



## Perception of occupational risks in autopsy rooms among Moroccan forensic pathologists

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### Abstract

**Introduction - Objective:** This occupational risk assessment initiative aims to provide an overview of autopsy rooms in Morocco. It focuses on identifying hazardous situations in order to establish the broad outlines of a global prevention action plan. This one targets the management of infectious and chemical risks, the prevention of musculoskeletal disorders, and psychosocial risks. This assessment is a useful working tool, which can be used as a monitoring indicator and support for the management of occupational risks in the hospital sector.

**Method:** This is a cross-sectional survey conducted in 2022, focusing on the perception of occupational risks in autopsy rooms among Moroccan forensic pathologists. The study was based on the elaboration of an anonymous questionnaire designed to collect information on the socio-professional characteristics of participants (gender, age, job position) as well as on the occupational risks perceived by each respondent. The questionnaire was distributed to all forensic pathologists via Google Forms, emphasizing the anonymous nature of the study. The responses were centralized and analyzed by the occupational medicine department, identifying potentially hazardous situations in Moroccan autopsy rooms.

**Results:** The obtained results show that the autopsy rooms are a significant source of occupational risks. 14 potentially hazardous situations are identified by the participants, including biological, physical, chemical, and organizational risks. Among these situations, 57.9% of respondents believe they are not adequately managed. The infectious risk is perceived as the primary hazard for anyone coming into contact with the deceased. The surveyed physicians noted that the autopsy room does not comply with the sanitary standards required for an operating theater.

**Conclusion:** This assessment reflects a participatory approach to identifying and managing occupational risks, actively involving healthcare personnel. It highlights hazardous situations, thereby improving working conditions for professionals and enhancing risk prevention and management in hospital sector.

**Keywords:** Autopsy room, forensic pathologist, preventive measure.

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## INTRODUCTION

The autopsy room represents a significant source of occupational risks. The infectious risk is perceived as the primary hazard for anyone coming into contact with the deceased. In addition, the musculoskeletal disorders can be induced or exacerbated by the professional activities of

forensic pathologists, constituting a public health problem and a major cause of absenteeism.

From an architectural perspective, an autopsy room should adhere to the sanitary standards of an operating theater. However, these requirements are not consistently implemented in practice. In Morocco, hospital morgues are often under-equipped and unsuitable.



The aim of this study is to identify potentially hazardous situations as perceived by forensic pathologists in autopsy rooms, in order to outline the framework of a comprehensive preventive action plan, focusing on the risks identified by the survey.

## Methods

This is a cross-sectional descriptive study conducted in 2022 among Moroccan forensic pathologists using a self-questionnaire. The questionnaire included general information as well as specific questions related to occupational risks in autopsy rooms.

The anonymously designed questionnaire aimed to collect data on the socio-professional characteristics of participants (gender, age, job position) and their perceptions of occupational risks associated at their job position. It was distributed via email to all forensic pathologists and included four main items:

- Items relating to the work environment: physical and chemical risks at the job position.
- Items concerning risks related to work organization.
- Items relating to safety.
- Items on occupational accidents and diseases: incidents and illnesses reported over the past three years.

The survey was conducted online via Google Forms. Out of 40 distributed questionnaires, 38 responses were obtained and subsequently forwarded to the occupational medicine department for analysis.

## Results

### Participants

Out of 40 questionnaires distributed to Moroccan forensic pathologists, 38 responses were received. The average age of participants was  $45.65 \pm 9.72$  years (29 to 63 years), with a male predominance (63.2%). Specialist physicians represented the majority (65.8%), followed by general practitioners (18.4%), university hospitalists (13.2%), and resident physicians (2.6%). Professional experience exceeding 10 years was reported by 60.5% of participants. In addition, 36.2% of respondents reported working more than 8 hours per day.

In this study, 14 potentially hazardous situations are identified by the participants. These were related to physical (4), chemical (1), safety (3) and work organization (6) risks (Table 1).

In terms of prevention, 57.9% of respondents considered these hazardous situations to be inadequately managed.

### Physical risks

The working conditions were deemed uncomfortable by 73.7% of participants. Approximately 76.3% of staff reported exposure to noise during their workday, and 55.5% indicated the use of equipment that subjects them to vibrations. Furthermore, 76.3% of participants considered the lighting in their workplace to be insufficient and inadequate,

compromising their efficiency and precision. 50% of respondents reported experiencing thermal discomfort.

### Chemical risks

Regarding chemical exposure among Moroccan forensic pathologists, 76.3% of participants reported being exposed to formaldehyde. In addition, safety data sheets for products were unavailable in 84.2% of cases, and product labeling was not respected in 68.4% of cases.

### Safety-related risks

In the studied hospitals, the safety was considered a secondary priority by 57.9% of participants and non-existent by 13.2%. Personal protective equipment was available in 55.3% of cases, primarily including gloves (100%), surgical masks (39.5%), protective goggles (7.9%), and face shields (2.6%).

Regarding exposure to biological materials, the protocol for handling blood exposure accidents was clearly defined in 60.5% of cases. Handwashing and disinfection procedures were followed in 94.7% of cases; however, infectious disease specialists and occupational physicians were not systematically contacted in 47.4% of incidents. 71.1% of participants reported workplace accidents to the administration.

In a hygiene context, 44.7% of participants reported that floors are cleaned regularly and immediately in the event of a spill. However, waste collection was reported as disorganized by 47.4% of participants.

The fire risk assessments showed that electrical installations were not periodically inspected in 86.8% of cases. According to 44.7%, the fire extinguishers are installed in the autopsy room, but detection and alarm systems are absent (81.6%). In addition, 94.7% of participants, emergency response and evacuation plans were not displayed.

Furthermore, the most frequent occupational accidents reported were blood exposure accidents (57.9%), followed by falls (34.2%) and injuries (7.9%).

### Work organization risks: musculoskeletal disorders (MSD) and psychosocial risks (PSR)

Over the past six months, the respondents reported experiencing muscle soreness in the neck and cervical (18.4%), in the wrist and hand (10.5%), and lumbago (50%).

The response to the question 'are you satisfied with your work?' provided negative for 57.9%, and 78.9% reported that their work is a source of stress. The forensic pathologists reported experiencing internal violence (15.8%) and external violence (55.3%).

94.7% of workers exposed to these occupational risks do not receive medical surveillance from their occupational physician.

### Medical surveillance

In this study, the forensic pathologists did not benefit from medical surveillance provided by an occupational physician.

## Discussion

### Architectural design of the autopsy room

From an architectural perspective, an autopsy room should adhere to the same health standards as an operating theatre, both in terms of structure and equipment. This includes specific requirements for lighting, soundproofing, and thermal comfort. In particular, lighting is crucial to the professional activity of forensic pathologists. It must meet the specific requirements of an operating theatre. Indeed, surgical lighting enables forensic pathologists to adequately observe the operative field, regardless of the surrounding conditions [1].

### Musculoskeletal disorders (MSD)

Musculoskeletal disorders (MSD) are a major cause of absenteeism and a significant health concern in hospital sector. An epidemiological study conducted at the Bouaké University Hospital, involving 394 healthcare workers, revealed that 79.7% of participants reported suffering from MSD, generally localized to the lumbar region (68.27%). In this study, 50% of respondents reported experiencing lower back pain. Clinically, dorso-lumbar spinal syndrome and cervical pain were the most frequently observed conditions, affecting 54.7% of cases.

MSD primarily result from biomechanical and psychosocial risk factors. Among the biomechanical factors, spinal flexion and manual handling were the most frequently reported, occurring in 64.9% and 83.2% of cases, respectively. Also, the repetitive movements were identified as a risk factor in 51.5% of cases. The psychosocial factors play a significant role as well; 57.9% of respondents reported dissatisfaction with their working conditions, and 78.9% perceived their work as a source of stress [3].

In this study, the obtained results are consistent with international publications. An epidemiological study in France involving 1,472 midwives demonstrated a high prevalence of MSD, with the most common locations being the lumbar spine (89.4%), cervical spine (88.3%), thoracic spine (87.8%), shoulders (81.4%), and wrists (79.1%) [4].

Another cross-sectional study conducted from January to June 2010 examined hospital staff at the Monastir University Hospital in Tunisia. The study included 173 physicians, 215 paramedical staff, and 51 workers. The incidence of MSD in this population was 65.3%. MSD were primarily represented by lumbago (74%), cervicalgia (38.1%) and gonalgia (23.3%) [4].

The prevalence of upper limb musculoskeletal disorders among healthcare worker in public hospital services over the 12 months preceding the survey was 40.27% for shoulders, 15.01% for elbows, and 29.35% for wrists [5].

In Morocco, the osteoarticular pathologies considered as compensable occupational diseases are listed in the occupational disease compensation tables, specifically in tables numbered 2.6 to 2.10 [6].

### Safety risks

The risks related to exposure to biological fluids and fire hazards will be discussed in this section. This study revealed that safety is often relegated to second place in healthcare facilities, as perceived by 57.9% of respondents. However, hospital directors bear the primary responsibility for prevention and are obligated to ensure health and safety in the workplace [6].

Blood exposure accidents are among the most frequent occupational accidents in healthcare sector. In France, national surveillance of BEA has been implemented since 2002 under the coordination of the RAISIN network (Alert, Investigation, and Surveillance Network for Nosocomial Infections). The reported incidence of BEA is 7.5 per 100 hospital beds [7]. In our study, BEA also represented the most frequent occupational accident, reported by 57.9% of respondents.

A survey conducted in 2000 by D. Nidegger et al. found that nurses (39.5%), doctors (21.8%), and students (13.6%) were the most affected professions. The majority of these accidents occurred in surgical (29.2%) and medical (24.3%) departments [8].

In Morocco, a multicenter survey conducted in March 2000 included 420 participants from hospitals and clinics in Taza, Témara, and a large public medical analysis laboratory in Rabat. The analysis revealed that the reporting rate of incidents increased with the specialization of departments, reaching 25.6% in surgery, 46.4% in emergency departments, and 66.7% in AIDS care units [9].

A national French survey of 5,000 randomly selected surgeons assessed their knowledge of risk factors for blood exposure in operating theatre and their attitudes toward accidents. Among respondents, 57.6% cited procedural complexity as the primary reason for underreporting, 8.6% considered it a private medical matter, and 20.4% listed other reasons [10].

A descriptive cross-sectional study conducted in gynecology and psychiatry departments in a central Tunisian university hospital identified factors for non-reporting, including lack of perception of a real risk of contamination (16%), length of procedures, and insufficient time available (10.6%) [11].

In autopsies, the level of infectious risk depends on the operator's immune competence and the infectious agent present in the deceased. Regardless of the cause of death, the infectious risks are primarily associated with decomposition and the resulting microbial proliferation, as well as the deceased's pathology.

The main diseases likely to be transmitted during an autopsy include tuberculosis, HIV, hepatitis B and C, hepatitis A, Creutzfeldt-Jakob spongiform encephalopathies, acute respiratory infections (SARS, COVID-19), herpes virus, and parasitic and fungal diseases. The contamination risk varies depending on the situation: it is low during external contact but increases significantly during organ extraction [12,13].

A study coordinated by the French National Institute for Research and Safety (INRS) and the GERES group in 1996 surveyed 26 hospital autopsy laboratories, involving 788 healthcare workers. Between 1990 and 1995, five cases of presumed occupational infectious diseases were retrospectively identified: one case each of hepatitis B, hepatitis C, tuberculosis, atypical mycobacterium infection, and toxoplasmosis [13].

Furthermore, foreign objects, such as bone fragments, present an additional risk [13].

#### Chemical risks

In this study, 76.3% of cases were exposed to formaldehyde. This substance is classified as a category 1 carcinogen by the IARC, with sufficient evidence linking it to nasopharyngeal cancer and myeloid leukemia. An excess of mortality due to leukemia, predominantly of the myeloid type, has been observed among professionals exposed to formaldehyde, including embalmers, funeral workers, and pathologists [14,15]. In addition to its carcinogenic potential, formaldehyde is an irritant to the skin and mucous membranes of the eyes, respiratory tract and digestive tract. It can also cause irritant or allergic contact dermatitis, as well as occupational asthma.

The local genotoxic effects, affecting nasal and oral mucosa, and systemic effects on peripheral lymphocytes, have also been reported among exposed workers. Exposure to formaldehyde can occur through direct contact, inhalation, or ingestion of aqueous solutions. However, available human data do not definitively conclude specific reproductive risks [14,15].

In this study, toxic products were not labeled in accordance with the classification and labeling requirements outlined in the CLP regulation.

#### Prevention

The prevention must comply with the general principles of prevention [16]. Although the Moroccan Labor Code does not explicitly define these principles, it references them in several sections. These principles include:

1. Avoid risks: eliminate hazards at source.
2. Assess risks: identify and analyze risks that cannot be avoided.
3. Combat risks at source.
4. Adapt work to the individual.
5. Consider technological advancements.
6. Replace hazardous materials or processes with non-hazardous or less hazardous alternatives.
7. Plan prevention: integrate safety measures into all aspects of planning
8. Prioritize collective protection measures: give precedence to collective protections over individual protections.
9. Provide appropriate instructions to workers.

#### Regulatory frameworks

The Moroccan constitution of July 29, 2011, recognizes health and safety at work as constitutional rights. It states that

workers must be protected against illnesses in general and, more specifically, against occupational diseases and workplace accidents [17].

Decree No. 2-12-431 of 21 Moharrem 1435 (November 25, 2013) outlines the conditions for the use of substances or preparations that may harm employees' health or compromise their safety. It details the roles of prevention actors, the employer's responsibility in assessing occupational risks, and the preventive measures and tools aimed at eliminating or minimizing exposure to hazardous chemical agents. The decree also mandates the regular inspection and proper maintenance of collective protective equipment and installations. In addition, it stipulates annual monitoring of occupational exposure limit values by qualified organizations [18].

The Labor Code (Law No. 65-99 of 2004) and the decree specify the responsibilities of occupational physicians. These include maintaining a medical file for each exposed worker and keeping an updated list of employees exposed to hazardous chemical agents. The occupational physician must conduct a pre-employment medical examination before assigning workers to their workstation, as well as periodic medical check-ups. After each examination, the physician issues a medical fitness certificate confirming that the worker has no medical contraindications for their position. This certificate must be renewed at least once a year by the occupational physician [6].

If an employee develops an occupational disease potentially linked to exposure to biological, carcinogenic, or hazardous chemical agents, all employees subjected to similar exposure in the same workplace must undergo medical examinations by the occupational physician as part of occupational disease screening [6].

The Ministerial Order No. 93-08 of 6 Joumada I 1429 (May 12, 2008), which establishes the general and specific measures for applying the principles outlined in Articles 281 to 291 of the Labor Code, details various aspects of technical prevention of chemical risks. It concerns the arrangement, cleaning and disinfecting of workplaces, disposing of residual or wash water, providing sanitary facilities, and ensuring the availability of chemical safety data sheets. It also enforces compliance with the classification, packaging, and labeling requirements for chemical substances [19].

The Ministerial Order No. 2625-12 of 26 Chaabane 1433 (July 16, 2012) establishes an indicative list of tasks requiring special medical surveillance. This list includes tasks likely to cause compensable occupational diseases or diseases of a professional nature, night work, and tasks involving exposure to hazardous chemical products [20].

#### Prevention levels

The preventive strategy of an organization should focus on the three levels of prevention to prevent the occurrence of harmful effects among employees exposed to chemical, physical, biological, or work-related organizational risks. The three prevention levels:

1. Primary prevention is based on the elimination of hazards, the assessment of occupational risks, and the implementation of collective technical measures, including:
  - Adherence to standard and universal precautions: Studies show that wearing two pairs of gloves, compared to one, reduces glove perforation rates at the end of an intervention from approximately 15% to 5% [21].
  - Ventilation and sanitation of premises to reduce contamination.
  - Availability of chemical safety data sheets.
  - Compliance with formaldehyde exposure limits: according to the 2019 European directive and the binding occupational exposure limits in France (2021), the limit value is set at 0.62 mg/m<sup>3</sup> or 0.5 ppm in healthcare, funeral services, and embalming sectors [14].
  - Classification and labeling of chemical products according to the CLP regulation. In our study, toxic products were not properly labeled.
  - Adapted ergonomic interventions, incorporating actions on psychosocial risks.

The objective of primary prevention is to reduce the incidence of occupational diseases by acting upstream of the risks.

2. Secondary prevention focuses on:
  - Medical measures: establishing enhanced medical surveillance in cases of carcinogenic risks to enable early detection of work-related pathologies.
  - Technical measures: collective and individual, such as mandatory reassessment of occupational risks following the identification of a work-related disease to adjust preventive measures.
3. Tertiary prevention aims to:
  - Avoid aggravation of occupational diseases by keeping employees in their jobs or facilitating their professional reintegration in cases of incapacity.
  - Remedy damages related to occupational diseases, including the declaration of the disease and its compensation.

The training and education of employees on occupational risks, as well as hygiene and safety measures in the workplace, are essential to ensure the effectiveness of the preventive strategy.

## Conclusion

Our study highlights the significant occupational risks present in autopsy rooms, encompassing biological, physical, chemical, and organizational risks. These risks place workers at considerable hazard if not effectively managed, underscoring the need for comprehensive preventive measures. Hospital administrators, particularly the director, must take proactive responsibility for workplace health and safety to protect their staff.

Addressing these risks requires a thorough assessment of high-risk environments through a multidisciplinary approach. This process identifies vulnerabilities, prioritizes

interventions, and allocates resources effectively. Implementing measures like advanced ventilation and regulatory compliance is crucial to mitigate these risks.

Promoting a safety-first culture through education and training is essential. Workers need the skills to manage risks, follow protocols, and use protective equipment effectively. These strategies ensure safety, compliance, and operational efficiency while reinforcing a commitment to workplace health and well-being.

## Competing interests

The authors declare that they have no competing interests.

**Table 1:** Summary of potentially hazardous situations identified in the autopsy room.

<p><b>Work organization risks: psychosocial risks (PSR) and musculoskeletal disorders (MSD)</b></p> <p>Handling heavy loads (83.2%)                      Postural constraints (64.9%)                      Job dissatisfaction (57.9%)                      Stress (78.9%)                      Internal violence (15.8%)                      External violence (55.3%)</p>
<p><b>Physical risks</b></p> <p>Handling vibrating devices (55.5%)                      Exposure to noise nuisances (76.3%)                      Thermal discomfort (50%)                      Inadequate lighting (76.3%)</p>
<p><b>Safety risks</b></p> <p>Unorganized waste collection (47.4%)                      Blood exposure accidents (BEA) (57.9%)                      Fire risks (56%)</p>
<p><b>Chemical risks</b></p> <p>Handling of formaldehyde (76.3%)</p>

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