INTERNATIONAL WORKSHOP AGREEMENT

IWA 38

First edition
2021-12

Requirements and recommendations for the construction of emergency medical facilities

Exigences et recommandations relatives à la construction d'installations médicales d'urgence

Reference number
IWA 38:2021(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

International Workshop Agreement IWA 38 was approved at a series of workshops hosted by the Standardization Administration of China (SAC), in association with China IPPR International Engineering Co., Ltd., held in Beijing, China, between January and April, 2021.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Over the past few decades, natural disasters, industrial accidents and severe epidemics have frequently occurred and caused great losses of human life and properties. In order to deal with these emergency issues, the construction of emergency medical facilities is very important and has practical significance.

In China, the Beijing Xiaotangshan Hospital (612 beds) was constructed in 7 days when SARS broke out in 2003. In 2020, the Wuhan Huoshenshan Hospital (1 000 beds) and the Wuhan Leishenshan Hospital (1 600 beds) were constructed in 10 days. These emergency medical facilities played an important role in fighting COVID-19.

This document summarizes the successful experiences accumulated from the construction of several emergency medical facilities including the projects mentioned above, studies the new problems revealed in different types of emergencies in the past, and develops a set of technical guidelines for the design of emergency medical facilities.

This document is intended to provide technical support for the safe, appropriate and rapid construction of emergency medical facilities. In the design of an emergency medical facility, its function and scale are determined by the type, characteristics, rescue plans and actual needs of the emergency. The site plan is set in a scientific and reasonable way. The various traffic flows in the facility are organized efficiently, and it should have a degree of flexibility, so as to meet the uncertainty in emergencies.

Requirements and recommendations for the construction of emergency medical facilities

1 Scope

This document provides requirements and recommendations for the rapid construction of emergency medical facilities, including various categories of public health emergencies, for handling large numbers of casualties and patients. The functional composition of emergency medical facilities is determined by the characteristics of the emergencies.

This document is applicable to new projects built on new sites or within existing medical institutions, where emergency medical facilities are constructed rapidly from steel-frames and prefabricated standard plates or box structures.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16890-1, *Air filters for general ventilation — Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)*

ISO 29463-1, *High efficiency filters and filter media for removing particles from air — Part 1: Classification, performance, testing and marking*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
emergency medical facility
medical facility which is built rapidly and completed in limited time in response to public health issues

3.2
reception area
area where patients and the injured are received for preliminary assessment, screening, triaging and filling in related forms

3.3
clean area
area where medical staff rest and live

Note 1 to entry: Respiratory infectious disease facilities are divided into different zones based on different sanitation and safety levels.

3.4
semi-contaminated area
working area for medical staff, which is accessible via the *hygienic pass-through area* (3.8)

EXAMPLE Offices, meeting rooms, treatment preparation rooms.

3.5
contaminated area
area where medical staff wearing personal protective equipment treat patients, including where patients enter or stay

EXAMPLE Consultation rooms, exam rooms, wards, waste storage.

3.6
negative pressure ward
separated ward equipped with a ventilation system which controls the air flow direction to ensure that its indoor static pressure is always lower than that of surrounding areas

3.7
buffer room
isolated small room where air flow in adjacent spaces is directed to form a sanitation and safety barrier

3.8
hygienic pass-through area
passage space set up at the entrance of *contaminated areas* (3.5), connecting areas of different sanitation and safety levels, where medical staff change shoes, put on/remove gowns, wash hands, shower, put on/remove personal protective equipment, etc.

3.9
medical quarantine area
buildings and facilities that are suitable for individual quarantine and medical observation in accordance with relevant regulations and requirements for epidemic prevention and control

4 Abbreviated terms

CT Computerized Tomography

5 Basic principles

5.1 Sustainability

With case-specific considerations on local resources and actual needs for medical treatment, emergency medical facilities shall respond to local conditions, make the best use of local materials, collaborate and share resources with local health systems, and operate efficiently.

5.2 Programme and circulation

In emergency medical facilities, spaces for rapid screening, triaging and treatment shall be strengthened. Access to imaging tests such as computerized tomography (CT) scan and surgical operation shall be unobstructed and efficient. For respiratory infectious disease facilities, negative pressure wards, negative pressure intensive care units and negative pressure operating rooms shall be set up when necessary.

5.3 Structure, mechanical and electrical systems

Reliable technology shall be adopted for the structural, mechanical and electrical systems of emergency medical facilities. Prefabricated modular structures, integrated components and pre-wired cabinets should be used.

5.4 Products and components

Products and components selected for emergency medical facilities shall be reliable and easy to maintain.

5.5 Information technology

Emergency medical facilities shall be equipped with information and intelligent technology systems, so as to collect and analyse timely information, to provide tele-consultation, diagnosis and treatment services, to deliver intelligent building management, and to promote data sharing and coordination in the emergency medical service network.

5.6 Safety

In emergency medical facilities, structural safety, non-structural system safety, biosafety, fire safety and environmental safety shall be ensured.

6 Site selection and planning

6.1 Site selection

For sites of emergency medical facilities, vacant spaces in existing medical facilities or their adjacent plots should be selected; reserved open spaces in urban disaster preparedness plans, such as city squares, parks and undeveloped land, can also be utilized. In general, the following conditions shall be met.

a) Geotechnical conditions shall be assessed with relevant standards to meet construction requirements.

b) Comprehensive municipal infrastructure shall be available.

c) There shall be a good transport network.

d) Respiratory infectious disease facilities shall be kept far away from densely-populated or environmentally-sensitive areas. An isolation zone no less than 20 m wide shall be set surrounding the campus, or other effective measures shall be taken to meet biosafety requirements.

6.2 Building layout

The configuration of emergency medical facilities shall be appropriately determined by functional programming. Their building layout and circulation shall be organized to be safe and efficient.

6.3 Circulation

In emergency medical facilities, the circulation patterns of people, logistics and vehicles shall be identified and planned in a scientific way.

6.4 Entrances

An ambulance cleaning and decontamination station shall be set up at the entrance of emergency medical facilities.

6.5 Preventing cross-contamination

Respiratory infectious disease facilities shall respect the following basic principles:

— control the source of infection;

— break the transmission chain;

— segregate high-risk groups.

The circulation paths of medical staff and patients shall be strictly separated. Different transportation routes for clean and contaminated goods shall be provided and they shall not intersect with each other.

6.6 Medical staff living area

When possible, a health professions staff living facility should be set up within or near the emergency medical facility, including a dormitory for on-duty staff and a designated medical quarantine area for staff who are about to leave the facility.

7 Architecture and structure system

7.1 General provisions

7.1.1 Zoning

The functional zones of emergency medical facilities shall include reception areas, medical technology areas (such as CT, point-of-care testing, etc.), ward areas, staff living areas and logistics areas.

7.1.2 Accessibility

The patient transfer route shall be barrier-free.

7.1.3 Construction method

Prefabricated built-in and modular units should be used for construction. For some special functional areas and areas connected to them, prefabricated components can be assembled on site based on actual needs.

7.1.4 Vertical circulation

For emergency medical facilities of two or more floors, ramps or bed elevators shall be set up at central traffic routes depending on the conditions. For facilities with biosafety risks, their vertical circulation for clean and contaminated areas shall be planned separately.

7.1.5 Interior fittings and surfaces

Materials of indoor fittings and surfaces shall be resistant to abrasion and corrosion, leak-proof and easy to clean and maintain. Anti-condensation and anti-seepage technical features shall also be adopted.

7.1.6 Structural reliability

The structural reliability target and seismic protection criterion of emergency medical facilities shall be determined by their service life, service requirements and construction period.

7.1.7 Structural system

The structural system shall be selected in consideration of local conditions, and should be easily fabricated, transported and installed. Prefabricated, light-weight structures should be used. Light-weight structures shall be wind-resistant, and the connection between their components shall be safe and reliable.

7.1.8 Leak-proof

The main structure of emergency medical facilities shall be impermeable and leak-proof.

7.1.9 Light-weight structure

When a light-weight building structure is adopted, the foundation and support frames of equipment such as air blowers and exhaust fans should be detached from the building structure. When a multi-storey light-weight building structure is adopted, heavy medical equipment such as CT shall be installed on the ground floor. If the ground floor is built above the ground, its bearing capacity and deformation shall be calculated.

7.2 Specific requirements for respiratory infectious disease facilities

7.2.1 Zoning

Facilities shall be arranged according to their medical procedures, and functional zoning shall be strictly implemented. The areas for medical staff and patients should be divided into clean areas, semi-contaminated areas and contaminated areas according to their sanitation and safety levels, and the three areas should be arranged in a sequential order in the direction of local prevailing winds. A hygienic pass-through area or buffer room shall be set up between two adjacent areas of different hygienic levels in the medical staff working area.

7.2.2 Preventing cross-contamination

The circulation paths of medical staff and patients shall be strictly separated. Different transportation routes shall be established for clean and contaminated goods. Any mixing or intersection shall be avoided.

7.2.3 Building layout and airflow management

The facility's layout shall be adapted to ensure effective air distribution. The indoor air should be strictly controlled to flow from clean areas to semi-contaminated areas and then to contaminated areas, creating a pressure gradient specified in relevant regulations.

7.2.4 Negative pressure ward

Negative pressure wards shall be located at the far-end of the indoor air distribution system. A double-door interlocked pass box shall be used for the transfer of materials between the ward and the staff corridor.

7.2.5 Medical waste

A temporary medical waste storage shall be set up on campus. The medical waste shall be collected, sealed, disinfected and temporarily stored before being shipped to a medical waste treatment station for centralized treatment.

7.2.6 Sealing

Appropriate sealing shall be ensured in the building structure. Mechanical and electrical pipes, ducts and cables shall be taken to seal where they pass through walls, floors and ceilings.

8 Water supply and drainage system

8.1 General provisions

8.1.1 Safety

The design of the water supply and drainage system of emergency medical facilities shall meet the requirements of relevant standards, and shall meet the requirements of efficient and safe operation during the epidemic period.

8.1.2 Water supply

The domestic water supply quota of emergency medical facilities shall meet the requirements set in relevant standards.

8.1.3 Water processing

In activities such as showering and washing, where the patient is at risk of a weakened immune system or wound infection, the domestic water supply shall be treated in accordance with the requirements of medical procedures. Appropriate treatment methods shall be selected to meet the specified requirements.

8.1.4 Valves for maintenance

Valves for maintenance shall be installed at points of use and plumbing fixtures. Stop valves shall be adopted, and they shall be labelled.

8.1.5 Hands-free faucets

Plumbing fixtures shall adopt hands-free faucets or take other measures to prevent cross infection and splashing of water from sinks and drains.

8.1.6 Plumbing fixtures

The selection and application of plumbing fixtures shall comply with the requirements of relevant standards, and shall meet the following provisions.

a) Single-handle faucets should be provided, and should not be equipped with aerators.

b) Medical staff shall be provided with sensor-regulated faucets, foot-pedal faucets or knee-operated faucets. When elbow-operated faucets are selected, the length of their handle shall be no less than 160 mm.

c) The material shall be resistant to acid corrosion.

d) The material shall be non-absorbent.

8.1.7 Trap seal

Measures shall be taken in indoor toilets to protect the trap seals of drainage systems. The depth of water seal in drain traps of plumbing fixtures shall be no less than 50 mm and no more than 100 mm.

8.1.8 Wastewater treatment

Sewage from emergency medical facilities shall be disinfected.

8.2 Specific requirements for respiratory infectious disease facilities

8.2.1 Sealing

Piping passing through floors and walls shall be taken to seal, to prevent air leakage from one space to another. When an opening is made in a wall between two spaces of different biosafety levels, strengthened sealing measures shall be taken, and the following provisions shall be complied with.

a) Pipe sleeves shall be used where pipes run through floors and walls. The sleeve in the floor or wall shall be precast or prefabricated, so as to ensure sealing.

b) The gap between the pipe and the sleeve shall be filled with compressed flexible material.

c) A cover plate shall be fitted to each side of the pipe sleeve, and shall be sealed with engineering adhesives.

d) Piping passing through floors or fire walls shall be met the limit value of fire resistance rate of floors or fire walls.

8.2.2 Water supply pump station

The domestic water supply pump station and the centralized domestic hot water plant shall be set up in clean areas or semi-contaminated areas.

8.2.3 Water tank

Break tanks with water pumps should be used for water supply in the domestic water supply system. When it is difficult to adopt break tanks for water supply in a retrofitting project, the risk of backflow contamination in the water supply system shall be assessed, and the following provisions shall be complied with.

a) When the risk of backflow contamination is low and the water supply pressure meets the requirements, the water supply system shall be equipped with reduced-pressure backflow preventers.

b) When the risk is relatively high, break tanks shall still be used for water supply.

8.2.4 Water supply system

The water supply system of emergency medical facilities shall be equipped with anti-contamination backflow prevention devices, and shall meet the following provisions.

a) The water supply systems for clean areas, semi-contaminated areas and contaminated areas should be independent from each other. If this is not possible, the water supply lines that supply water to semi-contaminated areas and contaminated areas shall be equipped with reduced-pressure backflow preventers.

b) Backflow preventers shall be set up for clean areas.

8.2.5 Drainage system

Measures shall be taken to protect the trap seals of drainage systems, and the following provisions shall be complied with.

a) The maximum design flow in vertical stack shall not be greater than 0,7 times the specified value set in local regulations.

b) Measures to refill the water seal in floor drains shall be taken, and water drained from wash basins to replenish water should be used.

8.2.6 Vent stack

The outlet of the vent stack of the drainage system shall be equipped with filter class ISO 45 H, as defined in ISO 29463-1, for filtration, or disinfection treatment shall be applied.

8.2.7 Outdoor sewage system

The outdoor sewage system shall adopt a closed system.

8.2.8 Sewage treatment

Sewage treatment of emergency medical facilities shall meet the following provisions:

a) the two-step enhanced disinfection process shall be adopted for sewage treatment;

b) the sewage treatment tank shall be closed, and the exhaust gas shall be collected and disinfected before discharge.

9 Heating, ventilation and air conditioning system

9.1 General provisions

9.1.1 Heating and air conditioning

Emergency medical facilities should adopt safe and appropriate heating and air conditioning technologies with regard to local climates.

9.1.2 Natural ventilation

The ventilation of emergency medical facilities for non-respiratory infectious diseases should adopt natural ventilation and make full use of building openings such as doors and windows.

9.2 Specific requirements for respiratory infectious disease facilities

9.2.1 Mechanical ventilation

A mechanical ventilation system shall be installed. Separate mechanical air supply and exhaust systems shall be set up for clean areas, semi-contaminated areas and contaminated areas, respectively. The static pressure shall be reduced in sequence from clean areas to semi-contaminated areas and then to contaminated areas.

9.2.2 Air filter

The air supply system in clean areas shall be equipped with two-stage filtration composed of ISO Coarse and ISO *e*PM2,5 50 %, as defined in ISO 16890. The air supply system in semi-contaminated areas and contaminated areas shall be equipped with three-stage filtration composed of ISO Coarse, ISO *e*PM2,5 50 % and ISO *e*PM1 80 %, as defined in ISO 16890. The exhaust system shall be equipped with filter class ISO 45 H, as defined in ISO 29463-1.

9.2.3 Air supply and exhaust outlets

Air supply diffusers in negative pressure wards shall be installed on the ceiling near the medical staff entrance, and exhaust outlets shall be installed on the wall below the patient's head opposite the air supply diffuser.

9.2.4 Pressure monitor

Air filters in air supply and exhaust systems shall be equipped with differential pressure detection and alarm devices.

9.2.5 Exhaust fans

The exhaust fans of contaminated and semi-contaminated areas shall be installed outdoors.

9.2.6 Exhaust discharge

Exhaust fans of contaminated and semi-contaminated areas shall be installed at the end of the exhaust ducts. Outlets of the exhaust system shall not be close to any area of human activity. The exhaust should be discharged at sufficient height. Exhaust outlets of the exhaust system and the sewage vent pipes shall be kept at a safe distance from the air intake of the air supply system.

9.2.7 Fresh air

For heating or cooling of fresh air, independent direct-expansion air-cooled heat pump units should be selected, and the supply temperature should be adjusted to room temperature. Auxiliary electric heating may be added in cold climates.

9.2.8 Negative pressure operating room

Negative pressure operating rooms shall be equipped with independent non-recirculation air conditioning systems, which bring in 100 % fresh air that is then exhausted directly. A central air supply diffuser with filter class ISO 45 H, as defined in ISO 29463-1, shall be set up over the operating table, and exhaust outlets with filter class ISO 45 H, as defined in ISO 29463-1, shall be installed on lower walls on both sides of the operating table. A pressure differential of no less than 5 Pa shall be maintained between the operating room and the corridor. A differential pressure monitor with screen display shall be installed near the door of the operating room.

9.2.9 Condensate

Condensate from air conditioning systems in the contaminated and semi-contaminated areas shall be collected centrally, and shall be discharged into the facility's sewage system through indirect drain for centralized treatment.

9.2.10 Intensive care unit

The design of intensive care unit shall meet the following provisions.

a) 100 % fresh-air non-recirculation air conditioning system shall be adopted.

b) The air supply shall be treated by three-stage filtration composed of ISO Coarse, ISO *e*PM2,5 50 % and ISO *e*PM1 80 %, as defined in ISO 16890. The exhaust shall be filtered by filter class ISO 45 H, as defined in ISO 29463-1 before discharge.

c) Filter class ISO 45 H, as defined in ISO 29463-1, for exhaust filtration shall be installed at the exhaust outlets of the room.

d) Air supply diffusers shall be installed on the ceiling above where medical staff typically stand, and exhaust outlets shall be installed on the wall below the patient's head.

e) The pressure differential shall be maintained at a minimum of 5 Pa between the intensive care unit and its adjacent buffer room, and between the buffer room and the staff corridor. A differential pressure monitor with screen display should be installed near the door.

10 Electrical and intelligent systems

10.1 General provisions

10.1.1 Power supply

A reliable power supply shall be utilized for emergency medical facilities, and an emergency power supply shall be set up.

10.1.2 Lighting

Light emitting diode (LED) lights should be used in lighting design; the colour temperature of the light source should not be greater than 4 000 K, and the colour rendering index (Ra) shall be greater than 80. In addition, measures shall be taken to reduce glare for patients in bed.

10.1.3 Equipotential bonding

Main equipotential bonding shall be carried out by emergency medical facilities; supplementary equipotential bonding shall be carried out in intensive care units, operating rooms, resuscitation rooms, treatment rooms and shower rooms or toilets with a shower.

10.1.4 Lightning protection

The lightning protection design shall comply with relevant standards.

10.1.5 Intelligent building systems

Emergency medical facilities shall be equipped with reliable intelligent building systems.

10.1.6 Equipment selection

Prefabricated substations, box-type or mobile generator sets, data centre modules and other complete sets of equipment should be used. Cable selection and application shall be based on the principles of rapid installation and easy maintenance.

10.2 Specific requirements for respiratory infectious disease facilities

10.2.1 Emergency power supply

The emergency power supply shall switch on automatically when the normal power supply is interrupted. For equipment which requires the standby power to activate within 0,5 s, a UPS system shall be provided. The emergency power shall serve the following loads:

a) operating rooms, intensive care units, resuscitation rooms and other electrical equipment related to patients' life safety and their illumination;

b) electrical load of the ventilation system in respiratory infectious disease wards;

c) power distribution and lighting loads of negative pressure wards, diagnosis and treatment rooms, important laboratories and diagnostic services;

d) vacuum suction equipment, air compressors, sewage treatment systems, medical incinerators, mortuary freezers, etc.

10.2.2 Sealing

Power distribution boxes and electrical rooms should not be planned in contaminated areas. Where a cable (slot) runs through areas of different air pressure, measures shall be taken to seal around it.

10.2.3 Disinfection and sterilization

Negative pressure wards, buffer rooms, toilets, sluice rooms, patient corridors and other spaces that require sterilization shall be equipped with disinfection facilities such as fixed or mobile ultraviolet lamps.

10.2.4 Telemedicine

If possible, a telemedicine system shall be set up, with computer information technologies, the internet and advanced medical equipment, to facilitate medical services such as telediagnosis, specialists consultation and data-sharing.

10.2.5 Video monitoring

Negative pressure wards and intensive care units shall be equipped with audio/video monitoring/communication systems.

10.2.6 Access control

The access control system shall be set up according to the circulation patterns, and touchless control shall be adopted. The access control shall be deactivated in case of emergency.

11 Medical gas system

11.1 General provisions

11.1.1 Principle of configuration

The medical gas system of emergency medical facilities shall be configured to be safe, appropriate and reliable, based on local resources and project requirements.

11.1.2 Medical gas source

The quality of medical gas should meet the requirements and standards for medical use. The gas source station may be set up separately or take advantage of the existing medical gas source on campus. When the existing medical gas source is considered, its gas consumption shall be re-calculated, and an appropriate level of redundancy shall be considered.

11.1.3 Medical gas station

The location and layout of the medical gas station shall be set in a scientific and reasonable way. The gas supply system shall be safe, reliable and easy to maintain, and shall not affect the environment of the emergency medical facility.

11.1.4 Pipeline and accessories

Materials for medical gas pipelines and accessories should be safe and reliable, and should meet relevant standards. An appropriate level of redundancy shall be considered in calculating pipe diameter and accessories.

11.1.5 Terminal units

Medical gas terminal units should be safe, reliable, meet the standards for medical use, and should be standardized units with clear labels. In determining the number of terminal units, both actual medical needs and appropriate back-up shall be considered.