Standards and recommendations for burns care in mass casualty incidents

Emergency Medical Teams

World Health Organization

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Foreword

In the face of emerging challenges, the global health community continually strives to fortify its response mechanisms. The unrelenting threat of infectious diseases, climate-related disasters and conflicts, as evidenced by events such as the ongoing COVID-19 pandemic and conflicts, underscores the urgency of establishing resilient health emergency preparedness and response systems. The lessons gleaned from these crises must serve as the foundation for comprehensive guidelines aimed at strengthening both local and global capacities.

Just as Emergency Medical Teams (EMTs) and the EMT Initiative have played pivotal roles in responding to climate-related disasters and infectious disease outbreaks, their expertise is indispensable in addressing the complexities that arise from mass casualty incidents (MCIs), particularly those involving burns. This publication embodies the collective knowledge and experience of the EMT network and its partners and endeavours to establish universal quality standards and recommendations, providing medical teams with a framework to rapidly and effectively respond to burns care in MCIs.

Drawing inspiration from successes in addressing climate-related disasters and highly infectious disease outbreaks, this initiative emphasizes the importance of robust national capacities. Countries are urged to swiftly scale up their deployable surge capacities and expertise, thus fostering a foundation for self-sufficiency. The Emergency Medical Team Initiative, through collaboration and coordination, facilitates the development of trusted partnerships and interoperable surge capacities on a global scale.

By offering a set of common quality standards and protocols, this publication lays the groundwork for enhanced interoperability among national, regional and international capacities and aspires to create a shared language and approach across diverse disciplines to further develop a comprehensive and coordinated response to burn care in MCIs. In doing so, it champions the mission of saving lives, alleviating suffering and protecting the most vulnerable during times of crisis. This publication marks a significant stride towards building resilient health-care systems that can effectively navigate the challenges presented by MCIs, ensuring a world better prepared to face the unexpected.

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Abbreviations

CBRN Chemical, biological, radiological and nuclear

BAT Burn Assessment Team

BST Burn Specialist Team

EMT Emergency Medical Team

EMTCC EMT Coordination Cell

GDG Guideline Development Group

GRADE Grading of Recommendations, Assessment, Development and Evaluation

IV intravenous

MCI mass casualty incident

MEDEVAC medical evacuation

ORS Oral Rehydration Salts

RCT randomized controlled trial

SCT Specialized Care Team

SMD standardized mean difference

TWG Technical Working Group

TBSA total body surface area

WASH water, sanitation and hygiene

WHO World Health Organization

Executive summary

Technical standard
Recommendation

	TOPIC	
1	General	As part of their mass casualty or disaster plan, it is recommended that Member States include specific provisions for a potential mass burn incident.
2	General	Burn Assessment Teams (BATs) serve advisory, clinical and coordination roles while Burn Specialist Teams (BSTs) serve a primary clinical role.
3	General	Member States should consider creating a national BAT or having bilateral or regional agreements to request BATs from neighbouring countries as part of their national EMT system and their national emergency response plan.
4	General	BSTs may be best shared regionally among multiple countries, either sourced from one larger country, and/or with contributions from experts and resources in nearby countries within the region.
5	General	Medical evacuation (MEDEVAC) may be a subset of coordination activities requiring specialized clinical support. Countries must consider the inclusion of a MEDEVAC coordination function within their national coordination mechanisms.
6	Coordination	While primary responsibility of coordination of EMTs remains with the appropriate national authority, during mass burn incidents, BATs and BSTs can support coordination at national and regional levels.
7	Coordination	In the event of a mass burn incident, and when national capacities are exceeded or specialized care support is required, countries should consider activation of mechanisms for possible international medical evacuation.
8	Triage	During a mass burn incident, three phases of triage should occur: (1) on-scene; (2) on arrival at the first receiving health facility; and (3) definitive triage after surgical scrub/wound cleaning.
9	Triage	On-scene, a standardized triage system for mass casualty incidents (MCIs) should be utilized, followed by a burn injury severity assessment determined mainly from percent total body surface area (%TBSA) burn estimation rather than depth assessment, as appropriate.
10	Triage	The %TBSA burn estimation tool utilized on-scene should reflect the tool most familiar to first responders. However, should guidance be required, the Wallace Rule of Nines estimation tool can be used for adults and the modified Rule of Nines for children.

	TOPIC	Technical standard / Recommendation
11	Triage	The decision to assign a patient to the "expectant" or "non-survivable" triage category should be made no earlier than when the patient arrives at the first receiving health facility.
12	Fluid management	For patients in mass burn incidents, treat with oral fluid resuscitation and where possible, supplement with intravenous (IV) fluid depending on patient need, clinical resources and provider discretion.
13	Fluid management	For patients in mass burn incidents, treat with oral fluid compared to no fluid.
14	Fluid management	For patients in mass burn incidents, give fluids as early as possible, on-scene or at a health facility.
15	Fluid management	For patients in mass burn incidents, use standard formulae for calculation of fluid resuscitation requirements.
16	Fluid management	For patients in mass burn incidents, no recommendation on optimal timing in calculation of fluid resuscitation requirements.
17	First aid	First aid for burns should include cooling, analgesia, cleaning, dressing and tetanus considerations.
18	Cooling	Cooling of the burn wound can occur from 10 minutes to three hours after the injury was sustained using potable/drinking water at room or cool temperatures.
19	Cleaning	Basic wound cleaning includes removing debris and irritants from the wound. Advanced cleaning should occur on arrival at the first receiving hospital with appropriate analgesia and/or sedation. If further extensive cleaning is required, a surgical scrub can be undertaken in the operating theatre with anaesthesia.
20	Dressing	Choice of dressing should be based on the characteristics of the wound, point of application, availability of dressing type, resource requirements of dressing and the ability of a patient to return for follow-up visits.
21	Tetanus	Tetanus vaccination should be up to date as per local guidelines and practices. Booster and/or immunoglobulin should be given as indicated.

	TOPIC	Technical standard / Recommendation
22	Antibiotics	Antibiotics should not be routinely given prophylactically to burns patients unless otherwise specifically clinically indicated.
23	Referral	Patients with < 20 % TBSA superficial/partial thickness burns and no special area burns may be discharged with adequate outpatient support, such as social and community support, with a clear care pathway communicated. Patients with > 20 % TBSA and/or deep dermal or special area burns should be evaluated by an experienced burn care specialist as they may require ongoing in-patient care. Consider transferring these patients to a specialist burn care centre.
24	Surgical interventions	Procedures that may be performed by non-burn surgeons include advanced wound cleaning, surgical scrub, escharotomy and fasciotomy. Excision, enzymatic debridement, grafting, local tissue rearrangements, flaps and contracture releases are examples of procedures that should be performed by surgeons skilled in burns care and/or by surgeons supported by relevant clinical expertise.
25	Rehabilitation	Rehabilitation requirements should be considered for all patients (based on burn severity and location of the burn) on arrival at the first receiving hospital.
26	Rehabilitation	Active and passive exercises, positioning, splinting and functional retraining should commence at the earliest phase of care, once vital functions are stable and considering precautions such as related trauma, wound breakdown, graft frailty, attached wires, low blood pressure, or infection.
27	Rehabilitation	Adequate analgesia should be administered prior to rehabilitation interventions as pain can reduce participation and performance.
28	Rehabilitation	Compression therapy and massage should be used early to minimize scarring and manage oedema.
29	CBRN	It is recommended that BATs and BSTs have the capability to support the initial care of chemical, biological, radiological and nuclear (CBRN) patients in the event of a CBRN MCI.

Chapter 1

Introduction

1 Introduction

1.1 Background

Health and operational support needs in emergencies have been well recognized *(1)*. In recent years the world has witnessed improving professionalization and standardization of care for communities affected by health emergencies – a change which has been brought about in part by the World Health Organization (WHO) Emergency Medical Teams (EMT) Initiative *(1, 2)*. The EMT initiative supports and encourages trained and appropriately skilled teams of national and international multidisciplinary personnel to deliver a coordinated approach to targeted clinical needs while adhering to minimum standards of care.

The evolving nature and changing definition of humanitarian emergencies has highlighted the need for a widened scope of practice for EMTs and more specialist teams able to target specific health needs. With origins in climate-related disasters, in recent years EMTs have had an increasing and influential role in outbreaks, conflicts and other man-made disasters *(3, 4)*.

Smaller scale but high-impact emergencies, such as mass burn incidents, have highlighted a need for specialist EMTs. Burn injury frequency following a mass casualty incident (MCI) should not be underestimated. The nature of burn injuries often results in a protracted clinical journey for the patient, commonly resulting in long-term health consequences affecting functioning, quality of life and mental health *(5, 6)*. Recent examples of MCIs with multiple burn-injured patients (Table 1) have demonstrated the extensive demands placed on health-care workers, health facilities and the overall health system – resulting in high, preventable morbidity and mortality *(7–10)*. In one example, a study of 455 casualties from the mass burn incident found mean treatment cost was US$ 48 977 per patient (with total medical cost from the incident estimated at US$ 38.5 million), mean length of hospital stay was 63 days, and mean time to school or social re-entry was 39 weeks *(6)*.

Specialist burn EMTs are well placed to help target specific needs which arise, particularly in building local burn resource capacity and capability. However, these teams must adhere to minimum standards of care. Standard-setting has proven a crucial strategy for health-care system strengthening, improving both patient safety and quality of care, and remains a core objective of the EMT 2030 Strategy *(11)*. As burn care capability varies globally, providing guidance to standardize burn care for mass burn incidents helps provide a platform for strengthening burns care for specialist EMTs, as well as health systems generally.

1.2 Scope and purpose

This document provides practical guidance for building capacity and capability for burns care from clinical, human resources and operational perspectives. Caring for burns patients from the incident scene to definitive treatment can be a complex, resource-consuming process with the potential to overwhelm health system capacity. It is therefore recommended that guidance in this document be applied to any contexts in which the local health system might struggle to cope and require surge support. The objective is to ensure the establishment and enhancement of specialist burn EMTs and surge capacities that are ready and able to deliver timely, effective and high-quality burns care in response to mass burn incidents, ultimately saving lives and alleviating suffering.

1.3 Document structure

This document is intended to be an all-in-one, practical resource for the building and operationalization of specialist burn EMTs and surge capacities. It encompasses operational requirements (Chapters 3 and 4), technical standards (Chapter 5), and clinical recommendations (Chapter 6). The clinical recommendations chapter focuses on fluid management as this is a key aspect of major burns care for which certain clinical practice adaptations for mass burn incidents have been contemplated. As clinical recommendations, their development followed additional methods and processes in accordance with the *WHO Handbook for Guideline Development, 2nd edition (12)* and the Guideline Review Committee.

1.4 Target audience

The target audience for this document ranges from health-care professionals and EMTs providing direct clinical care to burns patients to organizations and governments seeking to establish burns specialist teams. The document applies to professionals, teams and organizations responding to mass burn incidents nationally and/or internationally.

Table 1. Examples of recent mass burn incidents

Year	Event	Location	Estimated number of burn injuries (deaths)
2023	Fuel depot explosion	Armenia	300 (170)
2022	Vinnytsia missile strike	Ukraine	100 (28)
2022	BM Inland container depot explosion	Bangladesh	>200 (49)
2021	Wellington petroleum tanker explosion	Sierra Leone	>450 (151)
2018	MBUBA gas tanker explosion	Democratic Republic of the Congo	125
2018	Fuego Volcano eruption	Guatemala	>200
2017	Grenfell tower fire	United Kingdom of Great Britain and Northern Ireland	140
2015	Formosa fun coast park ignition	Taiwan, China	499
2015	Colectiv nightclub fire	Romania	144 (64)
2014	Kunshan factory aluminium dust explosion	China	230
2013	Fire at a Kiss nightclub	Brazil	>50
2013	Tazreen Fashions factory explosion	Bangladesh	>200 (112)
2010, 1994	Mount Merapi volcano eruption	Indonesia	>200

Spotlight

Mass burn incident in Armenia – September 2023

On 25 September 2023, a devastating explosion occurred at a fuel depot in Armenia, resulting in a significant number of casualties. The Government of Armenia reported 170 fatalities and nearly 300 injuries. The majority of the injured were male patients with severe burns, leading to a high demand for advanced and specialized burn care. The National Burns Center, with 80 beds, was fully occupied. Eight other hospitals in Yerevan also actively provided care. The Ministry of Health issued a request for international assistance, specifically for Burn Specialist Team (BST) and medical evacuation (MEDEVAC) capacity.

© WHO, Armenia refugee response: EMT Rehabilitation Training of Trainers

WHO, in coordination with the Ministry of Health of Armenia, established an EMT Coordination Cell (EMTCC) to ensure the smooth operation of EMTs on the ground, and the coordination of incoming teams and MEDEVAC activities.

Several EMTs expressed their willingness to support Armenia in this crisis. An Israeli Burn Assessment Team (BAT) arrived in Armenia and concluded that there were 200 severely burned patients, with 60 of them in severe and critical condition. BSTs, including Israel EMT, Samaritan's Purse, UK MED, and Italy EMT, in coordination with the Ministry of Health, deployed to hospitals where most patients were admitted. Together, these EMTs performed over 500 procedures, including escharotomies, skin grafts and surgical debridements.

At the same time, discussions took place between the Ministry of Health, WHO and the EMTCC to identify how best to address the post-response rehabilitation needs of patients, given the limitations of the health system. As part of the EMT exit strategy, a specialized train the trainer course was held through a collaborative effort engaging the Ministry of Health, WHO, EMTCC and EMTs. Coordinating capacity-building efforts as part of the exit plan of EMTs provided an opportunity to deliver a high level of training, resulting in a wider reach to health-systems strengthening over the recovery-filled months ahead.

© WHO / Spartak Avetisyan, medical evacuation of burns survivors in Yerevan, Armenia

The initial request from the Ministry of Health included MEDEVAC of burn patients as well as BSTs. A total of 19 patients were evacuated in collaboration with the Emergency Response Coordination Centre. Six countries (Belgium, Bulgaria, France, Italy, Spain and the United States of America) offered hospital capacity. Some of the countries organized their own MEDEVAC capacity while Romania and Luxemburg operated MEDEVAC flights under European Civil Protection Pool agreements.

Spotlight

Patient case from a mass burn incident in Ukraine – July 2022

On 14 July 2022, a Russian cruise missile launched against the city of Vinnytsia in central Ukraine struck a private civilian hospital killing 28 people, with over another 100 injured. Managing such a large number of severe burns patients, who also had other significant trauma-related injuries, placed enormous pressure on an already overburdened health-care system due to the impact of the war.

The Ukraine Ministry of Health requested support for the safe transfer of patients to the national tertiary level adult and paediatric burn centre in Lviv and beyond, into European regional specialized clinics. Artesans-ResQ, in collaboration with the Ministry of Health, conducted a rapid evacuation of these severe burn patients.

Navigating patient transfers and evacuations in Ukraine posed daunting challenges. Patient flow from the affected city to the medical evacuation hub in Lviv was uncoordinated, making proper referrals difficult. Additionally, no available aeromedical evacuation capabilities existed. Consequently, hybrid evacuation strategies were devised, combining ground patient transfers into Poland to access aeromedical evacuation there.

Addressing such challenges necessitates an extended preparatory phase and the deployment of specially trained teams. Ensuring continuous safe patient care during transport becomes paramount, underscoring the need for standardized procedures and specialized training. This becomes particularly crucial in the context of burn injuries where time frames for transportation are critical. The evacuation process also underscores the vital need for overarching coordination with clearly defined responsibilities, standardization of patient pathways and triage criteria.

Illustrative patient case

Following the missile attack, a 10-year-old male sustained combined blast and heat trauma with extensive burns encompassing 65% TBSA of 2nd and 3rd degree with his face, extremities and airway affected. Dislocated fractures in the left upper arm further complicated the situation.

The patient was initially transferred to Lviv by an ambulance team lacking appropriate intensive care capacities. Upon arrival in Lviv, his condition was critical and marked by inadequate resuscitation efforts. Four days after the initial injury, Artesans-ResQ conducted the first assessment visit in the paediatric burn centre in Lviv. Advanced burn care was provided, including analgesia, fluids, dressings, intensive care, surgical procedures and nutritional support. The patient was later transferred from Lviv to Rzeszow, Poland via ambulance (a 4.5-hour ground journey) followed by a 1.5-hour flight to Dresden, Germany.

The patient underwent hospitalization in a specialized burn centre in Dresden, where he received intensive care for an extended duration of six months. Subsequently, in August 2023, he successfully returned to his home town in Ukraine. As of November 2023, he remains engaged in daily rehabilitation activities while also attending school. The overall outcome of the patient's recovery is highly satisfactory, serving as a testament to the kind of success stories swift medical evacuation in the context of mass burn incidents can achieve.

Spotlight

Mass burn incident in Sierra Leone – November 2021

On 5 November 2021, a large explosion involving a loaded fuel tanker colliding with a truck occurred in Freetown, Sierra Leone. The resulting inferno killed over 101 people and injured more than 450. The local township hospital was overwhelmed, receiving 82 severely injured patients and 87 corpses on the first night, with only three doctors and eight nurses on duty in the emergency department.

There were immense gaps in managing such a huge MCI at the national level. The National Emergency Medical Services team and a disaster response unit were notified following the incident; however, the Ministry of Health and Sanitation did not harmonize coordination well, resulting in further loss of lives as patients were not properly triaged at the scene nor appropriately transferred to facilities. Some patients were transported via buses, motorbikes, taxis and private vehicles. Most died on arrival. Nationally, there were few general surgeons, only one reconstructive surgeon, no trauma surgeon and few emergency and critical care nurses. As there was no burns unit, patients had to be treated either in intensive care units or makeshift high dependency units.

The Government requested support from EMTs to augment available human resources and provide much-needed clinical care. On 6 November, WHO requested assistance from BATs and BSTs, with the WHO Regional Office for Africa leading guidance and support of the EMT deployment process. The Government accepted early offers from the

© WHO, Senegalese EMT

Italy BAT and Senegalese EMT. Having had a similar experience in DRC in 2018, the Senegalese EMT was mobilized and deployed 72 hours after the disaster. By 12 November, 10 experts, including plastic surgeons, anaesthesiologists, nurses and civil protection officers, had arrived.

EMTs were tasked to three different hospitals where patients were admitted to provide burns care, including reconstructive surgery, pain management, palliative care, wound dressings, rehabilitation, physiotherapy and psychosocial counselling. EMTs also provided on-the-job training to other clinical colleagues in burns management and palliative care. Of 155 patients admitted to the three facilities, 87 were discharged home.

Daily coordination meetings effectively managed the activities of the local team and the EMTs with technical updates by the team providing briefings to senior management from the Ministry of Health and Sanitation. Constraints in coordination processes, such as the legal and regulatory requirements of registering EMT members with the Sierra Leone Medical and Dental Council to secure practising licenses to enable work in the country, hampered timeliness of the response and delays in providing care to patients. This experience advises that EMT members' future credentialing paperwork be forwarded immediately after they are contacted for deployment while other preparatory procedures, such as travel arrangements, are ongoing.

The EMT team dispensed their clinical functions with high professionalism and maintained flexibility in adapting to a chaotic situation and few available resources. Local community members showed great appreciation for the work done by the team and this was partly attributed to having common backgrounds, with the EMT team coming from a similar lower-middle-income setting on the same continent.

For the Sierra Leone Ministry of Health, the response highlighted a need to strengthen coordination among partners, with better provision, allocation and use of resources (both donor and government). It also became apparent that there was an urgent need to train health-care workers, set up national EMTs and establish a burns unit with support from WHO and other partners.

© WHO, provision of specialized burns care

Chapter 2

Methods

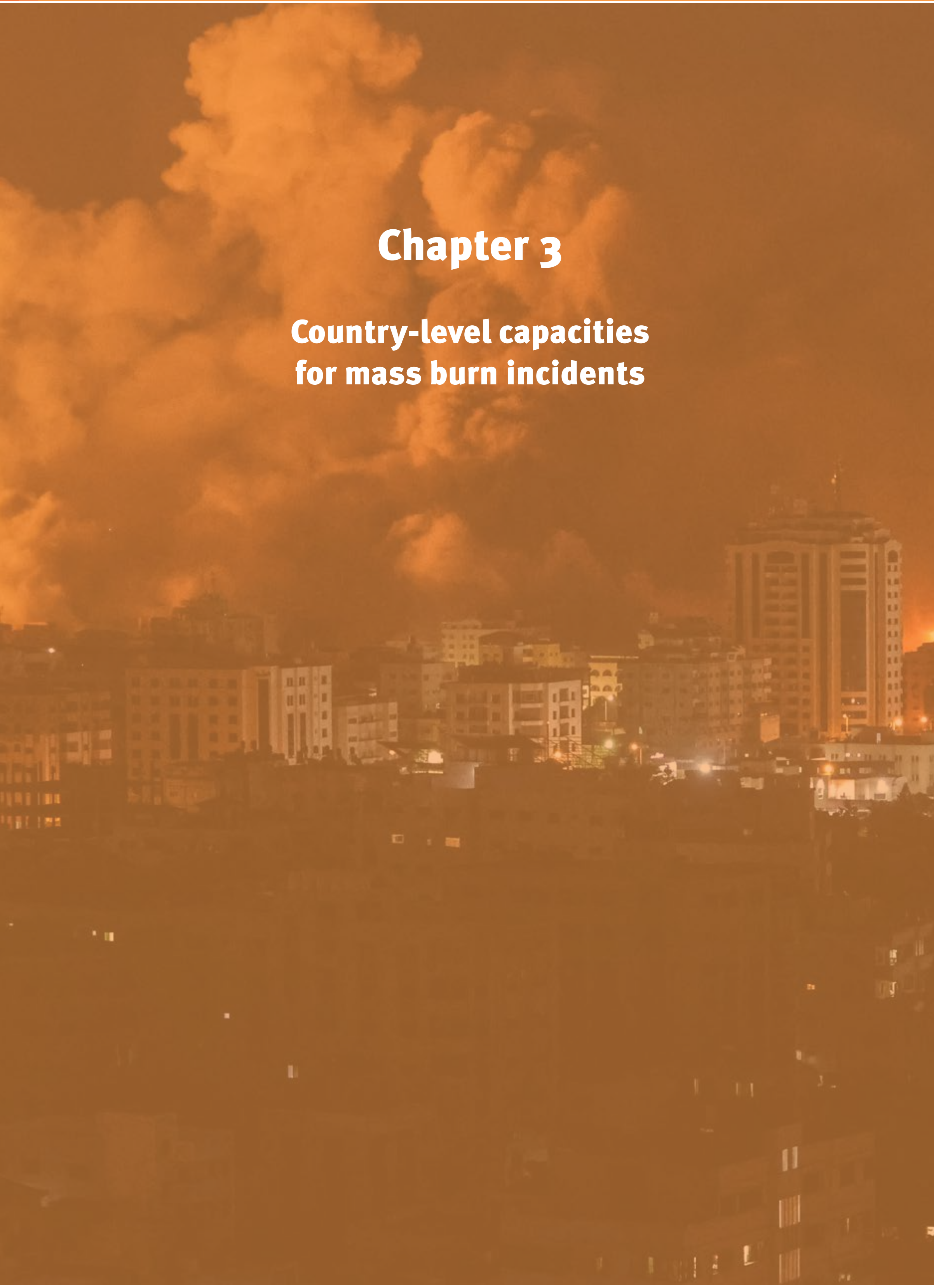
© WHO/ Spartak Avetisyan, medical evacuation of burns survivors in Yerevan, Armenia

2 Methods

The Technical Working Group (TWG) on Burns (2017–2019) conducted broad literature searches using key themes, including published and grey literature. Clinicians and experts from the global EMT community convened a TWG in 2017 to draft initial recommendations based on experiential practice and literature. Expert opinion played a major role in drafting recommendations. A draft document was circulated to the TWG and a survey subsequently circulated to the wider EMT community with a request to agree, partially agree or disagree with each recommendation, with space for comments. A second TWG meeting was convened in 2018 to review the updated document and attain consensus on survey results and comments. Another survey was sent to the EMT community and international burns organizations. A third TWG meeting was convened later in 2018 and the document updated.

Following both the development of a final draft of the TWG on Burns document from 2017–2019, and routine WHO Quality Assurance, Norms and Standards procedures for development of WHO normative products *(13)*, an external review of the final document was sought. Given newer global experiences in mass burn incidents and the recommendation to review new evidence under guidance of WHO headquarters, Science Division, Quality Norms and Standards Department, the external review group was expanded to a TWG. The TWG met virtually from 2021–2023 and updated technical standards on a shared document. This group evolved to become a guideline development group as it also sought to develop clinical recommendations.

The Guideline Development Group (GDG) 2023 followed the established standards and methods for the generation of trustworthy WHO guidelines as outlined in the *WHO Handbook for Guideline Development, 2nd Edition (12)*, and Grading of Recommendations, Assessment, Development and Evaluation (GRADE) methodology *(14)*. This approach can be summarized as: development and convening of a WHO steering group; a GDG; an external review group and a systematic review team, including methodologists; identifying and managing conflicts of interest; formulating clinical questions; selecting and rating key outcomes (conducted by online survey); formulating values and preferences; conducting systematic reviews and evidence assessment; and developing and writing recommendations using the GRADE approach.



Chapter 3

Country-level capacities for mass burn incidents

© WHO, Flames and smoke billow during air strikes in Gaza, October 9, 2023

3 Country-level capacities for mass burn incidents

As part of their mass casualty or disaster plan, it is recommended that Member States include specific provisions for a potential mass burn incident. This portion of the plan would ideally be drafted in collaboration with members of the burn specialist community. Similar to other parts of the mass casualty or disaster plan, the plan should be tested with relevant local, national and regional stakeholders and regular simulation exercises conducted at least every 2–3 years.

The mass burn incident portion of the plan should include: (i) type(s) of possible burn events and expected resulting types of injuries; (ii) response pillars, including coordination of EMTs; (iii) mechanisms to mobilize national teams/personnel (including ideally local/national EMT and BAT: (iv) mechanisms to receive international teams/personnel (including EMTs of all types); (v) approaches to care including communication pathways with transferring and receiving health facilities; (vi) specific provisions for possible requirement of MEDEVAC of patients within country or to other countries); (vii) written standard operating procedures; and (viii) resources available and possible sources for additional resources. Consideration should be given to the support and use of local and regional trauma teams (not burn specialized) and MEDEVAC teams, for example, EMTs specialized in MEDEVAC in augmenting some of the clinical work required. The integration of such teams is likely in the event of a large or mixed blast incident.

All countries should consider creating a BAT or having bilateral or regional agreements to request BAT from neighbouring countries as part of their national EMT system and their national emergency response plan. Should a country have few burns specialists, or prefer to retain these at the national referral centres, then BATs may be required from surrounding countries. BSTs may be best shared regionally among multiple countries, either sourced from one larger country, and/or with the contribution of experts and resources from nearby countries within the region.

3.1 Coordination

Ideally, coordination of an MCI should be led entirely by local government personnel experienced in operationalizing the coordination requirements as part of a health emergency operations centre. However, support is often required via external expertise to bridge gaps, support operationalization and help guide delivery. Thus, while the primary responsibility remains with the Ministry of Health or other appropriate national authority, coordination can be supported at a national and regional level by expertise from a BAT (see section below on BAT service provision).

Mass burn incidents present a number of unique challenges regarding coordination. In addition to the influx of high numbers of critically unwell patients to overburdened health facilities, existing burns services and relevant resources in many regions can often be sparse and/or already fully occupied. Clinical expertise may only be available at the capital city or tertiary level health facility, and the number of clinicians experienced in burn care minimal. Focus of coordination should include strategies to decompress specialist centres and harness additional resources where available.

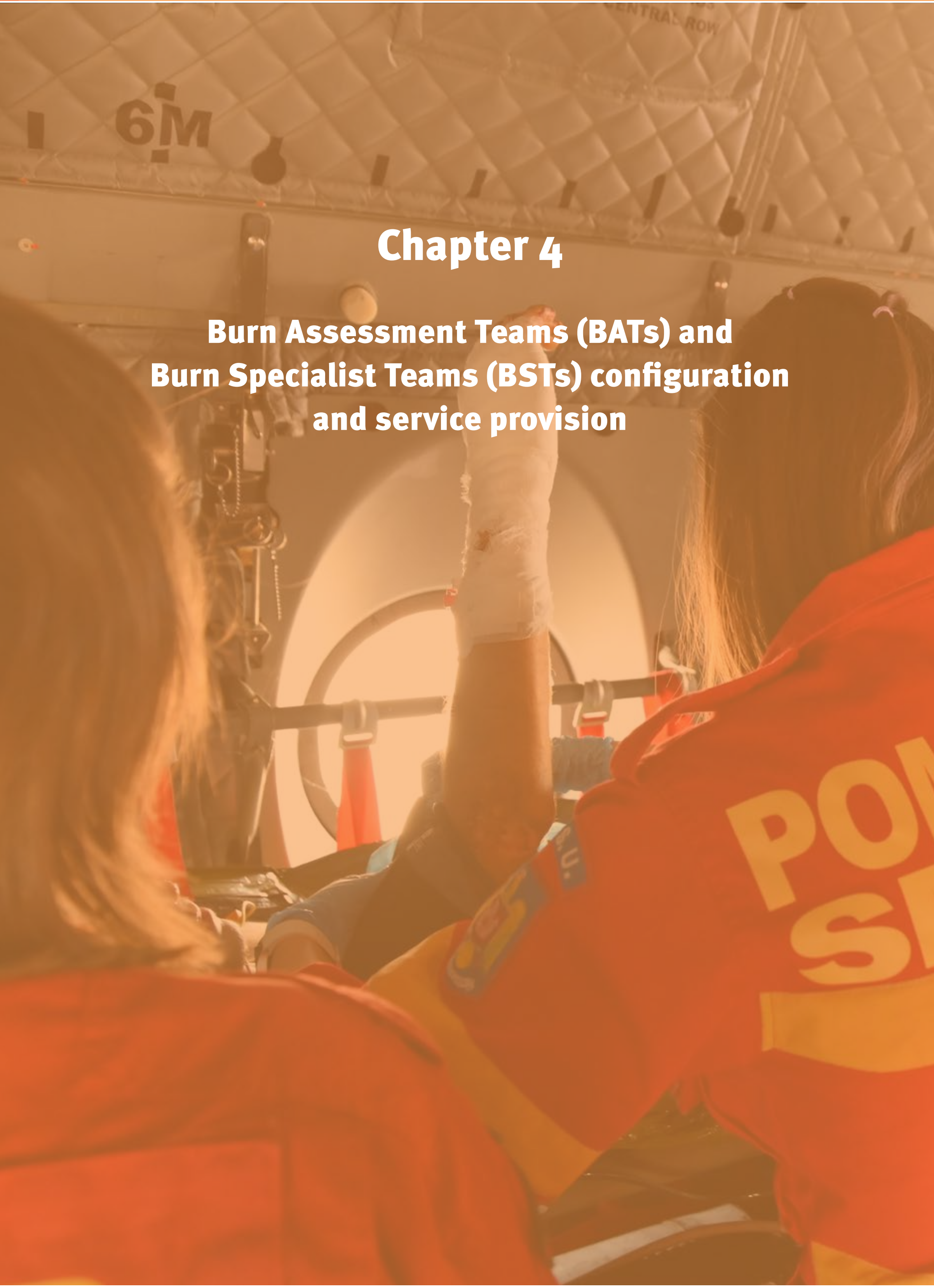
Additionally, specific considerations must be taken for an expected large number of MEDEVAC patients from the site or country. MEDEVAC may be a subset of coordination activities requiring specialized clinical support. This can be a function established within the EMTCC structure, which is purposed to provide overall coordination of all clinical surge capacities and responding medical teams (both national and international) to best meet additional health-care needs. The MEDEVAC function within will be to support the coordination of medical evacuation, with experienced clinical and coordination team members to inform operation support and logistics requirements. Countries should consider the inclusion of a MEDEVAC coordination function within their national coordination mechanisms.

Since the overall scope of coordination activities required is often broad, the requirement for efficient pooling and tasking of resources is vital. BATs and/or BSTs can provide an important resource in the form of technical and clinical expertise experienced in coordination and burns care who can help establish and strengthen coordination hubs. To ensure an effective response from EMTs and BSTs, coordination should be centralized and engage all relevant stakeholders, led through an established and nationally-led EMTCC.

General EMTs refer to the classic Type 1 (mobile and fixed), Type 2 and Type 3 teams that respond to conflict, outbreaks and climate-related disasters. Specialized care teams (SCTs) such as BATs and BSTs or for MEDEVAC, highly infectious diseases and spinal cord injuries, may embed into general EMTs or into local hospitals. Depending on their composition, expertise and infrastructure, EMTs may have the capability of delivering basic to intermediate level burns care *(1)*. However, EMTs that are not BSTs are recommended to support the care of a burn-injured patient only to within their existing capability. EMTs may host BATs and BSTs should a need arise (for example, if local hospitals are overwhelmed or unable to support a burns response). This situation is most likely to arise when a mass burn incident occurs while EMTs are already in-country, or following an event resulting in extensive burn and non-burn trauma injuries where there is a requirement for both EMT and BST support. In the presence of a BAT and/or BST, burn care capability of an EMT Type 2 or 3 can be strengthened, in a similar manner to the resultant increased capability of a local first receiving or tertiary hospital.

Chapter 4

Burn Assessment Teams (BATs) and Burn Specialist Teams (BSTs) configuration and service provision



© WHO/ Spartak Avetisyan, medical evacuation of burns survivors in Yerevan, Armenia

4 Burn Assessment Teams (BATs) and Burn Specialist Teams (BSTs) configuration and service provision

The role of BATs and BSTs are distinct but complimentary (see Table 2). The development of BATs is encouraged within all countries as a critical step in developing surge capacity for burns care.

Table 2. Overview of BAT and BST

	BAT	BST
Functions	Advisory; clinical; coordination	Clinical; coordination if requested
Timing of deployment	Deploy within hours; stay for two weeks	Deploy within days; stay for six weeks
Logistical considerations	Light, portable; self-sufficient for at least three days	Self-sufficient for two weeks prior to resupply
Source	National; regional if needed	Regional; global if needed

4.1 BATs

BATs play a pivotal role in the early phase of a response (see Table 3 for required team members). It is recommended that the BAT be national and capable of deploying quickly and efficiently following a mass burn incident with the capacity to fulfil a number of roles and support the local health system in the following functions:

1. advisory
2. clinical
3. coordination

4.1.1 Advisory function of BATs

- Estimate patient numbers and their initial estimation of severity; and
- provide a comprehensive check on resource availability in the first receiving health facility and specialist burn facilities.

4.1.2 Clinical function of BATs

- Support local health-care workers with the clinical (re)assessment, (re) triage and on-going care of patients at the first receiving health facility;
- ensure appropriate and adequate early resuscitation of burn-injured patients, including analgesia, fluid management and escharotomy if indicated;
- provide support and guidance to local health-care workers in the delivery of surgical interventions for burn care, including decision-making, performing scrub and early surgical interventions (for example, early debridement and grafting);
- provide support and guidance to local health-care workers in early rehabilitation of patients; and
- support the care of patients receiving palliative care.

4.1.3 Coordination function of BATs

- If requested, provide direct support to local coordinating teams centrally (ministry of health or similar) and hospitals;
- support decision-making regarding patient transfer, patient evacuation and patient (re)distribution;
- assist local authorities to determine the need for additional expertise in the form of BST;
- liaise with local coordinating bodies to assist with patient and resource coordination strategies; and
- ensure weekly activities are reported to the relevant authorities throughout their deployment and a final exit report.

4.1.4 Timing and duration of deployment for BATs

BATs ideally deploy immediately (within hours) following a request from the affected local health authority. BATs are not expected to assist on-scene and are best placed to focus their support centrally or at first non-specialist receiving hospitals, subject to local authority guidance. This mechanism also helps preserve the country's burn expertise at their relevant specialist hospitals (those individuals who are not part of the BAT). BATs are recommended to remain in place for two weeks with integration into the BST, as required.

4.1.5 BATs logistical considerations

BATs should ideally be self-sufficient in specialized equipment, consumables, communication tools, food, water and habitat and also be self-sufficient for their own needs in order to perform their function for a minimum of three days. Mass burn incidents are unlikely to have damaged all local infrastructure, thus large caches of tents and logistical equipment are not required, so teams should be light and portable to facilitate rapid deployment. Self-sufficiency in terms of food, water and habitat for teams can be sustained through the use of local hotels and resources if these are unaffected by the incident, but the team should expect to be self-sufficient in terms of paying their own bills or have this covered through their deploying agency and not burden the local system.

4.1.6 Recommended composition of BATs

Table 3. BAT required team members

	Number per team	Skill requirement
Team Leader	1	For example, emergency response manager experience (this is a non-clinical role)
Burns specialist surgeon	1	Minimum five years experience in burns care and multiple contexts
Burns experienced anaesthetist	1	Minimum five years experience in burns care in various contexts
Burns experienced nurse	1	Minimum five years experience in burns care across various contexts
Logistician	1	With water, sanitation and hygiene (WASH) and waste management experience
Rehabilitation specialist	1	Minimum five years experience in acute burns rehabilitation

4.1.7 Source of BATs

All countries should consider creating a BAT or having bilateral or regional agreements to request BATs from neighbouring countries as part of their national EMT system and their national emergency response plan. Should a country have few burns specialists, or prefer to retain these at national referral centres, then BATs may be required from surrounding countries. These would need to comply with international EMT standards, and be self-sufficient/self-caring for up to two weeks, but arrangements for such self-sufficiency in terms of team welfare is likely to be relatively easy to arrange locally, such as the use of local hotels and restaurants, without the need to bring large stocks of food and water. International BATs should be aware that they will likely be deployed into a hospital lacking burns service and therefore need to bring burns care equipment and consumables.

4.2 BSTs

BSTs are larger teams comprised of multidisciplinary, burn-experienced health-care workers (Table 4 lists recommended composition). Whether nationally or internationally-based, BST's have a number of important functions, not only in the clinical management of patients, but also in a coordinating role.

4.2.1 Clinical function of BSTs

- provide additional experienced personnel to provide support, advice and guidance to local health-care teams in the on-going clinical care of burn patients; and
- provide expertise, particularly regarding rehabilitation and long-term treatment plans for patients.

The main role of a BST has been recognized as capacity building, particularly for an existing health facility. It may be preferable to keep national health-care staff and expertise in their familiar place of work, rather than redistributing personnel to support other facilities – a role that can be supported by a BST. It is recommended that resource allocation be determined on a case-by-case basis, dependent on local context and resources, BST availability and type of incident.

4.2.2 Coordination function of BSTs

- Strengthen the capability of the BAT if required; and
- ensure weekly activities are reported to relevant authorities throughout their deployment and that a final exit report is filed.

4.2.3 Timing and duration of deployment for BSTs

BSTs are expected to deploy following an invitation from the local health authority after initial assessment by the BAT(s), which may be 48–72 hours or more post-event. International BSTs are not likely to arrive in-country for several days after the initial incident but should remain for six weeks. BSTs should support strategies to ensure a smooth handover of patients requiring on-going care and follow up.

4.2.4 BSTs logistical considerations

In line with BATs and the minimum standards and core principles for EMTs, BSTs must be self-sufficient for a minimum of two weeks prior to resupply. BATs and BSTs are not expected to provide their own field infrastructure as teams are most likely to be co-located within an existing facility.

4.2.5 Recommended composition of BSTs

Table 4. Recommended composition of a BST

Skill set	Essential experience/ Core skills	Number per team	Desirable experience
Team leader	Experience working in health emergency response coordination (this is a non-clinical role)	1	Experience in disaster management
Burns specialist surgeon	>5 years burns experience with general trauma experience	2	Experience working in trauma +/- mass burns or mass casualty
Anaesthetists	With burns experience (>5 years) and ICU experience	2	Austere environment experience/course

Skill set	Essential experience/ Core skills	Number per team	Desirable experience
Nurses	With burns experience +/- paediatric experience (2–5 years). Nurses should have experience in burns dressings, autoclaving, operating theatre nursing and 1–2 years clinical leadership experience.	5	Burns training
Medical logistician	For management of consumables and pharmacy	1	Experience in emergency health deployments, managing medical stock specific for burns care.
General operational support specialist	Includes logistics and WASH experience	1	Experience in emergency deployments, including managing team self-sufficiency, as well as the ability to support power, water, sanitation, environmental cleaning and waste management.
Nutritionist/ dietician	Experience in nutrition support in intensive care settings or limited-resource settings.	1	Experience in nutritional support for burns patients in resource-limited settings.
Rehabilitation specialist	With >3 years burns experience, including splinting and respiratory care.	2	

4.2.6 Source of BSTs

BSTs are potentially less likely to be deployed, more difficult to put together (especially for long deployments) and may be best shared regionally among multiple countries, either sourced from one larger country, and/or with contributions of experts and resources from nearby countries within the region.

4.3 Equipment and supplies for BATs/BSTs

As noted above, all BATs and BSTs are expected to be self-sufficient for their own needs and for the equipment and consumables required for the surgical and burns care they provide.

Following an initial situational assessment by BATs, any additional resources required can be sourced and provided by tasked BSTs. Consideration should also be given to the tasking of other specialist EMTs such as those supporting logistics or medical evacuation. These may be requested by BATs or local health authorities should this be identified as a need.

Recommendations regarding the equipment teams should deploy with are detailed in Table 5. A modularized approach to equipment is recommended. A modular system supports a standardized and simplified framework for burns equipment and expedites resupply. Thought should be given to the fact that burns treatment can continue for many months when considering stock volumes for each module.

The WHO Trauma and Emergency Surgery Kit (TESK 2019), WHO Major Trauma Backpack 2021 and other WHO kits provide several modules which may replace or supplement those below *(15)*.

Table 5. Recommended equipment/supplies modules

- Infrastructure module
- Resuscitation module
- Dressing module
- Laboratory module
- Pharmacy module
- Blood module
- Surgical module
- Nutrition module
- Rehabilitation module

4.3.1 Infrastructure module

Since mass burn incidents are, in general, not likely to damage health facility infrastructure on a large scale, BATs and BSTs are expected to co-locate with an existing facility. Although self-sufficiency of burns teams is required, they are not expected to be self-sufficient in the same manner as EMTs Types 1, 2, and 3 having full infrastructure support.

However, there are exceptions to this and consideration should be given to required self-sufficiency in such instances. These include the following.

- **Conflict:** infrastructural damage may exist due to conflict, and conflict settings may result in thermal and non-thermal burns (for example, chemical) to a large population, especially if health facilities are specifically targeted.
- **Climate-related disaster:** in the case of a mass burn incident as a consequence of a climate-related disaster, local and regional functioning health facilities and EMTs (national and international) may provide an infrastructural platform for delivery of health care. BATs and/or BSTs can co-locate with either.
- **Radiation:** gas plumes or other forms of contamination, such as radiation, may make it unsafe to use nearby health facilities and temporary EMT facilities may have to be erected in another safer area.
- **Explosion within a health facility:** surrounding health facilities may not be impacted and with external support, are able to provide needed burns care and facilities where burns teams can co-locate.

4.3.2 Resuscitation module

Consideration should be given to:

- airway equipment, such as nasopharyngeal and oropharyngeal airways
- suction
- supply of medical oxygen
- oxygen delivery tubing, masks and cannulae
- equipment for advanced respiratory support, including intubation, ventilation and tracheostomy
- urinary catheters and urine collection supplies
- observation and recording charts
- WHO checklists.

4.3.3 Dressing module

It is likely that the requirement for burn dressing equipment will far exceed the local supply in most settings after a mass burn incident. Accordingly, a dressings module of equipment should be available to be implemented as soon as possible after the incident. This module should include sufficient dressings, antiseptics and other basic equipment for undertaking regular dressing treatments on a large number of injured people.

4.3.4 Laboratory module

BATs and BSTs should aim to augment laboratory equipment available locally. Information on receiving hospitals existing laboratory capability should be determined by BATs and equipment needed to augment laboratory capability communicated to BSTs prior to their arrival.

Standard questions regarding the availability of blood transfusion services, basic laboratory, autoclave and radiology (chest X-ray in particular) are required. If not present, teams should consider bringing these capacities or liaising with local authorities to ensure they are on-site.

4.3.5 Pharmacy module

Quantity of pharmaceutical items should be estimated based on a two-week resupply and thus in line with recommendations for EMTs *(1)*. Though it is likely that the requirement for analgesics and anaesthetic agents will exceed the local supply in most settings, adjustments can be made to quantity and items according to local needs. Logistical measures should be in place among burns teams to ensure cold chain transport is available if required.

Analgesics and anaesthetics

Consideration should be given to augmenting the analgesics and anaesthetics commonly used within local hospitals. This may vary across contexts. Transportation of any controlled pharmaceutical agents, such as opiates, must follow international custom and country guidelines. Provisions for safe anaesthesia care with appropriate monitoring capacity must be considered if anaesthetics are brought.

Antiemetic and gastroprotective agents

Consideration should be given to augmenting the local supply of antiemetics and gastroprotective agents such as proton pump inhibitors, especially for the critically ill.

Antibiotics

Unless specifically clinically indicated, antibiotics should not routinely be given prophylactically to burn patients after a mass burn incident *(16)*. However, antibiotics may be required to treat secondary infections. Teams should consider bringing appropriate burns-specific antibiotics to commence therapy in the case of infection.

Oral and intravenous (IV) fluids

A large quantity of Oral Rehydration Salts (ORS) is recommended as nearly all burn patients will receive oral fluids. A supply of clean drinking water may be limited locally, therefore consideration should be given to providing bottled water along with ORS to avoid the need to boil water. Teams should also consider establishing a portable water purification system. This can serve as a backup if local supplies are insufficient or compromised, thereby providing a sustainable source of clean water for both drinking and medical purposes. Crystalloids are recommended for IV fluids, although consideration should be given to the logistics required for the weight and volume carried as deployed kit. Oral and IV fluids may be available locally, which the deploying team should try to determine prior to deployment and if so, their expiration dates, quantity available and storage conditions to ensure they meet required standards for medical use.

Tetanus

Tetanus vaccination is likely to be available in some quantity at local hospitals. Teams should also deploy with tetanus vaccine and immunoglobulin surge supplies if local stocks are unavailable.

Nutritional supplements and supplies

Nutritional supplements should form an essential part of pharmaceutical stocks. Recommendations include: multivitamins; zinc; vitamin C; supplementary feed options and a guide to calculating nutritional requirements in major burns *(17)*. Equipment supporting a nutritional focus should include mid-upper arm circumference tape, weighing scales and hanging paediatric scales. Nasogastric feeding tubes and syringes are vital for delivery of adequate ORS, oral and/or enteral nutrition. Nutritional intake monitoring charts should also be considered.

Post-exposure prophylaxis

As per EMT staff safety requirements, teams are recommended to carry a short course of HIV PEP for team members inadvertently exposed. The choice of drugs and regimen for HIV PEP should be in line with established national and/or international guidelines.

4.3.6 Blood module

A blood module may be required. As part of their initial assessment, the BAT should help determine the availability of safe blood for use and confirm the likely need for deployment of a blood module. Procedures to reduce the risk of bleeding are encouraged, for example, the use of local anaesthetic with adrenaline.

4.3.7 Surgical module

Although a BST should deploy with enough personnel to technically support a second operating theatre, it is more likely that the additional team members will be performing a wide range of roles, including supporting ward work, post-operative care, out-patient care, or second-assisting on complex cases. Specific considerations for surgical equipment should consider local capacity to engage in advanced wound cleaning, surgical scrub, escharotomy, fasciotomy, excision, enzymatic debridement, grafting, local tissue rearrangements, flaps and contracture releases, among others. Safe surgery checklists and patient documentation charts should also be part of this module.

4.3.8 Rehabilitation module

Plaster of Paris and other splinting materials such as polyvinyl chloride pipes should be sourced, as well as bandages to secure them in place. Pillows, rolls and wedges for positioning should also be considered.

4.4 BAT/BST training

All BAT and BST team members should have completed general EMT team member training followed by specialist training for burns. Team leaders and senior clinicians should also have training in coordination and emergency management. Specific training for BATs and BSTs should include:

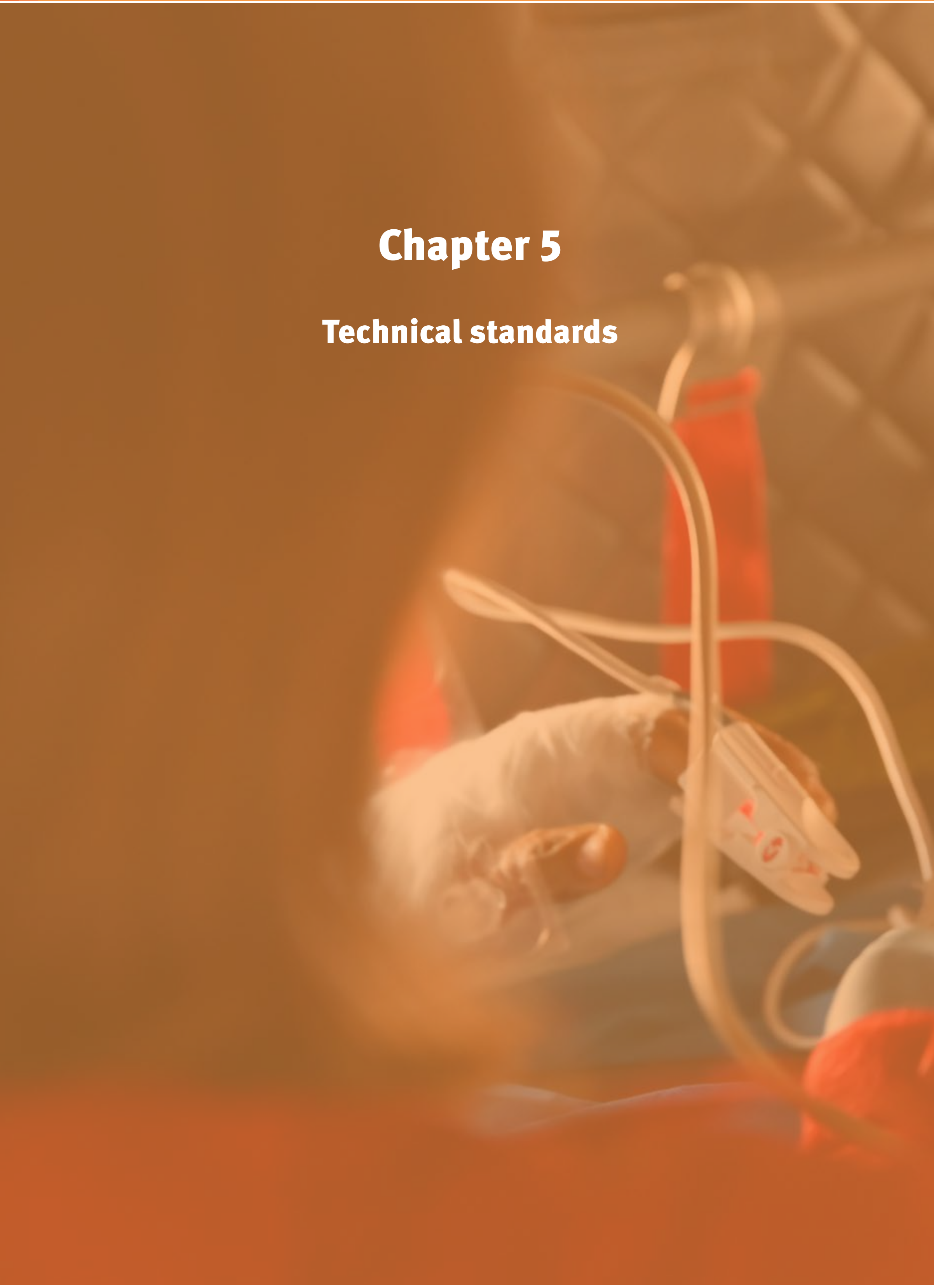
- assessment, coordination and leadership in MCIs with burn injuries
- clinical care, including resuscitation and safe patient transfer
- decision-making regarding the management of multiple burn patients
- lessons learnt, best practices and WHO standards and recommendations for mass burn incidents.

Globally, utilization should be made of existing courses (see Table 6) which meet the required learning outcomes, ensuring training is regionally accessible, open access and economically viable. Training for BATs is recommended to be delivered at a national level. Training specific for BSTs can be delivered centrally at a regional level.

Training for teams in low resource contexts should be sensitive and responsive to local and cultural needs, relevant to the type of health-care professional working with burns patients and tailored to meet the basic, intermediate and advanced levels of burn care *(18,19)*.

Table 6. Examples of burn care course topics

- Pre-hospital burn evaluation and care
- Basic burns nursing
- Basic/essential burns care
- Advanced burn care
- Advanced surgical burn care
- Burn anaesthesia and peri-operative care in austere circumstances
- Emergency management of severe burns
- Management of the critically ill burns patient
- Rehabilitation for burns
- Innovation in burns care
- Awareness/basic training in CBRN
- Nutrition for the burn patient in limited-resource settings



Chapter 5

Technical standards

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5.1 Patient flow overview

Burn-injured patients require timely and appropriate care from the scene of the incident onwards.

On-scene → **First receiving hospital** → **Transfer/referral**

Phase 1. On-scene: The scene of the incident and the site where first responders are most likely to attend to patients. First responders may include passers-by, local community members, emergency service personnel and health-care workers. Patients should be moved from the scene to the first receiving hospital/s by any form of transport available. Neither BAT nor BST should assist at the scene of the incident unless specifically requested. The roles of BATs and BSTs are deemed most suitable from the first receiving hospital onwards in the patient journey.

Where applicable, a health post should be considered an extension of the scene.

Phase 2. First receiving hospital: This facility is ideally a district-level hospital although it may be a tertiary hospital depending on the site of the incident and self-presentation of patients. Existing burn care capability, such as the presence of experienced health-care workers, burn care beds and appropriate operating facilities, is likely to be highly varied; however, all are likely to have the capability to deliver basic burns care of pain relief, wound cleaning and dressing. Some district hospitals may have the capability of delivering an intermediate level of burns care without additional support from BATs and/or BSTs.

To ensure early, appropriate and optimal patient care and support for local health-care teams, it is recommended that all first receiving hospitals attain intermediate burn-care capability, as needed, with support from deployed BATs and/or BSTs.

Phase 3. Transfer and referral: To target and utilize resources efficiency, referral and transfer of burn-injured patients should be viewed as multi-directional rather than a unidirectional "step-up" transfer from a district hospital to a tertiary hospital. Burn-injured patients requiring higher acuity and more specialist care should be transferred from the first receiving health facility to a tertiary hospital capable of delivering a higher level of burn care. Generally, these are patients with > 20 % TBSA burns and/or deep dermal or "special area" burns (see section on special area burns).

Consideration should also be given to decompress tertiary hospitals by transferring less severely injured burn patients (and non-burn-injured patients) to a district hospital to maximize specialist bed availability and preserve specialist resources. Decisions regarding patient referral and transfer are recommended to occur only after definitive triage has been undertaken by the first receiving hospital (with support from BATs and/or BSTs, as required). The burn care provision of a receiving health facility can be strengthened by incoming BATs and/or BSTs who can support the scale up of resources required to manage a large influx of patients while maintaining adequate level of burn care capability (Table 7).

Any transfer of a patient between hospitals should only occur once the patient is clinically stable and there has been appropriate communication between the referring and receiving hospital. Support from a central coordination hub may also be required.

Table 7. Suggested provision of burn care during a mass burn incident by level of health facility

	Role	Burn care capability level	Burn care capability
On-scene	First aid	Basic	Analgesia; wound cleaning; simple dressing; fluids
Primary (health post)	Extension of scene/ patients may self-present	Basic	Analgesia; wound cleaning; simple dressing; fluids
District (secondary)	First receiving hospital	Intermediate	Analgesia; wound cleaning; surgical scrub; fluids; dressings; limb positioning; excision and grafting (burns less than 20% TBSA); emergency procedures (escharotomy); nutritional support; early rehabilitation
Tertiary	Referral hospital (or first receiving hospital from self-presentations or scene vicinity)	Advanced	Analgesia; wound cleaning; surgical scrub; fluids; dressings; limb positioning; excision and grafting; emergency procedures (escharotomy); intensive care; special burn management; reconstructive surgery; nutritional support; burn specific rehabilitation

5.2 Triage

Triage is a dynamic process and will likely occur multiple times for the same patient, especially in an MCI. In MCIs, both trauma and/or burns may result and thus a rapid assessment and triage of injuries is required.

In general, three phases of triage are suggested to occur:

On-scene **On-arrival** **Definitive**

A three-phased triage approach is important, in part to ensure accurate patient assessment following an evolving injury, but also to ensure patients are provided the most suitable interventions for their burn injury in a timely manner. The three-phase triage approach also helps target limited national and international resources to needs, such as specialist beds and intensive care.

5.2.1 On-scene at site of incident

The first phase of triage occurs at the site of the incident. The first responder pool will vary in their experience of assessing injured patients and thus guidance should be familiar, simple and practical in its approach. BATs may support this as requested by local authorities.

General triage

Existing and conventional triage systems such as the WHO/ICRC/MSF/IFRC Integrated Interagency Triage Tool *(20)* or other standardized tools such as the Simple Triage And Rapid Treatment (START) *(21)* system should be applied to identify life-threatening injuries such as those compromising the airway (including inhalational burns, head and neck injuries), breathing (such as circumferential full thickness chest burns) or circulation (such as those causing massive haemorrhage). Patients are assigned an appropriate triage category according to the tool used.

The decision to assign a patient to the "expectant" or "non-survivable" or similar triage category is often difficult and sensitive within cultures and communities. Due to the dynamic nature of burn size estimation and potential on-scene estimation error, decision-making regarding survivability of a burn injury is recommended to occur at the first receiving health facility, ideally under expert guidance rather than on-scene.

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Burn specific triage: %TBSA burn estimation

Following conventional triage, assessment of burn severity can occur. On-scene assessment of burn severity should be determined mainly from %TBSA burn size estimation rather than depth assessment.

Estimation of %TBSA burn at scene supports a simple but early effective approach to initial burn triage. Mortality from burns is multifactorial although the relationship between %TBSA burn and survival is well known *(22)*. Depth should not be used as a severity assessment factor as scene responders may not be experienced nor trained in burn injury depth assessment. Additionally, the depth of a burn changes over time and can be difficult to assess even by burns specialists in the first 24 hours *(23)*. Over and underestimation of %TBSA burn is likely to occur on-scene, and environmental and cultural constraints may impact on how easily burn size estimation can occur *(24)*. A 2019 systematic literature review identified %TBSA burn miscalculations from 5% to 339% regardless of provider level with < 20% TBSA burns being disproportionately overestimated *(25)*. Thus, reassessment and re-triage on arrival at the first receiving hospital, and subsequently by burn-experienced staff, is essential.

The %TBSA burn size estimation tool utilized on scene should reflect the tool most familiar to the first responder. This is likely to reduce error and support an easy-to-use assessment for first responders to determine %TBSA burn. However, should guidance be required, the Wallace Rule of Nines %TBSA burn estimation tool should be used for adults (with the accompanying modified version for children) *(26)*. This method is simple, applicable across a variety of contexts, and is a commonly used burn size estimation tool used in pre-hospital environments *(27)*. On arrival at the first receiving health facility, additional tools and burn-experienced health-care workers may be available to re-estimate %TBSA burn as part of the overall reassessment and triage of the patient.

For an approach to further simplify %TBSA-based burn specific triage (which occurs only after general triage as appropriate), the guide below in Table 8 may be considered, taking into account additional special considerations such as age of the patient.

Table 8. Guide to %TBSA-based burn specific triage

Triage Category	Estimated %TBSA burn	Additional comments
Priority 3	< 20 %	
Priority 2	20–40 %	Circumferential limb burns; special area burns
Priority 1	> 40 %	Inhalational injuries; circumferential chest wall burns irrespective of %TBSA

5.2.2 On-arrival at first receiving health facility

The second phase of triage is recommended to occur at the first receiving facility immediately on patient arrival. BATs and/or BSTs are well placed to support both arrival and definitive triage.

On-arrival triage supports a re-evaluation of each patient with consideration given to survivability factors such as %TBSA burn, age, depth and site of burn, and patient comorbidities (Table 9). Burn size %TBSA recalculation at this stage may be completed using additional tools.

It should be noted that across all contexts paediatric burns are routinely difficult to assess and may result in over-estimation of burn size by the first receiving hospital compared to a specialist burns unit thus impacting transfer decisions *(28)*. Regular reassessment and re-triage supported by burns expertise is critical.

Table 9. Factors to consider during on-arrival and definitive triage

- %TBSA burn
- Depth of burn
- Site of burn
- Age of patient
- Comorbidities
- Resource availability
- Systems infrastructure: availability of specialist burns bed; capacity at national burns centres
- Accessibility to skilled burn care clinicians.

On arrival at the first receiving health facility the decision to assign a patient to the "Expectant" or "Non-survivable" or similar triage category remains difficult and sensitive. Support for such decision-making is recommended and can be offered by the BAT and/or BST. Once a decision has been made by the treating health-care team, implementation of palliative care interventions (see Table 10) is essential to ensure the patient's dignity and comfort. Consideration should also be given to the needs of the patient's family.

Patients with non-survivable injuries should be nursed at the health facility where they have been initially received. However, this decision should be at the discretion of the treating clinicians and may be influenced by availability of nursing care and locality of patient family.

Table 10. Palliative care recommendations

Minimum provision of palliative care should include:
- basic airway management - analgesia - simple dressings - oral fluids - catheter - vector control interventions (for example, mosquito nets) - mental health and bereavement support.

5.2.3 Definitive (after surgical scrub/wound cleaning)

The third phase of triage should also be undertaken at the first receiving health facility. Definitive triage should occur after extensive wound cleaning and/or surgical scrub, meaning when the extent, site and severity of burn injuries can be more accurately determined. BATs and/or BSTs are well placed to support both arrival and definitive triage.

A three-phased triage approach is important in part to ensure accurate patient assessment following an evolving injury, but also to ensure patients are provided with the most suitable interventions for their burn injury in a timely manner. The three-phase triage approach also helps in timely recruitment of national and international resources to appropriately deal with higher-care resource needs such as specialist beds and intensive care.

On-arrival and definitive triage should include an assessment of burn depth. Other survivability factors including patient age and comorbidities should also be considered during these phases of triage (Table 9). Decisions regarding onward clinical care and redistribution of patients can then be considered once a more accurate patient assessment has been completed. Paediatric burns >10% TBSA (determined after definitive triage), inhalational burns, special area burns and specific chemical burns should be triaged and managed in a tertiary hospital when possible.

5.3 Special area burns

Burns affecting the face, neck, perineum, genitalia, joints, hands and feet are designated special area burns. Burn expertise with BAT and/or BST support may be required to manage patients sustaining these kinds of burn injuries, regardless of %TBSA affected. Access of such patients to specialist care (such as rehabilitation specialists) is recommended to expedite and optimize recovery.

5.4 Inhalation injury

Inhalational injuries can cause significant morbidity and mortality *(29)*. Early recognition and intervention of likely airway compromise or respiratory failure is an important step towards improving patient outcome. First responders and those at the initial receiving health facility are advised to be observant for early signs and symptoms of a thermal inhalational injury. The type of incident and mechanism of a burn injury will also provide additional indications of the risk of inhalational injury. Signs of inhalational injury include soot in the mouth, facial burns, stridor, hoarseness and confusion *(29)*. Evaluation of inhalational injury is a critical step in the triage process.

Consideration should also be given to the possibility of chemical inhalational injuries, such as those resulting from mustard gas, phosphorus and chlorine following MCIs. Appropriate personal protective equipment is advised when managing patients suspected of being victims of a chemical incident. Additionally, awareness of the often delayed effects of the agent is important (for example, mustard agents) *(30)*. Industrial accidents can also give rise to inhalational injuries such as cyanide poisoning from acrylics *(31)*.

Early and appropriate interventions and referral of patients with suspected inhalational injuries to specialized burn centres can help support improved outcome. Early interventions include airway protection, oxygenation, cautious fluid management and respiratory rehabilitation.

Respiratory complications from inhalation injuries affect each patient differently. These may include: pain, anxiety, increased work of breathing and secretion retention. Early respiratory rehabilitation and optimal early patient positioning can help alleviate symptoms and prevent future complications in addition to ensuring the patient is equipped to manage their symptoms on discharge. Where possible, early mobilization should be encouraged to enable the patient to clear secretions and maintain cardiorespiratory system function. For children, this may take the form of play. A programme of breathing exercises and manual techniques should be used to support the patient to maximize lung function and chest expansion.

Advanced airway management (intubation and ventilation) is resource intense and thus this intervention should be considered at the earliest possible phase of care.

5.5 First aid and dressings

First aid for burn injury influences the clinical course and severity of the burn *(32–34)*. Basic first aid can be continued from on-scene into the first receiving hospital and includes the following.

5.5.1 Cooling

Cooling of the burn wound can occur from 10 minutes to three hours after the injury was sustained using potable/drinking water of room or cool temperature. Cooling is associated with improvement in re-epithelialization over the first two weeks post-burn and decreased scar tissue at six weeks *(33, 35)*. Consideration should be given to patients who are at risk of hypothermia, in which cases resuscitation efforts should be prioritized over burn cooling.

5.5.2 Analgesia

Provision of pain relief is critical for patients with burn injuries and should be offered in conjunction with cooling and/or just before cleaning if possible.

5.5.3 Cleaning

Basic cleaning involves removing debris and irritants from the wound using potable/drinking water of room or cool temperature. Rings, watches or any other jewellery/clothing should be removed from the burned area as swelling will ensue.

Advanced (thorough) cleaning should occur on arrival at the first receiving hospital with appropriate analgesia and/or sedation.

If extensive wound cleaning is required, the surgical scrub of burn wounds can be undertaken in the operating theatre by clinicians while the patient is under anaesthesia. This intervention can be supported by burn experts from the BAT and/or BST.

5.5.4 Dressing

A basic non-circumferential, light, clean dressing or plastic wrap may be applied after basic cleaning. Application of substances such as eggs, butter, toothpaste or similar should be avoided.

More extensive understanding of the pathophysiology of wound healing and developments in dressing technology has resulted in significant advances in burn wound care and dressings *(36)*. There are a number of modernized dressings available that are designed to be left in place for a longer duration than simple daily or alternate day dressings. However, the former may be considerably more expensive.

After wound cleaning, options for dressings should be considered according to:

(a) the wound characteristics (for example, infected versus non-infected);
(b) point of application (on-scene or health facility);
(c) availability of dressings, including routine dressings and/or specialist dressings likely to be externally sourced;
(d) cost-benefit implications and resource requirements (such as staffing); and
(e) ability of patient to return for follow up.

In a mass burn incident, availability of staff to regularly change dressings and dressing availability (potentially affected by lack of local and international resupply) are likely to be compromised. Consideration also needs to be given to the logistical requirement of transporting dressings if brought to the health facility by a BAT and/or BST, including packaging weight and volume, air transport costs, clinical waste disposal requirements and local transportation.

5.5.5 Tetanus considerations

Confirm if a patient has had their tetanus vaccination and it is up to date as per local guidelines and practices. Give booster and/or immunoglobulin as indicated.

5.6 Out-patient burn management

Effective out-patient care of the burn-injured patient requires patient compliance and adherence to treatment. Clear communication, easily accessible clinics and simple burn care pathways should be made available to patients and their families. Community engagement in burn care and burn prevention is also important and helps provide support for patient recovery.

Patients with < 20% TBSA superficial/partial thickness burns and no special area burns may be discharged with adequate outpatient support (for example, social and community support and clear care pathway communicated).

Patients with > 20% TBSA and/or deep dermal or special area burns should be evaluated by an experienced burn care specialist as they may require ongoing in-patient care. Consider transferring these patients to a specialist burn care centre.

5.7 Surgical interventions

Surgical interventions that the local surgical teams are unfamiliar with or inexperienced in should be supported by clinical expertise from BAT and/or BST, supplementing the use of existing procedural guidance and checklists.

Procedures that may be performed by non-burn surgeons include advanced wound cleaning, surgical scrub, escharotomy and fasciotomy. As limb-salvaging and life-saving interventions, escharotomies and/or fasciotomies are deemed to be an important part of the initial management and stabilization approach to burn patients. These may be performed at a first receiving hospital provided infrastructure and local skill sets are available.

Excision, enzymatic debridement, grafting, local tissue rearrangements, flaps and contracture releases are examples of procedures that should be performed by surgeons skilled in burns care and/or by surgeons supported by clinical expertise. Full thickness burns should ideally be managed (excised) within the first week of injury while partial thickness may be managed beyond the first week. Excisions of burns < 20% TBSA in adults and < 10% in children may be may be performed at a first receiving hospital, supported by burns expertise, provided infrastructure and local skill sets are available. Only skilled burn surgeons (supporting a district or tertiary hospital) should undertake excision in patients with > 20% TBSA burn (adult) and > 10% TBSA burn (children).

5.8 Rehabilitation

Early access to rehabilitation can have a significant impact on patient outcomes and reduce the risk of secondary complications, such as immobility and contractures. The hypermetabolic response from severe burns, coupled with prolonged bed rest make patients vulnerable to secondary complications *(37, 38)*. This is especially critical in the context of limited in-patient bed availability during a mass burn incident.

Active and passive exercises, positioning, splinting and functional retraining should commence at the earliest phase of care, once vital functions are stable and considering precautions such as related trauma, wound breakdown, graft frailty, attached wires, low blood pressure or infection. Adequate analgesia should be administered prior to rehabilitation interventions as pain can reduce participation and performance.

In the context of burn injuries, the focus of rehabilitation is on:

- reducing oedema
- managing pain
- encouraging early mobilization
- preventing or reducing disfigurement
- supporting functional recovery
- minimizing the impact of scarring on range of movement.

Rehabilitation specialists have specific skills to target these objectives. Rehabilitation specialists are potentially also well-suited to take over the care of burns patients once surgical intervention and wound care has been completed. However, improving patient outcomes from burn injury through effective rehabilitation strategies remains the responsibility of the entire treating team in collaboration with the patient *(39)*.

Rehabilitation requirements should be considered for all patients (based on burn severity and location of the burn) on their arrival at the first receiving hospital. Depending on need, rehabilitation interventions may include:

- respiratory physiotherapy (see section on inhalation injuries)
- stretching and range of movement exercises
- strength and coordination exercises
- ambulation
- activity of daily living/functional retraining
- anti-contracture positioning.

Burn contractures can develop within weeks. Splinting and positioning are essential for maintaining tissue length during wound healing and to maximize functioning. Oedema post-burn injury can be aggravated by limb dependency and can restrict wound healing and movement, as well as exacerbate pain *(40)*. Elevated positioning facilitates lymphatic drainage and, along with massage and compression, can be used to effectively manage oedema. When burns are grafted or deep partial or full thickness burns are being managed expectantly, position the burnt/grafted skin to counteract contractile forces, using splints when indicated, to prevent contracture and manage oedema.

- Splinting

  Splinting can be used post-skin grafting to immobilize the limb. The typical regime post-skin graft is to continually immobilize the affected joint area(s) for five to seven days (depending on the state of the graft take), followed by night-wear of splints. However, this should be decided in consultation with the surgeon. Splints may be applied in theatre while the patient is under anaesthesia or during post-operative recovery to minimize discomfort. The indication for splinting is based on the severity and location of the burn, and the patient's ability to move actively. Splinting should be particularly considered for young children and sedated patients who may not be able to actively participate in stretching and exercises. Photographs or pictures can be used to illustrate ideal positioning.

  Splinting and anti-contracture positioning should be considered for conservatively managed wounds that do not heal within two weeks, as the risk of scarring increases. Thermoplastic is the ideal splinting material as it can be remoulded over time and achieve good conformality, but alternative materials, such as Plaster of Paris and PVC piping may also be considered in more resource-scarce settings. Innovative resources can also be used for mouth (wooden spatula) and neck splint (suction tubes wrapped with cotton and gauze).

- Scar management

  Compression therapy and massage should be used to minimize scarring and manage oedema. In the context of moderate and severe burns, compression therapy can reduce scar height, and alleviate some of the discomfort of immature scars, such as blood rush and itching. Scar massage similarly works to soften scars and can improve skin movement and reduce hypersensitivity *(37)*.

Compression can be achieved with bandaging, tubular elastic stockings and pressure garments. While customized compression garments may not be available in resource-scarce settings, compression should aim to achieve a pressure of 24 mmHg. Compression bandages or garments should be worn 23 hours a day, with regular monitoring, until scar maturation. Scar maturation can continue for 12–18 months and complications can arise for years following discharge from acute care.

As patients with severe burns will continue to use compression and massage well beyond discharge, education in correct use/technique is critical in addition to education about on-going scar care. Encouraging participation during inpatient stay is important to improving chances of continuity post-discharge. Identification and coordination with local rehabilitation providers and disability organizations is an important aspect of discharge planning, particularly in a mass burn incident. This is especially critical for paediatric patients who will require on-going intervention due to the impact of growth on scar tissue.

5.9 Chemical, biological, radiological and nuclear (CBRN) considerations

BATs and BSTs are recommended to have the capability to support the initial care of CBRN patients in the event of a CBRN MCI. They are not expected to deliver care to patients in hot zones, nor involve themselves in scene decontamination but should have provision to provide an early basic package of care to include basic airway management, analgesia, oral rehydration, urinary catheterization, dressings and antibiotics as required (and potentially in the form of patient self-administered kits). Mental health and bereavement support is also suggested. Team members should have good awareness and basic training in CBRN but do not require specialist or higher-level training. Specific knowledge on chemical burns, thermonuclear and radiation burns is recommended when possible.

The general principles of burn care offered by BATs and BSTs can be applied to CBRN incidents. For example, in the event of a thermonuclear mega-event, analgesia, hydration and wound care can be provided by burn teams to support victims.

Chapter 6

Clinical recommendations: fluid management

© WHO, deployed EMT burns care experts at the National Burn Center in Yerevan, Armenia

6 Clinical recommendations: fluid management

Unlike trauma injuries resulting in massive haemorrhage and where early "fluid" (often packed red cells and clotting agents in addition to or instead of crystalloids) is required to preserve life, the fluid shifts resulting from burn injuries is slower, thus giving time for extended fluid management. IV fluids are routinely used in the management of the systemic inflammatory response and capillary leak syndrome following a severe burn injury, with complications such as haemoglobinuria and myoglobinuria from renal failure secondary to burn injuries being avoidable with early administration of fluids *(41)*. However, broad evidence also exists detailing the complications of excessive fluid administration in patients with burn injuries *(42)*. Reported complications include abdominal compartment syndrome, pulmonary oedema, interstitial tissue leakage, airway compromise, and acute respiratory distress syndrome, among others *(43–45)*. Excessive fluid resuscitation in the first 24 hours after a burn can occur and increases the chances of developing many of the complications listed above *(42, 43)*.

Complications such as those listed above affecting just one individual will impact the resource and skill requirement for the patient's on-going management – a scenario amplified significantly in a mass casualty situation where multiple burns patients are at risk of developing resource intense complications if inappropriate fluid regimes are used.

What triggered these recommendations?

These recommendations on fluid management of patients in mass burn incidents were triggered by the 2020–2023 TWG on Burns. While initial draft recommendations were developed from 2017–2019, the 2020–2023 group sought to review them as part of an external review. During those discussions, it became evident that:

- new experiences from mass burn incidents between 2019–2023 around the world had formulated new opinions about fluid management in these contexts;
- new evidence was available regarding fluid management in low-resource contexts; and
- the previous recommendations did not follow WHO normative procedures, including GRADE methodology for clinical recommendations and other procedures outlined in the *WHO Handbook for Guideline Development*.

Values and preferences

Given the high volume of patients and constrained resources during MCIs, the GDG panel placed a relatively high priority on interventions that are feasibly and rapidly implemented across a large number of acutely ill patients by often inexperienced burn care providers, and a lower value on interventions that have high degrees of uncertainty with respect to clinical benefit and are unlikely to be feasible. The GDG acknowledged that substantial variability in these values and preferences across patients are likely to exist, and that frequently reassessing the available resources will be important.

Selecting and rating the importance of outcomes

GDG members selected and then prioritized outcomes from the perspective of patients via an online survey, as per Table 11 below.

Table 11. GDG outcome rating from the perspective of patients who are part of a mass burn incident

Ranking 1 - most important; 7 - least important	**Outcome**
1	Mortality
2	Pulmonary oedema†
3	Aspiration event
4	Acute kidney injury
5	Abdominal compartment syndrome*†
6	Urine output*
7	Ability to swallow

* tied for ranking
† subsequently grouped together as complications of fluid over-resuscitation

6.1 Oral versus IV fluids

RECOMMENDATION

For patients in mass burn incidents, treat with oral fluid resuscitation, and where possible, supplement with IV fluid depending on patient need, clinical resources and provider discretion. (Conditional recommendation, very low certainty evidence)

Practical information

Oral fluid can be provided as potable drinking water with ORS. This approach to patient fluid management should be continued beyond arrival at the first receiving hospital and guided by the patient's clinical response. If IV fluids are indicated, oral supplementation can continue.

Consideration should be given to oral fluid intake for patients requiring surgical interventions, thus requiring sedation and/or anaesthesia. It is recommended that if fasting is required prior to a planned surgical intervention then oral fluids may be temporarily halted. If an emergency procedure is required then, as per standard guidance, airway precautions are important.

Evidence to decision

Benefits and harms

IV fluid resuscitation is the standard of care when there are available clinical resources, and should be considered as the preferred option for patients. There are possible harms of oral fluid resuscitation in mass burn incidents, such as the possible risk of aspiration and under-resuscitation. There was no human data to inform the GDG on further harms, and the benefits mostly relate to the feasibility of implementation in mass burn incidents.

Certainty of the evidence

There is very low certainty that oral fluid resuscitation may increase in-hospital mortality compared to IV fluid resuscitation, but the available evidence is uncertain. The effects on other outcomes are only available for acute kidney injury, where the effect of oral fluid resuscitation is not estimable. There is moderate certainty evidence that oral fluid resuscitation results in slight to no reduction in urine output during the first 24 hours post-injury. Data was not available for any other outcomes.

Values and preferences

The GDG, deriving from their expertise and experience as providers in MCIs and/or in the care of patients with burns, placed higher priority on interventions that could be feasibly and rapidly delivered to a large number of acutely ill patients, often by inexperienced burn care providers, and made a conditional recommendation for oral fluid resuscitation in specific circumstances. The panel acknowledged that the context may rapidly change, whereby providers and resources may alter, leading to transitioning to IV fluid resuscitation at the earliest possible opportunity.

Resources and other considerations

The GDG emphasized the principle of equity, where it is ensured that all patients involved in the mass burn incident have access to the best possible outcome. Additionally, the GDG emphasized adequate resources must be available for adequate monitoring such as urine output monitoring of individual patients who may require further management options.

Additional considerations noted by the TWG

- There are likely to be multiple, competing demands for first responders' time on scene of an MCI.
- Logistically, the volume and weight of IV fluid that would need to be transported by first responders or brought on-scene if IV fluids were instigated during this phase may be impractical. Oral/enteral fluid resuscitation may provide comparative logistical advantages, such as lower weight and volume of ORS sachets, less equipment and less expertise for administration, but there are still some practicalities to be considered: potable water and ORS sachets need to be sourced, delivered and constituted, and some expertise is still required to monitor clinical response and tolerance.
- The accuracy of administration of IV fluid may easily be overlooked (for example, ensuring an appropriate volume of fluid is titrated) and the attention to detail lacking. The risk of administering an inappropriate volume of IV fluid to a patient is thus high and the resultant fluid-related complications increased. This would be particularly hazardous in the pre-hospital environment within this context to all patients but particularly those sustaining inhalational injuries.
- If extended delays in transporting the patient from the scene to a health facility are likely, fluids may be considered, including judicious IV fluids using the formulae suggested. The risks of fluid overload and other complications from over resuscitation by IV fluid must be considered and mitigated for, particularly with a wide range of provider skills in responding to mass burn incidents.
- In patients with concurrent trauma injuries, on-scene IV fluids should be considered on a case-by-case basis as per standard trauma protocols according to type of injury, injury severity and the clinical status of the patient.

Subgroup analysis

There is insufficient data to inform on potential subgroup effects. Specific subgroups that the GDG were interested in were children and severity of burn, as measured by %TBSA affected. Clinical discretion was emphasized by the GDG, as described in the recommendation, where children who would not be able to follow instructions for oral resuscitation and those with a high severity of burn would more likely benefit from IV fluid resuscitation during mass burn incidents. Additionally, those severely injured with compromised mental status are at a high risk from complications with oral fluid resuscitation.

Clinical question/PICO

Population: patients with major burns (≥ 15 % TBSA for adults, ≥ 10 % TBSA for children)

Intervention: initial (first 24–72 hours post-burn injury) fluid resuscitation via the oral route

Comparator: initial fluid resuscitation via the IV route.

Summary of findings

The summary of findings from human studies on the effect of oral/enteral fluid resuscitation compared to IV fluid resuscitation is presented in Table 12. Based on three randomized controlled trials (RCTs) totalling 100 participants, oral/enteral fluid resuscitation is associated with a statistically insignificant increased risk of mortality, but the evidence is very uncertain, and little to no difference in urine output at 24 hours, with moderate certainty of evidence.

Table 12. Summary of Findings: oral/enteral compared to IV fluid resuscitation for initial management of major burns (human studies) *(46)*

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Plain language summary
	Risk with intravenous fluid resuscitation	Risk with oral/ enteral fluid resuscitation				
Mortality (in-hospital)	143 per 1000	**181 per 1000** (52 to 472 per 1000)	**OR 1.33** (0.33 to 5.36)	70 (2 RCTs)	**Very low** Due to serious risk of bias[1], indirectness[2] and imprecision[3]	The evidence is very uncertain about whether oral/enteral fluid resuscitation increases in-hospital mortality compared to IV fluid resuscitation.
Acute kidney injury (within 72 h post-burn injury)	0 per 1000	**0 per 1000** (0 to 0 per 1000)	not estimable	24 (1 RCT)	**Very low** Due to serious risk of bias[1], indirectness[2] and imprecision[3]	The effect of oral/ enteral fluid resuscitation on the occurrence of acute kidney injury within 72 h post-major burn injury cannot be determined from available evidence.
Urine output (during first 24 h post-burn injury)	-	SMD **0.17 SD lower** (0.65 lower to 0.31 higher)	-	70 (2 RCTs)	**Moderate** Due to indirectness[2]	Oral/enteral fluid resuscitation likely results in little to no difference in urine output during the first 24 hours post-major burn injury.
Complications of fluid over-resuscitation - not reported	-	-	-	-	-	
Aspiration events - not reported	-	-	-	-	-	

* The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).
CI: confidence interval; OR: odds ratio; SMD: standardized mean difference

Explanations

1. Risk of bias: serious. Overall high risk due to high risk of bias in predominant study, which had significant deviations from intended intervention with 9/15 (60%) of oral fluid (intervention) group crossing to IV fluids due to gastrointestinal intolerance such as nausea or vomiting.
2. Indirectness: serious. Findings from clinical trial setting of individual burn care may not be directly applicable to setting of mass casualty incidents, which likely have (1) less clinical attention per patient, (2) greater proportion of delayed presentations or interventions, and (3) include patients with multiple injuries, inhalational injuries and comorbidities, who were excluded for some of these trials.
3. Imprecision: serious. Few total events. Result with wide confidence interval which includes both no effect and large effect.

Source: Hsiao KH, Kalanzi J, Watson SB, Murthy S, Movsisyan A, Kothari K, et al. Oral/enteral resuscitation in the initial management of major burns: A systematic review and meta-analysis of human and animal studies. Burns Open. 2024. doi: 10.1016/j.burnso.2024.100364 *(46)*.

6.2 Oral fluids versus no fluid

RECOMMENDATION

For patients in mass burn incidents, treat with oral fluid compared to no fluid (Best practice statement).

Evidence to decision

Benefits and harms

Providing fluid, of any sort, to patients with burns, was deemed by the GDG to likely have greater benefits over potential harms in mass burn incidents based on indirect evidence from the burns literature that has established the importance of fluid resuscitation in major burns in general, the accepted standards of care for burns under routine (meaning non-mass casualty) circumstances, and scientific understanding of the pathophysiology of burn injuries and burn shock.

Certainty of the evidence

There is no published human evidence to inform this recommendation. The GDG examined animal evidence, which was downrated substantially for indirectness.

Values and preferences

The GDG, deriving from their expertise and experience as providers in MCIs and/or in the care of patients with burns, placed higher priority on interventions that could be feasibly and rapidly delivered to a large number of acutely ill patients, often by inexperienced burn care providers, and stated that providing oral fluid, compared to no fluid, would be preferred.

Resources and other considerations

The GDG emphasizes the principle of equity, where it is ensured that all patients involved in the mass burn incident have access to the best possible outcome. Oral fluid was deemed to be widely available, even in the most austere of circumstances.

Clinical question/PICO

Population: patients with major burns (≥ 15 % TBSA for adults, ≥ 10 % TBSA for children)

Intervention: initial (first 24–72 hrs post-burn injury) fluid resuscitation via the oral route

Comparator: no initial fluid resuscitation

Summary of findings

Available evidence on the effect of enteral fluid resuscitation compared to no fluid resuscitation for major burns is only from animal studies. The summary of findings is presented in Table 13. The evidence is very uncertain, but enteral fluid resuscitation is associated with a statistically insignificant reduction in mortality, improved serum creatinine levels and increased urine output compared to no fluid resuscitation.

Table 13. Summary of findings: enteral compared to no fluid resuscitation for initial management of major burns (animal studies)

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Plain language summary
	Risk with no fluids	Risk with enteral fluid resuscitation				
Mortality (at 24 h post-burn injury)	674 per 1000	**375 per 1000** (142 to 693 per 1000)	**OR 0.29** (0.08 to 1.09)	90 (4 RCTs)	**Very low** Due to very serious indirectness[1] and serious imprecision[2]	Enteral fluid resuscitation compared to no fluid resuscitation may reduce mortality at 24 h post-major burn injury, but the available evidence is very uncertain.
Acute kidney injury (serum creatinine level at 24 h post-burn injury)	-	SMD **3.48 SD lower** (4.69 lower to 2.28 lower)	-	32 (2 RCTs)	**Low** Due to very serious indirectness[1]	Enteral fluid resuscitation compared to no fluid resuscitation may result in better serum creatinine levels at 24 h post-major burn injury.
Urine output (during first 48 h post-burn injury)	Mean urine output (first 48 h post-burn injury) was 0.52 mL/kg/h	MD **0.55 mL/kg/h higher** (0.38 higher to 0.72 higher)	-	12 (1 RCT)	**Very low** Due to very serious indirectness[1] and serious imprecision[3]	Enteral fluid resuscitation compared to no fluid resuscitation may increase urine output during the first 48 h post-major burn injury, but the available evidence is very uncertain.
Complications of fluid over-resuscitation - not reported	-	-	-	-	-	
Aspiration events - not reported	-	-	-	-	-	

* The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).
CI: confidence interval; MD: mean difference; OR: odds ratio; SMD: standardized mean difference

Explanations
1. Indirectness: very serious. Laboratory-based study using animal models therefore significant indirectness in applicability to (1) human patients in (2) real-world clinical setting with (3) mass casualties.
2. Imprecision: serious. Wide confidence interval that includes no effect.
3. Imprecision: serious. Single study with small sample size. Optimal information size not met.

Source: Hsiao KH, Kalanzi J, Watson SB, Murthy S, Movsisyan A, Kothari K, et al. Oral/enteral resuscitation in the initial management of major burns: A systematic review and meta-analysis of human and animal studies. Burns Open. 2024. doi: 10.1016/j.burnso.2024.100364 *(46)*.

6.3 Timing of fluids

RECOMMENDATION

For patients in mass burn incidents, give fluids as early as possible, on-scene or at health facility (Best practice statement).

Evidence to decision

Benefits and harms

Early initiation of fluids for patients with burns was deemed by the GDG to likely have greater benefits over potential harms in mass burn incidents based on indirect evidence from the burns literature on timeliness of fluid resuscitation in major burns in general, the accepted standards of care for burns under routine (meaning non-mass casualty) circumstances, and scientific understanding of the pathophysiology of burn injuries and evolution of burn shock.

The only harm mentioned related to feasibility of implementation, where on-scene implementation was deemed potentially challenging. Further work to ensure that oral fluid is available in sufficient quantities by first responders would be beneficial.

Certainty of the evidence

There is very low-certainty evidence that delayed (at health facility) initiation of IV fluid resuscitation may increase the occurrence of acute kidney injury following major burn injury, based on one observational study. There was no evidence to inform the GDG on other clinical outcomes of relevance. Given this, a best practice statement was issued based on the overall importance of this guidance to health practice, indirect evidence of benefits over harms, and low likelihood of direct evidence to emerge.

Values and preferences

The GDG, deriving from their expertise and experience as providers in MCIs and/or in the care of patients with burns, placed higher priority on interventions that could be feasibly and rapidly delivered to large number of acutely ill patients, often by inexperienced burn care providers, and stated that providing early fluid, compared to later fluid, was consistent with these values.

Resources and other considerations

Providing early fluid, compared to later fluid, can be considered in the context of recommendations for oral fluid, when compared with IV fluid. This approach incorporates provider discretion, patient needs and clinical resources available.

Decision-making between oral fluid and IV fluid, supplemented with decision-making between early fluid versus later fluid, will necessarily be driven by the context that the care providers are facing.

The GDG emphasizes principles of equity, where the aim is that all patients involved in the mass burn incident have access to the best possible outcome. This approach, where early fluid is recommended, compared with later fluid, is consistent with this focus on seeking equity in clinical outcomes.

Clinical question/PICO

Population: patients with major burns (≥ 15 % TBSA for adults and ≥ 10 % TBSA for children) in resource-limited settings, defined as: (i) low- or middle-income countries, (ii) battlefield/far-forward combat casualty settings, or (iii) austere or wilderness environments.

Intervention: delayed (at health facility) initiation of IV fluid

Comparator: on-scene initiation

Summary of findings

The summary of findings for delayed (at health facility) initiation of IV fluids compared to on-scene initiation is presented in Table 14. The available evidence is very limited and is derived from a single observational study with 34 patients. The evidence is very uncertain about whether delayed IV fluid resuscitation is associated with an increased risk of acute kidney injury compared to on-scene initiation.

Table 14. Summary of findings: delayed (at health facility) initiation of IV fluid resuscitation compared to on-scene initiation for major burns

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Plain language summary
	Risk with on-scene initiation	Risk with delayed (at health facility) initiation of IV fluid resuscitation				
Mortality – not reported	-	-	-	-	-	-
Acute kidney injury	267 per 1000	**474 per 1000** (174 to 794 per 1000)	**OR 2.48** (0.58 to 10.62)	34 (1 observational study)	●○○○ **Very low** Due to serious risk of bias[1], indirectness[2] and imprecision[3]	The evidence is very uncertain regarding whether delayed (at health facility) initiation of IV fluid resuscitation compared to on-scene initiation increases the occurrence of acute kidney injury following major burn injury.
Urine output – not reported	-	-	-	-	-	-
Complications of fluid over-resuscitation - not reported	-	-	-	-	-	-

* The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).
CI: confidence interval; OR: odds ratio

Explanations

1. Risk of bias: serious. Some concerns due to lack of clarity on the measure and time frame for outcome of acute kidney injury used in this study. Baseline comparison of intervention and exposure groups unavailable, therefore unclear as to whether there were any differences and biases within these groups. Included numbers in each group were only a sub-set of total study participants.
2. Indirectness: serious. Findings based on individual care in battlefield/combat casualty care setting. While there may be similarities to MCI in terms of resource constraints, there are also key differences such as high level of attention due to individual cases, less delay to presentation, and higher access to resources on arrival at military hospital.
3. Imprecision: serious. Single study with small sample size.

Source: Hsiao KH, Kalanzi J, Watson SB, Murthy S, Movsisyan A, Kothari K, et al. Adapted approaches to initial fluid management of patients with major burns in resource-limited settings: A systematic review. Burns Open. 2024. doi: 10.1016/j.burnso.2024.100365 *(47)*.

6.4 Formulae for calculation of fluid resuscitation requirements

RECOMMENDATION

For patients in mass burn incidents, use standard formulae for calculation of fluid resuscitation requirements (Best practice statement).

Practical information

There are several standard formulae for calculation of fluid resuscitation requirements in burns patients. Due to lack of evidence, the panel could not make a recommendation regarding use of one formula versus another. The formula utilized by health workers in an MCI should ideally be what is most familiar. An example calculation is described in Table 15.

Table 15. Example calculation of fluid resuscitation requirements using different formulae

Parkland (Baxter) formula (%TBSA dependent)	Modified Parkland formula (%TBSA dependent)	Modified Brooke formula (%TBSA dependent)	Simplified formula (non-%TBSA dependent)
4 mL × %TBSA × weight (kg) = volume (mL) over 24 hours – ½ in first 8 hours, ½ over subsequent 16 hours	3 mL × %TBSA × weight (kg) = volume (mL) over 24 hours – ½ in first 8 hours, ½ over subsequent 16 hours	2 mL × %TBSA × weight (kg) = volume (mL) over 24 hours	100 mL × weight (kg) = volume (mL) over 24 hours

Example: patient weighing 70 kg with 50 % TBSA burns

Parkland (Baxter) formula (%TBSA dependent)	Modified Parkland formula (%TBSA dependent)	Modified Brooke formula (%TBSA dependent)	Simplified formula (non-%TBSA dependent)
Volume delivered over 24 hours would be: 4 × 50 × 70 = **14 000 mL**	Volume delivered over 24 hours would be: 3 × 50 × 70 = **10 500 mL**	Volume delivered over 24 hours would be: 2 × 50 × 70 = **7000 mL**	Volume delivered over 24 hours would be: 100 × 70 = **7000 mL**

Evidence to decision

Benefits and harms

The benefits of a modified or simplified formula are through the ease of implementation across a large number of patients, where a calculation of, for example, 100 mL/kg/hr for the first 24 hours would be implemented for every arriving patient with > 40 % TBSA burn. The harms of implementing a simplified formula are a failure to incorporate the diversity of patients and their severity of burn injury, along with a lack of familiarity of the formula for health workers already under duress from a MCI, with the possibility of over- or under-resuscitating patients. This is potentially most challenging in small children, where the simplified non-%TBSA-based formula provides much less fluid in the first 8 hours of the resuscitation period across most range of %TBSA burn sizes than do standard %TBSA-based formulae.

Certainty of the evidence

There were no studies that met the search criteria comparing outcomes from using simplified (non-%TBSA dependent) formulae versus standard (%TBSA-dependent) formulae for calculating fluid resuscitation requirements. Modelling studies were found, but these were not deemed sufficient by the GDG. Given the importance to health practice of actionable recommendation on this matter, and that comparative evidence was unlikely to emerge, a best practice statement on using standard formulae was issued.

Values and preferences

The GDG emphasized providing each patient the best opportunity to achieve the best possible outcome. Concerns regarding inappropriate resuscitation strategies with a simplified formula, in the absence of any comparative evidence suggesting benefit, coupled with ease of calculation, generally of %TBSA-based formulae, led the GDG to consider that the current standard of care that is used in non-mass casualty situations be considered for mass burn incidents.

Resources and other considerations

Standard formulae for fluid resuscitation requirements reflect %TBSA involvement. This is often difficult to assess precisely, and the GDG emphasized that while a simplified fluid resuscitation formula to ease feasibility of implementation might be useful, the risks of over-simplifying resuscitation strategies could not be justified due to the absence of evidence.

Further research on the safety of simplified (non-%TBSA dependent) formulae for fluid resuscitation requirements are required.

Clinical question/PICO

Population: patients with major burns (≥ 15 % TBSA for adults and ≥ 10 % TBSA for children) in resource-limited settings, defined as: (i) low- or middle-income countries, (ii) battlefield/far-forward combat casualty settings, or (iii) austere or wilderness environments.

Intervention: simplified 100mL/kg/24h formula (non-%TBSA dependent)

Comparator: standard %TBSA-dependent formula

Summary of findings

No studies found

6.5 Timing in calculation of fluid resuscitation requirements

RECOMMENDATION

For patients in mass burn incidents, there is no recommendation on the optimal timing in calculation of fluid resuscitation requirements (No recommendation).

Practical information

The use of standard formulae to calculate fluid resuscitation requirements is best practice, as recommended in the preceding section. When using these formulae, there is established practice of calculating fluid resuscitation requirements from time of injury. However, in the context of mass burn incidents, no recommendation could be made on the optimal timing to be used.

Evidence to decision

Benefits and harms

In MCIs the time of injury may be either unknown or specifically known, assuming common time of injury across patients. As in all situations, there may be delays in receiving medical attention and thus delays in initiating fluid resuscitation. The benefits of calculating from the time of injury is the avoidance of a possibility of under-resuscitation by providing catch-up fluids. The harms of calculating from the time of injury include the feasibility of knowing the relevant information or the possibility of having the wrong information as well as potential for large-volume catch-up fluids when there are significant delays to initiation, leading to either fluid over- or under-resuscitation.

The confidence in the effect estimates was so low, especially with no comparative evidence, that the GDG felt any recommendation on this would be too speculative. Given this lack of evidence, the lack of knowledge relating to downstream effects of relevant comparators, and the criteria for issuing a best practice statement not being fulfilled, it was elected to issue no recommendation.

Certainty of the evidence

There is no evidence to inform the GDG on clinical outcomes of relevance, with one observational study available that was not informative on the relevant outcomes.

Values and preferences

Incorporating the values and preferences helped inform the GDG to come to a "No recommendation". Acknowledging the evidence base, established clinical practice, and values and preferences led to highly speculative recommendations, which the GDG felt it better left as "No recommendation".

Resources and other considerations

Clinical teams can consider the local context when considering implementing varied approaches to catch-up fluid resuscitation strategies. As discussed in previous recommendations, fluids should be initiated as early as possible, hopefully obviating the need for this recommendation and limiting the relevance of catch-up fluid resuscitation strategies. However, mass burn incidents vary greatly, and standardizing fluid resuscitation protocols across a group of patients who arrive simultaneously will assist with implementation. Regardless of timing for calculation, fluid status of the patient should be regularly assessed and adjusted using standard measures of urine output, capillary refill time, heart rate, respiratory rate, oxygen saturation and other parameters.

Clinical question/PICO

Population: patients with major burns (≥ 15 % TBSA for adults and ≥ 10 % TBSA for children) in resource-limited settings, defined as: (i) low- or middle-income countries, (ii) battlefield/far-forward combat casualty settings, or (iii) austere or wilderness environments.

Intervention: fluid requirements calculated from time of arrival

Comparator: fluid requirements calculated from time of injury

Summary of findings

The available evidence on calculating fluid requirements from time of arrival (see Table 16) at the first receiving health facility compared to from time of injury is extremely limited and very uncertain. Based on a sole, single-armed intervention study, calculating from time of arrival maintained adequate urine output and had no complications of fluid over- or under-resuscitation. The intervention effect remains unknown as there was no comparison group.

Table 16. Summary of findings: fluid requirements calculated from time of arrival compared to time of injury for major burns

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Plain language summary
	Risk with fluid requirements calculated from time of injury	Risk with fluid requirements calculated from time of arrival				
Mortality - not reported	-	-				
Acute kidney injury	-	**0 per 1000** (0 to 0 per 1000)	**not estimable**	10 (1 observational study)	⨁◯◯◯ **Very low** Due to serious risk of bias[1], indirectness[2] and imprecision[3]	Effect of calculating fluid requirements from time of arrival, compared to calculating from time of injury, on the occurrence of acute kidney injury cannot be determined from available evidence.
Adequate urine output (>0.5 mL/kg/h during first 24 h of admission)	-	**0 per 1000** (0 to 0 per 1000)	**not estimable**	10 (1 observational study)	⨁◯◯◯ **Very low** Due to serious risk of bias[1], indirectness[2] and imprecision[3]	Effect on adequate urine output cannot be determined from available evidence.
Complications of fluid over-resuscitation	-	**0 per 1000** (0 to 0 per 1000)	**not estimable**	10 (1 observational study)	⨁◯◯◯ **Very low** Due to serious risk of bias[1], indirectness[2] and imprecision[3]	Effect on occurrence of complications of fluid over-resuscitation cannot be determined from available evidence.

* The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).
CI: confidence interval

Single-arm observational cohort study with 10 participants. Occurrence of acute kidney injury 0/10 (0%), adequate urine output 10/10 (100%), and complications of fluid over-resuscitation 0/10 (0%).

Explanations
1. Risk of bias: serious. Some concerns due to lack of identification of potential confounders as well as lack of clarity on measurement and time frames for outcomes of acute kidney injury and fluid over-resuscitation.
2. Indirectness: serious. Paediatric population, and in context of individual care, which may differ from expected level of care during a mass casualty incident.
3. Imprecision: serious. Single study with small sample size. Optimal information size not met.

Source: Hsiao KH, Kalanzi J, Watson SB, Murthy S, Movsisyan A, Kothari K, et al. Adapted approaches to initial fluid management of patients with major burns in resource-limited settings: A systematic review. Burns Open. 2024. Doi: 10.1016/j.burnso.2024.100365 *(47)*.

Chapter 7

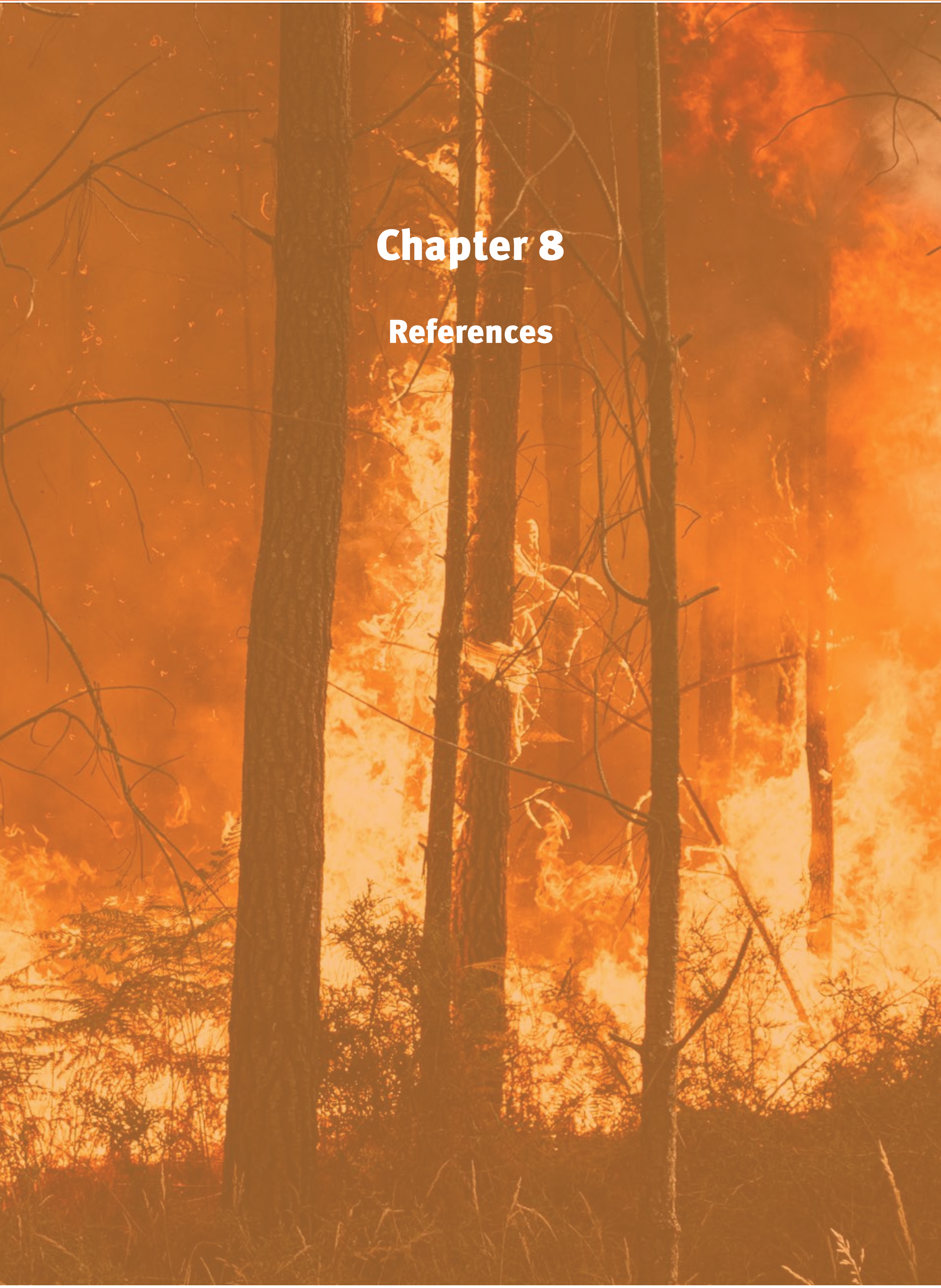
Research needs

© WHO/ Nare Shahinyan,
physiotherapist demonstrating functional movements after skin grafting at the "Essential Burn Rehabilitation" training of trainers in Yerevan, Armenia

7 Research needs

The following areas for further research on mass burn incidents were highlighted by the TWG:

- burn injury triage for mass burn incidents;
- studies evaluating efficacy and outcomes of using non-%TBSA dependent formulae for fluid calculation;
- efficacy and availability of impregnated dressings (such as silver) and anti-septic agents (such as povidone-iodine, alcohol, chlorhexidine, and honey) in lower- middle-income countries and mass burn incidents; and
- open wound management during mass burn incidents, including frequency of showering, application of topical agents, and splinting/ rehabilitation manoeuvres.



Chapter 8

References

8 References

1 World Health Organization (WHO). Classification and minimum standards for emergency medical teams. Geneva: WHO; 2021. https://iris.who.int/handle/10665/341857

2 Cranmer HH, Biddinger PD. Typhoon Haiyan and the professionalization of disaster response. N Engl J Med. 2014;370(13):1185–7.

3 World Health Organization (WHO). Global health emergency workforce: Report by the Director-General. In: Sixty-Eighth World Health Assembly A68/27. Provisional agenda item 16.1. Geneva; WHO; 2015. Available from: https://apps.who.int/gb/ebwha/pdf_files/WHA68/A68_27-en.pdf

4 Ravi SJ, Snyder MR, Rivers C. Review of international efforts to strengthen the global outbreak response system since the 2014-16 West Africa Ebola Epidemic. Health Policy Plan. 2019;34(1):47–54.

5 Kao HK, Loh CYY, Kou HW, Kao KC, Hu HC, Chang CM, et al. Optimizing mass casualty burns intensive care organization and treatment using evidence-based outcome predictors. Burns J Int Soc Burn Inj. 2018;44(5):1077–82.

6 Ma H, Tung KY, Tsai SL, Neil DL, Lin YY, Yen HT, et al. Assessment and determinants of global outcomes among 445 mass-casualty burn survivors: A 2-year retrospective cohort study in Taiwan. Burns. 2020;46(6):1444–57. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0305417919300749

7 World Health Organization (WHO). "The situation is critical." Emergency Medical Teams (EMTs) caring for severely burned refugees shoulder to shoulder with Armenian doctors. [Internet]. WHO; 2024 [cited 2024 May 28]. Available from: https://www.who.int/europe/news-room/feature-stories/item/the-situation-is-critical.--emergency-medical-teams-(emts)-caring-for-severely-burned-refugees-shoulder-to-shoulder-with-armenian-doctors

8 Kamara RF, Oyugi B, Kamara IF, Kabba M, Relan P, Baldé T. Review of the Senegalese Military Emergency Medical Team (EMT) Deployment Following a Tanker Explosion in Freetown, Sierra Leone. Prehospital Disaster Med. 2022;37(S2):s84–s84. Available from: https://www.cambridge.org/core/product/identifier/S1049023X22001832/type/journal_article

9 Chuang S, Woods DD, Ting HW, Cook RI, Hsu JC. Coping With a Mass Casualty: Insights into a Hospital's Emergency Response and Adaptations After the Formosa Fun Coast Dust Explosion. Disaster Med Public Health Prep. 2020;14(4):467–76. Available from: https://www.cambridge.org/core/product/identifier/S1935789319000697/type/journal_article

10 Almeland SK, Depoortere E, Jennes S, Sjöberg F, Lozano Basanta JA, Zanatta S, et al. Burn mass casualty incidents in Europe: A European response plan within the European Union Civil Protection Mechanism. Burns. 2022;48(8):1794–804. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0305417922001917

11 World Health Organization (WHO). Emergency Medical Teams 2030 strategy. Geneva: WHO; 2023. https://iris.who.int/handle/10665/372867

12 World Health Organization (WHO). WHO handbook for guideline development. 2nd ed. Geneva: WHO; 2014. https://iris.who.int/handle/10665/145714

13 World Health Organization (WHO). Quality Assurance, Norms and Standards [Internet]. 2024 [cited 2024 Mar 14]. Available from: https://www.who.int/our-work/science-division/quality-assurance-norms-and-standards

14 Schünemann H, Brożek J, Guyatt G, Oxman A, editors. GRADE handbook for grading quality of evidence and strength of recommendations. Updated October 2013. The GRADE Working Group; 2013. Available from: https://gdt.gradepro.org/app/handbook/handbook.html

15 World Health Organization (WHO). Emergency health kits. [Internet]. 2024 [cited 2024 Mar 14]. Available from: https://www.who.int/emergencies/emergency-health-kits

16 Ramos G, Cornistein W, Cerino GT, Nacif G. Systemic antimicrobial prophylaxis in burn patients: systematic review. J Hosp Infect. 2017 Oct;97(2):105–14.

17 Chapter 15: Burn Injuries. In: Giannou C, Balden M (Eds.). War Surgery. Working with limited resources in armed conflict and other situations of violence. Volume 1. Geneva: International Committee of the Red Cross; 2010. Available from: https://www.icrc.org/en/doc/assets/files/other/icrc-002-0973.pdf

18 Potokar T, Moghazy A, Peck M, Bendell R, Fanstone R. Setting standards for burn care services in low and middle income countries. Interburns; 2013. Available from: https://www.medbox.org/document/setting-standards-for-burn-care-services-in-low-and-middle-income-countries

19 Amat Camacho N, Hughes A, Burkle FM, Ingrassia PL, Ragazzoni L, Redmond A, et al. Education and Training of Emergency Medical Teams: Recommendations for a Global Operational Learning Framework. PLoS Curr. 2016 Oct 21;8:ecurrents.dis.292033689209611ad5e4a7a3e61520d0.

20 World Health Organization (WHO). Clinical care for severe acute respiratory infection: toolkit: COVID-19 adaptation, update 2022. Geneva; WHO: 2022. https://iris.who.int/handle/10665/352851

21 Super G. START: A triage training module. Newport Beach CA Hoag Meml Hosp Presbyt. 1984;

22 Capek KD, Sousse LE, Hundeshagen G, Voigt CD, Suman OE, Finnerty CC, et al. Contemporary Burn Survival. J Am Coll Surg. 2018;226(4):453–63. Available from: https://journals.lww.com/00019464-201804000-00020

23 Monstrey S, Hoeksema H, Verbelen J, Pirayesh A, Blondeel P. Assessment of burn depth and burn wound healing potential. Burns. 2008;34(6):761–9. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0305417908000417

24 Lin CH, Lin CH, Tai CY, Lin YY, Shih FFY. Challenges of Burn Mass Casualty Incidents in the Prehospital Setting: Lessons From the Formosa Fun Coast Park Color Party. Prehosp Emerg Care. 2019;23(1):44–8. Available from: https://www.tandfonline.com/doi/full/10.1080/10903127.2018.1479473

25 Pham C, Collier Z, Gillenwater J. Changing the Way We Think About Burn Size Estimation. J Burn Care Res. 2019;40(1):1–11. Available from: https://academic.oup.com/jbcr/article/40/1/1/5104866

26 Wallace AB. The exposure treatment of burns. Lancet. 1951;1(6653):501–4.

27 Thom D. Appraising current methods for preclinical calculation of burn size - A pre-hospital perspective. Burns J Int Soc Burn Inj. 2017;43(1):127–36.

28 Face S, Dalton S. Consistency of total body surface area assessment in severe burns: Implications for practice. Emerg Med Australas EMA. 2017;29(4):429–32.

29 Badulak JH, Schurr M, Sauaia A, Ivashchenko A, Peltz E. Defining the criteria for intubation of the patient with thermal burns. Burns J Int Soc Burn Inj. 2018;44(3):531–8.

30 Seth R, Chester D, Moiemen N. A review of chemical burns. Trauma. 2007;9(2):81–94. Available from: http://journals.sagepub.com/doi/10.1177/1460408607083960

31 Reade MC, Davies SR, Morley PT, Dennett J, Jacobs IC, Australian Resuscitation Council. Review article: management of cyanide poisoning. Emerg Med Australas EMA. 2012;24(3):225–38.

32 Guilabert P, Usúa G, Martín N, Abarca L, Barret JP, Colomina MJ. Fluid resuscitation management in patients with burns: update. Br J Anaesth. 2016;117(3):284–96. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0007091217337881

33 Read DJ, Tan SC, Ward L, McDermott K. Burns first aid treatment in remote Northern Australia. Burns. 2018;44(2):481–7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0305417917303984

34 Wood FM, Phillips M, Jovic T, Cassidy JT, Cameron P, Edgar DW, et al. Water First Aid Is Beneficial In Humans Post-Burn: Evidence from a Bi-National Cohort Study. Latus J, editor. PLOS ONE. 2016;11(1):e0147259. Available from: https://dx.plos.org/10.1371/journal.pone.0147259

35 Nguyen NL, Gun RT, Sparnon AL, Ryan P. The importance of initial management: a case series of childhood burns in Vietnam. Burns J Int Soc Burn Inj. 2002;28(2):167–72.

36 Baartmans MGA, de Jong AEE, van Baar ME, Beerthuizen GIJM, van Loey NEE, Tibboel D, et al. Early management in children with burns: Cooling, wound care and pain management. Burns J Int Soc Burn Inj. 2016;42(4):777–82.

37 European Burns Association (EBA). European Practice Guidelines for Burns Care. 4th ed. 's-Hertogenbosch: EBA; 2017. Available from: https://www.euroburn.org/documents/

38 ISBI Practice Guidelines Committee, Steering Subcommittee, Advisory Subcommittee. ISBI Practice Guidelines for Burn Care. Burns J Int Soc Burn Inj. 2016;42(5):953–1021.

39 Gosselin RA, Kuppers B. Open versus closed management of burn wounds in a low-income developing country. Burns J Int Soc Burn Inj. 2008;34(5):644–7.

40 Rowan MP, Cancio LC, Elster EA, Burmeister DM, Rose LF, Natesan S, et al. Burn wound healing and treatment: review and advancements. Crit Care. 2015;19(1):243. Available from: https://ccforum.biomedcentral.com/articles/10.1186/s13054-015-0961-2

41 Klein MB, Hayden D, Elson C, Nathens AB, Gamelli RL, Gibran NS, et al. The association between fluid administration and outcome following major burn: a multicenter study. Ann Surg. 2007;245(4):622–8.

42 Parvizi D, Kamolz LP, Giretzlehner M, Haller HL, Trop M, Selig H, et al. The potential impact of wrong TBSA estimations on fluid resuscitation in patients suffering from burns: things to keep in mind. Burns J Int Soc Burn Inj. 2014;40(2):241–5.

43 Peeters Y, Lebeer M, Wise R, Malbrain MLNG. An overview on fluid resuscitation and resuscitation endpoints in burns: Past, present and future. Part 2 - avoiding complications by using the right endpoints with a new personalized protocolized approach. Anaesthesiol Intensive Ther. 2015;47 Spec No:s15-26.

44 Tejiram S, Tranchina SP, Travis TE, Shupp JW. The First 24 Hours. Surg Clin North Am. 2023;103(3):403–13. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0039610923000166

45 Saffle JR. Fluid Creep and Over-resuscitation. Crit Care Clin. 2016;32(4):587–98. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0749070416300598

46 Hsiao KH, Kalanzi J, Watson SB, Murthy S, Movsisyan A, Kothari K, et al. Oral/enteral resuscitation in the initial management of major burns: A systematic review and meta-analysis of human and animal studies. Burns Open. 2024. doi: 10.1016/j.burnso.2024.100364.

47 Hsiao KH, Kalanzi J, Watson SB, Murthy S, Movsisyan A, Kothari K, et al. Adapted approaches to initial fluid management of patients with major burns in resource-limited settings: A systematic review. Burns Open. 2024. doi: 10.1016/j.burnso.2024.100365.

48 Guyatt GH, Alonso-Coello P, Schünemann HJ, Djulbegovic B, Nothacker M, Lange S, et al. Guideline panels should seldom make good practice statements: guidance from the GRADE Working Group. J Clin Epidemiol. 2016;80:3–7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0895435616302311

Annexes

© Norway EMT, Greece fire response

Annex 1. List of example triage systems

TRIAGE TOOL	CORRESPONDING CATEGORIES
WHO/ICRC/MSF/IFRC Interagency Integrated Triage Tool (IITT)	Red, Yellow, Green
South African Triage Scale (SATS)	Red, Orange, Yellow, Green, Blue
Australian Triage Scale	Category 1, Category 2, Category 3, Category 4, Category 5
Canadian Triage and Acuity Scale (CTAS)	Level I, Level II, Level III, Level IV, Level V
Manchester Triage Scale	Immediate (Red, 1), Very urgent (Orange, 2), Urgent (Yellow, 3), Standard (Green, 4), Non-urgent (Blue, 5)
Emergency Severity Index (ESI)	Level 1, Level 2, Level 3, Level 4, Level 5
Simple Triage and Rapid Treatment (START)	Expectant (Black), Immediate (Red), Delayed (Yellow), Minor (Green)
Sort, Assess, Life-saving Intervention, Treatment/Transport (SALT)	Minor (Green), Delayed (Yellow), Immediate (Red), Expectant (Gray), Deceased (Black)
Triage Sieve and Sort	Priority 1, Priority 2, Priority 3, Dead
Soterion Rapid Triage System	Level 1, Level 2, Level 3, Level 4, Level 5

Annex 2. List of example formulae for %TBSA burn calculation

FORMULA NAME	FORMULA
Wallace Rule of Nines (adults)	9% full head and neck (anterior and posterior surfaces); 9% anterior and posterior surfaces of each upper limb (18% for both); 9% anterior torso; 9% lower abdomen/trunk; 9% upper back; 9% lower back; 18% anterior and posterior surfaces of each lower limb (36% for both); 1% perineum.
Wallace Rule of Nines (children)	18% full head and neck (anterior and posterior surfaces); 9% anterior and posterior surfaces of each upper limb (18% for both); 9% anterior torso; 9% lower abdomen/trunk; 9% upper back; 9% lower back; 13.5% anterior and posterior surfaces of each lower limb (27% for both); 1% perineum.
Wallace Rule of Nines (infants)	21% full head and neck (anterior and posterior surfaces); 10% anterior and posterior surfaces of each upper limb (20% for both); 13% anterior torso/trunk; 13% back; 13.5% anterior and posterior surfaces of each lower limb (27% for both); 5% buttocks; 1% perineum.
Rule of Palm (Palmer)	Patient's palm represents 1%. Estimate from fingers positioned together.
Lund-Browder Chart (adults)	3.5% anterior head; 3.5% posterior head; 1% anterior neck; 1% posterior neck; 2% upper anterior arm; 2% upper posterior arm; 1.5% lower anterior arm; 1.5% lower posterior arm; 1.5% anterior palm; 1.5% posterior palm; 13% anterior trunk/abdomen; 13% back; 4.75% anterior thigh; 4.75% posterior thigh; 3.5% anterior shin; 3.5% posterior calf; 1.75% anterior foot; 1.75% posterior foot; 2.5% each buttock; 1% perineum.
Lund-Browder Chart (age variation – 0, 1, 5, 10, 15)	Modifications to above for each age variation of age 0, 1, 5, 10, 15
Smartphone applications	Various integrated formulae utilizing predefined device or object dimensions as representative percentage.

Annex 3. List of example formulae for fluid calculation

FORMULA NAME	FORMULA
Parkland Formula (Baxter formula)	4 mL/kg/%TBSA 50% given in first 8 hours 50% given in next 16 hours
Modified Parkland formula	2 mL/kg/%TBSA
Brooke Formula	1.5 mL/kg/%TBSA crystalloid and 0.5 mL/kg per %TBSA burn + 2 L free water
Cincinnati Formula	4 mL/kg/%TBSA + 1500 mL/m2 BSA
Galverston Formula	5000 mL/m2 TBSA + 2000 mL/m2 BSA
USA ISR Burn Centre	Estimate the burn size to the nearest 10; %TBSA x 10 = initial rate for fluid resuscitation. Every 10 kg above 80 kg the fluid rate should be increased by 100 mL/hr
Evans Formula	In the first 24 hours gives 1 mL/kg/% burn plus colloids at 1 mL/kg/% burn plus 2000 mL glucose in water. Next 24 hours gives crystalloids at 0.5 mL/kg/% burn, colloidal at 0.5 mL/kg/% burn and the same amount of glucose in water as in first 24 hours

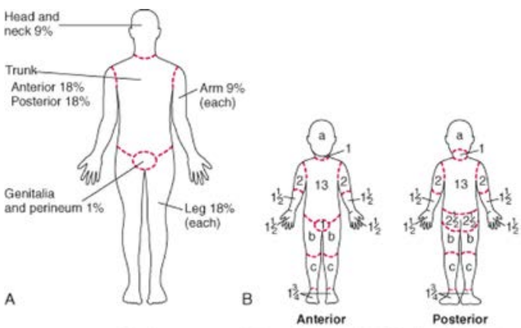
Annex 4. Example burns data form (EMTCC use)

EMT Burns Response Daily Data Form – October 2023
Organization Name:
Team Name:
Team Type:
Contact person:
Email address of contact person:
Date of activity (dd/mm/yy):
Latitude:
Longitude:
Region where deployed:
City where deployed:
Facility name (if relevant):
Number of new consultations today:
Number of adults consultations today:
Number of children (< 19 years of age) today:
New admissions today:
Number of patients discharged today:
Number of referrals today:
Number of dead on arrival:
Number of deaths within facility:
Total patients with injuries:
Total procedures:
Total dressing changes:
Escharotomies:
Skin grafts:
Surgical debridements:
Other procedures:
Other comments/concerns:

Annex 5. Example initial burns injury assessment form (EMT or facility use)

INITIAL BURN INJURY ASSESSMENT & EVALUATION

Date:	Patient ID:
Name of Assessing Staff (print):	Family Name:
Position (i.e. nurse, doctor):	First Name:
Signature:	Date of Birth:



Relative percentage of body surface area (% BSA) affected by growth

Body Part	Age 0 yr	1 yr	5 yr	10 yr	15 yr
a = 1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2
b = 1/2 of 1 thigh	2 3/4	3 1/4	4	4 1/4	4 1/2
c = 1/2 of 1 lower leg	2 1/2	2 1/2	2 3/4	3	3 1/4

(A) Rule of nines (for adults) and
(B) Lund-Browder chart (for children) for estimating extent of burns
https://www.msdmanuals.com/en-gb/professional/multimedia/figure/a-rule-of-nines-for-adults-and-b-lund-browder-chart-for-children-for-estimating-extent-of-burns

TIME of Injury:

TIME of Arrival:

WHAT Happened:

BURN Type:

BURN % TBSA CHART

Draw skin loss areas you see.
DO NOT include simple erythema in the % TBSA estimation.

BURN % TBSA	1st Assessment	2nd Assessment
Time		
Signature		

- Suspected Inhalation Injury ☐
- Circumferential Burn ☐
- Other Injuries ☐
- IV Fluid Resuscitation ☐
- Oral Fluid Tolerated ☐
- Pain Management ☐
- Tetanus Status Established ☐

INITIAL FIRST AID:

INITIAL WOUND MANAGEMENT:

Discharge Home ☐ Wound Clinic ☐ Admit ☐ Refer & Transfer ☐

Annex 6. Example medical evacuation/referral form

BURN PATIENTS MEDEVAC PATIENT REFERRAL FORM

EMT

Date: Time:

PATIENT INFORMATION

Full Name:	Phone:
Patient ID number:	Language:
Date of birth:	Gender:
Address of discharge destination: (if known)	
Accompanied by escort Yes ☐ No ☐	Full Name:

TASKING INFORMATION

Referral to: Name of facility or service	
Contact: Full name	Phone:
	Email:
Location: Address/Site/District	
	Phone:
Referring from: Name of facility or service	Email:
Contact: Full name	
Location: Address/Site/District	

Priority 1 2 3 **Dependency** 1 2 3

Transfer type: Primary ☐ Interhospital transfer ☐ Repatriation ☐

MEDEVAC INFORMATION

MEDEVAC Team:	
Flight info:	
Inbound:	Outbound:
Destination for this patient:	

CLINICAL INFORMATION

Mechanism of injury or illness:

Primary diagnoses: **1.**

2.

3.

Past medical history:

Allergies:

Treatments initiated: (including medication/oxygen/procedures/lines/drains/fluids)

- ☐ Ongoing
- ☐ Ongoing
- ☐ Ongoing
- ☐ Ongoing

NOTE: Please attach copy of medication chart at discharge or list of current medications
(including dose and time of last dose and ensure at least 72 hours supply of regular medications)

Patient observations:

Date	Time	Temp	HR	BP	Cap refill	RR	Sp02	Fi02	GCS AVPU	BGL	Other weight

WBC ☐ ___ Leucopenia ☐ ___ Hemoglobin ☐ ___ Electrolytes ☐ ___ Creatinine ☐ ___

Other:

Special cases: ☐ Obstetrics ☐ Burns ☐ Paediatrics ☐ Vulnerable group (disability/elderly/SGBV)

Precautions: ☐ Infectious disease/MDRO ☐ Spinal precautions ☐ Behavioural ☐ Altitude

Additional considerations: ☐ Bariatric ☐ DNR ☐ Other

Reason for referral: Such as higher level of care required/specialist care required/limited hospital capacity

Transportation needs: Transfer using basic, advanced or critical care platform

Follow-up requirements: surgical review, removal of cast, or removal of external fixator

FUNCTIONAL STATUS

Mobility ☐ Bed bound ☐ Wheelchair ☐ Crutches ☐ Walking frame ☐ Requires assistance ☐ Independent

Self-care ☐ Carer dependent ☐ Requires assistance with activities of daily living/hygiene/meals ☐ Independent

Cognitive impairment ☐ **No** ☐ **Yes** Define key features if dementia-related or intellectual impairment

Nutritional requirements:

Assistive devices(s) provided or required:

Compiled by: **Signature:**

Position:

Patient fit-for-transfer: ☐ **No** ☐ Yes Details if applicable

Patient care funding: ☐ Insurance Details if applicable

Patient or carer consent: ☐ Signature if possible

NOTE: This form must accompany the patient's medical file and a copy of the form should be retained by the referring team.

Patient ventilated: ☐ Yes ☐ No ☐ Non-invasive ventilation ☐ Mechanical ventilation

☐ FiO_2: Tidal volume mL PEEP cm H_2O RR: breaths/min

Other ventilation settings:

Additional considerations – Burns

Diagnosis ☐ Confirmed ☐ Clinical ☐ Close contact

Vaccination details

Additional considerations – Chemical, Biological, Nuclear, Radiological

Diagnosis ☐ Confirmed ☐ Clinical ☐ Close contact

Vaccination details

NOTE: This form must accompany the patient's medical file and a copy of the form should be retained by the referring team. A copy should be transmitted to the Ministry of Health through EMTCC.

END OF REFERRAL FORM

Annex 7. Parts of existing WHO kits applicable to burn care

Module	Sets from existing WHO kits
Resuscitation	- KMEDTESM1BA–A1 (TESK 2017 module 1B) SET, RENEWABLES, ANAESTHESIA, BASIC MATERIAL - KMEDTESM1CA–A1 (TESK 2017 module 1C) SET, SUPPLEMENTARY, ANAESTHESIA MATERIAL - KMEDTESM1CS–A1 (TESK 2017 module 1C) SET, INTUBATION & LARYNGOSCOPE
Dressings	- KMEDTESM1BD–A1 (TESK 2017 module 1B) SET, RENEWABLES, DRESSING MATERIAL - KMEDTESM1BDB–A1 (TESK 2017 module 1B) SET, RENEWABLES, DRESSING MATERIAL, BURNS - KMEDTESM1BG–A1 (TESK 2019 module 1B) SET, RENEWABLES, GLOVES - KMEDTESM1BI–A1 (TESK 2019 y module 1B) SET, RENEWABLES, INJECTION MATERIAL
Pharmacy	- KMEDTESM1AB–A1 (TESK 2019 module 1A) SET, DRUGS, BASIC - KMEDTESM1AC–A1 (TESK 2019 module 1A) SET, DRUGS, CONTROLLED - KMEDTESM1AI–A1 (TESK 2019 module 1A) SET, DRUGS, INFUSIONS - KMEDTESM1ADG–A1 (TESK 2019 module 1A) SET, DRUGS, DANGEROUS GOODS - KMEDTESM1ACC–A1 (TESK 2019 module 1A) SET, DRUGS, COLD CHAIN
Surgical	- (TESK 2022 mod 2A) SET, GENERAL SURGERY INSTRUMENTS, DRESSING - (TESK 2022 mod 2A) SET, GENERAL SURGERY INSTRUMENTS, SKIN GRAFT - KMEDTESKM2A01A1 (TESK 2022 mod 2A) SET, GENERAL SURGERY INSTRUMENTS, BASIC SURGERY - KMEDTESKM2A05A1 (TESK 2022 mod 2A) SET, GENERAL SURGERY INSTRUMENTS, DPC (suture) - KMEDTESKM2A06A1 (TESK 2022 mod 2A) SET, GENERAL SURGERY INSTRUMENTS, DEBRIDEMENT - KMEDTESKM2A08A1 (TESK 2022 mod 2A) SET, GENERAL SURGERY INSTRUMENTS, FINE(pediat), complementary
Rehabilitation	- (TESK – 2024*) MODULE 3, Essential Rehabilitation equipment

Annex 8. Clinical recommendations development process and methods

This annex provides further details on the process and methods used in the development of the clinical recommendations in Chapter 6. This followed the process and methods outlined in the *WHO Handbook for Guideline Development, 2nd edition*, with oversight of the WHO Guideline Review Committee.

Evidence synthesis and assessment

The priority questions to be addressed by the clinical recommendations were identified by the GDG. These were formulated into PICO-structured review questions by the systematic review team with input from the methodologist, clinical chair, GDG and technical members of the WHO Steering Group. The important outcomes of interest were rated and selected by the GDG. The systematic reviews were conducted in accordance with pre-defined protocols and the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. The available evidence was synthesized with outcome-based intervention effect estimates, where amenable, and evidence certainty assessed using GRADE methodology. These were presented to the GDG using GRADE summary of findings tables.

Formulation of recommendations

The GRADE approach was used to formulate recommendations. GDG deliberations on the direction and strength of recommendations were facilitated by the methodologist and clinical chair. In their formulation, the GDG considered the balance of benefits and harms (with reference to the GRADE summary of findings tables, including effect estimates and confidence intervals), certainty of evidence, values and preferences, resource implications, and other considerations such as equity, acceptability, and feasibility. As recognized in the limitations of the GRADE approach, there were circumstances in which the GDG was unable to issue a GRADE-formulated recommendation, particularly due to lack of direct evidence, but for which actionable statements were deemed necessary for health practice and where there were certainty of benefits outweighing undesirable effects supported by indirect evidence. In such circumstances, an ungraded Best Practice Statement was issued in accordance with the five criteria set out by the GRADE Working Group *(48)*. Decisions and recommendations were made by consensus. Pre-defined rules for decision-making had specified a voting process in case consensus could not be reached: 80% of GDG members was required to formulate a strong recommendation, and a simple majority for conditional recommendations. However, in the end, voting was not needed for any of the recommendations. The final recommendation statements were drafted by the responsible technical officer according to the GDG's decisions and formulations, approved by the GDG, and shared with the WHO Steering Group.

External review

The clinical recommendations (and full document) were reviewed by an external review group composed of members of the EMT Strategic Advisory Group, with balanced representation of geographical regions and gender. Any feedback and comments were considered by the GDG, and incorporated as appropriate by the responsible technical officer. The clinical recommendations section (Chapter 6) of the final document was then reviewed and approved by the WHO Guideline Review Committee.

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Management of conflicts of interest

All contributors were required to complete and return the standard WHO Declaration of Interests forms for experts along with their CVs. These were evaluated by the responsible technical officer for relevance of any declared interests, and for significance of any potential conflicts of interest based on their nature, number and value, scope of relationship, and extent of discretion. The approach to managing any significant conflicts of interest was partial or total exclusion from participation, assessed and/or consulted on a case-by-case basis. The contributing experts' names and their brief biographies were compiled and made publicly available.

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