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REVIEW

Don't forget the children—paediatric patients in mass casualty events and major incident planning

Rachel Jenner[1]

Stefano Piscitelli[2]

Author details can be found at the end of this article

Correspondence to:
Rachel Jenner
(rachel.jenner@mft.nhs.uk)

Abstract

Major incidents and mass casualty events can affect people of all ages. However, when planning the response to a major incident the focus is often on adult casualties rather than children. It is essential that the needs of paediatric patients are taken into account throughout major incident planning. Whether considering equipment, staffing or surgical and critical care capacity, hospitals should meet the needs of children as well as adults following a major incident and where possible, keep families together. The new Major Incident Triage Tool introduced in the National Health Service (NHS) in 2024 has a tendency to over triage paediatric casualties and so hospitals who may be receiving children following a UK major incident must be aware of this and plan for the potential implications. This article reviews the evidence and learning from previous mass casualty events and makes recommendations for hospitals to ensure that the needs of children will be met if a major incident occurs.

Key words: Child; Disaster planning; Hospitals; Emergency planning; Mass casualty incidents; Major incidents; Terrorism

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Introduction

Over the last decade, from terrorist attacks to the recent coronavirus disease (COVID)-19 pandemic, there have been many major incidents.

A major incident is defined as 'a sudden event that has serious consequences and disruptive ramifications, which requires the establishment of special arrangements' (JESIP, 2024). The location, type and timing of major incidents are unpredictable; however, it is entirely predictable that major incidents will occur. Major incidents often have a serious impact on healthcare facilities as they can undermine the normal functioning of hospitals (Hodgetts and Mackway-Jones, 2012). When a major incident is declared, the goal of healthcare providers is to focus on maximising overall survival (Malik et al, 2021b). However, there is a tendency to allocate more resources to adults than paediatric patients (Mortamet et al, 2019). All ages should be treated equally following a major incident. Children are often involved and sometimes specifically targeted (Markenson and Krug, 2009). The needs of children should be considered throughout major incident planning and preparedness and we should seek to learn from incidents involving children. We carried out a structured literature search and reviewed the published articles on major incidents affecting children in order to identify transferable learning. This paper explores the potential impact that major incidents can have on children and paediatric services and makes recommendations regarding measures that can be taken to improve hospital responses.

There are various types of major incident, this article will focus on mass casualty events which are defined in the Emergency, Preparedness, Resilience and Response (EPRR) National Health Service (NHS) Concept of Operations Framework as 'an incident (or series of incidents) causing casualties on a scale that is beyond the normal resources of the emergency and healthcare services ability to manage'. It is important that healthcare facilities are able to manage mass casualty incidents (Saadatmand et al, 2023).

Learning from mass casualty events can be applied to other areas of major incident planning. We have summarised the key recommendations in Table 1.

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Table 1. Summary of recommendations for National Health Service (NHS) hospitals for major incident preparedness for children

Phase of EPRR	Recommendation
Mitigation-MI plan	All hospitals should be prepared to manage people of all ages following a major incident
	Families should be kept together whenever possible following a major incident
	The major incident plan should have the needs of children considered in all sections
	The command-and-control structure within a major incident plan should consider paediatric casualties and the role of specialist paediatric staff
Preparedness-Training	A training gap analysis should be carried out in order to inform major incident training plans for both adult and paediatric services
	Training exercises should include paediatric casualties
Preparedness-Equipment	Hospitals should ensure they have enough and appropriately sized equipment to manage children following a major incident
Response-Triage	Clinical staff and hospitals should understand the Major Incident Triage Tool being used locally and the implications and limitations of triage tools for paediatric casualties
Response-Reception	Hospitals should identify areas for the reception and admission of paediatric patients following a major incident
Response-Identification of casualties	There should be a clear plan for managing unidentified and/or unaccompanied children which follows safeguarding principles
Response-Blood and surgical management	Hospitals should have a paediatric major haemorrhage plan
	If there are a large number of paediatric casualties, specialist paediatric surgeons should be allocated to the youngest and the smallest children
Recovery	There should be psychological support available for children, families and staff affected by a major incident

EPRR, Emergency, Preparedness, Resilience and Response; MI, major incident.

NHS statutory framework

NHS Hospital Trusts use the EPRR Framework to fulfil their statutory duties under the Civil Contingencies Act (CCA) 2004. This states that 'The NHS must be able to plan for and respond to a wide range of incidents and emergencies that could affect health or patient care. It is the responsibility of the NHS to ensure it has the necessary plans and documentation for a potential major incident'.

The phases of emergency response

Responding to a disaster or major incident can be considered in four phases illustrated in Figure 1.

Mitigation

Hospital major incident planning

One of the most widely used strategies to ensure effective service delivery is to have emergency plans (Herstein et al, 2021). Following Hurricane Katrina, it was reported that having a specific emergency plan for children was crucial in saving lives (Godfred-Cato et al, 2023).

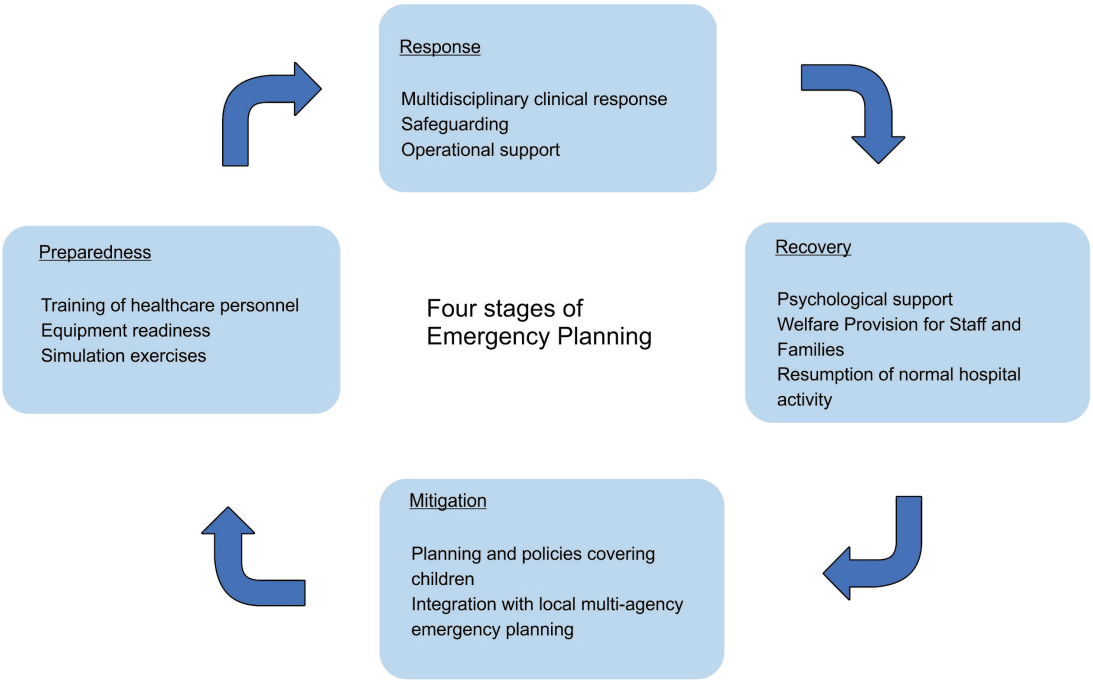

Figure 1. Four stages of emergency planning adapted for hospitals.

Within hospitals, emergency planning is traditionally demonstrated via the major incident plan (MIP). This establishes a command-and-control framework, defining roles, responsibilities, and response. It is a key document for adequately preparing for incidents, allowing the outlining of an organised response framework. The flexibility and adaptability of the MIP to a specific event have been recognised as key factors for effective emergency management (MacKinnon et al, 2022). Having a well-structured plan for major incidents is vital to increase hospital capacity and ensure an appropriate level of care in the face of pressure caused by a significant influx of casualties (Thompson et al, 2009).

The needs of children should be considered throughout the MIP and not relegated to an appendix at the end. When defining actions associated with roles within the MIP, it is important to consider whether the person in that role covers all ages, for example, the emergency department consultant or communications lead, or whether the role needs duplicating to ensure the appropriate skills, e.g., consultant paediatrician and consultant physician will be responsible for children only or adults only, respectively.

The concept of command-and-control was developed in military operations and adapted to the hospital context. This defines the structure and hierarchy of response to an incident, with three levels of command: Strategic (Top/Gold), Tactical (Middle/Silver), and Operational (Ground level/Bronze). Although the literature indicates that most MIPs focus on responding to incidents involving primarily adults (Gilchrist and Simpson, 2019), this structure is also applicable in paediatrics. A multidisciplinary approach to the command-and-control structure is fundamental in planning the response and recovery following an incident involving children (MacKinnon et al, 2022). The effectiveness of the implementation and enactment of MIPs in response to a major incident has been demonstrated on several occasions, as highlighted by the attacks in Nice in July 2016 and Manchester in 2017, significantly contributing to the saving of lives.

Preparedness

Training

In the emergency preparedness phase, it is important to ensure staff are trained to manage patients of all ages. The physiological and psychological characteristics of children differ from adults. Review of previous literature reveals that in emergency preparedness programmes, paediatric training is often neglected. Studies have shown that the implementation of

simulation training for personnel improves clinical outcomes in paediatric emergencies and that simulation for emergency personnel is a critical element for ensuring positive outcomes (Hu et al, 2022; Thim et al, 2022). Simulating the response to emergencies through tabletop exercises, simulations or live-play exercises is a key strategy in emergency preparedness. Paediatric casualties should be included in these exercises.

An emergency planning training gap analysis is useful to identify the skills present and required within hospital staff so that effective training schedules can be developed.

Equipment

Hospitals should assess the amount of equipment and medications required to manage the reception phase of a major incident. Paediatric emergency departments may lack adequate resources for the allocation and stock of medications (WHO, 2016). In the United States, the introduction of the Paediatric Disaster Preparedness Toolkit by the Emergency Medical Service for Children Innovation and Improvement Centre has improved the organisation of disaster response, equipping healthcare staff with the necessary tools to ensure an adequate level of treatment, as underlined by Godfred-Cato et al (2023). There are no current NHS paediatric equipment guidelines for major incidents, however a suggested list is published by Mackway-Jones and Carley (2018) which we recommend. Equipment of varying sizes is required to manage children of all ages. To prevent waste or expiry of equipment, the rotation of stock between reserves for major incidents and products used daily should be implemented.

Response

In the British health system, major incident patients are classified into three priority types: Priority (P)1, P2, P3 which are described in Table 2. Normally, casualties with P1 injuries are transported to major trauma centres (MTCs), P2 to trauma units and local emergency hospitals will receive P3 patients.

Where possible, seriously injured paediatric patients should be transported to specialised centres to ensure better quality of care (Desmond et al, 2022). In some parts of the UK a single MTC treats adults and children, which allows the maintenance of family unity in the event of a major incident. However, there are also areas where paediatric and adult MTCs are located in different hospitals which can lead to division of families. If parents or caregivers are injured but conscious; it is unlikely that they will agree to be separated from their injured children and may decline treatment. After the terrorist attack at the Manchester Arena in 2017, injured parents were admitted to the children's hospital alongside their children, ensuring families remained together at a time of extreme stress (Craigie et al, 2020).

It is essential to consider the management of families and their treatment as a single unit. Although managing injured adults may be outside the comfort zone of specialist children's hospitals, it is preferable to plan to do this safely and effectively rather than have injured adults in the hospital as parents with no plan to assess and manage their

Table 2. Triage priority categories

Priority	Timescale	Description
Priority 1	Immediate	Casualties who require immediate lifesaving interventions (advanced life support now and/or surgery within 2 hours)
Priority 2	Urgent	Casualties who require surgical or other interventions within 2–4 hours
Priority 3	Delayed	Casualties whose treatment may be delayed beyond 4 hours and/or walking wounded
Dead		
Priority 1 Hold	Expectant	Casualties whose injuries are so severe they cannot survive or that are so severe that their treatment would compromise the care and survival of others

injuries. We recommend that all hospital major incident plans consider the need to treat people of all ages.

It is also important to note that ambulant casualties may self-present to hospitals, bypassing any triage system. In these circumstances, they may present to the nearest medical facility regardless of its designation. After the London bus bombing in 2005, adult casualties presented to the nearby Great Ormond Street Hospital where they received initial treatment despite it being a dedicated paediatric hospital with no emergency department.

Triage

Following a mass casualty event, the ambulance service will set up a triage area at the scene. As described by Smith (2023), children have higher heart and respiratory rates than adults so if triage tools use physiological variables such as heart rate and respiratory rate, without an adjustment for age, children will be over-triaged. Human nature and lack of experience in assessing injured children may also lead to over-triage of paediatric casualties.

Comparing the performance of eleven Major Incident Triage Tools (MITTs) at predicting need for life-saving interventions in children, the one which best predicts need for life-saving interventions in children was the UK Military Battlefield Casualty Drills Triage Sieve (Malik et al, 2021a). Triage tools need to be simple and intuitive to use, but also reliable and easily applicable in the field in order to quickly identify care priorities (Malik et al, 2021a).

In 2023 NHS England published the Ten Second Triage (TST) Tool (**Figure 2**) for rapid use by first responders who may not have a clinical background and the MITT for use by clinicians at the site of a major incident to assign priority status to injured people (**Figure 3**). TST is simple and quick to use and does not require counting or calculations of heart or respiratory rate, reducing cognitive burden at the scene.

MITT is an all-age tool which assigns a P1 category to all under 2-year-olds injured in a major incident. Vassallo et al (2022) explain how this simplifies decisions at the scene but may cause problems downstream if paediatric MTCs receive large numbers of young children identified as P1 due to their age or naturally high heart rate but without serious injury it could impact on their ability to receive and manage other P1 older children with life threatening injuries. MITT recommends rescue breaths in children under twelve who are not breathing if their mechanism of injury is consistent with a primary respiratory arrest.

It is expected that the MITT will also be recommended for use for in hospital triage in the NHS (personal communication). The impact of MITT on flow of injured children into hospitals following a mass casualty event is a topic we recommend further research on and clinical judgement may be needed to reassess and retriage children assigned P1.

Reception

To manage an influx of casualties, hospitals need to free up space in the emergency department, wards and ensure the availability of operating theatres and intensive care unit beds. Plans must include children. In order to increase reception capacity, it is essential to evaluate which inpatients can be discharged or transferred (Hick et al, 2008; Bird et al, 2020). However, during the acute phase of a major incident, it is likely that ambulance resources will prioritise primary transport of casualties to hospital with limited options for secondary transfer. All hospitals with paediatric services, regardless of whether they are designated as paediatric MTCs, should identify an area for the reception of children following a major incident.

Designating specific departments for the reception of patients allows for the organisation and grouping of patients, offering logistical benefits to the hospital and clinicians. This can facilitate mutual support among medical staff and those involved in the incident. Dolan and Krug (2006) discuss how, in the aftermath of Hurricane Katrina, the creation of specialised care areas focusing both on the medical and emotional aspects of patient care improved outcomes.

Additional staff may be needed to support the response to a major incident. MIPs should identify staff who need to be called in from home, including paediatric clinicians, and establish a strategy for this. It is recognised that increasing staff, both for adult and

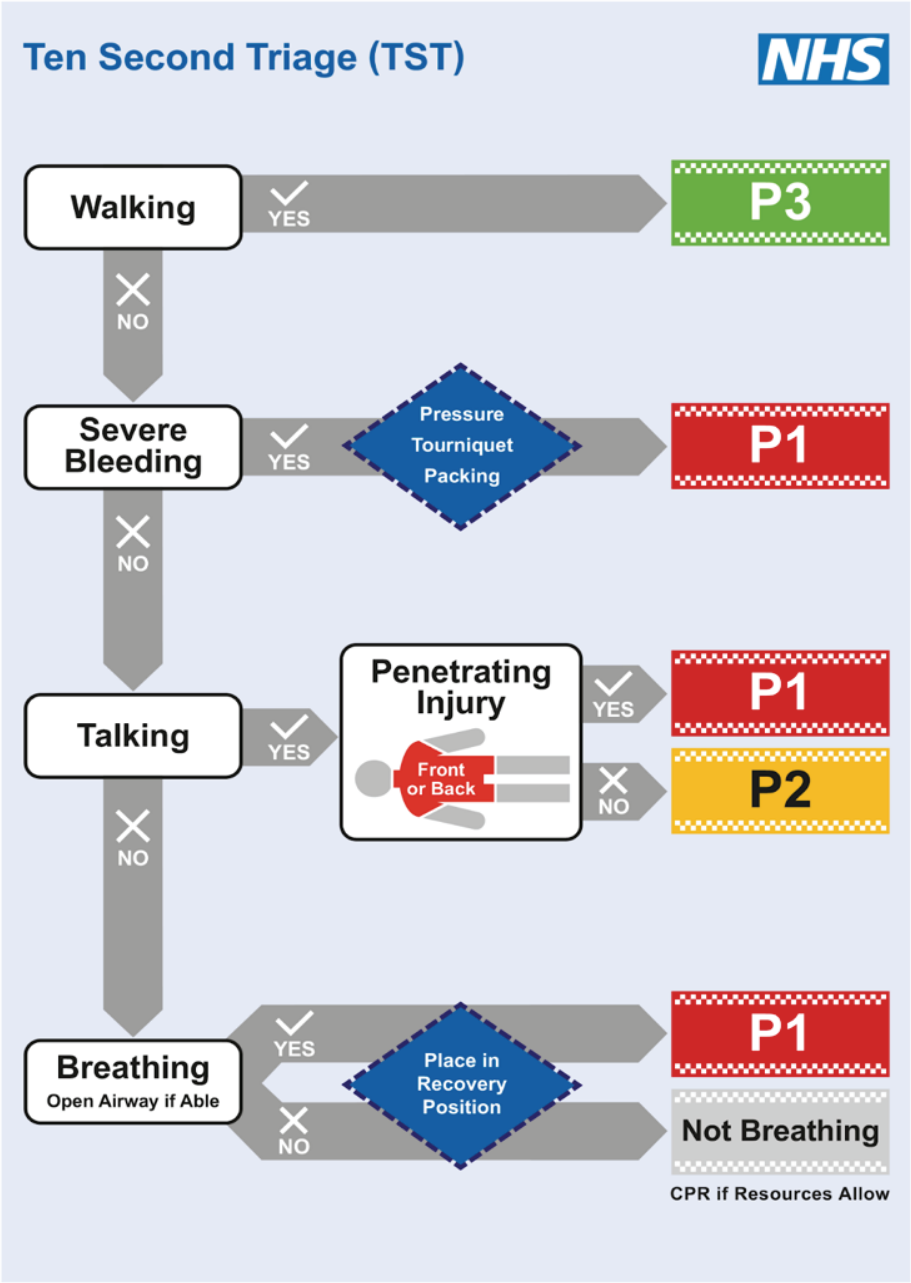

Figure 2. Ten Second Triage (TST) Tool (reproduced with permission from NHS England).

paediatric incidents, ensures an optimal level of care, as highlighted by Koenig and Schultz (2009) and Cicero and Baum (2008).

It is crucial that such a strategy takes into account both the immediate needs arising from the incident but avoids calling in so many people that future shifts are uncovered. Practical issues, such as travelling time and transport availability, must also be considered. The use of messaging applications like WhatsApp can speed up communication, but risk too many responders during daytime, while messages at night may not be read. Individual telephone calls ensure a more organised response but are time consuming.

Identification of casualties

Following a mass casualty event, some patients may be unconscious and unidentified. This is a particular problem for children who may not carry any identification documents. A

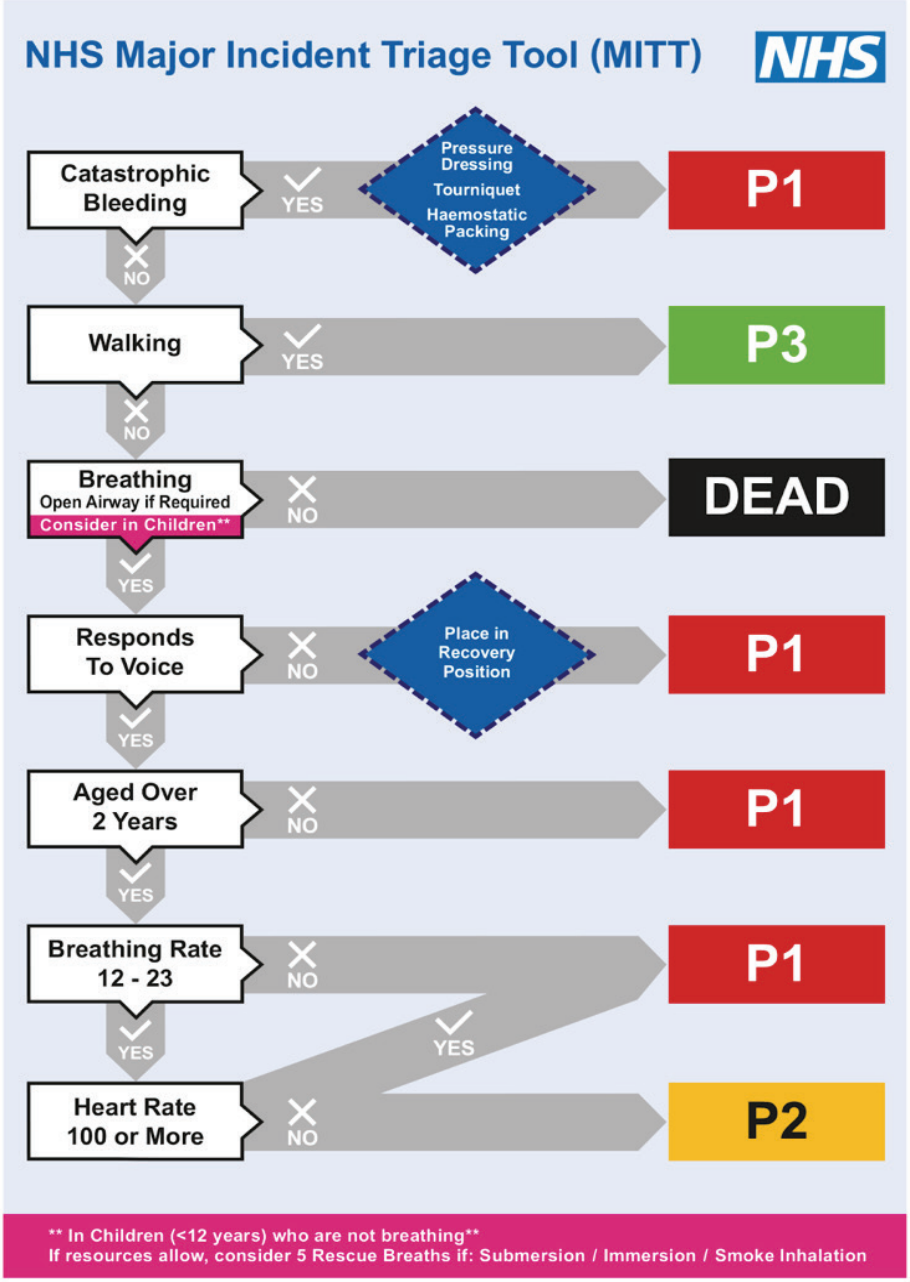

Figure 3. NHS Major Incident Triage Tool (MITT) (reproduced with permission from NHS England).

safeguarding approach should be taken, and police and social workers may be needed to help with identification and reunification of families.

Blood and surgical management

If there are multiple severely injured casualties there may be significant demand for blood and blood products to treat major haemorrhage. This should be used alongside tranexamic acid and measures to control bleeding such as pressure and packing wounds or tourniquets. Local major incident plans and major haemorrhage pathways should make it clear how to access these products and have specific instructions for management of major haemorrhage in children. In the UK, hospitals where a major incident has been declared can link in with the national NHS blood transfusion service so that additional supplies of blood and blood products can be supplied to the hospital.

In some cases, surgical management may be required to control bleeding. In children, as well as adults, this should take a damage control approach. If specialist paediatric surgeons are available but many injured children, the paediatric expertise should be focused on the youngest and smallest children.

Recovery

Recovery following a major incident requires time, effort, and attention. The psychosocial impact of incidents can have profound and lasting effects on all parties involved, requiring a comprehensive approach to care and support. In this context, Psychological First Aid, as outlined and endorsed by the World Health Organization (WHO), is a valuable tool (WHO, 2014). This provides immediate support to incident victims and facilitates their connection to post-traumatic support services, contributing significantly to the recovery process and subsequent social reintegration after trauma.

The research by Askenazy et al (2023), examining the terrorist attacks in Nice in 2016, describes effective psychological support practices implemented following such events. The authors underscore the importance of promoting an environment of calm and security from the outset to prevent development of chronic stress. They also highlight the need for early identification of children who display signs of vulnerability to future mental disorders, through review of their medical records and family history (Askenazy et al, 2023). This enables timely referral to appropriate psychiatric interventions and optimal recovery.

After the terrorist attack at Manchester Arena in 2017, a significant initiative provided psychological support to those affected: the creation of the Greater Manchester Resilience Hub. This aimed to mitigate stress and prevent the onset of post-traumatic psychological problems (Hind et al, 2021). All individuals who had bought tickets to the event were contacted via email and invited to undergo psychological screening. Support was also offered to professionals involved. For children and adolescents, assessment included the Children's Impact of Event Scale and the subscales of the Revised Children's Anxiety and Depression Scale, to identify depression, generalised anxiety disorder, and separation anxiety (Hind et al, 2021). The scheme was considered a success, and recommendations have been made to include this model in emergency response plans.

Recovery of the hospital's normal processes also takes time. There may be a long 'tail' of the incident with patients needing ongoing surgery and rehabilitation. The command-and-control structure should also be applied to the recovery phase. Mutual aid from other hospitals may be required and this is particularly likely in paediatrics where the bed base is smaller, there are less specialist paediatric staff and services may be regional. For example, after the Manchester Arena attack paediatric major trauma patients were diverted to another children's hospital for the next week.

Conclusion

We have highlighted the complexity and challenges that the healthcare world faces in managing major incidents involving children. We followed the emergency management cycle, from preparation to response, examining the unique challenges and needs associated with incidents involving paediatric populations. From pre-hospital triage to recovery phases, both psychological and operational, major incident response and planning should specifically consider children. Table 1 summarises our recommendations to optimise hospital responses following major incidents affecting children.

The analysis of case studies reveals innovative approaches that improve the response to paediatric emergencies. Strategies like that of the Greater Manchester Resilience Hub have shown how child-specific psychological interventions can facilitate recovery and have positive effects.

In conclusion, the management of children in major incidents is an evolving area. We recommend that healthcare facilities, care personnel, and policymakers consider the distinct needs of children in emergency planning. We aim to raise awareness and encourage greater attention towards improving existing protocols, training, and developing more inclusive strategies. Integrating the recommendations outlined in the document at every stage of the emergency management cycle aims to improve the clinical treatment

of children and to emphasise the significant duty of care we have towards this population who represent our future.

Key points

- Children are often affected in mass casualty events.
- Due to their unique characteristics and vulnerability, the needs of children must be considered throughout emergency planning.
- All healthcare facilities should be prepared to meet the needs of children in major incidents.

Author details

[1]Paediatric Emergency Department, Manchester University NHS Foundation Trust, Manchester, UK

[2]Emergency Preparedness and Resilience, The Christie NHS Foundation Trust, Manchester, UK

Availability of data and materials

All data included in this study are available upon request by contact with the corresponding author.

Author contributions

RJ and SP conceived of and wrote the paper. SP did the literature search and referencing. Both authors contributed to the important editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics approval and consent to participate

Not applicable.

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Conflict of interest

The authors declare no conflict of interest.

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