Validating Signs and Symptoms From An Actual Mass Casualty Incident to Characterize An Irritant Gas Syndrome Agent (IGSA) Exposure: A First Step in The Development of a Novel IGSA Triage Algorithm

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Contribution to Emergency Nursing Practice

- Chemical exposures daily pose a significant threat to life. Rapid assessment by first responders/emergency nurses is required to reduce death and disability. Currently, no informatics tools for Irritant Gas Syndrome Agents (IGSA) exposures exist to process victims efficiently, continuously monitor for latent signs/symptoms, or make triage recommendations.
- This study uses actual patient data from a chemical incident to characterize and validate signs/symptoms of an IGSA Syndrome. Validating signs/symptoms is the first step in developing new emergency department informatics tools with the potential to revolutionize the process by which emergency nurses manage triage victims of chemical incidents.

Abstract

Introduction: Chemical exposures can pose a significant threat to life. Rapid assessment by first responders/emergency nurses is required to reduce death and disability. Currently, no informatics tools for irritant gas syndrome agents (IGSA) exposures exist to process victims efficiently, continuously monitor for latent signs/symptoms, or make triage recommendations. This study describes the first step in developing ED informatics tools for chemical incidents: validation of signs/symptoms that characterize an IGSA syndrome.

Methods: Data abstracted from 146 patients treated for chlorine exposure in one emergency department during a 2005 train derailment and 152 patients not exposed to chlorine (a comparison group) were mapped to 93 possible signs/symptoms within 2 tools (WISER and CHEMM-IST) designed to assist emergency responders/emergency nurses with managing hazardous material exposures. Inferential statistics (χ^2/Fisher's exact test) and diagnostics tests were used to examine mapped signs/symptoms of persons who were and were not exposed to chlorine.

Results: Three clusters of signs/symptoms are statistically associated with an IGSA syndrome ($P < .01$): respiratory (shortness of breath, wheezing, coughing, and choking); chest discomfort (tightness, pain, and burning), and eye, nose and/or throat (pain, irritation, and burning). The syndrome requires the presence of signs/symptoms from at least 2 of these clusters.

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This study was funded by National Library of Medicine grant 1R01LM011648.

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J Emerg Nurs 2017;43:333-8.
Available online 28 March 2017
0099-1767

http://dx.doi.org/10.1016/j.jen.2016.11.001

The latency period must also be considered for exposed/potentially exposed persons.

Discussion: This study uses actual patient data from a chemical incident to characterize and validate signs/symptoms of an IGSA syndrome. Validating signs/symptoms is the first step in developing new ED informatics tools with the potential to revolutionize the process by which emergency nurses manage triage victims of chemical incidents.

Key words: Triage; Chemical exposure; Mass casualty; Validation study; Irritant Gas Syndrome Agent

Acute chemical exposures occur on a daily basis and pose a significant threat to life. Rapid medical assessment and accurate identification of a chemical exposure by first responders and emergency nurses are crucial in reducing death and disability.[1–4] A study of the January 2005 Graniteville SC chlorine disaster that killed 9 persons and sent hundreds to the local community hospital found that usual triage systems do not recognize signs and symptoms specific to irritant gas syndrome agents (IGSA) or latent signs of respiratory distress associated with chemical exposures.[1–4] IGSA gasses/liquids (also known as choking lung or pulmonary agents) include such chemicals as chlorine anhydrous ammonia and sulfur dioxide and may cause severe irritation and swelling of the respiratory tract (lining of the nose throat and lungs).[5,6] None of the triage systems analyzed in our previous study[1] demonstrated efficacy in establishing priorities for treatment of chlorine victims. Furthermore no informatics tools currently exist to help first responders and emergency nurses process victims efficiently, continuously monitor for latent signs and symptoms or provide triage recommendations for IGSA exposures.[1–4] To mitigate the "surge" of casualties into emergency departments after a chemical mass casualty incident (MCI) informatics solutions are needed so emergency nurses can quickly and accurately identify, process and triage patients. This study describes the validation of the signs and symptoms of an IGSA syndrome using patient data from an actual incident. This validation is the first step in the development of an IGSA triage algorithm that will soon be incorporated into a new prototype informatics tool to revolutionize the process by which emergency nurses manage triage victims of chemical incidents.

IGSAs are important in manufacturing raw materials and are transported daily through communities by railcar, truck, and barge.[7,8] Exposure to IGSAs can happen in a variety of settings, including those that involve a deliberate release of these agents (eg, global terrorism), resulting in injury or death to hundreds or thousands of people. The United States Department of Homeland Security estimated that an attack on a large urban chlorine gas storage tank used in municipal water supply and sewage treatment could kill 17,500 people, severely injure 10,000, and hospitalize 100,000.[9] Even the best-prepared city is not capable of coping with an MCI of this magnitude. To manage the "surge" of casualties into a health care facility after an MCI, emergency responders and emergency nurses use triage to rapidly assess patients and prioritize their care with the goal of saving as many lives as possible.[10,11]

Typical field triage such as Simple Triage and Rapid Treatment (START)[12] uses only 4 parameters to assess a triage treatment priority: ability to walk, respirations, perfusion (pulse or capillary refill), and ability to follow simple directions. ED triage tools such as the Emergency Severity Index (ESI)[13] include the assessment of patients requiring immediate life-saving interventions (level 1) and high-risk situations, such as patients who are confused, lethargic, disoriented, in severe pain, or have danger zone vital signs (level 2). Data analysis for the Graniteville study showed an overestimate of the victims classified as levels 1 and 2 using the ESI triage system and an underestimate of red (immediate) victims by the START/JumpSTART (pediatric START) system.[1] Patients exposed to chemicals can experience dramatic and latent changes in signs and symptoms (specifically low oxygen saturation) and thus require ongoing monitoring and evaluation, a factor that current triage systems do not consider.[1] Triage algorithms specific to IGSA exposures are needed to accurately determine the priority of care.[1,4]

Two main challenges are encountered in the treatment of victims of IGSA MCIs: (1) rapidly identifying the chemical involved and (2)identifying, triaging, and processing the persons who are exposed with accuracy, precision, and efficiency to improve patient outcomes.[1] Informatics solutions that improve early identification, processing, and triage for patients admitted to the emergency department after an IGSA exposure will enhance the application of science in emergency nursing and disaster informatics. The use of actual data from a chemical incident to validate the signs and symptoms of an IGSA syndrome will be used in the development of a new ED triage algorithm specific to IGSA incidents. This validation is the first step in the development of an informatics tool that will incorporate the IGSA triage algorithm to help emergency nurses accurately and efficiently detect an MCI, identify an IGSA syndrome, and triage patients during a chemical MCI.[4,6]

Methods

Only de-identified data were used for this study. The Office of Research Compliance at the University determined that this study was exempt from the protection of human subject's regulations. All information from the paper medical records of the 198 patients seen in the emergency department at the local