CSIRO PUBLISHING

IN FOCUS
https://doi.org/10.1071/MA23055

Microbiology Australia

Disaster management in clinical laboratories and blood banks

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Received: 17 September 2023
Accepted: 5 October 2023
Published: 31 October 2023

Cite this:
Ayhan FY (2023)
Microbiology Australia
44(4), 190–192. doi:10.1071/MA23055

ABSTRACT

The challenge of disaster management in healthcare facilities is dealing with the incident's consequences and maintaining regular operations. Diagnostic and clinical microbiology laboratories have a critical role in the early diagnosis of causative agents of infectious diseases that could spread rapidly in the community and lead to outbreaks. Blood banks are also crucial to maintain the blood supply chain and to cope with the raised demand for blood components because of disaster-related injuries. It is thus necessary to prepare emergency plans, including step-by-step action plans for various disaster scenarios. Even though inconvenient conditions exist during disasters, biosafety and biosecurity precautions still apply, as well as quality control requirements in diagnostic and clinical laboratories and blood banks.

Keywords: blood bank, diagnostic and clinical laboratory, disaster management, disaster preparedness, emergency plan.

The terms disaster, crisis and emergency have distinct definitions. Disaster is the term used to define situations that refer to malfunctioning the community and leading to the losses or injuries of humans, economic demolition and environmental destruction. It is almost impossible to cope with a disaster using the resources of the affected community. By contrast, an emergency is an unpredictable circumstance that entails setting aside usual procedures to save lives and protect the environment. A crisis is a sudden change that makes it difficult to cope with an emergent condition in ordinary work or life.[1–3]

Dealing with an emergency, crisis or disaster requires an action plan that includes pre-, peri- and post-event activities and interventions. The first stage of an action plan is the mitigation phase, which minimises the impact of a potential incident and reduces its subsequent disruptive effects. The second is the preparedness phase, involving the prediction of the exposure, the assessment of the risks and vulnerabilities, and the implementation of the actions. Next is the response phase, which includes coping with the incident's aftermath. The final stage is the recovery phase to resume work and restore the facilities' abilities.[3]

These two aspects mentioned above of the disaster are challenging for the diagnostic and clinical laboratory and blood bank. Although the facility should serve the community during or after the emergency, the tragedy would also affect it. Therefore, the action plan must consist of operations for both distinct aspects. After assessing potential vulnerabilities, designing intended actions comes next. Structural and non-structural vulnerabilities, plus organisational and administrative vulnerabilities, should be evaluated distinctively.

An action plan should (1) clearly define the difference between emergency plans for disaster and daily routine work. (2) Define essential requirements to continue the facility's operations. (3) List these requirements in the emergency plans. (4) Prioritise important operations and the staff responsible for them, emergency communication, critical goods, equipment, and data protection are necessary to maintain any facility's functions during and after a disaster. (5) State the evacuation routes, assembly points, shutdown procedures, restoring backup data, closure period and alternative laboratories for the damaged facilities. Developing emergency plans is beneficial for helping people suffering from a disaster and preventing significant damages for those involved in the incident.[3–5]

During a disaster, the aim of the microbiology laboratories is early and accurate diagnosis of the causative agents of infections. However, besides diagnosing individual patients, identifying the pathogens that might potentially cause outbreaks would be the primary task for medical microbiologists.[6]

In a disaster, consider deploying portable, mobile, temporary–stationary, or fixed laboratory facilities for laboratory service. Portable laboratories are helpful for

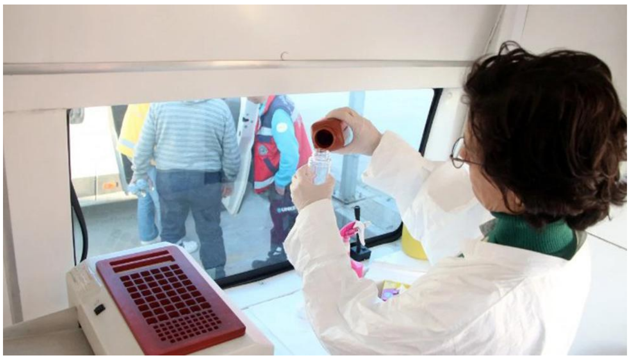

Fig. 1. Mobile laboratory servicing at the disaster area after the earthquake hit Turkey in 2023 (reproduced with the permission of DHA-Demiroren News Agency).

small-scale testing, e.g. water analysis for epidemiological surveys. Mobile laboratories are flexible for both medical diagnostic testing and epidemiological surveys (Fig. 1).

Temporary stationary laboratories can serve in vehicles, carriers, tents, or fixed buildings. Fixed laboratories in existing buildings would be preferable to provide a system for pre-analytical, analytical and post-analytical requirements besides biosafety and biosecurity precautions. Although point-of-care testing may be an efficient alternative for the disaster period, quality assurance remains essential.[6,7]

Laboratory conditions are significant for determining the Hospital Safety Index (HSI), a universal assessment tool for health services. Laboratory safety ratings are critical parameters for estimating HSI listed in the World Health Organization (WHO) guidelines. Safety is rated low if laboratory equipment is in poor condition and breached biosafety. If the equipment is in good condition and the laboratory has well-established biosafety precautions with appropriate measures for protection and security, the safety rating is high.[8]

In case of emergency, besides considering the biosafety precautions, biosecurity also has to be taken notice in clinical microbiology laboratories. A laboratory response network for biothreats designed by the American Society of Microbiology stipulated the establishment of sentinel laboratories with the capability of surveillance of emerging microorganisms and pandemics.[9]

All disasters affect the functioning of blood banks and transfusion services in a particular manner. Natural disasters (e.g. earthquakes, floods, tsunamis, landslides) may disrupt the blood supply chain by damaging the transportation infrastructure and keeping healthcare facilities inoperative. Pandemics challenge blood inventory management by reducing blood donations and paring back the workforce of blood establishments. Mass casualty incidents may disable the blood banks because of the high demand for blood donations.[5,10]

Using mock scenarios or computer simulations to predict blood product requirements during a disaster is advisable. Furthermore, *Tabu Search*, a metaheuristic problem-solving approach by mathematical modeling, is suggested to determine post-disaster temporary blood bank locations.[5,11,12]

Although it is improper to transfuse untested blood even in emergencies, the 'Walking Blood Bank' concept is for the troublesome absence of blood products in particular situations leading to mass casualties such as war or terrorist attacks. The term describes the practice of transfusion of whole blood taken from typed donors for blood group and screened for infectious disease markers in previous donations.[13]

As constituent parts of the health care system, diagnostic and clinical laboratories, and blood banks are utilities that would have crucial roles in minimising the health impacts of the disaster. Early diagnosis of infectious diseases, offering essential tests used in caring for the disaster victims and providing safe blood components for transfusion are significant tasks assigned to such laboratories.[14]

In conclusion, management requires a holistic approach, which includes vulnerability assessment, mitigation strategies and preventive measures, and rapid response to the incident without any concession from the quality requirements.

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Data availability. The data that support this study are available in the article and in *GP36: Planning for Laboratory Operations During a Disaster*[4] and *The role of laboratories and blood banks in disaster situations.*[14]

Conflicts of interest. The author declares that they have no conflicts of interest.

Declaration of funding. This research did not receive any specific funding.

Acknowledgments. The author thanks Doğukan Ünal (DHA, Demirören News Agency, Türkiye) for permission to use the image in Fig. 1 in this article.

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Biography

Dr F. Yüce Ayhan (MD) is a medical microbiology specialist with a PhD in blood banking and transfusion medicine. In his present position, he is the head of the medical microbiology laboratory and director of the transfusion center at Dr Behçet Uz Children's Training & Research Hospital (İzmir, Türkiye). He has served as secretary general for the İzmir Branch of the Turkish Red Crescent Society and was involved in disaster preparedness and first aid training between 2003 and 2012.