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Review Article

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COVID-19 Outbreak: Safety Measures for Diagnostic Laboratories- A Review

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ABSTRACT

Health workers are the front line workers of this outbreak but lab workers and technicians are also indirectly vulnerable to infection. Our laboratories take all necessary protective measures to reduce occupational and health-related risks. Despite these protective measures, our lab workers and technicians are getting infected, so this review mainly focuses on the safety measures related to the health of doctors and lab technicians in the current scenario. The use of digital resources and personal protective equipment has increased tremendously in all laboratories, resulting in a significant increase in daily laboratory expenses.

Key-words: Coronavirus, COVID-19, Disinfectant, Health-related risks, Laboratory, Pandemic, Transmission

INTRODUCTION

Nowadays modern testing facilities are available in all laboratories for the final diagnosis of the disease. Most of the patients have no direct interaction with the laboratory staff, but the work related to the examination of tissue, blood, saliva etc of serious patients is done by them. Doctors, technicians working in the laboratory are constantly exposed to infectious material such as body material, contaminated equipment, laboratory surfaces and highly sensitive substances.

The most obvious sources of infection are fresh tissue and body fluids. During this pandemic, the number of hospitalized patients has increased, which has increased the number of laboratory tests. Although the risk of infection in chemically stabilized samples is very low in the laboratory, almost all infectious agents are easily inactivated by laboratory chemicals.

However, under heavy workloads, routine medical laboratory staffs are exposed to biological hazards in the laboratory through several routes, mainly through transmission from patients and their relatives [1]. Infection can also spread to laboratory staff indirectly, due to the formation of aerosols by working on the samples of patients, or through the cut skin, the infection can spread throughout the body [1,2].

This dreaded and contagious disease has hit health services worldwide in 2020. It is now imperative to digitize those departments and laboratories where traditional methods are used; this can prevent possible transmission of the virus between the homes of doctors, technicians, laboratory staff etc [3].

After the corona epidemic, there was a big change in the way of working in diagnostic laboratories and hospital departments, in which laboratories should be adapted using technology, techniques and digitalization like high-speed internet, screen sharing software, digital photography (whole slide imaging) [3]. The use of digital resources and personal protective equipment has

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increased tremendously in all laboratories, resulting in a significant increase in daily laboratory expenses.

Route of Transmission

Patient ⟷ Technician ⟷ Pathologist

But according to the current scenario of covid-19 virus infection, safety and caution should be taken while receiving the sample collection as the aerosol is spreading with speaking, coughing and sneezing.

Viruses can accumulate and survive on lab sample collection bottles, requisition forms, and even on microscope surfaces. The coronavirus is a member of the coronaviridae family that is commonly found in many different animal species including cats, camels, bats etc. including mammalians [4,5].

The SARS-CoV-2 virus is the cause of the worldwide epidemic of coronavirus disease. The disease has been named 'COVID-19 pneumothorax' and the virus has been named 'SARS-CoV-2' by the International Committee on Taxonomy of Viruses [5]. It is an infectious disease caused by a mutated virus discovered by China that spreads rapidly by droplets of saliva released through speech or droplets from the nose [6-8].

According to research by scientists from The New England Journal of Medicine, Institute of Health, CDC, UCLC and Priston University, mutated coronavirus 2019 can remain stable in aerosols and on surfaces of objects for several hours to several days. A normal person is potentially infected with the coronavirus, when he or she comes in contact with aerosols produced by an infected person's sneezing or coughing. Reducing the airborne transmission of the virus requires new inventions of drugs and vaccines as well as positive lifestyle changes to avoid the inhalation of infectious aerosols [9,10].

In March 2020, Doremalen *et al.* [10] studied that the half-lives of SARS-CoV and SARS-CoV-2 were similar in aerosols, with median estimates of approximately 1.1 h, but the half-life of SARS-CoV-2 was longer than that of SARS-CoV on cardboard [9]. Some researchers studied the persistence of SARS-CoV Strain P9 on different types of inanimate surfaces and reported 4–5 days persistence on paper at room temperature [11]. Lai *et al.* [12] reported the persistence of SARS-CoV Strain GVU6109 on paper for 24 h at room temperature [13].

Table 1: Different surface stability [13]

S.No.	Medium/ surface	Surface stability duration (hours)
1	Aerosol	3
2	Copper	4
3	Cupboard	24
4	Stainless steel	48-72
5	Plastic	48-72

The few possible routes of human-to-human transmission of COVID-19 are- Transmission of large droplets in the mouth, nose or eyes from the mouth of an infected person, and physical contact with droplets deposited on surfaces [14,15].

The coronavirus is not destroyed on the surface of Polytetrafluoroethylene (Teflon), polyvinyl chloride (PVC), ceramic tiles, glass silicone rubber etc. for 5 to 6 days. Some researchers found that the coronavirus is inactivated on the surface of copper and copper alloys because of the constant generation of reactive oxygen on the surface of the copper, which destroys the viral genome and irreversibly affects the virus morphology [16,17].

It has been claimed by some researchers that a wide range of biological microbes can be considered to effectively inactivate with some disinfectant methods. The virus can be inactivated by heat treatment like 56°C for 90 min, 67°C for 60 min or 75°C for 30 min can be used [11]. It can also be inactivated by chemical treatment by preserving the sample in formalin for 24 hours or incubating for 24 to 48 hours in glutaraldehyde [18]. Ethanol has also been recognized as a broad-spectrum and strong antiviral agent against the enveloped virus [19]. It has also been reported that 0.1% sodium hypochlorite, 0.5% hydrogen peroxide have been good disinfectants in the laboratory [20].

Para-violet radiation is effective for 60 minutes on objects that cannot be chemically and heat-treated [11,21].

Following are some precautions for the laboratory-

- All laboratory workers should be fully vaccinated against the COVID-19 vaccine.
- According to the corona protocol, proper physical distance should be maintained as well as the use of face masks, glasses and gloves.

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- Items touched by the patient such as sample containers and requisition cards may become infected, so laboratory assistants should exercise utmost caution and clean the container with surgical spirit or household disinfectant before touching it.
- Tissue should be sent in plastic Ziplock bags from the concerned departments. Firstly, the primary container should be placed in the larger secondary container and then the Secondary container should be placed in a zip-lock plastic bag.
- With the development of technology, in the modern medical world, patient details and investigation reports can be sent to the doctor in soft copy through the Internet through contactless delivery on the computer.
- Gloves and eye protection goggles, masks and PPE kits should always be used during aerosol-generating procedures during grossing or macroscopic examination of human tissue, as well as the laboratory must be ventilated.
- Care should be taken while handling needles, knives, blades and other sharp objects in the laboratory and after use, such objects should be thrown in a container with proper colour coding, puncture-proof, labelled and covered in the box.
- Pens, pencils, scales other items used in the reporting room and laboratory should also be kept clean with disinfectants. After completing the procedure in the laboratory, wash hands immediately with soap and water for 20 to 30 seconds, in case of excessive contamination, an alcohol-based hand sanitizer can also be used, if soap and water are not available, an alcohol-based hand sanitizer, surgical spirit, hydrogen peroxide can also be used, never touch the mouth, nose and other parts of the body with dirty gloves and unwashed hands, even avoid touching objects outside the lab. https://www.osha.gov/coronavirus/control-prevention/laboratory
- Investigators should always use different microscopes because the microscope is too close to the investigator's mouth and nose during use and can spread infection
- Because the majority of the microscope is made of steel and plastic, before and after use in the reporting room, clean the camera, telephone, computer, keyboard, stationery, doorknobs etc disinfecting. UV chamber must be used for disinfecting.
- The medical world has made an important contribution to stop this epidemic; all people should take small precautions like corona protocol, which helps us to fulfil our duty towards humanity.
- The test report can be sent easily to the email of the surgeon and the patient, the clothes used by the doctor and the laboratory staff should be washed with detergent and autoclaved. At this time many countries have developed different corona vaccines, although drugs are still being evaluated for rapid treatment.

CONCLUSIONS

The medical world has made an important contribution to stop this epidemic. In diagnostic laboratories and hospitals, additional efforts must be adopted to render the virus inactive during human tissue handlings. Hence, an intense precautionary protocol is required in the laboratory for future healthy human life. All Governments should keep a positive scientific approach on this and take accurate policies, decisions for better results in the quality of life.

The goal of this review is to spread information about physical and biological agents that can be used to inactivate the virus and appeal to everyone that small precautions and care will help us stop this pandemic and serve and save humanity.

CONTRIBUTION OF AUTHORS

Research concept- Dr. Bharat Sankhla, Dr. Khushboo Kachhwaha

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