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The Laboratory Preparedness and Tasks in Disaster Situations

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Abstract

Emergencies and disasters require prompt and adequate response, and assistance needs to be provided and monitored until normal services resume. To meet these demands, contingency plans and preparedness are essential. Clinical laboratories should have a comprehensive disaster plan for all types of disaster situations. This plan should provide a high level of comprehensive security control for the laboratory, personnel, and equipment and include processes to ensure the continuation of health care in the laboratory. In order to respond quickly and adequately to an emergency or disaster, each country should establish a national emergency plan and emergency preparedness and response mechanisms in the health sector. Clinical laboratories should also be included in plans suitable for this emergency preparedness. In the event of a disaster, the service processes of clinical laboratories may also be disrupted, and at the same time, personnel, equipment, material, and facility problems may occur, and/or a new laboratory may be established. In this article, the scope of disaster preparedness and disaster plans in clinical laboratories and the basic stages of the processes are summarized.

Keywords: Laboratory, natural disaster, POCT

Introduction

Disasters

Natural disasters have occurred throughout human history. Throughout history, disasters have led to the collapse of nations and the destruction of societies. A disaster is described as a serious disruption of the functioning of a community or society involving widespread human, material, economic, or environmental losses and impacts that exceed the ability of the affected community or society to cope using its own resources.[1-3] Earthquakes, landslides, volcanic eruptions, floods, hurricanes, tornadoes, blizzards, tsunamis, cyclones, wildfires, and pandemics are all natural disasters that kill thousands of people and destroy habitat and property each year.[4-6] The paralysis of health services, deaths, injuries, refugees, nutritional problems, problems with the availability of clean water, environmental sanitation problems, infectious diseases, and psychological problems are the most common health crises that we have to deal with.

Among the natural disasters experienced in Turkey, earthquakes accounted for 64%, floods 15%, landslides 16%, fires 4%, avalanches 1%, and others 1%.[3] Undoubtedly, earthquakes are the most affecting natural disasters and the most destructive in terms of their results. When the earthquakes that have occurred in our country in the last century are examined, it is seen that there is a devastating earthquake approximately every 10 years. Excluding the 1999 Marmara earthquake, it is estimated that 65% of the loss of life and property in Turkey in the last 60 years was caused by earthquakes.[7] Thousands of people died or became disabled as a result of the Marmara and the most recent Kahramanmaraş-Hatay earthquakes. Unfortunately, hospitals, university hospitals, and other health institutions are among the buildings destroyed during these earthquakes. Many health workers and their families died in these earthquakes. These data show that we perceive that we are in an earthquake zone as a country and that we need to be prepared for natural disasters both institutionally and individually.[8]

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Clinical Laboratory and Disasters

Clinical laboratories are health-care facilities that provide a wide range of laboratory procedures that aid physicians in carrying out the diagnosis, treatment, and management of patients.[5] These functions of the laboratory will also need to be maintained in disaster situations, where resources such as supplies and staff are often limited. The medical laboratory should include disaster preparedness plans in the quality safety processes. The best emergency response plan is a single plan that will ensure that the laboratory continues to serve in various disaster scenarios. It is necessary to take the necessary measures for the uninterrupted maintenance of laboratory services.[4] An experienced laboratory specialist in this regard should be part of the disaster planning team to determine the laboratory needs. Every health institution has hospital disaster management plans that can be implemented in case of natural disasters. Clinical laboratories and a laboratory's response to emergencies play vital roles in this context. Laboratory emergency preparedness management must be able to identify laboratory capabilities and provide an immediate response within 96 hours after a disaster occurs.[2] If you have infrastructure that has not been affected by the disaster and you are in a position to provide laboratory services, it is necessary to determine critical tests related to the disaster and the minimum device track. The lack of reagents, equipment, electrical power, and material suppliers; the difficulty of reaching the disaster site; decreased communication; and insufficient staff are common obstacles encountered in laboratory services during disaster times.[3]

Emergency preparedness is a multifaceted objective, and there is not a set way to achieve this goal appropriately. There are many types of exercises for use with personnel in crisis preparedness training. These all extend the utility of the written plan. Each component carries equal weight; one type of exercise does not substitute for another. Seminars and workshops serve to orient staff to develop plans in emergency situations. Tabletop or scenario exercises are based on hypothetical yet realistic events and formulate a course of action in response to emergency conditions. Moreover, live practice drills can focus on training for a specific emergency procedure that involves the entire facility staff and may extend to outside response agencies.[5]

In order to prepare the laboratory for disasters in advance, it is essential to recover the laboratory successfully when disaster strikes. A laboratory disaster plan enables you to save primarily samples and data. The first problem we encounter after the disaster is a lack of resources and personnel. Having a disaster plan beforehand allows you to identify emergency laboratory analyses that depend on limited resources and target recovery immediately after a disaster.[6]

Disaster Plans for Biochemistry Laboratory

By following the steps mentioned below, it is possible to create a plan to prepare the laboratory for disaster.[6-7]

1. Take photos of all equipment for the laboratory's insurance process.
   This action will provide us with physical evidence of both the space and equipment that were affected during the disaster.
2. Use cloud storage.
   The fact that laboratory data, documents, and patient records are stored on the cloud protects them against power outages and computer damage.
3. Keep staff and company contact information up-to-date and share it.
   If the contact information of the laboratory employees is up-to-date, it becomes possible to reach the affected employees during the disaster or to request support from those who are far away. It shortens the time to act and to give instructions. Besides, it is important to list the company information (address, phone, email, etc.).
4. Keep laboratory inventory lists up-to-date and have copies.
   The biosafety hazard level differs according to the laboratory materials used. Each laboratory must have an up-to-date inventory list of its materials, and a copy must also be available outside the laboratory. And also, in the presence of a list, insurance coverage can be used in cases of material loss. List the device and kit-chemical information.
5. Maintain backup generators, a water supply, and storage units for samples and reagents.
   It should be ensured that the power supply of refrigerators where samples, reagents, and solutions are stored is connected to the generator. It is important to have backup external storage units in case the generators that will be activated in the event of a power outage are out of function. External storage units could be located either in the same institution or another attainable place nearby. Keep track of your water supply and find out how long you will last in the event of a water outage.
6. Keep the alarm system activated for any disaster situation.
   The alarm system should be active against any disaster development. It is important that the contact information of the personnel to be reached when the alarm is activated is up-to-date and that these personnel are trained for emergency situations.
7. Have off-site storage for critical samples.
   Study samples, patient samples that need to be protected, and project samples should be stored in portions, and if possible, sample backups should be stored in a contracted unit separate from the laboratory.
8. Have an emergency plan and share it.
   In the event that opportunities and the labor force are limited during the recovery process in the post-disaster period, it should be handled according to a predetermined task sharing plan. It is important that this process be provided as in-service training beforehand.

Biochemical Laboratory Organization in Disaster Areas

Clinical laboratories undertake 3 important tasks in disaster situations. They are, respectively, contributions to the diagnosis and treatment of infectious diseases that may develop after a disaster, conducting standard health tests on disaster victims, and safely receiving and preparing blood products.[8,9] However, in the early stages of a disaster, laboratory services may be aimed at identifying larger health problems rather than diagnosing patients. In assessing needs, it is important to evaluate the type of disaster (e.g., earthquake, destructive wind, flood, extreme climate, epidemic disease, war, famine) and local conditions (e.g., national economic situation, geographical conditions, transportation, and communication situation) as a whole. In addition, the presence of health facilities, especially in the affected area, is decisive in situations such as the number of people affected and the availability of water, food, sanitation facilities, shelter, and electricity.[10]

Laboratory facilities that can be used in a disaster area are defined in 4 groups.[11,12]

1. Commercially available and portable laboratories are designed to perform a limited number of critical tests in places that vehicles cannot reach. The important components of a portable laboratory are the items used for sample collection and transportation, along with patient testing equipment. The collected samples can be transported to a basic laboratory for analysis.
2. A mobile laboratory is mounted on some kind of carrier or placed in it. It should have some kind of air conditioning, as they can quickly get extremely hot. It is not possible to perform most laboratory tests at high ambient temperatures.
3. Temporarily built laboratories are set up in tents or existing local buildings, such as a local house, school, or community building. This type of laboratory facility can be used temporarily until a suitable location is available. Since most laboratory equipment requires electricity, an electric generator is important. A storage room should be located on the cool, shady side of the laboratory or in a separate place. It is important that heat-sensitive tests and reagents are not exposed to high ambient temperatures. Portable cold cases or refrigerators are recommended for storing cold chain reagents or tests.
4. Existing (or built) laboratory facilities

Selection of Critical Test Panels

Identify the most critical functions and tests. During the disaster recovery period, resources such as personnel and supplies are limited. The number of applications to the laboratory reaches its maximum. At this point, the choice of point-of-care tests (POCT) will be important. First of all, priority should be given to perform the following biochemical tests, and the necessary equipment (centrifuge, tubes, and microscope) should be supplied.[13,14] As stated in published literature studies, the most requested tests in

the event of a disaster include the metabolic panel (sodium, potassium, carbon dioxide, HCO_3, chloride, blood urea nitrogen, creatinine, glucose), and the complete blood count (hemoglobin/hem atocrit). Other tests performed include those for urea, uric acid, creatinine, calcium, phosphate, sodium, potassium, coagulation tests, liver function tests, blood gases (pH, sO2, pCO_2, tCO_2), and a urine dipstick test for myoglobin.[1]

The advantage of using POCT is that it gives fast results and does not require the processing of samples like a centrifuge. There is no need for specially trained personnel. The disadvantage of using POCT is that the small sample volume may affect the accuracy of the results. Blood glucose, glycated hemoglobin, blood gases, cholesterol, and hematological analyses can be performed among the tests that are checked in POCT.[15] The use of innovative POCT in combination with certain tactics will improve disaster preparedness.[2]

Conclusion

We must admit that nature is extremely strong. And it is futile to fight or resist it. We need to accept its potential and embrace nature. Although preanalytical, analytical, and postanalytical phases are important for biochemical laboratory processes, these processes are evaluated after temporary conditions are established in case of disaster.

Coordination, maintenance, and restructuring of health services in disasters and return of laboratories to their routine activities can only be possible with an effective and applicable plan. Medical laboratories should be an important part of health action plans, and a clinical laboratory supervisor should be included in the disaster team.

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