CRITICAL ANALYSIS OF A TRANSLATIONAL TRIAGE RESEARCH DEVELOPMENT TOOL IN STANDARDIZING PREHOSPITAL TRIAGE DECISION-MAKING SYSTEMS IN MASS CASUALTY INCIDENTS

Haider Hussein Mani Al Hatila[1]*, Hatem Nasser Ali Al sarour[2], Mohammed Ali Saleh ALAbdullah[3], Dhafer Ali Saleh Alqahtani[4], Abdullah Nasser Ali Al-Suroor[5]

Abstract

It describes the critical review of a translational triage research and development instrument designed to facilitate the development of standardized pre-hospital triage decision-making systems in mass casualty incidents (MCI). The tool aims to enhance the reliability and practicality of the sorting procedures for emergency response service providers in a situation with a more significant number of patients. Based on a comprehensive literature review, the research addresses the years of evolution of pre-hospital triage systems, recalls the key challenges that are faced by current triage practices, and projects the implications of the research tool for the increased accuracy of triage making. The article presents the methodology, describes the outcomes and findings from real-life field studies, and suggests potential research and clinical perspectives for future studies. Accordingly, recommendations to incorporate the tool into mass casualty triage emergency protocols and move the research field forward are stated.

Keywords: translational triage, prehospital triage, mass casualty incidents, decision-making, emergency response

[1]*Ministry of Health, Saudi Arabia, Email: Haidarha@moh.gov.sa
[2]Ministry of Health, Saudi Arabia, Email: Halsarour@moh.gov.sa
[3]Ministry of Health, Saudi Arabia, Email: moalalabdullah@gmail.gov.sa
[4]Ministry of Health, Saudi Arabia, Email: Al-king-32@hotmail.com
[5]Ministry of Health, Saudi Arabia, Email: Abnaali@moh.gov.sa

***Corresponding Author:** Haider Hussein Mani Al Hatila
*Ministry of Health, Saudi Arabia, Email: Haidarha@moh.gov.sa

DOI: 10.53555/ecb/2022.11.9.115

Introduction

MCI incidents make the response management of emergency personnel extremely difficult as they are forced to deal with large numbers of injured people whom they can scarcely have at their disposal, in addition to the time constraints imposed. Putting the decision-making process of triage into them has been of paramount importance for the prioritization and optimization of outcomes in emergencies. As a result, many present-day triage systems still need to be standardized, and their application may vary in priority and utility in distinct settings. This essay identifies the development and implementation of a translational triage tool in MCI to be used for decision-making as to who to treat based on priority by pre-hospital systems. Through undertaking the process of assessing the tool's algorithm, findings, possible drawbacks, and implications for science in the future, this research aims at increasing the comprehension of the impact of such tools in improving triage and providing a road map for future studies (Follmann et. al 2021).

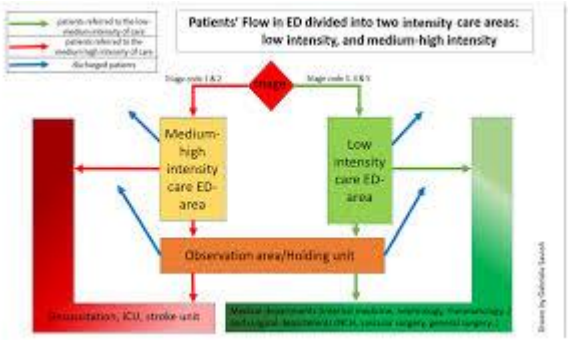
Literature Review

Pre-hospital triage system

The literature review follows the historical development of pre-hospital triage systems, from the princess on poisoned stepmother battles and emergent battlefield medicine to contemporary multi-casualty incident scene response protocols. Particular stages are considered, including the launch of tags tied to a protocol and the adoption of a triage algorithm template, are considered for an analysis of the evolution of triage processes.

Graph analyzing the importance of using triage algorithms and protocols.

An investigation into various triage algorithms and protocols used in mass casualty incidents (MCIs) is a random thing. The process entails a review of the three well-known systems, START, JumpSTART, and Triage Sieve, and their respective methods of patient categorization, treatments, intended operations, and situational changes as they may be affected by disasters.



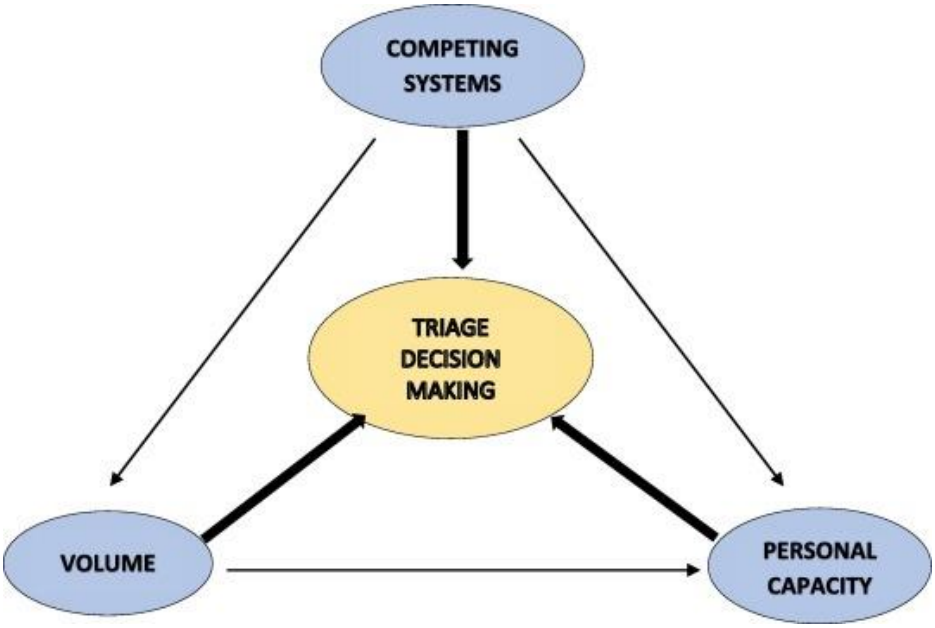
(Michel et. al 2024).

Strengths and Weaknesses of Triage Systems in Existence.

We critically and thoroughly analyze current pre-hospitality triage systems, highlighting their strengths and weaknesses. On the one hand, they are good at this and do their jobs very well, but at the same time, they could be pretty tricky, subjective, and inconsistent. The review discusses the importance of outlining and taking steps to cover these shortcomings, which should lead to the enhancement of triage practices.

Factors Influencing Triage Decision-Making

The description of triaging operations is presented with emphasis on patient urgency, resource availability, and overall health communication among responders. In this review, the interaction implications of the factors involved in the prioritization of triage, resource allocation, and, among all, higher-level decision-making in a low-recognition environment of a significant crime incident will be put into check (Follmann et. al 2021).



(Marsden, 2020).

Identified Gaps and Shortcomings

The process of evaluation involves exploring the identified deficiencies and shortcomings of existing triage methods through the literature. First, medical workers may need help with inhomogeneity in triage decrees, non-uniformity of training and education among emergency responders, and complexities in communication and organization during the response efforts of MCI. The report highlights deficiencies in triage protocols, which should be similar and supported by decision-making tools and algorithms to provide more consistency and efficiency in triage procedures.

The article ends with a well-rounded review of pre-hospital triage systems for MCIs, paying attention to the historical background of these systems, key concepts, and growing problems. The discussed paper describes the tracing of different triage algorithms, protocols, and factors driving the process of triage decision-making, followed by the determination of the existing gaps and shortcomings in the area. Hence, the triage protocols and decision support tools will be brought to mainstream MCI management as the key to enhanced effectiveness.

Methods

Approach to Tool Development

The research methodology involved mixing and matching two research methods, namely qualitative and quantitative approaches, to fine-tune and validate the translational triage research tool. This method was multi-staged, which combined what was written in the literature, the opinions of experts, and, finally, sources of primary information for the tool to be tested as reliable and valid (Bernal et. al 2023). Utilizing diverse information sources and experience, the methodology accounts for the foam and Picard development factors of MCIs in pre-hospital triage decision-making.

Literature Review

We identified the established triage protocols, the decision-making framework for pre-hospital triage in MCI, and the efforts of published research in the same field through a comprehensive literature review. This stage was a critical learning phase, which helped to identify key ideas in the triage methodology of trend-setting and gave rise to the research tool.

Expert Consultation

Experts gave their opinions on the project, which many times helped to make the translational triage research tool better than it was at the beginning. The critical stakeholders, for instance, emergency medical practitioners, trauma doctors, and disaster managers were approached to help get perspectives, suggestions, and validation of the humanity tool's content and structure. They have been involved in the whole process of the tool's development to define its real-life relevance and flag the factors that contribute to completing the triage scenario.

Empirical Validation

The developmental process of our research tool was an iterative process of refinement while assessing input and testing the outcomes of stakeholders in simulated MCI scenarios. This iterative approach

enabled testers to quickly execute changes and modifications, thereby enhancing the tool's efficiency and effectiveness. Besides that trial, the tool went through empirical validation in the form of a retrospective analysis of triage decisions made in natural MCI settings. Trials against accepted triage protocols will further provide a way to see to what degree the system is effective, consistent, and appropriate in such settings in the real world.

Data collection and analysis

The study employed several data collection techniques, such as surveys, interviews, and observational examinations, to collect data on triage methods, decision sociability, and outcomes. For data collection, the analysis involved using both qualitative and quantitative techniques to help in the identification of patterns, trends, and the risk of global triage.

Ethical Considerations

Ethical issues related to patient rights, such as privacy, confidentiality, and informed consent, were comprehensively considered in all stages of this project. Measurement of the application of criteria and protection of subjects from abuse and any harm was achieved to guarantee the security of the fundamental rights and welfare of human research participants (Masoumian Hosseini et. al 2023).

To conclude, the proposed methodology was an effective and systematic technique for creating and verifying the translational triage research tool. The conduct of various approaches, among others reviewing the literature, consulting experts, and performing empirical validation, resulted in the instrument's reliability, validity, and applicability in real-life situations in pre-hospital triage settings.

Results and Findings

Agreement Rates between the Tool and Established Protocols

The quality control showed high commonality between the tool utilization triage research and the established triage protocols. A numerical comparison of the outcomes of triage based on tool usage with those done using the established protocols was made to show that a substantial level of concordance was recorded. After triaging patients into different categories and triage levels based on their acuity levels, we use tables and graphs to show agreement rates (Yánez Benítez et. al 2023). The tool consistently adheres to care standards and demonstrates consistency in this area.

Accuracy of Patient Prioritization

The outcome confirms the feasibility of ranking the patients using the triaging tool that was carried out in between clinical and investigational research. The tool assists with data-driven triage decisions, which compare with patients' documentation when it comes to the analysis of outcomes. Charts and graphs are illustrated regarding the allocation of the patient acuity levels and the respective triage decisions, which serves as a visual aid to prove the tool's suitability in identifying and categorizing the highest risk of patients.

Efficiency of Decision-Making Processes

Efficiency metrics, such as time interval control and throughput rates, demonstrate the ability of the tool to reduce the burden on the decision-making process in disasters. Triage times and throughput rates were found in the data analysis of pre-and post-implementation of the system to be reduced and increasing, respectively. A graphic presentation of the past timeline and the performance metrics as compared to the conditions taken under the implementation of the tool in actual emergency scenarios is the most effective way to show that the tool is worth using in triaging in the real world (Cimino & Braun 2023).

Interpersonal conversations

Qualitative perspectives on the acceptability of the translational triage research tool, revealed after stakeholder interviews and through focus (or group) discussion, are of great value to us in gauging the usability of the tool as well as the obstacles it may face. The overall Visualization in qualitative analysis allows for the extraction of themes like ease of use, complexity of mechanisms, and integration into existing workflows. In addition, participants' quotes and passages from the stakeholder focus groups are used in the text. The findings of the thematic analysis are shown to present a complicated understanding of stakeholders' perspectives and experiences with the tool.

The overall impact and implications

Finally, this quantitative and qualitative research results in a summary of the influence of the triage translator tool on prehospital triage and mass casualty events. Summary tables displaying the most important results and conclusions are developed to encourage the interpretation and digesting of the results, respectively. The paper subsequently traverses the implications of the findings for practice, policy, and subsequent research, emphasizing the potential of the research

model to standardize and streamline ambulance priority-setting processes, leading to efficient health systems and improved health outcomes in significant crises (Sigle et. al 2023).

Discussion

Standardizing Triage Decision-Making

The talk gets rolling with the deliberation of whether or not this research tool serves the purpose of standardizing triage decision-making in mass casualty incidents (MCIs). The trial results show that the tool is effective in having a more significant impact on consistency and standardization in triage rating, enabling more informed patient prioritization and resource allocation. The tool helps to get clear on decision support and aids in the mitigation of different triage practices of the emergency response employees, hence enhancing the overall efficiency and effectiveness when a massive crowd is being handled (Koca et. al 2023).

Change in the healthcare environment

After that, the chapter deals with the short-term effects of the recent technique on the patient's outcome and resource management. Results indicate that fast and precise triage under efficient tool support helps patients obtain better clinical outcomes, such as a reduction in mortality and morbidity rates (Najafi et.,al 2021).. In addition, it boosts the performance of the healthcare system by affecting the distribution of scarce resources such as medical personnel, equipment, and supplies, which increase the effectiveness of the system in response to large-scale outbreaks, thus saving lives and reducing the use of healthcare resources.

Considerations for Implementation

An assessment of the methodology that comprises the utilization of the research in various emergency response settings follows. Features like the technology backbone, training regimes, and domain-specific collaboration give the impetus to smooth integration and deployment of a new tool into the existing triage protocol. It is essential that implementation strategies are customized to allow for a range of contexts, such as organizational landscape, location, and culture, to have this tool embraced and effective in various healthcare systems and communities.

Challenges and opportunities

It also discusses the great likes and challenges, plus the opportunities involved with the application of the research equipment. Scalability, sustainability, and adaptation to the culture are being named as critical challenges that require solutions if long-term effectiveness and usefulness are to be achieved. Strategies are needed to surmount these challenges and realize their potential. These strategies include the exploitation of advancements in technology, establishing partnerships with other stakeholders such as industry, government, and the local community, and providing continuous training and education to emergency responders.

Future research directions

To conclude, it clarifies the potential research directions and the possibility of increasing productivity with the tool implementation. Some of the zones of competence include the expansion of the algorithm and decision support functionality, running prospective tests to check its actual effectiveness in the real world, and investigating novel technology integration into the concept and human-machine interface development. Through the filling of these research voids, future projects will then join or add to the ongoing global movement towards the innovation of mass casualty triage, which will translate to better emergency response capabilities everywhere (Zhang et. al 2023).

Conclusion

Hence, the application of translational triage research and development tools is an obvious step towards the creation of a standard matrix for the decision-making of priority in prehospital triage malt casualty incidents. Its empirical proof and stakeholder engagement are said to make the tool a game changer for all emergency triage necessitates. Suggestions towards integration into the present working scheme, along with further educational training and joint research, will improve societal changes and the role of the tool in facing the complex challenges of modern emergency medicine. Continuing to develop and take an interdisciplinary collaboration course, this tool guarantees that the patients will be safe and the health system will be stable in the case of mass casualty incidents due to the modern technology used.

Recommendation

I*ntegration into SOPs as embedded into the accepted working procedures.*

A potential solution could be introducing translational triage research machinery to the guidelines of the operation of emergency response agencies and healthcare institutions. Organizations can integrate the tool into their standard procedures to identify and categorize probable survivors at mass casualty scenes. This will ensure that triage

remains the responder's focus and that the results are consistently systematic. It is necessary to agree on these integrations as well as the establishment of operating rules and guidelines, including the line of authority and coordination between emergency responders and other relevant public organizations (Usoro et. al 2023).

Training and education programs

One more suggestion is to develop training and education programs aimed at providing emergency responders with the chance to get acquainted with the use of the research tool. An extensive training package should contain content that would assist responders in having sufficient knowledge and skills of the tool that would help them in using it in a real-world scenario. The training programs should include a combination of training on-the-job with learned trainees, simulations, and case studies to increase responders' skill sets and familiarize them with triage decision-making and tool use. Moreover, continuing education courses ought to be set up, and all respondents should keep in mind that any updates or refinements made to the tool will be effective only if they continue to use it regularly (Khorram-Manesh et. al 2021).

Research and Evaluation efforts

Moreover, the evaluation of the long-term effect of the transitional triage research tool is highly recommended for the research area to check. Comprehensive research should be conducted to assess the performance of the system in terms of its contribution to crucial decision-making, the outcomes of patients, and significant operational performance indicators (KPIs). For these studies, both quantitative and qualitative methodologies need to be considered so that the evaluation must put all aspects of the tool's utility and usability into the spotlight when addressed in various emergency response contexts. Practical tool evaluation and feedback mechanisms for subsequent improvements and fine-tuning should be on standby. The adjustment process would run parallel to the tool's evolution.

Embracing Evidence-Based Approaches

As the last recommendation, practitioners are encouraged to practice evidence-based methodologies and pursue collaborative relationships in the process of using and perfecting the research module. By taking a combined advantage of the deemed studies, best practices, and actual practical know-how, the responsible persons develop an optimally designed tool that can perform more functions and cause more impact. Collaborative stakeholders such as academic institutions, buddy industries, and other state players will boost the tools' development ability, dissemination, and adoption, which will help mass casualty incident units be resilient and effective when responding to mass incidents.

Reference

1. Khorram-Manesh, A., Nordling, J., Carlström, E., Goniewicz, K., Faccincani, R., & Burkle, F. M. (2021). A translational triage research development tool: standardizing prehospital triage decision-making systems in mass casualty incidents. *Scandinavian journal of trauma, resuscitation and emergency medicine*, *29*, 1-13. https://link.springer.com/article/10.1186/s13049-021-00932-z
2. Khorram-Manesh, A., Burkle Jr, F. M., Nordling, J., Goniewicz, K., Faccincani, R., Magnusson, C., ... & Carlström, E. (2022). Developing a translational triage research tool: part two—evaluating the tool through a Delphi study among experts. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *30*(1), 48. https://link.springer.com/article/10.1186/s13049-022-01035-z
3. Khorram-Manesh, A., Carlström, E., Burkle, F. M., Goniewicz, K., Gray, L., Ratnayake, A., ... & Magnusson, C. (2023). The implication of a translational triage tool in mass casualty incidents: part three: a multinational study, using validated patient cards. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *31*(1), 88. https://link.springer.com/article/10.1186/s13049-023-01128-3
4. Cuthbertson, J., Weinstein, E., Franc, J. M., Jones, P., Lamine, H., Magalini, S., ... & Caviglia, M. (2023). Sudden-onset disaster mass-casualty incident response: a modified Delphi study on triage, prehospital life support, and processes. *Prehospital and Disaster Medicine*, *38*(5), 570-580. https://www.cambridge.org/core/journals/prehospital-and-disaster-medicine/article/suddenonset-disaster-masscasualty-incident-response-a-modified-delphi-study-on-triage-prehospital-life-support-and-processes/25A7EC7CB1D5286EFA78EE88A4968E67
5. Miller, M., Bootland, D., Jorm, L., & Gallego, B. (2022). Improving ambulance dispatch triage to trauma: A scoping review using the

framework of development and evaluation of clinical prediction rules. *Injury*, *53*(6), 1746-1755. https://www.sciencedirect.com/science/article/pii/S0020138322002078

6. Usoro, A., Mehmood, A., Rapaport, S., Ezeigwe, A. K., Adeyeye, A., Akinlade, O., ... & Razzak, J. (2023). A scoping review of the essential components of emergency medical response systems for mass casualty incidents. *Disaster medicine and public health preparedness*, *17*, e274. https://www.cambridge.org/core/journals/disaster-medicine-and-public-health-preparedness/article/scoping-review-of-the-essential-components-of-emergency-medical-response-systems-for-mass-casualty-incidents/4C3CF9D286C29411A9EFDE17ADD21B41
7. Cimino, J., & Braun, C. (2023). Clinical Research in Prehospital Care: Current and Future Challenges. *Clinics and Practice*, *13*(5), 1266-1285. https://www.mdpi.com/2039-7283/13/5/114
8. Sigle, M., Berliner, L., Richter, E., van Iersel, M., Gorgati, E., Hubloue, I., ... & Wunderlich, R. (2023). Development of an Anticipatory Triage-Ranking Algorithm Using Dynamic Simulation of the Expected Time Course of Patients With Trauma: Modeling and Simulation Study. *Journal of Medical Internet Research*, *25*, e44042. https://www.jmir.org/2023/1/e44042/
9. Zhang, J., Liu, K., Chen, R., Ren, J., Wang, R., Li, L., ... & Wan, Y. (2023). Assessment of three triage systems by medical undergraduate students using simulated disaster patients: a comparative study. *Frontiers in Disaster and Emergency Medicine*, *1*, 1169851. https://www.frontiersin.org/articles/10.3389/femer.2023.1169851/full
10. Najafi, Z., Abbaszadeh, A., Vaezi, H., Rassouli, M., Mirhaghi, A., & Anboohi, S. Z. (2021). Hospital Triage Standards: a qualitative study and content analysis based on experts' Experiences in Iran. *Frontiers in Emergency Medicine*, *5*(4), e43-e43. https://fem.tums.ac.ir/index.php/fem/article/view/672
11. Marsden, M. (2020). *The Impact of a Bayesian Network for Pre-Hospital Decision-Support after Trauma* (Doctoral dissertation, Queen Mary University of London). https://qmro.qmul.ac.uk/xmlui/handle/123456789/79826
12. Koca, A., Polat, O., Oğuz, A. B., Genc, S., Günalp, M., Değirmenci, S., ... & Sevindik, M. (2023). Reliability and validity of a new computer-based triage decision support tool: ANKUTRIAGE. *Disaster Medicine and Public Health Preparedness*, *17*, e162. https://www.cambridge.org/core/journals/disaster-medicine-and-public-health-preparedness/article/reliability-and-validity-of-a-new-computerbased-triage-decision-support-tool-ankutriage/4B51083923A3C71798BB691F3AF2EA37
13. Freshwater, E. (2022). *An evaluation of a trauma unit bypass tool in predicting major trauma* (Doctoral dissertation, University of Southampton). https://eprints.soton.ac.uk/469588/
14. Yánez Benítez, C., Tilsed, J., Weinstein, E. S., Caviglia, M., Herman, S., Montán, C., ... & Faccincani, R. (2023). Education, training and technological innovation, key components of the ESTES-NIGHTINGALE project cooperation for Mass Casualty Incident preparedness in Europe. *European Journal of Trauma and Emergency Surgery*, *49*(2), 653-659. https://link.springer.com/article/10.1007/s00068-022-02198-1
15. Masoumian Hosseini, M., Masoumian Hosseini, S. T., Qayumi, K., Hosseinzadeh, S., & Ahmady, S. (2023). Crossover design in triage education: the effectiveness of simulated interactive vs. routine training on student nurses' performance in a disaster situation. *BMC research notes*, *16*(1), 313. https://link.springer.com/article/10.1186/s13104-023-06596-5
16. Bernal, S. L., Pérez, M. Q., Beltrán, E. T. M., Curto, M. D. C. M., Yanakiev, Y., Pérez, M. G., & Pérez, G. M. (2023). Opportunities for standardization in emergency scenarios in the European Union. *International Journal of Medical Informatics*, *179*, 105232. https://www.sciencedirect.com/science/article/pii/S1386505623002502
17. Follmann, A., Ruhl, A., Gösch, M., Felzen, M., Rossaint, R., & Czaplik, M. (2021). Augmented reality for guideline presentation in medicine: randomized crossover simulation trial for technically assisted decision-making. *JMIR mHealth and uHealth*, *9*(10), e17472. https://mhealth.jmir.org/2021/10/e17472
18. Michel, J., Manns, A., Boudersa, S., Jaubert, C., Dupic, L., Vivien, B., ... & Tsopra, R. (2024). Clinical decision support system in emergency

telephone triage: A scoping review of technical design, implementation and evaluation. *International Journal of Medical Informatics*, 105347. https://www.sciencedirect.com/science/article/pii/S1386505624000108

19. Khorram-Manesh, A., Mortelmans, L. J., Robinson, Y., Burkle, F. M., & Goniewicz, K. (2022). Civilian-military collaboration before and during Covid-19 pandemic—A systematic review and a pilot survey among practitioners. *Sustainability*, *14*(2), 624. https://www.mdpi.com/2071-1050/14/2/624
20. Hu, F., Yang, J., Yang, B. X., Zhang, F. J., Yu, S. H., Liu, Q., ... & Chen, J. (2021). The impact of simulation-based triage education on nursing students' self-reported clinical reasoning ability: a quasi-experimental study. *Nurse Education in Practice*, *50*, 102949. https://www.sciencedirect.com/science/article/pii/S1471595320310350
21. Alazmy, W., & Williams, B. (2021). Barriers and challenges to emergency medical services response to disasters and mass casualty incidents in the Middle East. *International Journal of Emergency Management*, *17*(2), 105-121. https://www.inderscienceonline.com/doi/abs/10.1504/IJEM.2021.122928
22. Gamberini, L., Imbriaco, G., Ingrassia, P. L., Mazzoli, C. A., Badiali, S., Colombo, D., ... & Della Corte, F. (2022). Logistic red flags in mass-casualty incidents and disasters: A problem-based approach. *Prehospital and Disaster Medicine*, *37*(2), 197-204. https://www.cambridge.org/core/journals/prehospital-and-disaster-medicine/article/logistic-red-flags-in-masscasualty-incidents-and-disasters-a-problembased-approach/9D3EDE78797F6422D6B675B187570013
23. Haut, E. R., Kirby, J. P., Bailey, J. A., Phuong, J., Gavitt, B., Remick, K. N., ... & Bulger, E. M. (2023). Developing a National Trauma Research Action Plan: Results from the trauma systems and informatics panel Delphi survey. *Journal of Trauma and Acute Care Surgery*, *94*(4), 584-591. https://journals.lww.com/jtrauma/fulltext/2023/04000/developing_a_national_trauma_research_action_plan_.13.aspx
24. Shickel, B., Balch, J., Aggas, J. R., Loftus, T. J., Kotanen, C. N., Rashidi, P., & Guiseppi-Elie, A. (2023). Scoring for Hemorrhage Severity in Traumatic Injury. In *Biomarkers in Trauma, Injury and Critical Care* (pp. 1135-1152). Cham: Springer International Publishing. https://link.springer.com/content/pdf/10.1007/978-3-031-07395-3_58.pdf