

## Evaluation of Laboratory Biosafety in Khartoum State Primary Health Care Centers, Sudan

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### Abstract

**Background:** This study was designed to assess the biosafety precautions in primary care health centers in Khartoum state. Diagnostic laboratories in seven localities were selected by stratified simple random sampling technique was assessed by using a designed questionnaire and a check list.

**Results:** Among 33 laboratories, 0 (0.0%) were appointing a biosafety officer. 0 (0.0%) supplied with an alarm system, have trained personnel, and have fire exit. Provision of personnel protection, 12 (36.4%), always wearied laboratory coat, 6 (18.2%) personnel used gloves with every procedure, 25 (75.8%) washed their hands regularly. All laboratories, 33 (100%) have cleaning personnel, and in 21 (63.3%) removal of infectious material waste was done daily. Vaccination program for hepatitis and tuberculosis were identified in 16 (48.5%) of the laboratories.

**Conclusion:** There is a great need to establish and implement biosafety precautions program in governmental reference primary health care laboratories.

### Introduction

Laboratory services are essential health care services. In developed countries, laboratory-aided preventive, diagnostic and prognostic testing plays a central role in modern medicine. Similar advantages should be possible in developing countries, but this will require the application of appropriate technologies that optimize the use of limited resources [1].

Laboratory Biosafety is described as a safe method for managing infectious agents in laboratory environment, where they are handled and maintained [2].

Implementation of biosafety precautions decreases the exposure to the risk factors inside the laboratory. In 1949, Sulkin and Pike published the first serious surveys of laboratory associated infections [3].

A study conducted by Adel Hussein, a total number of 190 laboratories was investigated. The study found that only 32 (16.8%) of laboratories appointed biosafety officers [4]. So our study was specific for governmental primary health care centers.

Another study done in three teaching hospitals in Khartoum state determine the seropositivity of hepatitis B infection, associated risk factors and history of vaccination among staff Participants comprised 245 randomly selected hospital staff; 12 (4.9%) reacted positively for HBsAg [5].

### Materials and Method

**Study design:** Prospective Cross-sectional study.

**Study setting:** The study was conducted in Khartoum state governmental reference primary health care laboratories, Sudan.

**Study period:** June 2013-March 2014.

**Study subject:** Diagnostic laboratories in Khartoum state primary health care governmental reference centers.

**Sample size:** 5 primary health centers laboratories from each 7 locality in Khartoum state Sudan were investigated randomly.

### Results

#### Demographic information

A total number of 33 reference governmental Primary Health Care (PHC) laboratories in Khartoum state have been investigated about their compliance with standard biosafety precautions during study period using questionnaire and checklist. These laboratories divided into seven localities: Khartoum, GabalAwelya, Bahri, Omdruman, Umbada, Karary and East Nile state as the following.

All this laboratories are public governmental reference PHC as provided care coverage for state localities. Total staff numbers in these centers were 181.27 (81.8%) laboratories work two shifts and 6 (18.2%) work one shift. Gender ratio between staff was 3:1 female / male, their age between 22-59 years olds.

#### Biosafety results

**Biosafety level determination:** 25 (75.8%) of laboratories are dealing with high risk of life threatening disease like screening test to detect tuberculosis. They are located in the same building of their centers.

**Procedure:** The standard operating procedures (SOPs) for clean-up of spills are present in 5 laboratories (15.2%) of all laboratories. Only 6 (18.2%) have a system of reporting laboratory accidents.

**Standard microbiological practices:** Three laboratories (9.1%) have international biohazard warning symbols and a sign. Entry to lab is restricted in only 2 laboratories (6.1%). Self-closed doors in 5 (15.2%) and (3.0%) has been provided with windows fitted with arthropod-proof screen. Most working staff interviewed in this study was complained from the working temperature. About 23 (69.7%) suffering from insufficient comfortable working temperature especially Sudan is tropical contrary and mean of room temperature in summer without air condition is 34°C. 5 (15.2%) laboratories had separated room for sampling and separated room for sample isolation.

Toilets and washing facilities are provided separately for both male and female staff in 5 (15.2%) laboratories. Drinking water is available for staff in 9 (27.3%) and only one laboratory (3.0%) has staff room for eating and drinking.

**Safety equipment's:** Regarding personnel protections for staff, there is no safety glasses, face shields or cloth for chemical and radioactive materials, personal clothing inside laboratory found in 33 (100%). Personal Close-toed foot wear found in only 3 (9.1%) of investigated subjects. Automatic pipette usage in 32 (97%), but only 5 subjects (15.2%) have written procedures for the clean-up of spills, 8 (24.2%) have written SOPs (standards operation procedures) and in 18 (54.5%) lab equipment properly labeled.

All subjects use safe needle devices in collection of samples but there is no biosafety cabinet, screw capped tubes and bottles were used in 31 (93.9%), autoclave found in five centers (15.2%), only one incinerator (3.0%), plastic disposable Pasteur pipette were used in 28 (84.4%) laboratories, sharp disposal container in 27 (81.8%) and there is no chemical waste container nor radioactive waste container.

**Laboratory facilities:** None of these laboratories have a biosafety officer nor did any of the staff have laboratory biosafety training. 32 (97.0%) use to clean benches during the day and between shifts. Wearing of lab coat at 12 (36.4%) always wear (all shift), 20 (60.6%) some time (during shift) and 1 (3.0%) not found. When investigated about gloves worn in all lab procedures resulted in 6 (18.2%) Usually (all shift), 21 (63.6%) some time (during shift) and 6 (18.2%) work without glove.

There is no any type or trace for arthropod and rodent control programme and no training in response to emergency nor personnel training in using and transporting compressed and liquid gases although compress gas cylinders, high pressure valves found in 14 (42.4%). 17 (51.5%) of the investigated labs stated that they are covered by appropriate medical services provided, but no one had personnel trained in fire emergencies.

Reporting of laboratory accidents were found at 6 (18.2%) laboratories. All 33 (100%) centers have First aid room use in emergency situation to serve injuries and work accidents for medical staff but there is no Personnel trained in fire emergencies. On the other hand, lack of mechanism for reporting laboratory accidents 27 (81.8%) lead to more infection and injuries among medical staff. Cleaning personnel found in 33 (100%) centers but removal of the waste of infectious materials daily in 21 (63.6%), 7 (21.2%) every one week, 5 (15.2%) every two weeks. Engineering and maintenance services are available in 16 (48.5%) laboratories. Hand wash basin provided in 29 (87.9%). No fire alarm system and no fire emergency exist. Only one

center (3.0%) has fire extinguisher, gas cylinder and liquid petroleum gas tank kept away from sources of heat in 28 (84.4%) laboratories. Four laboratories (12.1) have their switches of lighting placed outside the building.

**Immunization:** 16 (48.5%) laboratories had hepatitis B virus vaccination programme, 4 of them (12.1%) applied BCG vaccine and 3 (9.1%) vaccinate the staff against Tetanus.

## Discussion

This study assessed the laboratory biosafety of governmental reference PHC Khartoum state and their compliance to standard biosafety precautions.

The role of laboratory biosafety officers is very important to supervise and train staff in this area. There were no appointed biosafety officers in all investigated laboratories and so there were no staff training. This may explain the low number 6 (18.2%), of laboratories reporting accidents and which lead to more complications such as infection and injuries among the staff. In Japan, the laboratory biosafety system improved very much after a study in 2004 suggested that biosafety systems are lacking or inadequate in clinical laboratories in Japan and must be established at the earliest possible opportunity [6].

Similar situations are seen in developing countries such as in Pakistani. A study done by Nasim et al. investigated laboratory biosafety perception and practices during routine work in clinical laboratories [7]. They concluded that laboratory technicians in Pakistan lack awareness of good laboratory practices and biosafety measures and also face a lack of resources.

The study identified the unsafe environment as there were no any type or trace for arthropod and rodent control programme. Services available for medical staff and laboratory were poor, and a lot of laboratory supervisors, (69.7%) complain from instable laboratory working temperature.

Only 5 (15.2%) of these laboratories were provided with specific toilet and washing facilities separately for both male and female staff and one laboratory (3.0%) has staff room for eating and drinking. In 17 centers (51.5%) laboratory staff eats and drink inside laboratory. It is well known that availability of these services in working area, such as PHC centers will improve environment, and increase the compliance of medical staff towards biosafety precautions. On the other hand, lack of facilities and services (toilet and washing facility, staff room for eating and drinking) do not help in improvement of behavior and attitude of staff regarding biosafety.

There is no training in response to emergency or personnel training in using and transporting compressed and liquid gases. In addition to that there was full absent of fire alarm system in targeted reference PHC Khartoum state. The staff is well aware of these precautions, but they are not following policies as a result of the absence of biosafety officer due lack of concern towards this job. The percentage of laboratory accident recorded in work site increased from (14.7%) to (18.2%) in comparison to Adel Hussein Elduma study [4].

The wide range usage of automatic pipette (97%) indicates improvement of applying biosafety material. They were used before to deal with pipetting by mouth for sample collection. Now the staff members still use mouth pipetting for chemicals like Drabkin, which contain toxic material and diluents in 20 (60.6%) laboratories [8].

Mouth pipetting for samples and chemicals is forbidden in all laboratories in Khartoum state.

Provision of personal protective equipment is very important. Attitude like wearing lab coats, using gloves, hand wash, safety glasses, face shields and close-toed foot wear will help to protect workers and decrease injuries and infection in the working area. The current situation tells that the personnel protections is minimal for staff as there is no safety glasses, face shields nor clothes for chemical and radioactive materials if there is applicable investigations required. Street clothing inside laboratory found in 33 (100%), and most of the laboratory staff put their bags on working benches and tables where chemical reagents and supplies are present [9].

There is a significant improvement in staff vaccination programs during last five years especially against hepatitis B virus. We recognized increase of laboratories with programme for hepatitis B virus vaccination from only (10%) in the year 2009 [4], to (48.5%). The increase in number of vaccinated staff is not only among laboratory staff, it is in all health care workers, like nurses and doctors. This can be explained by the improvement in blood screening facilities which identify many cases and prove that one of the major threats to health care workers is Hepatitis B virus. There is a moderate increase in BCG vaccination programme (12.1%) in investigated centers now, compared with (6.2%) in year 2009.

## Conclusion

The results of this study provided valuable information regarding the laboratory biosafety implementations in governmental references PHC, in Khartoum state.

The standard of laboratory biosafety at the included center's identified a low level of biosafety procedures, due to absence and/or not appointing a biosafety officer. The personnel lack training in this field and laboratory accidents are not properly reported.

The attitude of staff at these centers is not good and this is due to absence of services facilities, such as separate toilets, private restroom for changing clothes and eating. Attitude like wearing lab coats, using gloves, hand wash, Safety glasses, face shields and close-toed foot wear will help to protect workers.

Regarding biosafety precautions in governmental reference PHC Khartoum state laboratories there is great need to establish fire alarm system, arthropod and rodent control programme.

## Recommendation

-Establish fire alarm system in primary health care centers in Khartoum state Sudan.

- Start biosafety training programme and appoint biosafety officer in each center and organizing workshops, conferences and training courses for staff improvement.

- Increase laboratory personnel awareness towards biosafety principles.

- Improve working environment conditions and provide services to staff.

- Expand in immunization programme to include all laboratories in primary health care centers in Khartoum state Sudan.

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