contact with waste and tissues complete with cadaver management plan.

MRG1011: Engineering controls in place such as exhaust ventilation, coolers and Cadaver Storage facility.

MRG101a: Appropriate ventilation systems (e.g. downdraft tables that capture the air around the cadaver).

MRG1011a1: Ventilation of the autopsy suite that achieves at least 6 room air changes per hour (vented to the exterior) with the air flow moving away from the operators' breathing zone.

MRG1011a2: Local exhaust ventilation is provided over bone cutting saws or band saws used for sectioning of tissue.

MRG1014: Respiratory protection - Stench and Formaldehyde effects minimized.

MRG1013: All personnel who are in contact with the body or any specimens must use personal protective equipment (PPE) of an adequate standard.

For all the seven variables representing implementation of universal precautions for formaldehyde exposure and other ventilation challenges, most facilities (50% and above) reported "No universal precautions in place" between 19 (48.7%) facilities for variable MRG1006 and 37 (94.8%) facilities for MRG1011 as compared to "Universal Precautions fully in place" at between 1(2.6%) of the facilities for variables MRG1014, MRG1011a2, MRG1011a1 & MRG1011 while only 4 (10.3%) of the facilities was the highest number to have implemented the precautions fully. The highest contributing factor is absence of engineering controls in place such as exhaust ventilation, coolers and Cadaver Storage facility in the morgues.

(N=39)	USP fully in place	USP partially in place	Certain elements of USP in place	USP hardly in place	No USP in place
MRG1003	3 (7.7%)	6 (15.4%)	10 (25.6%)	2 (5.1%)	18 (46.2%)
MRG1008	4 (10.3%)	9 (23.1%)	7 (17.9%)	2 (5.1%)	17 (43.6%)
MRG1011b	5 (12.8%)	2 (5.1%)	0	3 (7.7%)	29 (74.4%)
MRG1011c	6 (15.4%)	2 (5.1%)	3 (7.7%)	3 (7.7%)	25 (64.1%)
MRG1011d	5 (12.8%)	3 (7.7%)	6 (15.4%)	2 (5.1%)	23 (59.0%)
MRG1012	1 (2.6%)	2 (5.1%)	7 (17.9%)	7 (17.9%)	22 (56.4%)
MRG1013	2 (5.1%)	4 (10.3%)	12 (30.8%)	0	21 (53.8%)
MRG1013a	4 (10.3%)	5 (12.8%)	6 (15.4%)	3 (7.7%)	21 (53.8%)
MRG1022	6 (15.4%)	0	0	4 (10.3%)	29 (74.4%)

<b>MRG1031</b>	18 (46.2%)	2 (5.1%)	1 (2.6%)	0	18 (46.2%)
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**Table 4:** Implementation of Precautions for Blood-borne Pathogens Exposures (BBPEs): Contributing variables (variables representing implementation of precautions for BBPEs).

MRG1003: Work surfaces devoid of potentially infectious materials e.g. body fluids and tissues.

MRG1008: SOP on Housekeeping: Clean-up and decontamination procedures are adhered to.

MRG1011b: Vacuum systems for power saws in the morgue.

MRG1011c: Shields in place when significant splash hazards are anticipated.

MRG1011d: Appropriate Surgical equipment in place for autopsy and corpse preparation.

MRG1012: SOP – USP as required by the Blood-borne Pathogens Standards in place.

MRG1013: All personnel in contact with the body or any specimens must use personal protective equipment (PPE) of an adequate standard.

MRG1013a: Use of additional PPE if blood exposure is anticipated during autopsies or orthopedic surgery such as: Surgical caps, hoods, shoe covers or boots when gross contamination anticipated.

MRG1022: Protection of staff by means of vaccination.

MRG1031: Procedures are in place to deal with autopsy “surprises” that may cause the case to be re-evaluated in mid-procedure, and reclassified in the high-risk category.

For the ten variables, most facilities (43.6% and above) reported “No universal precautions in place” the highest contributing variables were MRG1003, MRG1011b, and MRG1022 at 74.4% compared to “Universal Precautions fully in place” at 7.7%, 5% and 6% respectively for the same variables. 18(46.2%) of the facilities had implemented “procedures to deal with autopsy “surprises” that may cause mid-procedure case evaluation and risk category (MRG1031). The highest implemented precaution.

**Provision and proper use of Personal Protective Equipment (PPE) as part of HIRAC:** The contributing factors/variables as indicated in Table 6 were; non-provision of latex allergy alternatives readily accessible to those employees who are allergic to the latex gloves normally provided at 26(66.7%), lack of shields in place when significant splash hazards are anticipated at 25(64.1%), non-facilitation for all personnel who are in contact with the body or any specimens to use PPE of adequate standard at 21(53.8%), non-provision for use of additional PPE if blood exposure is anticipated during autopsies or orthopedic surgery (e.g. surgical caps, hoods, shoe-covers or boots) when gross contamination is anticipated at 21(53.8%), lack of measures for respiratory protection with regards to minimizing stench and formaldehyde effects at 20(51.3%) and lack of procedures in place to deal with autopsy “surprises” that may cause the case to be re-evaluated in mid-procedure, and re-classified in the high-risk category at 18(46.2%).

**The Relationship between presence of a documented OHS management plan and practice of Universal Precautions (USP) for Morgues:** In order to establish the relationship between application of

individual universal precautions for the morgue and the presence of a documented OHS management plan for the same respondent facilities, a Spearman’s rho correlation test was performed on all the 13 USP variables namely: SOPs domestication and sticking to best practice principles for OHS Management; protection of staff by means of vaccination; latex allergy: alternatives readily accessible; the mortuary’s performance contract annual report includes a section devoted to its OHS performance; appropriate ventilation systems (e.g. downdraft tables that capture the air around the cadaver); ventilation of the autopsy suite that achieves at least 6 room air changes per hour (to the exterior) with air flow away from operators’ breathing zone; local exhaust ventilation is provided over bone-cutting saws or band-saws for sectioning of tissue; appropriate equipment provided e.g. power-saws, band-saws and vacuum systems in the morgue; use of additional PPE if blood exposure and gross contamination is anticipated (e.g. surgical caps, hoods); respiratory protection - stench and formaldehyde effects minimized; and adjustable cadaver tray available with supportive comfortable chairs that includes foot-rests provided.

(N=39)	USP fully in place	USP partially in place	Certain elements of USP in place	USP hardly in place	No USP in place
<b>ADM111</b>	5 (12.8%)	1 (2.6%)	3 (7.7%)	6 (15.4%)	24 (61.5%)
<b>ADM112</b>	5 (12.8%)	0	2 (5.1%)	10 (25.6%)	22 (56.4%)
<b>ADM113</b>	4 (10.3%)	1 (2.6%)	12 (30.8%)	11 (28.2%)	11 (28.2%)
<b>MRG100 1</b>	3 (7.7%)	5 (12.8%)	11 (28.2%)	1 (2.6%)	19 (48.7%)
<b>MRG100 5</b>	3 (7.7%)	12 (30.8%)	4 (10.3%)	2 (5.1%)	18 (46.2%)
<b>MRG100 7</b>	4 (10.3%)	6 (15.4%)	11 (28.2%)	0	18 (46.2%)
<b>MRG100 8</b>	4 (10.3%)	9 (23.1%)	7 (17.9%)	2 (5.1%)	17 (43.6%)
<b>MRG101 2</b>	1 (2.6%)	2 (5.1%)	7 (17.9%)	7 (17.9%)	22 (56.4%)
<b>MRG103 1</b>	18 (46.2%)	2 (5.1%)	1 (2.6%)	0	18 (46.2%)

**Table 5:** Use of administrative controls as part of HIRAC: Contributing Variables (variables representing use of administrative controls as part of HIRAC).

ADM111: A Written Plan: The facility’s top administration issued a document explicitly highlighting the importance of good OHS management.

ADM112: The facility’s annual report includes a section devoted to its OHS performance on the provisions GoK OSHA 2007 regulatory framework.

ADM113: SOPs Domesticated - The facility sticks to best practice principles for OHS management e.g. SOP on handling emergencies displayed.

MRG1001: Worksites clean sanitary and orderly.

MRG1005: Aisles and passage ways are appropriately clear.

MRG1007: Repair of holes/cracks in the floor, sidewalks or other surfaces to make safe.

MRG1008: SOP on Housekeeping: Clean-up and decontamination procedures are adhered to.

MRG1012: SOP – USP as required by the Blood-borne Pathogens Standards in place.

MRG1031: Procedures are in place to deal with autopsy “surprises” that may cause the case to be re-evaluated in mid-procedure, and reclassified in the high-risk category.

For all the nine variables, most facilities had not implemented the precautions. 24 (61.5%) of the facilities did NOT have “A Written Safety Plan issued by the facility’s top administration explicitly highlighting the importance of good OHS management (ADM111). Other critical precautions were, MRG1012 (SOP - Universal Precautions as required by the Blood-borne Pathogens Standards in place) at 22 (56.4%), and lack of a section devoted to facility’s OHS performance based on regulatory framework in the facility’s annual report (ADM112) at 22 (56.4%).

(N=39)	USP fully in place	USP partially in place	Certain elements of USP in place	USP hardly in place	No USP in place
MRG101 1c	6 (15.4%)	2 (5.1%)	3 (7.7%)	3 (7.7%)	25 (64.1%)
MRG101 3	2 (5.1%)	4 (10.3%)	12 (30.8%)	0	21 (53.8%)
MRG101 3a	4 (10.3%)	5 (12.8%)	6 (15.4%)	3 (7.7%)	21 (53.8%)
MRG101 4	1 (2.6%)	8 (20.5%)	8 (20.5%)	2 (5.1%)	20 (51.3%)
MRG103 1	18 (46.2%)	2 (5.1%)	1 (2.6%)	0	18 (46.2%)
MRG103 2	6 (15.4%)	2 (5.2%)	2 (5.1%)	3 (7.7%)	26 (66.7%)

**Table 6:** Provision and Proper use of Personal Protective equipment (PPE) as part of HIRAC: Contributing Variables (Variables for provision and use of PPE as part of HIRAC).

MRG1011c: Shields in place when significant splash hazards are anticipated.

MRG1013: All personnel who are in contact with the body or any specimens must use PPE of adequate standard.

MRG1013a: Use of additional PPE if blood exposure is anticipated during autopsies or orthopedic surgery such as: Surgical caps, hoods, shoe covers or boots in when gross contamination anticipated.

MRG1014: Respiratory protection - Stench and Formaldehyde effects minimized.

MRG1031: Procedures are in place to deal with autopsy “surprises” that may cause the case to be re-evaluated in mid-procedure, and reclassified in the high-risk category.

MRG1032: Latex Allergy: Alternatives readily accessible to those employees who are allergic to the gloves normally provided.

For all the six variables, most facilities (46.2% and above) reported “No universal precautions in place” the highest contributing variables were MRG1032, MRG1011c, and MRG1013 at 66.7%, 64.1, and 53.8 respectively as compared to “Universal Precautions fully in place” at between 2.6%, and 46.2% respectively for the lowest and highest ranking variables. The highest implemented precaution was “procedures to deal with autopsy surprises that may cause mid-procedure review and reclassification of risk” (MRG1031) at 18(46.2%).

As shown in Table 7, the following correlations were observed: domestication of SOP and the call for facility to stick to best practice principles for OHS management ( $\rho=0.632$ ;  $P=0.001$ ); protection of staff by means of vaccination (e.g. Hepatitis B vaccination program available) ( $\rho=0.546$ ;  $P=0.001$ ); latex allergy alternatives readily accessible to employees allergic to latex gloves normally provided ( $\rho=0.356$ ;  $P=0.026$ ); administrative accountability where the mortuary’s performance contract annual report includes a section devoted to its OHS performance ( $\rho=0.875$ ;  $P=0.001$ ); provision of engineering controls such as appropriate ventilation systems e.g. downdraft tables that capture the air around the cadaver ( $\rho=0.424$ ;  $P=0.007$ ); ventilation of the autopsy suite that achieves at least 6 room air changes per hour (to the exterior) with air flow away from operators’ breathing zone ( $\rho=0.478$ ;  $P=0.002$ ); inbuilt/local exhaust ventilation and vacuum systems for power saws or band saws used for sectioning of tissue ( $\rho=0.474$ ;  $P=0.002$ ); provision of appropriate equipment for procedures (e.g. power saws, band saws and vacuum systems) in the morgue ( $\rho=0.331$ ;  $P=0.040$ ); use of additional PPE if blood exposure and gross contamination is anticipated (e.g. surgical caps, hoods) ( $\rho=0.793$ ;  $P=0.0001$ ); respiratory protection program where stench and formaldehyde effects are minimized ( $\rho=0.744$ ;  $P=0.0001$ ) and adjustable cadaver facility/tray available with supportive comfortable chair for users including foot-rests ( $\rho=0.401$ ;  $P=0.011$ ). These findings demonstrate that the presence of a documented OHS administration plan positively impacts on implementation of individual universal safety precautions for the morgues.

The presence of a written OHS management plan issued by facility’s top administration highlighting importance of a good OHS management seemed to positively influence implementation of key universal precautions for the morgue. In cases where a facility had a written safety plan, the 11 marked precautions (\*\*), were in place.

## Discussion

This study was executed six years after the government of Kenya enacted Occupational Safety and Health Law (OSHA 2007) and four years after the Ministry of Health adopted the Human Resources for Health (HRH 2009/2013) Strategic Plan and Policy. Key highlights of these initiatives included the need to improve health care workers’ safety, health and wellness as an output through improved leadership and management and instituting a results-based management system in traditionally-neglected areas of the healthcare system in Kenya [26], such as the mortuaries [9]. The current survey therefore evaluated



OSH management planning and practice of universal safety precautions in Kenyan government-owned morgues.

Overall, the results from the five key components of universal precaution for morgues revealed that more facilities had no precautions in place as compared to those that had or had partially implemented these precautions. For instance, 66.7% of the morgues lacked appropriate engineering controls installations for safety and

ease of work as compared to 7.7% of the morgues that had universal precautions fully in place. These findings are largely attributed to older designs of mortuary or adopting rooms originally not designed for morgues, but currently being used as morgues once the facility was upgraded from a lower rank (KEPH level 3) -where mortuary services were not initially offered, to a higher rank (level 4)-where mortuary services is critical [9].

Spearman's rho – correlations (N=39) [**.Corr. significant at ≤0.05 level (2-tailed)]	rho	P
SOPs Domesticated and the facility sticks to best practice principles for OHS Management	0.632**	0.001
Protection of staff by means of vaccination (e.g. Hepatitis B Vaccination Program available)	0.546**	.0001
Latex Allergy: Alternatives readily accessible to employees who are allergic to latex gloves.	0.356**	0.026
The mortuary's performance contract annual report includes a section devoted to its OHS performance.	0.875**	.0001
Appropriate ventilation systems (e.g. downdraft tables that capture the air around the cadaver).	0.424**	0.007
Ventilation of the autopsy suite that achieves at least 6 room air changes per hour (to the exterior) with air flow away from operators' breathing zone.	0.478**	0.002
Local exhaust ventilation is provided over bone cutting saws or band-saws for sectioning of tissue.	0.474**	0.002
Appropriate equipment provided e.g. power-saws, band-saws and vacuum systems in the morgue.	0.331**	0.040
Use of additional PPE if blood exposure and gross contamination is anticipated e.g. Surgical caps, hoods.	0.793**	0.0001
Respiratory protection - Stench and Formaldehyde effects minimized	0.744**	0.0001
Adjustable cadaver tray available with Supportive comfortable chairs that includes foot-rests provided.	0.401**	0.011

**Table 7:** The relationship between presence of a documented OHS Management plan and practice of universal precautions for Morgues.

These findings are in concordance to previous observations in which it was demonstrated that many old mortuaries built to old standards were no longer compatible with current good work practices for OHS [9,27]. The results further showed that 23.1% of the facilities had only partially implemented the universal precautions particularly those adjustments that needed additional resources. This confirms previous findings in Nigeria [18] in which it was observed that morgues were phased out in resource re-allocation to sections considered most deserving within the facility. Such a practice results in worker exposures to such risks as blood splash and formaldehyde among others. For better results, all stakeholders including mortuary staff need to be involved in planning and implementation of facility upgrading and maintenance. The blue print for facility upgrade to a level that requires a morgue should have a section devoted to morgue experts for input on addressing critical factors such as irreducible minimum for an operational mortuary. The irreducible minimum should include; (1) provision for dry/slip resistant surfaces or wet surfaces covered with non-slip materials; (2) a functioning waste management system (preferably in-built) that allows minimal contact with waste and tissues; (3) appropriate exhaust/ventilation system and cadaver storage facility e.g. coolers and downdraft tables that capture the air around the cadaver; (4) appropriately-ventilated autopsy suite that achieves at least 6 room air changes per hour (vented to the exterior) with the air flow moving away from the operators' breathing zone; (5) local exhaust ventilation provided over bone-cutting saws or band saws used for sectioning of tissue; (6) vacuum systems for power saws and (7) adjustable cadaver tray/holder with supportive comfortable chairs that includes foot-rests for procedures. In addition, the hospital administrators and senior personnel in the Ministry of

Health should have regular and adequate training in safety requirements and regulations to ensure correct administration of staff safety at facility levels.

### Implementation of Universal Precautions for Formaldehyde exposure and related ventilation

**Challenges:** While formaldehyde remains the preferred fixative chemical for the preservation of cadavers, exposure to formaldehyde fumes is known to cause various acute and chronic toxic effects in humans [28]. The acute effects are irritation of upper respiratory tract and eyes, lacrimation, "burning" of nose and throat, and contact dermatitis, while chronic effects include carcinogenicity and mutagenicity [28]. The current study observed that 69.2% of the facilities had not implemented the universal precautions for formaldehyde exposure. The contributing factors were lack of engineering controls, for example, exhaust ventilation, coolers and cadaver storage facility in 37 (94.9%) facilities, lack of a respiratory protection program in 19 (48.7%) and non-provision for ventilation of the autopsy suite that achieves at least 6 room air changes per hour (vented to the exterior) with the air flow moving away from the operators' breathing zone in 31 (79.5%) facilities. These are critical safety measures and staff in these facilities definitely faces risks of formaldehyde fumes exposure. These findings are consistent with those reported in the print media as one of the causes of occasional worker protests across public morgues in Kenya [29]. This report showed that mortuary workers had to endure the stench of decomposing human bodies piled high on the floor since the coolers at Nairobi's biggest mortuary were out of order. Staff had resorted to

taking frequent shots of alcohol to reduce their sense of smell [29]. These findings are disturbing as they point to lack of preparedness, poor planning and oversight in designing and maintenance of morgues. However, studies show that administrative controls and good ventilation, besides being critical safety elements on formaldehyde exposure, presents an added advantage to preservation. In a previous study on reducing the toxic effects of formaldehyde, it was observed that the toxic effects of formaldehyde fumes during dissection and embalming can be reduced by good exhaust ventilation systems [28]. For better results in achieving precautions for formaldehyde exposures, the hospitals administrators should have in place continuous maintenance programs for the morgues besides stakeholder inclusion in designs. In addition, the mortuary staff and regulators should adopt the known measures for reducing the toxic effects of formaldehyde fumes during dissection, embalming and storage besides putting in place the following; (1) good exhaust ventilation systems, (2) creating awareness on potential health hazards of formaldehyde through training and process regulations, (3) use of alternatives such as standardized embalming fluids, (4) installation of eye washing stations in case of accidental splashing of formaldehyde into the eyes, (5) installation of negative pressure pump systems to further reduce formaldehyde vapors from the air, (6) mandatory use of protective equipment like apron, gloves and mask to avoid direct skin contact, (7) reviewed work procedures to avoid working between exhaust vent and the sources of formaldehyde vapours, and avoiding spillage of embalming fluid [28].

### **Precautions for Blood-borne Pathogens Exposures (BBPEs) and Use of Personal Protective**

**Equipment (PPE):** Mortuary workers are exposed to blood-borne pathogens (BBPs) at work [18]. Accidental occupational exposure of healthcare workers to blood and body fluids after skin injury or mucous membrane contact constitute risks for transmission of BBPs such as Human Immunodeficiency Virus (HIV), Hepatitis B virus (HBV) and Hepatitis C virus (HCV) are well documented [30]. The results presented here, revealed that 69.2% of the facilities did not have in place the universal precautions, 25.6% had partially implemented the precautions while only 5.1% had universal precautions fully in place. The contributing factors shown in the current study include cases of work surfaces littered with potentially infectious materials such as body fluids and tissues reported in 29 (74.4%) of facilities, lack of shields in place when significant splash hazards are anticipated in 25 (64.1%) including poor housekeeping and administrative control mechanisms. This mirrors the findings in a similar study in Nigeria that described mortuaries as “abandoned” and not considered as a priority in resource allocation [11]. These results are also consistent with other previous studies conducted in Kenya’s Rift Valley Provincial Hospital [30] in which it was shown that 25% of health-care workers reported having been exposed to blood and body fluids in the preceding 12 months, with higher rates of percutaneous injuries occurring during stitching (30%), a common procedure in morgues.

The results on vaccination against HBV showed that only 6(15.4%) of the facilities had their staff vaccinated against HBV as compared to 29(74.4%) that had not implemented the precaution. These findings parallel a previous study investigating the risk of BBP exposure among Zambian health care workers [31]. The results from the Zambian case study demonstrated that the average annual sharps injury rate were 1.3 injuries per worker with service workers (housekeepers, laundry, ward assistants) accounting for the highest rate of such injuries (1.9 per

year), while on preventive measures, only 8% were fully vaccinated against HBV [31]. Overall, the results in the current study are also consistent with those of the study conducted among individuals and small groups during the outbreaks such as Ebola in Uganda and Democratic Republic of Congo in which it was revealed that three key themes pointed to the vulnerability of the present OHSMS in protecting health care workers [32]. The themes are identified as lack of protective gear, basic equipment, and other resources necessary to provide care and exceptional commitment to the profession in a context where the lives of the health care workers were in jeopardy [32]. In order to improve the management of BBP exposures, a systems approach backed with on-the-job awareness training as a precursor to safety culture establishment is a necessity. This begins with understanding the risks of BBP transmission which is fundamental to prioritizing interventions when resources are limited [31]. As reported in a previous study on occupational risk infections among funeral service practitioners in Maryland, USA [33], low rate of HIV infection and HBV infections were correlated with well-established non-occupational risk behaviors [33]. Consequently, these findings on HIRAC practices in morgues in Kenya calls for an established OSHA program in the Kenyan morgues through enhanced participatory administrative controls approach.

### **Use of administrative controls as part of HIRAC**

Additional results on the use of administrative controls or work practices as part of HIRAC were disquieting as 48.7% of the facilities had no formal universal precautions in place as compared to 12.8% that had precautions fully in place. While all the other safety precautions may directly require some financial in-put, the application of administrative controls may not require direct financial in-put. This is a critical low-cost quality assurance component that can be utilized by most morgues as an immediate measure to curb exposure. The contributing factors such as lack of a written safety plan by the facility’s top administration at 24(61.5%), points to a major administrative safety lapse which in-turn negatively impact implementation of other control measures (such as generation and use of SOPs and provision and proper use of PPEs). These results are consistent with the findings in a previous study [29] in which it was shown that morgues were congested with supplies stored on the pathways, freezers were full of cadavers and unclaimed bodies were piled up due to regulatory bottlenecks and lack of policy implementation [29]. The current study showed that 56.4% of the facilities had no universal precautions in place for the provision and proper use of PPE as compared to 15.4% that had precautions fully in place. However, given that provision and proper use of PPE is more of an administrative function as it is personal [34], better results can be achieved by re-engineering administrative controls within the facilities to include provision and proper use of PPE.

Previous studies also show that PPE is probably the single most over-used and least understood risk control measure [9,35]. It falls at the bottom of the hierarchy of controls as it is a last resort measure which is often permitted to come as close to the person as their clothing [35]. In the current study, the contributing factors to poor management of PPE were largely administrative.

These results are concordant with previous findings in Kenya and Nigeria which observed that in the morgues, PPE was either not provided at all or given to other most deserving sections within the facility [9,11]. The authors lament that lack of and improper use of PPE exposes workers to blood splash. In the same study, they propose

three HBV vaccines in all mortuary workers besides implementing other universal safety protocols [11].

The significance of administrative controls is further demonstrated by related studies [34] in which it was shown that a thorough review of control measures and working practice in light of the elevated biological monitoring results lead to significant improvements in the protection factors of PPE supplied, compliance with correct PPE use, and the working environment. The consequence is significant reductions in actual worker exposure to benzene – an aromatic volatile compound like formaldehyde [34].

### **The relationship between the presence of a documented OHS management plan and practice of universal precautions for Morgues**

The results of correlation analysis revealed an interesting observation on the significance of an OHSM plan in successful implementation of the universal safety precautions in the morgue as shown in Table 7. There was a relationship between presence of a written OHS management plan sanctioned by facility's top administration and the implementation of several universal precautions. In cases where a facility had a safety blue print, several precautions were reported in place. Such precautions included the domestication of SOPs and the call for facility to stick to best practice principles for OHS management, protection of staff by means of vaccination (e.g. Hepatitis B vaccination program available), use of additional PPE if blood exposure and gross contamination is anticipated and provision of appropriate equipment for morgue procedures. These findings are in line with the observations in a previous study [36], in which it was observed that a documented health and safety plan besides having four key elements (management commitment and employee involvement, worksite analysis, hazard prevention and control), reflects by definition, the key components of effective safety and health program [36]. Other schools of thought add two more components to these key elements namely training and evaluation of program effectiveness [37]. These two additional components aid in worker involvement and capacity building and provision for feedback for program capacity strengthening [37].

The presence of a written plan shows a commitment to safety by the management [37-40], hence the motivation of the staff to adhere to the standards as a minimum measure. This is because a written plan seeks to, among other things, involving all stakeholders who can always use it as a reference [9]. It is a clear testimony of negotiations and understanding of all the parties involved, particularly employer and employees [41]. As shown by the current results, the impact of a documented OHSM plan on mortuary safety is indubitable. A well thought-out, participatory written plan is the key to successful OHSM program [42]. Since the factors surrounding the autopsy service may change (e.g. new technology may permit easier solutions) forcing the practicability of a planned action to change, the preparation of a written plan of the control measures, in consultation with employees, provides the basis for planning and continuous audit of the service. Given that such a plan is a living document under constant review, and include a summary of temporary and long-term measures to be implemented immediately and eventually to control risks and to protect employees [27], it serves as additional impetus for the stakeholders to implement every aspect of the plan or give a proper reason for non-compliance. Such an exercise provides good grounds for responsibility and accountability on the part of stakeholders. Such plans often include appropriate procedures for preventive

maintenance, procedures for monitoring the application of work practices, protection of staff by means of vaccination, respiratory protection program and blood-borne pathogens exposure control procedures, PPE and staff health status [43]. While all these are components of universal precautions well known to most workers in the health arena [43], evidence exists of inconsistent observance of these doctrines by healthcare workers [27], pointing out to the critical role of documented OHS plan in addition to education of workers on risks and institution of standard operating procedures to safeguard the health of mortuary workers [18].

### **Conclusions**

Universal safety precautions (USP) are largely not applied in Kenyan government-owned mortuaries with all the measures of universal safety precautions returning an alarming level on the hierarchy of controls scale. There is a need for an urgent and significant improvement in OHS administration for a "safety-first culture". For best results, a documented OHS Management Plan sanctioned by top management as part of daily operations should be preceded by implementation of individual USP measures. This is an OHSM blue print for morgues, detailing implementation strategy, responsibility and mechanism for monitoring and feedback. Since it is generally acknowledged that OHS-based management systems reduces accidents and injury rates besides improving productivity [5], a total management approach to the development of written programs for hazard identification, the mitigation of hazards by the use of common safety and health tools, and development of a safe workforce through communications and training critical to mortuary safety should be implemented to spur the growth of a safety culture both within the morgues and hospital administration. Such a blue print would trigger motivational techniques including behavior-based safety, involvement and training, and address the administrative control issues by providing a strong foundation stakeholders need to function as effective managers of workplace safety and health [9,42]. The result of this approach would be a one-stop shop safety guideline for all stakeholders in the mortuary sector to steer the full implementation of the universal mortuary safety precautions as part of implementing OHSM programmes in the morgues across the country.

### **Conflict of Interests**

There is no conflict of interest from any of the authors of the manuscript due to commercial or any other affiliations

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### **References**

1. Team DMP (2006) Care and respect in death: good practice guidance for NHS mortuary staff, Department of Health, London.
2. European C (2004) e-Health-making healthcare better for European citizens: An action plan for a European e-Health Area. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the regions COM.

3. Wu TC, Liu CW, Lu MC (2007) Safety climate in university and college laboratories: impact of organizational and individual factors. *J Safety Res* 38:91-102.
4. Safety and Health at Work.
5. Subhani MG (2010) Study of Occupational Health & Safety Management System (OHSMS) in Universities' Context and Possibilities for its Implementation: A case study of University of Gavle. University of Gavle, FACULTY OF ENGINEERING AND SUSTAINABLE DEVELOPMENT.
6. Healthcare Facilities.
7. Sepkowitz KA, Eisenberg L (2005) Occupational deaths among healthcare workers. *Emerg Infect Dis* 11: 1003-1008.
8. Babatunde EBEO, Charles CCCA, Adebayo TATO, Kofoworola AKAO (2010) Awareness of occupational health hazards and the practice of universal safety precautions among mortuary workers in South West Nigeria. *Nig Q J Hosp Med* 20:192-196.
9. Okoth-Okelloh AM, Ogonda BA, Ogolla S, Tonui WK, Onyango R (2013) Quality Assurance for Occupational Health and Safety Administration (OSHA) In the Morgue: The Impact of SOP Domestication on Implementation and Practice of Universal Safety Precautions in Kenya. *Journal of Biology, Agriculture and Healthcare* 3: 1-10.
10. Great Britain (2003) Health Services Advisory C, Great Britain H, Safety E: Safe Working and the Prevention of Infection in the Mortuary and Post-Mortem Room: HSE Books.
11. Ogunnowo BE, Anunobi CC, Onajole AT, Odeyemi KA (2010) Awareness of occupational health hazards and the practice of universal safety precautions among mortuary workers in South West Nigeria. *Nig Q J Hosp Med* 20: 192-196.
12. Rouveix E, Madougou B, Pellissier G, Diaougah H, Saley SM, et al. (2015) Promoting the Safety of Healthcare Workers in Africa: From HIV Pandemic to Ebola Epidemic. *Infect Control Hosp Epidemiol*, 36: 361-362.
13. Burnett RA (2004) Royal Institute of Public H, Hygiene: Handbook of Anatomical Pathology Technology: Royal Institute of Public Health & Hygiene.
14. Bakhshi SS (2001) Code of practice for funeral workers: managing infection risk and body bagging. *Commun Dis Public Health* 4: 283-287.
15. Erickson PA (1996) Practical Guide to Occupational Health and Safety: Elsevier Science.
16. Boardman J, Lyon A (2006) Defining best practice in corporate occupational health and safety governance. London: Acona Ltd Amadeus House Floral Street London.
17. Government of Kenya - Ministry of Labor.
18. Ogunnowo B, Anunobi C, Onajole A, Odeyemi K (2012) Exposure to blood among mortuary workers in teaching hospitals in south-west Nigeria. *Pan Afr Med J* 11: 61.
19. ILO/WHO: Joint ILO/WHO guidelines on health services and HIV/AIDS. Volume TMEHS/2005/8. GENIVA: ILO; 2005.
20. (2012) List of Public health facilities in Kenya.
21. Yamane T (1967) Statistics an Introductory Analysis 2nd Ed 2nd edition. New York: Harper And Row.
22. Walls Chris, Brownless Jeff (2000) Mortuaries - Guidelines to Promote Safe Working Conditions - Managing Health and Safety Risks in New Zealand Edited by Labour Do. Wellington, New Zealand: Occupational Safety and Health Service of the Department of Labour.
23. Online Survey Generator Instructions]
24. Shelby D Hunt, Van R Wood, Lawrence B Chonko (1985) Corporate Ethical Values and Organizational Commitment in Marketing. *The Journal of Marketing*.
25. John L Pierce, Randall B Dunham, Blackburn RS (1979) Social Systems Structure, Job Design, and Growth Need Strength: A Test of a Congruency Model. *The Academy of Management Journal* 22: 223-240.
26. GOK-MOH (2009) National Human Resources for Health Strategic Plan - 2009-2012. Volume 1. Edited by Services MoM. Nairobi: Ministry of Medical Services.
27. Walls C, Brownless J, Cluroe A, New Zealand. Occupational S, Health S (2000) Managing Health and Safety Risks in New Zealand Mortuaries: A Guideline to Promote Safe Working Conditions: Occupational Safety and Health Service of the Department of Labour.
28. Dixit D (2008) Role of Standardized Embalming Fluid In Reducing The Toxic Effects Of Formaldehyde. *Indian Journal of Forensic Medicine & Toxicology* 2: 01-06.
29. Nyambega G (2012) Kenya: Workers Protest Stench of Death At City Morgue. In Daily Nation on the Web. Nairobi Kenya: Nation Media Group.
30. Mbaisi EM, Wanzala P, Omolo J (2013) Prevalence and factors associated with percutaneous injuries and splash exposures among health-care workers in a provincial hospital, Kenya, 2010. *Pan African Medical Journal*.
31. Phillips EK, Simwale OJ, Chung MJ, Parker G, Perry J, et al. (2012) Risk of bloodborne pathogen exposure among Zambian healthcare workers. *J Infect Public Health* 5: 244-249.
32. Hewlett BL, Hewlett BS (2005) Providing care and facing death: nursing during Ebola outbreaks in central Africa. *J Transcult Nurs* 16: 289-297.
33. Gershon RR, Vlahov D, Farzadegan H, Alter MJ (1995) Occupational risk of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus infections among funeral service practitioners in Maryland. *Infect Control Hosp Epidemiol* 16: 194-197.
34. Jones K, McCallum J (2011) Benzene Exposure During Tunnelling - Using Biological Monitoring to Assess Control Measures and Working Practice. *Annals of Occupational Hygiene* 55: 248-252.
35. Nix D (2011) Understanding the Hierarchy of Controls. In *Machinery Safety 101: Safe Designs and Safe Workplaces*.
36. Gustin JF (2007) Safety Management: A Guide for Facility Managers: Fairmont Press, Incorporated.
37. Roughton J, Mercurio J (2002) Developing an Effective Safety Culture: A Leadership Approach: Elsevier Science.
38. Blunt C (2000) Achieving a Safety Culture Transition. In *The First National Conference on Occupational Health and Safety Management Systems, July 2000: 2000; Melbourne Vic. Australia*. Edited by Warwick Pearse, Clare Gallagher, Bluff L. Crown Content.
39. HSE: Defining best practice in corporate occupational health and safety governance. In *Health and Safety Executive -RESEARCH REPORT 506. 11/06 edition*. Edited by Lyon JBA. London: Acona Ltd; 2006.
40. Minguillón RF, Yacuzzi E (2009) Design of an indicator for health and safety governance. Buenos Aires - Argentina: UNIVERSIDAD DEL CEMA.
41. Grammeno G, Ltd CCHA (2006) Planning Occupational Health [and] Safety: CCH Australia Limited.
42. Reese CD (2008) Occupational Health Safety Management: A Practical Approach: CRC PressINC.
43. Kim LE, Evanoff BA, Parks RL, Jeffe DB, Mutha S, Haase C, Fraser VJ (1999) Compliance with Universal Precautions among emergency department personnel: Implications for prevention programs. *American journal of infection control* 27: 453-455.