

Control Of Infectious Diseases And Safety Measures In Laboratories In The Government Health Sector In The Kingdom Of Saudi Arabia

Suhail Ali Alsahabi¹, Dhamin Ali Khalaf Alanazi², Daniyah kheder ALGhamdi³, Rawan Abdulrahman Almutairi⁴, Norah Saud Almubaddil⁵, Ageel Mohammed Alrbaee⁶, Adnan Ahmed Alssaygh⁷, Majed Abdullah Ahmed Alshehri⁸, Abdulrahman Hassan Halawi⁹, Abdullah Mohammed Hijri¹⁰, Naif Menahi Rashdan AL moteri¹¹, Abdullah Mohammad Al Marshad¹², Abeer Ahmed Mubarak¹³, Abdullah Munaj Alshalawi¹⁴, Fahd Hezam F Alrwais¹⁵, Saad Fahad Alharbi¹⁶, Mousa Ahmed Al Rabaee¹⁷, Mazyed Jazel Nahi Alotaibi¹⁸

1. Suhail Ali Alsahabi, Laboratory, Almuzahmiah General Hospital, Ministry of Health, Kingdom of Saudi Arabia.
suhailali.sm11@gmail.com
2. Dhamin Ali Khalaf Alanazi, Laboratory, Almuzahmia General Hospital, Ministry of Health, Kingdom of Saudi Arabia.
Dhamin9@gmail.com
3. Daniyah kheder ALGhamdi, Laboratory, Almuzahmia General Hospital, Ministry of Health, Kingdom of Saudi Arabia.
t.t.rgg@hotmail.com
4. Rawan Abdulrahman Almutairi, Laboratory, Almuzahmia General Hospital, Ministry of Health, Kingdom of Saudi Arabia. Rawamu980@gmail.com
5. Norah Saud Almubaddil, Laboratory, Almuzahmia General Hospital, Ministry of Health, Kingdom of Saudi Arabia.
norahalmubaddil@gmail.com
6. Ageel Mohammed Alrbaee, Laboratory, Almuzahmiah General Hospital, Ministry of Health, Kingdom of Saudi Arabia. ageel999@hotmail.com
7. Adnan Ahmed Alssaygh, Laboratory, Almuzahmia General Hospital, Ministry of Health, Kingdom of Saudi Arabia.
adnanalssaygh@gmail.com
8. Majed Abdullah Ahmed Alshehri, Medical Laboratory, Regional laboratory-Aseer, Ministry of Health, Kingdom of Saudi Arabia. mdx4449@gmail.com

9. Abdulrahman Hassan Halawi, Laboratory, Riyadh Regional Laboratory, Ministry of Health, Kingdom of Saudi Arabia.
zhkhma1@gmail.com
10. Abdullah Mohammed Hijri, Laboratory, Jazan Regional laboratory, Ministry of Health, Kingdom of Saudi Arabia.
abdullahejri@hotmail.com
11. Naif Menahi Rashdan AL moteri, Lab Tecinician, AL artawyah General Hospital, Ministry of Health Kingdom of Saudi Arabia. Naaaif265@gmail.com
12. Abdullah Mohammad Al Marshad, Lab Specialty, AL artawyah General Hospital, Ministry of Health Kingdom of Saudi Arabia. diib@hotmail.com
13. Abeer Ahmed Mubarak, Lab Tech, Eman General Hospital, Ministry of Health, Kingdom of Saudi Arabia.
abajhrz@moh.gov.sa
14. Abdullah Munaj Alshalawi, Medical Laboratory Specialist, Ministry of Health, Kingdom of Saudi Arabia. Abo-monje@hotmail.com
15. Fahd Hezam F Alrwais, Medical Laboratory, Riyadh Third Cluster, Ministry of Health, Kingdom of Saudi Arabia.
Fahdhw1@gmail.com
16. Saad Fahad Alharbi, Speciality Laboratory, Al Shabikiya Health Center, Ministry of Health, Kingdom of Saudi Arabia.
saadfa2@moh.gov.sa
17. Mousa Ahmed Al Rabaee, Laboratory, regional laboratory in Asir, Ministry of Health kingdom of Saudi Arabia.
malrabaee@moh.gov.sa
18. Mazyed Jazel Nahi Alotaibi, Laboratory Specialist, Marat General Hospital, Ministry of Health, Kingdom of Saudi Arabia. mazyeda@moh.gov.sa

Abstract

Health professionals in medical laboratories face a range of occupational risks due to their constant exposure to hazardous biological agents, which puts them at an increased risk of contracting infections linked to biological laboratories. A number of published reports have demonstrated the risk that laboratory-associated infections of newly or re-emerging diseases pose to medical laboratory personnel in general and lab workers in particular. These workers may be at heightened risk of contracting a variety of infectious diseases, such as HIV, HBV, and HCV. The purpose of this study is to examine the management of infectious diseases and demonstrate safety protocols in laboratory settings within the Kingdom of Saudi Arabia's public health

system. It also seeks to investigate public knowledge about laboratory biosafety.

Keywords: infectious diseases, safety measures, laboratory, government health, KSA.

Introduction

In general, laboratory personnel encounter numerous occupational hazards at work, and if sufficient preventive protective measures are not implemented, their health and safety may be seriously jeopardized. These risks may be biological, chemical, or physical. Occupational dangers are common, and workers' health and safety could be seriously jeopardized if the proper safety precautions are not taken. Among those employees are those in clinical laboratories, who deal with a variety of dangers and hazards on a regular basis, including those from centrifuge accidents, infectious aerosols, spills, broken glass, cuts from sharp instruments, and injuries from needle sticks. For instance, there is a higher chance that clinical laboratory employees will contract bacterial (like TB) and viral (such hepatitis B and C, corona virus, and HIV), all of which can spread by percutaneous injury. Medical laboratory personnel were among the health care workers who were thought to have a high risk of laboratory acquired tuberculosis infection (Hofmann et al., 2017).

Safety can be described as a means of averting mishaps or minimizing potential harm to individuals or property. Any medical laboratory should prioritize health and safety due to the possible dangers associated with handling infectious and dangerous materials. By encouraging appropriate laboratory techniques and providing the necessary safety equipment, these dangers can be reduced or completely eliminated. Safety training is necessary to establish excellent safety practices, and while laws govern certain areas of health and safety in the workplace, conditions in laboratories differ widely from one another. It is the employer's and all employees' obligation to ensure laboratory safety (Ziara, 2017).

Health professionals in medical laboratories face a range of occupational risks due to their constant exposure to hazardous biological agents, which puts them at an increased risk of contracting infections linked to biological laboratories. A number of published reports have demonstrated the risk that laboratory-associated infections of newly or re-emerging

diseases pose to medical laboratory personnel in general and lab workers in particular. These workers may be at heightened risk of contracting a variety of infectious diseases, such as HIV, HBV, and HCV. Utilizing protective barriers like masks, gloves, gowns, aprons, or protective eyewear can lower the risk of infection in medical laboratories. These measures are part of good laboratory practices and universal precautions. Fit-tested respirators with an N-95 rating and biological safety cabinets for aerosol-generating manipulations with biosafety level 2 procedures should be used and inspected on a regular basis (Khasawneh, 2014).

Aim of the study

The purpose of this study is to examine the management of infectious diseases and demonstrate safety protocols in laboratory settings within the Kingdom of Saudi Arabia's public health system. It also seeks to investigate public knowledge about laboratory biosafety.

Objectives

1. To show safety measures in laboratories in the government health sector in KSA.
2. To explore general awareness of laboratory biosafety.
3. To know about emergency preparedness.

Literature Review

Biological sample infections and compromised equipment are among the everyday risks that clinical laboratory employees face. Research, for instance, indicated that employees in clinical laboratories have a higher chance of contracting viruses, including the Middle East Respiratory Syndrome (MERS-CoV), HIV, and hepatitis viruses (HBV and HCV). Furthermore, it has been demonstrated that healthcare personnel, including clinical laboratory staff, have a high rate of bacterial occupational infections. For instance, compared to the general population, clinical laboratory technicians had a roughly seven-fold increased chance of contracting tuberculosis infection in research carried out in the United Kingdom (Auta et al., 2017).

Needlestick injuries are one of the main ways that healthcare workers get infections. The literature indicates that the majority of hepatitis and HIV infections among healthcare workers are caused by needlestick injuries. Furthermore, most of these illnesses happen in developing nations. An examination of needlestick injuries revealed that injuries could

occur at any stage of the needle usage process. Major risk factors include, but are not limited to, recapping of the needle, job load, inadequate training, and disregard for safety precautions. Infections and needlestick injuries can be considerably decreased by requiring employees to adhere to protocols and practices for infection control, injury prevention, and the use of protective gear (Matsubara al., 2017).

Risk factors of infectious diseases

A variety of risk factors can lead to the development of an infectious disease. Man is a social animal who actively participates in social interactions, so the likelihood of contracting an infection is great. However, the infection is dependent on the individual's immunity, behaviour (such as using drugs or steroids, engaging in sports, eating poorly, etc.), and other external variables such as blood transfusions, medical transplants, etc. The aging population, urbanization, poverty, globalization, and illiteracy are socioeconomic and political variables that may also contribute to the spread of infectious illnesses. The social and economic spheres may be negatively impacted by the possibility of an infectious illness outbreak or its effects (Alanezi, 2017).

Tests and diagnosis

Finding the infectious agent is a necessary step in the diagnosis of an infectious disease. Various tests are employed in this procedure. Symptomatic diagnosis is the process of diagnosing a disease based only on its symptoms; further testing may be necessary to confirm the diagnosis. Microscopy, biochemical testing, and microbial culture are utilized in the diagnosis of infectious disorders. To determine the pathogens, common testing include blood, urine, faeces, and other samples. X-rays, PET (positron emission tomography), CAT (computerized axial tomography), nuclear magnetic resonance (NMR), and other methods are also employed in this procedure (Alanezi, 2017).

Disease Surveillance

Infectious illness outbreaks must be evaluated, anticipated, and mitigated, and this requires public health surveillance. An important factor in being ready for large gatherings (MGs) is surveillance. In order to establish priorities, determine when actions are needed, and assess those interventions' outcomes, health decision makers must have fast and reliable information about infectious disease episodes. Over the past twenty years,

researchers have underlined how critical it is to detect newly developing infectious illnesses and monitor the incidence of more established ones, as well as how critical it is to enhance public health monitoring. "Ongoing systematic data collection, analysis, and interpretation, closely integrated with timely dissemination of the resulting information to those responsible for preventing and controlling disease and injury" is the definition of public health surveillance (Chiolero & Buckeridge, 2020).

An important function of surveillance systems is to monitor infectious diseases that have pandemic potential (e.g., SARS and influenza), with timely detection of health events such as outbreaks, especially at mass gatherings (MGs). Traditional and disease-specific surveillance relies on passive routine reporting by health care facilities and diagnostic laboratories for structured predefined information regarding infectious disease events. However, this indicator-based surveillance (IBS) is inefficient because of limited resources, time, and reporting systems, which results in the incomplete reporting of data on emerging infectious diseases. Other methods of surveillance have emerged with advancements in computational sciences to complement the shortcomings of IBS and improve the timeliness and sensitivity of surveillance systems. Digital surveillance uses the internet, other computer-based systems, and emerging technologies for communications and diagnosis (Hayati et al., 2021).

Infection Prevention and Control in Healthcare System in KSA

In Saudi Arabia, infectious diseases have taken countless lives, despite the fact that most of them are treatable or preventable. The most common chronic infections that spread quickly among KSA residents are amoebic dysentery, chickenpox, and brucellosis, according to reports released by the Ministry of Health. An institution or healthcare facility may develop IPC quality assurance departments whose job it is to carry out infection control policies and procedures. IPC is a relatively new but developing field in Saudi Arabia, where the Saudi MOH is in charge of setting up a number of disease control and prevention centres across the country. For example, the establishment of the Command-and-Control Centre (CCC) aimed to improve infection prevention and build up methods to monitor infections both within the Kingdom of Saudi Arabia and globally. Hospital data is used by organizations like the Centres for Medicare and Medicaid to

monitor hospital performance for IPC-related issues. To identify and lower the risk of infection acquisition and transmission among patients, employees, and visitors, every Saudi healthcare facility is also required to plan, implement, and oversee an infection prevention and control (IPC) program. In all of its hospitals, the MOH helped to set up infection control services. Additionally, the MOH offers all healthcare personnel field epidemiology and in-house training on infection management. In order to meet significant domestic demand, the Saudi Council for Health Specialties also developed a specialized training centre in infectious disease in internal medicine and paediatrics (Colet et al., 2018).

Infection prevention and control in laboratory staff

A useful, evidence-based strategy to preventing unnecessary infections and potential dangers from harming patients and healthcare professionals is to implement infection prevention and control guidelines. It consists of a series of guidelines designed to lessen and avoid the harm that infectious agent exposure can cause to patients and healthcare professionals. The IPC program mandates that all laboratory and other healthcare professionals become familiar with both standard and transmission-based precautions. Hand hygiene, wearing personal protective equipment (PPE) such as masks, gowns, gloves, plastic aprons, face shields, and protective eyewear, handling sharp objects safely, frequent environmental cleaning, and waste management are some of the precautions that need to be taken. It should be made clear that infection prevention and control guidelines in the UK are primarily concerned with clinical work and the prevention of infection transmission on wards. Specialized nursing and medical workers make up the IPC team. Health and safety regulations are followed in UK clinical laboratories and other establishments where individuals could be exposed to biological agents. Other nations, like the Kingdom of Saudi Arabia, apply the IPC guidelines to clinical laboratories in addition to wards, and laboratory personnel is eligible to join the IPC team (Aldhamy et al., 2022).

Maintaining laboratory biosafety (bio-containment levels)

Despite being a long-standing notion, biosafety has just lately emerged as a crucial aspect of laboratory work. When working with harmful microorganisms, biosafety precautions are designed to minimize lab-associated infections and stop them from seeping into the surrounding environment. Biosafety

levels (BSLs) were created by the Centres for Disease Control and Prevention (CDC) and are used while working with microorganisms in the laboratory. The BSLs state that different levels of biosafety precautions should be taken depending on the type of work being done and how harmful the microorganisms being handled are. When working with pathogens that produce only mildly hazardous diseases or agents incapable of causing disease, BSL-1 stands for the precautions that must be followed. BSL-1 is commonly found in teaching labs that are physically connected to buildings and does not necessitate the development of dedicated facilities (Fig. 1) (Laith et al., 2022).

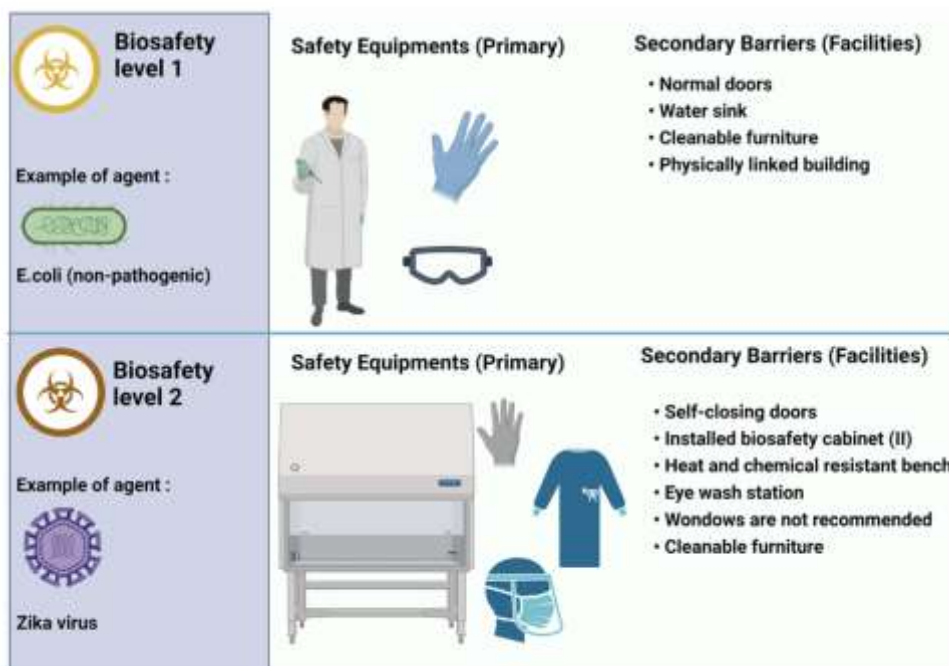


Fig. 1. Describes some of the measurements taken when practicing biosafety level 1 (upper part) and biosafety level 2 (lower part) (Laith et al., 2022).

When dealing with pathogenic agents that cause diseases that are somewhat dangerous, BSL-2 is used. BSL-2 lab personnel should have specialized training in handling pathogens, have very restricted lab access, and do the majority of their work in biosafety cabinets (Fig. 1). When dealing with organisms that cause severe and fatal infections, BSL-3 and BSL-4 are both used; BSL-4 has a greater risk of infection by aerosol route. BSL-4 pathogens are less well understood in terms of transmission and do not currently have any vaccinations or treatments. Special engineering and construction are needed for both BSL-3 and BSL-4 buildings, where the lab must be segregated and have limited access.

Furthermore, BSL-3 and BSL-4 mandate the employment of specific safety gear, such as full-body protective suits or other full-body protective lab attire (Fig. 2) (Laith et al., 2022).

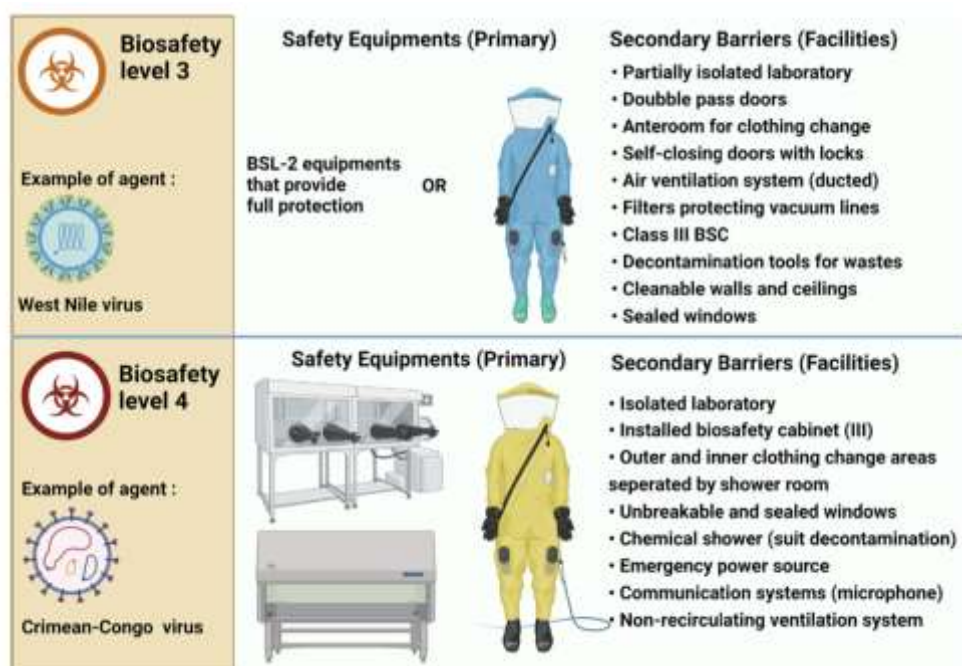


Fig. 2. Describes some of the measurements taken when practicing biosafety level 3 (upper part) and biosafety level 4 (lower part) (Laith et al., 2022).

General awareness of laboratory biosafety

A first and crucial step toward achieving sustainability in biosafety and biosecurity is raising knowledge of the biological risks connected to laboratory activity and technologies misuse. Increasing awareness can enable any nation that uses biotechnology to put biosafety and biosecurity principles into practice by making it easier to spot and address possible biohazards that aren't yet known. Thankfully, many Middle Eastern nations are already becoming more cognizant of biosafety and biosecurity. The translation of biosafety rules, guidelines, and training curricula into Arabic, the most commonly spoken language in the Middle East, is another noteworthy action made by several nations. This will significantly contribute to raising the understanding of biosafety procedures and biosecurity among Arabic-speaking researchers, students, and laboratory personnel (Laith et al., 2022).

Emergency Preparedness

The primary causes of health care-associated transmission and the aetiology of outbreaks in Saudi hospitals are overcrowding

in the emergency department (ED) and inadequate ventilation. Consequently, this may indicate an overcrowded situation inside the institution, an inpatient bed occupancy that approaches or surpasses maximum capacity, and/or a failure to adhere to and comprehend the significance of putting infection control and prevention (ICP) measures into practice.

Internationally renowned organizations, such as the US Centres for Disease Control and Prevention and the World Health Organization (WHO), endorse this viewpoint. The organizations are in favour of following the ICP guidelines. In order to prevent and control the spread of pathogens, basic infection control measures (B-IC), also known as standard and transmission-based precautions, are crucial. These include using personal protective equipment (PPE) like high-efficiency particulate respirators (e.g., N-95 or R-95), maintaining cleanliness of the environment and equipment, and following respiratory/cough etiquette (Butt et al., 2016).

Conclusion

An infection prevention and control (IPC) program must be designed, implemented, and overseen by Saudi healthcare facilities in order to minimize the risk of illness acquisition and transmission among patients, staff, and visitors. To lower the numerous hazards connected to healthcare-associated infections (HAIs) and enhance patient safety, healthcare facilities should assess their need for infection control and implement an active infection control program. Infections represent a significant obstacle to KSA preventive and control initiatives. In order to keep the public healthy and stop the spread of cross-infection, all healthcare professionals are essential. Formal, required infection control training and policies would reflect workplace hazards. The associated laboratory and healthcare facilities should be thoroughly inspected.

References

1. Hofmann, D. A., Burke, M. J., & Zohar, D. (2017). 100 years of occupational safety research: From basic protections and work analysis to a multilevel view of workplace safety and risk. *Journal of applied psychology*, 102(3), 375.
2. Ziara, K. S. (2017). Chemical Safety in Chemistry Departments Laboratories at Iraqi Universities. *Iraqi National Journal of Chemistry*, 17(2).
3. Khasawneh, A. (2014). Improving occupational health and workplace safety in Saudi Arabia. *Int J Dev Sust*, 3, 261-7.

4. Auta, A., Adewuyi, E. O., Tor-Anyiin, A., Aziz, D., Ogbole, E., Ogbonna, B. O., & Adeloye, D. (2017). Health-care workers' occupational exposures to body fluids in 21 countries in Africa: systematic review and meta-analysis. *Bulletin of the World Health Organization*, 95(12), 831.
5. Matsubara, C., Sakisaka, K., Sychareun, V., Phensavanh, A., & Ali, M. (2017). Prevalence and risk factors of needle stick and sharp injury among tertiary hospital workers, Vientiane, Lao PDR. *Journal of Occupational Health*, 59(6), 581-585.
6. Alanezi, F. (2017). Infectious diseases management framework for Saudi Arabia (SAIF).
7. Chiolerio, A., & Buckeridge, D. (2020). Glossary for public health surveillance in the age of data science. *Journal of Epidemiology and Community Health*. <https://doi.org/10.1136/jech-2018-211654>
8. Hayati, N., Ramli, K., Suryanegara, M., & Salman, M. (2021). An Internet of Things (IoT) reference model for an infectious disease active digital surveillance system. *International Journal of Advanced Computer Science and Applications*, 12(9).
9. Colet, P. C., Cruz, J. P., Cacho, G., Al-Qubeilat, H., Soriano, S. S., & Cruz, C. P. (2018). Perceived infection prevention climate and its predictors among nurses in Saudi Arabia. *Journal of Nursing Scholarship*, 50(2), 134-142.
10. Aldhamy, H., Maniatopoulos, G., McCune, V. L., Mansi, I., Althaqafy, M., & Pearce, M. S. (2022). Knowledge, attitude and practice of infection prevention and control precautions among hospital laboratory staff: a mixed-methods systematic review.
11. Laith, A. E., Alnemri, M., Ali, H., Alkhawaldeh, M., & Mihyar, A. (2022). *Journal of Biosafety and Biosecurity*.
12. Butt, T. S., Koutlakis-Barron, I., AlJumaah, S., AlThawadi, S., & AlMofada, S. (2016). Infection control and prevention practices implemented to reduce transmission risk of Middle East respiratory syndrome-coronavirus in a tertiary care institution in Saudi Arabia. *American Journal of Infection Control*, 44(5), 605-611.