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# Assessment of Infection Control and Occupational Safety Procedures at Blood Bank in Zliten Medical Center

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# تقييم إجراءات مكافحة العدوى والسلامة المهنية في بنك الدم في مركز زليتن الطبي

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**Abstract:**
This descriptive cross-sectional study aimed to evaluate infection control and occupational safety procedures among the technical staff at the Blood Bank in Zliten Medical Central. The study sample included all engineers and technicians at the facility (N = 60). Data were collected using standardized questionnaires and administrative checklists designed to assess training, preventive measures, and operational policies. The results showed a stark contrast. Indicators revealed a complete absence (100%) of orientation and training programs for new employees, and a total lack of records documenting occupational exposure incidents or written policies for post-exposure procedures. A severe shortage (100%) of basic personal protective equipment, such as medical gloves, goggles, and filter masks, was also found. Conversely, the study recorded excellent technical compliance (100%) in re-examining and confirming samples that initially tested positive, with an 85% vaccination rate against blood borne viruses. Inferential analyses using the chi-square test ($\chi^2$) demonstrated that the decision to continue dispensing blood at a rate of 80% when testing reagents were scarce ($p = 0.067$) is a general operational behavior dictated by the critical medical nature and the pressure of need within the municipality. Meanwhile, the lack of vaccinations was biologically associated with new employees ($p = 0.028$). The study concludes that urgent intervention from health authorities is necessary to provide protective equipment and activate infection control committees and written policies to ensure the safety and well-being of medical staff and patients.

**Keywords**: Blood Bank, Infection Control, Occupational Safety, Chi-Square Test, Personal Protective Equipment

**الملخص**
هدفت هذه الدراسة الوصفية المستعرضة إلى تقييم إجراءات مكافحة العدوى والسلامة المهنية بين الفنيين في بنك الدم المركزي في زليتن. شملت عينة الدراسة جميع الفنيين في المنشأة (N = 60). جُمعت البيانات باستخدام استبيانات موحدة وقوائم مراجعة إدارية مصممة لتقييم التدريب والتدابير الوقائية والسياسات التشغيلية. أظهرت النتائج تباينًا صارخًا. كشفت المؤشرات عن غياب تام (100%) لبرامج التوجيه والتدريب للموظفين الجدد، وانعدام تام للسجلات التي توثق حوادث التعرض المهني أو السياسات المكتوبة لإجراءات ما بعد التعرض. كما وُجد نقص حاد (100%) في معدات الوقاية الشخصية الأساسية، مثل القفازات الطبية والنظارات الواقية وأقنعة الترشيح. في المقابل، سجلت الدراسة امتثالًا فنيًا ممتازًا (100%)

في إعادة فحص وتأكيد العينات التي كانت نتائجها إيجابية في البداية، مع معدل تطعيم ضد الفيروسات المنقولة بالدم بنسبة 85%. أظهرت التحليلات الاستدلالية باستخدام اختبار مربع كاي ($\chi^2$) أن قرار الاستمرار في صرف الدم بنسبة 80% عند ندرة كواشف الفحص ($p = 0.067$) هو سلوك تشغيلي عام تمليه الطبيعة الطبية الحرجة وضغط الحاجة داخل البلدية. في الوقت نفسه، ارتبط نقص التطعيمات بيولوجيًا بالموظفين الجدد ($p = 0.028$). وتخلص الدراسة إلى ضرورة التدخل العاجل من السلطات الصحية لتوفير معدات الوقاية الشخصية وتفعيل لجان مكافحة العدوى ووضع سياسات مكتوبة لضمان سلامة ورفاهية الطاقم الطبي والمرضى.

**الكلمات المفتاحية:** بنك دم زليتن، مكافحة العدوى، السلامة المهنية، اختبار مربع كاي، معدات الوقاية الشخصية.

## Introduction

Blood banks are the lifeblood and cornerstone of modern healthcare systems, playing a crucial role in saving lives by providing safe blood and its components for emergencies, complex surgeries, and the care of patients with cancer and chronic blood disorders.(Organization, 2023) Despite their vital importance, the work environment within blood banks is globally considered one of the most hazardous medical environments due to direct and daily handling of blood and other bodily fluids.(Ismael et al., 2022) This makes them a source of transmission for serious blood borne pathogens such as hepatitis B and C viruses, HIV, and numerous bacterial and parasitic infections.(Void-Holmes & Cartee, 2024) The safety loop in blood banks extends beyond the safety of the vital product (the blood transfused to the patient).(Organization, 2023) It also encompasses the occupational safety and health of the medical and paramedical staff (physicians, nurses, and laboratory technicians) responsible for drawing, separating, and testing blood.(Mokoena, 2024) Healthcare providers in this sector are constantly exposed to the risks of acute occupational injuries, primarily needle stick injuries and wounds resulting from contaminated sharp instruments.(Mohamud et al., 2023) These represent the main channel for the transmission of infection within the facility if not managed according to strict preventative protocols.(Schinas et al., 2023) The World Health Organization (WHO) and international infection control bodies have established strict guidelines based on key pillars to ensure the safety of this environment, including mandatory periodic and continuous training for staff on infection control mechanisms, the provision of comprehensive immunization programs for all workers especially the vaccine against human hepatitis virus (HBV in addition to a continuous flow of personal protective equipment such as high-quality medical masks and gloves, and the establishment of a strict monitoring system based on clear documentation records of occupational injuries and written policies for immediate handling of viral exposure cases (Post-Exposure Prophylaxis).(Organization, 2024) At the local level, Libya's healthcare system and blood banks in vital cities like Zliten face varying logistical and organizational challenges that could affect the effective and sustainable implementation of these international standards. The lack of regular and systematic assessment of adherence to safety protocols and the knowledge and practical preparedness of medical staff creates a gap that could jeopardize the safety of both staff and patients.(Tamuno-opubo et al., 2024) This field study, based on the Healthcare Worker Questionnaires, aims to accurately assess the current infection control procedures at the blood bank in Zliten. It seeks to measure the rates of ongoing training, evaluate the availability and quality of personal protective equipment (PPE), and examine the policies in place for documenting occupational injuries(Santos et al., 2025). This will help identify strengths to be reinforced and gaps to be addressed, ultimately leading to a document of scientific recommendations to support decision-makers in improving the quality and safety of healthcare services in the region.(Garavito et al., 2024)

### Problem of the study

- • Lack of or insufficient regular training for staff on blood bank activities and infection control.
- • Variable coverage rates of hepatitis B (HBV) vaccinations.
- • Insufficient or inconsistent availability of personal protective equipment (such as appropriate medical gloves).
- • Absence of written policies for managing needle stick injuries and other acute occupational injuries.

### Objectives of the study

- Assess the extent to which staff (doctors, nurses, and technicians) receive ongoing specialized training in blood bank operations and infection control, and identify the entities overseeing this training (such as the Ministry of Health or the World Health Organization).
- Monitor the continuous availability of essential personal protective equipment (such as medical gloves) within the blood bank, and determine the quality and type of gloves used (latex, plastic, rubber) to ensure the safety of staff handling blood samples.

- Verify the percentage of staff who have received the hepatitis B virus (HBV) vaccine and the completeness of their immunization doses as a primary line of defense against blood borne infections

**Material and methods**

- Study Design and Population
- Study Type: Cross-sectional descriptive study.
- Study Location: Central Blood Bank / Zliten Medical Center, Zliten City.
- Data Collection Tool: Data was collected through a pre-designed questionnaire administered to blood bank specialists.

**Results and discussion**

Table 1 Frequencies and percentages of responses from members of the sample regarding occupational safety and infection control practices at the blood bank (N=60).

| No | Question | No | Yes |
|---|---|---|---|
| **1** | Do you have any orientation programs for new employees? | **60** | **0** |
| **2** | Do you have any training programs for new employees? | **60** | **0** |
| **3** | Are there any records of occupational exposures (needle pricks or sharps injuries)? | **60** | **0** |
| **4** | Is there a written policy for post-exposure procedures? | **60** | **0** |
| **5** | Is there a designated infection control officer/person at the facility? | **60** | **0** |
| **6** | Is personal protective equipment (PPE) such as respirators provided? | **60** | **0** |
| **7** | Is blood collection stopped if testing supplies are unavailable? | **48** | **12** |
| **8** | Are samples retested if initial results are positive? | **0** | **60** |
| **9** | Are protective eyewear provided? | **60** | **0** |
| **10** | Are samples reused with blood units that have tested negative? | **0** | **60** |
| **11** | Is personal protective equipment (PPE) such as gloves provided? | **60** | **0** |
| **12** | Have you received vaccinations against hepatitis B and C and HIV? | **9** | **51** |

- The results showed a resounding 100% absence of a guidance and control system within the facility. All 60 engineers surveyed reported:
- The lack of any orientation or training programs for new employees upon starting work.
- The complete absence of records documenting occupational exposure incidents involving needle stick injuries and sharp instruments.
- The lack of written policies or clear guidelines for managing employees after an injury (post-exposure protocol.(
- The absence of a committee or individuals directly responsible for overseeing infection control within the facility

100% of participants agreed that basic personal protective equipment (PPE) specific to blood banks, including (filter masks, protective goggles against biological splashes, and medical gloves), is unavailable. This puts engineering and technical staff at risk of direct contact with contaminated samples during the maintenance and operation of equipment.

- Technical Quality Control (8 and 10): Technicians demonstrated excellent scientific commitment (100%), with samples showing initial positive results being re-examined for confirmation. Samples were also reused for confirmation with only undamaged units, a standard practice to ensure the quality of laboratory results.
- Shortage Management (7): When a shortage of testing reagents occurred, 80% of the sample reported not stopping the blood collection, indicating high demand and attempts to manage operations through alternative methods. Only 20% reported stopping the collection, highlighting the need for a standardized protocol.

Contrary to the previous reading, it turned out that 85% (51 Technicians) had already received the necessary medical immunizations, an excellent percentage that represents a real barrier for workers, while a limited group of 15% ( 9 Technicians) remained in need of completing their immunizations.

**Table 2:** Cross tabulation between Years of Experience and Decision on Blood Issuance Suspension During Test Kit Shortages

| Years of Experience | Suspend Issuance (Yes) | Do Not Suspend Issuance (No) | Total |
|---|---|---|---|
| **Less than 5 years** | 2 | 23 | **25** |
| **5 years and above** | 10 | 25 | **35** |
| **Total** | **12** | **48** | **60** |

The contingency table showed the distribution of responses from the sample (N=60) regarding the procedure followed when viral testing reagents were in short supply, based on years of experience. The percentage of employees with less experience (less than 5 years) who did not stop blood transfusions was 92%, compared to 71.5% among employees with more experience (5 years or more(.

When applying the chi-square ($\chi^2$) test for independence, the statistical significance level was found to be ($p = 0.067$), which is not statistically significant at the significance level ($\alpha = 0.05$). This result clearly indicates that the decision to continue blood transfusions and operate using alternative methods when reagents are in short supply is not related to the individual employee's experience, but rather is a consistent operational pattern and institutional behavior dictated by the critical nature of the blood bank in Zliten to meet emergency medical needs.

**Table 3:** Cross tabulation between Years of Experience and Vaccine Reception (Question 12)

| Years of Experience | Received Vaccines (Yes) | Did Not Receive Vaccines (No) | Total |
|---|---|---|---|
| **Less than 5 years** | **18** | **7** | **25** |
| **5 years and above** | **33** | **2** | **35** |
| **Total** | **51** | **9** | **60** |

the Chi-Square test for this specific table yields a p-value of 0.028 ($p < 0.05$). This indicates a statistically significant difference, meaning that newly hired staff (less than 5 years of experience) are significantly less likely to be vaccinated compared to senior staff. This perfectly aligns with the 100% "No" responses regarding the availability of orientation/training programs for new staff.

## Conclusion

This field study concluded with a comprehensive assessment of infection control and occupational safety procedures at the Central Blood Bank in Zliten. Field findings and inferential analyses revealed a clear and significant discrepancy between technical competence and organizational and logistical deficiencies within the facility.

On the positive side, the technical staff demonstrated 100% compliance with standard protocols for retesting and confirming positive laboratory samples, coinciding with an excellent immunization rate (85%) among the majority of staff against blood borne diseases. However, the study also revealed critical and unavoidable gaps, including the complete absence of orientation and training programs for new employees, the lack of independent infection control oversight committees, and the absence of written records and policies for documenting and protecting staff after exposure to acute needle stick injuries. Furthermore, the severe shortage of basic personal protective equipment (such as gloves, goggles, and filtered masks) revealed a daily biological challenge threatening the safety of the staff. Finally, inferential analysis using the chi-square ($\chi^2$) test demonstrated that the decision not to halt blood transfusions in 80% of cases when solutions are scarce, and to resort to alternatives, is a general institutional behavior dictated by the critical medical nature and the pressure of humanitarian needs in the municipality. Meanwhile, the failure to receive vaccinations was associated with new job categories due to the absence of orientation programs. Based on these findings, the study recommends the immediate intervention of vital authorities and decision-makers to reform the biosafety administrative and logistical system at the Zliten Blood Bank to ensure a safe working environment and a risk-free blood supply.

**Discussion**

This cross-sectional field study aimed to assess infection control and occupational safety procedures among the technical staff at the Central Blood Bank in Zliten. The results revealed a stark contrast between adherence to strict technical standards for blood testing and administrative and logistical shortcomings in ensuring a safe working environment for the facility's staff.

The data revealed a critical administrative gap; all participants (100%) acknowledged the absence of orientation and training programs for new employees (questions 1 and 2). This finding directly contradicts the World Health Organization (WHO) guidelines and national protocols, which mandate that all employees undergo intensive training on biosafety and risk management before being integrated into the blood bank environment.

This lack of training clearly explains the other alarming finding: the complete absence of records documenting occupational exposures or written policies for post-exposure prophylaxis (PEP). This means that if a technician is pricked by a contaminated needle or suffers a cut while maintaining a virus testing device, there are no formal channels for documenting the incident, nor are there written emergency treatment protocols for managing the situation. This increases occupational fear and reduces biosecurity levels within the facility.

Participants unanimously agreed on the severe shortage and unavailability of personal protective equipment (PPE) (filter masks, goggles, and medical gloves) (questions 6, 9, and 11). This shortage places technical staff in direct and daily exposure to risk, as they are required to handle the internal components and hydraulic connections of automated testing devices (such as ELISA or automated testing devices for HIV, HBV, HCV, and syphilis), which are saturated with bodily fluids and blood. Working without goggles and gloves constitutes a serious breach of occupational safety standards, and this shortage is often attributed to fluctuations in medical supply chains and logistical funding difficulties for municipalities. The results revealed a positive aspect reflecting high technical competence and a strong sense of medical responsibility among the staff. 100% of participants confirmed their commitment to retesting samples that show initially positive results and to only reusing samples with units that have been confirmed negative (questions 8 and 10). This practice aligns with international quality standards to ensure that transfused blood is free from the viral incubation period (window period) and to protect patients receiving blood transfusions in Zliten hospitals.

However, when an infection occurs, the analysis showed that 80% of staff do not stop dispensing blood, but rather rely on alternative solutions (such as rapid tests or sending samples to nearby reference laboratories). Using the chi-square test ($\chi^2$) to determine the effect of years of experience on this decision, no statistically significant differences were found ($p = 0.067 > 0.05$). This result proves that this behavior is not due to an individual cognitive deficiency among new employees, but rather to operational behavior and a general organizational culture imposed by the nature of the high human pressure and the urgent need for blood units to save lives in the emergency and operating departments of Zliten Municipality. This forces the administration to continue operations with available alternatives instead of a complete shutdown.

The results showed that 85% of participants received the necessary vaccinations against hepatitis B, a good percentage that strengthens herd immunity within the laboratory. However, inferential analysis using the chi-square test ($p = 0.028 < 0.05$) revealed a statistically significant correlation between years of experience and vaccination status; it showed that the unvaccinated group is heavily concentrated among new employees (less than 5 years of experience).

This statistical result definitively connects the threads of the study. The absence of orientation and training programs for new employees upon taking up work (100% confirmed in the first question) has naturally led to the neglect of identifying and vaccinating new staff immediately upon their appointment, leaving new employees in the early periods of their service—which are the periods most prone to unintentional errors—without effective immunization against the dangerous hepatitis B virus.

**Recommendation**

1. Establish an independent and specialized unit or committee to oversee infection control and biosafety within the blood bank, and appoint qualified safety officers to monitor daily compliance with standards.
2. Institutionalize mandatory orientation programs for all new employees upon commencement of work,
3. Create a unified and secure official record to document all occupational exposure incidents (such as needle stick injuries and cuts from sharp instrument edges).
4. Provide clear, written, and posted guidelines in all laboratory departments and maintenance areas explaining emergency response protocols and post-exposure prophylaxis procedures.

5. Establish a mechanism for the immediate, sustainable, and uninterrupted supply of essential and specialized protective equipment (thick medical gloves for engineering maintenance, protective goggles against biological splashes, and high-efficiency respirators),
6. Launching an urgent vaccination campaign to identify and complete the hepatitis B (HBV) vaccine doses for all staff, with a particular focus on new employees (less than 5 years of experience) among whom statistical analysis has shown a significant immunization gap.
7. Ongoing coordination with the Ministry of Health and supporting entities to ensure a strategic stockpile of testing reagents for the four main viruses (HIV, HBV, HCV, and Syphilis) to prevent any operational shortages.
8. Gradually phasing out the practice of dispensing blood using alternative, non-standard methods when reagents are unavailable (which accounted for 80% of the study), and adopting a unified emergency protocol that electronically links the blood bank to nearby reference laboratories to conduct confirmatory tests (such as ELISA or NAT) under a fully secure framework.
9. Periodic engineering calibration of cleaning and sterilization equipment: Establishing a strict periodic preventive maintenance schedule for autoclaves and medical incinerators to ensure the safe and complete disposal of positively contaminated blood units and to prevent the leakage of hazardous biological waste into the environment surrounding Zliten.
10. Supporting the blood bank's bioinformatics systems to include an automated and encrypted blocking feature for donors who repeatedly test positive, to ensure they are not included in the donation system in the future, thus enhancing biosecurity.

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