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HEALTHCARE EMERGENCY PREPAREDNESS INFORMATION GATEWAY

Hospital Surge Capacity and Immediate Bed Availability Topic Collection

6/1/2015

ASPR

ASSISTANT SECRETARY FOR PREPAREDNESS AND RESPONSE

Topic Area Collection: Hospital Surge Capacity and Immediate Bed Availability

Hospitals and healthcare coalitions are faced with challenges that multiply after natural or human-caused events or disasters. Surge planning—and immediate bed availability in particular—are critical components of every healthcare facility's emergency plan and response ability. These resources highlight recent case studies, lessons learned, tools, and promising practices for planning and improving capabilities for a surge event.

Each resource in this Topic Collection is placed into one or more of the following categories (click on the category name to be taken directly to that set of resources). Resources marked with an asterisk (*) appear in more than one category.

Must Reads

Barbera, J.A. and Macintyre, A.G. (2009). Medical Surge Capacity and Capability: The Healthcare Coalition in Emergency Response and Recovery. Washington, DC: U.S. Department of Health and Human Services.

The authors wrote this guide as a companion piece to the MSCC handbook, providing tips for developing, implementing, and maintaining effective Healthcare Coalitions.

Boyer, Edward W., Fitch, James, and Shannon, Michael W. (2009). Pediatric Hospital Surge Capacity in Public Health Emergencies. Boston, MA: The Center for Biopreparedness, Division of Emergency Medicine, Children's Hospital Boston, Harvard Medical School and Worcester, MA: Department of Emergency Medicine, University of Massachusetts Medical Center, University of Massachusetts Medical School.

The recommendations contained in this document can help medical professionals develop tailored responses to mass casualty events involving pediatric patients.

California Hospital Association Hospital Preparedness Program. (2011). Pediatric/Neonatal Disaster and Medical Surge Plan and Preparedness Toolkit. Contra Costa Health Services.

This toolkit can help neonatal and pediatric medical care professionals build and sustain related disaster preparedness programs.

Centers for Disease Control and Prevention. (2007). (Updated) In A Moment's Notice: Surge Capacity for Terrorist Bombings: Challenges and Proposed Solutions. Atlanta, GA: The Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Injury Response.

The authors synthesized comments from a series of expert panel meetings on identifying innovative strategies hospitals could adopt to address terrorism-related surge issues.

Einav, S., Hick, J.L., Hanfling, D., Erstad, B., Toner, E., Branson, R. Kanter, R., Kissoon, N., Dichter, J., Devereaux, A., and Christian, M.D. (2014). Surge Capacity Logistics: Care of the Critically Ill and Injured During Pandemics and Disasters: CHEST Consensus Statement. Chest. 146(4_suppl):e17S-e43S.

The authors list 22 suggestions specific to surge capacity and mass critical care under the following topics: stockpiling of equipment, supplies, and pharmaceuticals; staff preparation and organization; patient flow and distribution; deployable critical care services; and using transportation assets to support surge response.

Institute of Medicine. (2012). Crisis Standards of Care: A Systems Framework for Catastrophic Disaster Response. Washington, DC: National Academies Press.

Chapter 7 of the framework, Hospitals and Acute Care Facilities, provides a high level of detail related to implementing surge strategies, including immediate bed availability.

Kelen G.D., McCarthy, M.L., Kraus C.K., Ding, R., Hsu, E.B., Li, G., Shahan, J.B., Scheulen, J.J., and Green, G.B. (2009). Creation of Surge Capacity by Early Discharge of Hospitalized Patients at Low Risk for Untoward Events. (Abstract only.) Disaster Med Public Health Prep. 3(2 Suppl):S10-6.

The authors examined the effect of reverse triage (early patient discharge) on inpatient bed surge capacity and found that surge capacity may be greater than previously thought.

National Association of County and City Health Officials. (2014). Responding to Medical Surge in Rural Communities: Practices for Immediate Bed Availability. Washington, DC: The National Association of County and City Health Officials.

The focus of this report is on immediate bed availability in rural healthcare settings. The authors conducted a literature review and synthesized data collected during interviews with representatives in four areas: Mississippi, Southwest Utah, Virginia, and Southeast Texas.

*Tadmor, B., McManus, J., Koenig, K.L. (2006). The Art and Science Of Surge: Experience From Israel and the U.S. Military. Acad Emerg Med 13(11): 1130-4.

According to the authors, the "art" of surge includes decisions, authority, and responsibility, and the "science" includes numbers and benchmarks. The authors share surge strategies used by the U.S. military and Israel that can be replicated by other healthcare systems.

*Watson, S., Rudge, J., and Coker, R. (2013). Health Systems' "Surge Capacity": State of the Art and Priorities for Future Research. Milbank Q. 2013 Mar; 91(1): 78–122.

The authors share the results of a literature review that included surge capacity, and conclude that more work needs to be done in the area of generating strong frameworks and data collection methods.

Capabilities

*Alabama Department of Public Health. (2010). Multi-State, Multi-Organizational Solution to Limited Regional Pediatric Medical Surge Capacity in the Southeastern United States.

The speakers in this webcast share strategies for addressing obstacles associated with pediatric surge.

Aucoin, R. (2006). Hurricane Katrina: One Hospital's Experience. Critical Care. 10(1): 109.

The author shares his hospital's experiences preparing for, responding to, and recovering from Hurricane Katrina. He shares lessons learned regarding anticipating patient surge, relocating critical patients, and interagency communications.

*Barbera, J.A. and Macintyre, A.G. (2007). Medical Surge Capacity and Capability: A Management System for Integrating Medical and Health Resources During Large-Scale Emergencies. Second Edition, September 2007. Washington, DC: U.S. Department of Health and Human Services.

This handbook provides an overview of the Medical Surge Capacity and Capability (MSCC) Management System and describes how the model can be applied and integrated across six "tiers of response."

Barbera, J.A. and Macintyre, A.G. (2009). Medical Surge Capacity and Capability: The Healthcare Coalition in Emergency Response and Recovery. Washington, DC: U.S. Department of Health and Human Services.

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*Challen, K. and D. Walter. (2006). Accelerated Discharge of Patients In The Event Of a Major Incident: Observational Study of a Teaching Hospital. BMC Public Health 6: 108.

The authors surveyed United Kingdom Primary Care Trust Hospitals over a period of time to determine the number of beds they could "free up" in the event of a major incident.

DelValle Institute for Emergency Preparedness. (2014). 2013 Boston Bombings: Response and Recovery. (Infographic). Office of Public Health Preparedness, a Division of the Boston Public Health Commission.

This infographic includes general statistics and depicts how emergency medical services effectively distributed patients after the Boston Marathon bombing.

Eastman A.L., Rinnert, K.J., Nemeth, I.R., Fowler, R.L., Minei, J.P. (2007). Alternate Site Surge Capacity in Times of Public Health Disaster Maintains Trauma Center and Emergency Department Integrity: Hurricane Katrina. (Abstract only.) J Trauma. 2007 Aug;63(2):253-7.

The Dallas Convention Center Medical Unit was established just after Hurricane Katrina, and the authors explain how the medical surge capacity provided by this unit absorbed patient volume while also minimizing impact on routine operations.

*Fagbuyi, D. B., K. M. Brown, et al. (2011). A Rapid Medical Screening Process Improves Emergency Department Patient Flow During Surge Associated With Novel H1N1 Influenza Virus. (Abstract only.) Ann Emerg Med 57(1): 52-9.

The authors used a new rapid screening process to manage patient surge associated with the 2009 H1N1 pandemic and found that it—along with a slight increase in staffing—improved patient flow and had no effect on emergency room return rates within two or seven days.

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The article details a real-life reverse triage situation where a full hospital freed up 56 beds (16% of capacity) to treat casualties suffering from blast injuries.

*Soremekun, O.A., Zane, R.D., Walls, A., Allen, M.B., Seefeld, K.J., and Pallin, D.J. (2011). Cancellation Of Scheduled Procedures as a Mechanism to Generate Hospital Bed Surge Capacity-A Pilot Study. (Abstract only.) Prehosp Disaster Med 26(3): 224-9.

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According to the authors, the "art" of surge includes decisions, authority, and responsibility, and the "science" includes numbers and benchmarks. The authors share surge strategies used by the U.S. military and Israel that can be replicated by other healthcare systems.

Trust for America's Health. (2009). H1N1 Challenges Ahead. Washington, DC: Trust for America's Health.

The authors provide an overview of hospital surge during influenza season and used CDC's FluSurge program to approximate the number of patients that could be hospitalized per state in a pandemic influenza scenario.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2012). Healthcare Preparedness Capabilities: National Guidance for Healthcare System Preparedness.

Capability 10, Medical Surge, highlights functions, tasks, and resource elements healthcare system preparedness practitioners should build and maintain to ensure resilience to disasters and emergencies that involve or affect the healthcare system.

*U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2013). Hospital Preparedness Program (HPP) Healthcare Preparedness Capability Review National Call: Capability 10: Medical Surge and Immediate Bed Availability (IBA).

During this national call, speakers shared information about medical surge and how hospital staff can use immediate bed availability to operationalize Capability 10.

Immediate Bed Availability

Bayram, J. D., S. Zuabi, et al. (2011). Disaster Metrics: Quantitative Benchmarking of Hospital Surge Capacity in Trauma-Related Multiple Casualty Events. (Abstract only.) Disaster Med Public Health Prep. 2011 Jun;5(2):117-24

The authors complemented a literature review with mathematical modeling to illustrate the importance of quantitatively benchmarking various components of hospital bed surge capacity.

Cantrill, S., and Pons, P. (2009). HAvBED 2: Hospital Available Beds for Emergencies and Disasters: A Sustainable Bed Availability Reporting System. Denver, CO: Denver Health.

The authors provide an overview of the Hospital Available Beds for Emergencies and Disasters (HAvBED) reporting system, with chapters dedicated to definitions and data elements, data entry, HAvBED and the National Incident Management System, and recommendations for facilities interested in implementing the system.

Centers for Disease Control and Prevention. (2007). (Updated) In a Moment's Notice: Surge Capacity for Terrorist Bombings: Challenges and Proposed Solutions. Atlanta, GA: The Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Injury Response.

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During this national call, speakers shared information about medical surge and how hospital staff can use immediate bed availability to operationalize Capability 10.

Pediatric

Boyer, E., Fitch, J., and Shannon, M. (2009). Pediatric Hospital Surge Capacity in Public Health Emergencies. Agency for Healthcare Research and Quality.

The recommendations contained in this document can help medical professionals develop tailored responses to mass casualty events involving pediatric patients.

Frost, P. (2010). Pediatric Surge Planning: Solutions Within Reach. Sacramento, CA: California Hospital Association 2010 Disaster Conference.

The author stresses the importance of community hospitals in planning for and managing pediatric surge.

Kanter, R.K. and Moran, J.R.(2007). Pediatric Hospital and Intensive Care Unit Capacity in Regional Disasters: Expanding Capacity By Altering Standards Of Care. Pediatrics. 2007 Jan;119(1):94-100.

The authors examine the capacity of New York City hospitals to accommodate a large pediatric surge and find that while altering standards of care could help address the increase in demand, intensive care unit capacity would not be sufficient in the event of larger-scale disasters.

*Minnesota Department of Health. (2013). Minnesota Pediatric Surge Primer and Template Plan. St. Paul, MN: Minnesota Department of Public Health.

This primer provides planning guidance for healthcare facilities that do not typically provide pediatric inpatient or pediatric trauma services. The website provides links to additional pediatric surge resources.

Sills, M., Hall, M., Fieldstone, E., Hain, P., Simon, H., Brogan, T., Fagbuyi, D., Mundorff, M., and Shah, S. (2011). Inpatient Capacity at Children's Hospitals during Pandemic (H1N1) 2009 Outbreak, United States. Emerg Infect Dis. 17(9): 1685–1691.

The authors examined data from 34 U.S. children's hospitals during the 2009 H1N1 pandemic and found that during the fall, occupancy was actually 6% lower than it was during the same period of the previous seasonal influenza period (95% and 101% respectively). Using this data, they built five models to project occupancy and better understand the impact a more virulent pandemic could have on a facility.

Pediatric, Webinar/Training

*Alabama Department of Public Health. (2010). Multi-State, Multi-Organizational Solution to Limited Regional Pediatric Medical Surge Capacity in the Southeastern United States.

The speakers in this webcast share strategies for addressing obstacles associated with pediatric surge.

Rady Children's Hospital, San Diego. (2011). Pediatric Surge Planning: Train the Trainer.

This online course provides an in-depth overview of the special considerations associated with pediatric surge planning. The authors describe hospital incident command system activation, specific tools and actions linked to pediatric surge, and provide tips for developing a surge plan.

Plans, Tools, and Templates

Alachua County Health Department (Florida). (2012). ESF 8 Annex Example. (Login required.) National Association of County & City Health Officials.

The Medical Surge Capacity Annex shows how Alachua County outlines roles and responsibilities in the event of a natural or human-caused incident.

*California Hospital Association Hospital Preparedness Program. (2011). Pediatric/Neonatal Disaster and Medical Surge Plan and Preparedness Toolkit. Contra Costa Health Services.

Neonatal and pediatric medical care professionals can use this toolkit to build and sustain related surge plans.

*Denver Health. (2009). Disaster Alternate Care Facilities: Report and Interactive Tools. Agency for Healthcare Research and Quality.

The report and associated tools can help emergency planners and other stakeholders select, staff, and stock Disaster Alternate Care Facilities.

*Florida Department of Health. (2012). Hospital Mass Casualty Incident Planning Checklist. Florida Department of Health.

This checklist is rooted in the "whole community approach" and provides step-by-step guidance for those planning for significant increases in demand as a result of a critical incident.

*Hick, J.L., Koenig, K.L., Barbisch, D., and Bey, T.A. (2008). Surge Capacity Concepts for Health Care Facilties: The CO-S-TR Model for Initial Incident Assessment. (Abstract only.) Disaster Med Public Health Preparedness. 2008;2(Suppl 1):S51–S57.

The authors provide a framework and checklist for initial surge actions and areas of attention for a hospital in the first hour after a mass casualty incident.

*Minnesota Department of Health. (2013). Minnesota Pediatric Surge Primer and Template Plan. St. Paul, MN: Minnesota Department of Public Health.

This primer provides planning guidance for healthcare facilities that do not typically provide pediatric inpatient or pediatric trauma services. The website provides links to additional pediatric surge resources.

*Moser, R., Jr., Connelly, C., Baker, L., Barton, R., Buttrey, J., Morris, S., Saffle, J., and Whitney, J.R.. (2006). Development of A State Medical Surge Plan, Part II: Components of a Medical Surge Plan. (Abstract only.) Disaster Manag Response. 2006 Jan-Mar;4(1):19-24.

The authors summarize the main components of Utah's medical surge plan and provide information on immediate bed availability, plan activation and response, and communications.

*NYC Health. (2013). Patient Surge in Disasters: A Hospital Toolkit for Expanding Resources in Emergencies. Queens, NY: NYC Department of Health and Mental Hygiene.

Users can request actual plans via email on this website. They can also use this toolkit, which provides links to templates and other surge tools, to help determine their surge planning, staffing, and supply needs.

Pennsylvania Department of Health. (2012). Medical Surge Management Series. Harrisburg, PA: Pennsylvania Department of Health

This collection of PDF documents outlines Pennsylvania's strategy for mass response, and includes information on alternate care sites and the delivery of healthcare with scarce resources.

Richmond City Health District (Virginia). (2012). Health and Medical Surge Plan. (Login required.) National Association of County & City Health Officials.

This plan can be used as an example by those looking to plan for post-disaster public health and medical surge response.

Santa Clara County Public Health. (2008). Hospital Surge Capacity Toolkit. National Association of County & City Health Officials.

The creators of this toolkit include information on providing medical surge capacity, tracking patients, and establishing alternate care sites. Each section of this toolkit is available in Microsoft Word and PDF format, allowing users to tailor it to their

requirements. Users can download the files or order a CD-ROM containing the templates from the National Association of County and City Health Officials.

Southeastern District Health Department (Idaho). (2012). Medical Surge Capacity Plan Annex. (Login required.) National Association of County & City Health Officials.

This plan can serve as an example for local health departments interested in establishing region-wide preparedness for a mass casualty or surge event.

Stanislaus County Health Department (California). (2010). Medical Surge Plan Example. (Login required.) National Association of County & City Health Officials.

Focused on pandemic influenza, this plan includes several modeling tools and appendices on surge response, surge measures for healthcare facilities, implementing and monitoring surge response, and recovering from surge.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2015). Hospital Surge Evaluation Tool. U.S. Department of Health and Human Services.

This tool can be used by hospital emergency planners, administrators, and other personnel to both assess and enhance their facility's surge plans. It includes evaluation tools specific to emergency department triage and hospital incident command.

Resource Allocation

*Challen, K. and D. Walter. (2006). Accelerated Discharge of Patients in the Event of a Major Incident: Observational Study of a Teaching Hospital. BMC Public Health 6: 108.

The authors surveyed United Kingdom Primary Care Trust Hospitals over a period of time to determine the number of beds they could "free up" in the event of a major incident.

Griffiths, J.L., Estipona, A., and Waterson, J.A. (2011). A Framework for Physician Activity During Disasters And Surge Events. (Abstract only.) Am J Disaster Med. 2011 Jan-Feb;6(1):39-46.

During surge events, physicians can assist with reverse triage and patient flow.

Hanley, M.E. and Bogdan, G.M. (2008). Mechanical Ventilation in Mass Casualty Scenarios. Augmenting Staff: Project XTREME. Respir Care. 53(2):176-88.

Non-respiratory therapy staff can be trained to augment staff and help patients in respiratory failure after a critical incident.

Hassol, A. and Zane, R. (2006). Reopening Shuttered Hospitals to Expand Surge Capacity. Centers for Disease Control and Prevention.

The authors explore the use of closed facilities to provide extra capacity in the aftermath of a critical incident, focusing on facility structure, equipment and supplies, staffing considerations, patient transport, security, and patient information.

Kelen G.D., McCarthy, M.L., Kraus C.K., Ding, R., Hsu, E.B., Li, G., Shahan, J.B., Scheulen, J.J., and Green, G.B. (2009). Creation of Surge Capacity by Early Discharge of Hospitalized Patients at Low Risk for Untoward Events. (Abstract only.) Disaster Med Public Health Prep. 2009 Jun;3(2 Suppl):S10-6.

The authors examined the effect of reverse triage (early patient discharge) on inpatient bed surge capacity and found that surge capacity may be greater than previously thought.

*Richards, G.A. and Sprung, C.L. (2010). Chapter 9. Educational Process. Recommendations and Standard Operating Procedures for Intensive Care Unit and Hospital Preparations for an Influenza Epidemic or Mass Disaster. (Abstract only.) Intensive Care Med. 2010 Apr;36 Suppl 1:S70-9.

This article focuses on intensive care unit surge and lists recommended standard operating procedures for staff assigned with managing patient flow.

*Satterthwaite, P. S. and C. J. Atkinson. (2012). Using 'Reverse Triage' to Create Hospital Surge Capacity: Royal Darwin Hospital's Response to the Ashmore Reef Disaster. (Abstract only.) Emerg Med J 29(2): 160-2.

The article details a real-life reverse triage situation where a full hospital freed up 56 beds (16% of capacity) to treat casualties suffering from blast injuries.

*Soremekun, O.A., Zane, R.D., Walls, A., Allen, M.B., Seefeld, K.J., and Pallin, D.J. (2011). Cancellation of Scheduled Procedures as a Mechanism to Generate Hospital Bed Surge Capacity-A Pilot Study. (Abstract only.) Prehosp Disaster Med 26(3): 224-9.

The authors examined the impact of delaying hospital procedures on immediate bed availability.

Stratton, S.J. and Tyler, R.D. (2006). Characteristics of Medical Surge Capacity Demand for Sudden-Impact Disasters. Acad Emerg Med. 13(11):1193-7.

Using data from "established databases and published reports," the authors examined both the baseline capacity of U.S. healthcare facilities and the length of time it took for external facilities to provide assistance after a no-notice critical incident. They concluded that communities should plan to maintain their provision of medical services without assistance for at least 24, and as much as 96 hours, after such an incident.

*Tadmor, B., McManus, J., Koenig, K.L. (2006). The Art and Science of Surge: Experience from Israel and the U.S. military. Acad Emerg Med 13(11): 1130-4.

According to the authors, the "art" of surge includes decisions, authority, and responsibility, and the "science" includes numbers and benchmarks. The authors share surge strategies used by the military and Israel that can be replicated by other healthcare systems.

Rural/ Frontier

*National Association of County and City Health Officials. (2014). Responding to Medical Surge in Rural Communities: Practices for Immediate Bed Availability. Washington, DC: The National Association of County and City Health Officials.

The focus of this report is on immediate bed availability in rural healthcare settings. The authors conducted a literature review and synthesized data collected during interviews with representatives in four areas: Mississippi, Southwest Utah, Virginia, and Southeast Texas.

Surge/Mass Care Response

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The authors surveyed United Kingdom Primary Care Trust Hospitals over a period of time to determine the number of beds they could "free up" in the event of a major incident.

Davis, D. P., J. C. Poste, et al. (2005). Hospital Bed Surge Capacity in the Event of a Mass-Casualty Incident. (Abstract only.) Prehosp Disaster Med 20(3): 169-76.

The authors sought a more accurate way to determine hospital bed surge capacity by using physician and nurse manager assessments (instead of traditional cross-sectional hospital census data).

Einav, S., Hick, J.L., Hanfling, D., Erstad, B., Toner, E., Branson, R. Kanter, R., Kissoon, n., Dichter, J., Devereaux, A., and Christian, M.D. (2014). Surge Capacity Logistics: Care of the Critically Ill and Injured During Pandemics and Disasters: CHEST Consensus Statement. Chest. 2014;146(4_suppl):e17S-e43S.

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Einav, S., Limor Aharonson-Daniel, L., Weissman, C., Freund, H., and Peleg, K. (2006). In-Hospital Resource Utilization during Multiple Casualty Incidents. Ann Surg. 243(4): 533–540.

Data from patients admitted to six Level 1 Trauma Centers in Israel just after a mass casualty incident allowed the authors to develop related guidelines for hospitals to activate in the event of similar events.

*Fagbuyi, D. B., K. M. Brown, et al. (2011). A Rapid Medical Screening Process Improves Emergency Department Patient Flow During Surge Associated with Novel H1N1 Influenza Virus. Ann Emerg Med 57(1): 52-9.

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This toolkit provides links to templates and other surge tools that can help hospital staff determine their surge planning, staffing, and supply needs.

Phillips, S.J., Knebel, A., Johnson, K. (2009). Mass Medical Care with Scarce Resources: The Essentials. U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response.

The goal of this guide is to help community and hospital planners meet patient demand when it outweighs supply. The authors also dedicate a chapter to the use of alternative care sites.

*Richards, G.A. and Sprung, C.L. (2010). Chapter 9. Educational process. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. (Abstract only.) Intensive Care Med. 2010 Apr;36 Suppl 1:S70-9.

This article focuses on intensive care unit surge and lists recommended standard operating procedures for staff assigned with managing patient flow.

Roberts, M., Hodge, J. Jr., Gabriel, E., Hick, J., Cantrill, S., Wilkinson, A., and Matzo, M. (2007). Mass Medical Care with Scarce Resources: A Community Planning Guide. U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response.

The authors share information on standards of care, tools and resources, and case studies of how hospitals have planned for mass casualty events.

*Satterthwaite, P. S. and C. J. Atkinson. (2012). Using 'reverse triage' to create hospital surge capacity: Royal Darwin Hospital's response to the Ashmore Reef disaster. (Abstract only.) Emerg Med J 29(2): 160-2.

The article details a real-life reverse triage situation where a full hospital freed up 56 beds (16% of capacity) to treat casualties suffering from blast injuries.

*Soremekun, O.A., Zane, R.D., Walls, A., Allen, M.B., Seefeld, K.J., and Pallin, D.J. (2011). Cancellation of scheduled procedures as a mechanism to generate hospital bed surge capacity-a pilot study. (Abstract only.) Prehosp Disaster Med 26(3): 224-9.

The authors examined the impact of delaying hospital procedures on immediate bed availability.

Stratton, S.J. and Tyler, R.D. (2006). Characteristics of medical surge capacity demand for sudden-impact disasters. Acad Emerg Med. 2006 Nov;13(11):1193-7.

Using data from "established databases and published reports," the authors examined both the baseline capacity of U.S. healthcare facilities and the length of time it took for external facilities to provide assistance after a no-notice critical incident. They concluded that communities should plan to maintain their provision of medical services without assistance for at least 24, and as much as 96 hours, after such an incident.

*Tadmor, B., McManus, J., Koenig, K.L. (2006). The art and science of surge: experience from Israel and the U.S. military. Acad Emerg Med 13(11): 1130-4.

According to the authors, the "art" of surge includes decisions, authority, and responsibility, and the "science" includes numbers and benchmarks. The authors share surge strategies used by the U.S. military and Israel that can be replicated by other healthcare systems.

Surge Planning

*Barbera, J.A. and Macintyre, A.G. (2007). Medical Surge Capacity and Capability: A Management System for Integrating Medical and Health Resources During Large-Scale Emergencies. Second Edition, September 2007. Washington, DC: U.S. Department of Health and Human Services.

This handbook provides an overview of the Medical Surge Capacity and Capability (MSCC) Management System and describes how the model can be applied and integrated across six "tiers of response."

Be Prepared California. (2008). Standards and Guidelines for Healthcare Surge During Emergencies. California Department of Public Health, Public Health Programs, Emergency Preparedness Office.

Together with a variety of stakeholders, the California Department of Public Health developed standards for healthcare facilities and communities to implement during surge events.

*California Hospital Association Hospital Preparedness Program. (2011). Pediatric/Neonatal Disaster and Medical Surge Plan and Preparedness Toolkit. Contra Costa Health Services.

This toolkit can help neonatal and pediatric medical care professionals build and sustain related disaster preparedness programs.

Corcoran, S. P., A. S. Niven, et al. (2012). Critical care management of major disasters: a practical guide to disaster preparation in the intensive care unit. (Abstract only.) J Intensive Care Med 27(1): 3-10.

In this article, the authors provide a summary of the threat of major disasters and an overview of mass critical management to help intensive care unit directors prepare their teams for similar events.

DeLia, D. (2006). Annual bed statistics give a misleading picture of hospital surge capacity. (Abstract only.) Ann Emerg Med. 2006 Oct;48(4):384-8, 388.e1-2.

According to the author, surge capacity estimates should include daily variation in patient volume and within-year variation in bed supply; relying simply on the latter may provide inaccurate estimates.

*Denver Health. (2009). Disaster Alternate Care Facilities: Report and Interactive Tools. U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response.

The report and associated tools can help emergency planners and other stakeholders select, staff, and stock Disaster Alternate Care Facilities.

Duley, M. (2005). The next pandemic: Anticipating an overwhelmed health care system. Yale J Biol Med. Oct 2005; 78(5): 355–362.

The author summarizes one state's planning activities surrounding pandemic influenza. Each healthcare facility had do address four objectives, including increasing bed availability.

*Fagbuyi, D. B., K. M. Brown, et al. (2011). A rapid medical screening process improves emergency department patient flow during surge associated with novel H1N1 influenza virus. Ann Emerg Med 57(1): 52-9.

The authors used a new rapid screening process to manage patient surge associated with the 2009 H1N1 pandemic and found that it—along with a slight increase in staffing—

improved patient flow and had no effect on emergency room return rates within two or seven days.

*Florida Department of Health. (2012). Hospital Mass Casualty Incident Planning Checklist. Florida Department of Health.

This checklist is rooted in the "whole community approach" and aims to help the healthcare community prepare for significant increases in demand as a result of a critical incident.

*Griffiths, J.L., Estipona, A., and Waterson, J.A. (2011). A framework for physician activity during disasters and surge events. (Abstract only.) Am J Disaster Med. 2011 Jan-Feb;6(1):39-46.

During surge events, physicians can assist with reverse triage and patient flow.

Hick, J. L., Barbera, J. A., and Kelen, G.D. (2009). Refining surge capacity: conventional, contingency, and crisis capacity. (Abstract only.) Disaster Med Public Health Prep 3(2 Suppl): S59-67.

In this article, the authors suggest using a three-level surge capacity taxonomy (conventional capacity, contingency capacity, and crisis capacity) to bolster hospital surge planning.

Hick, J.L., Einav, S., Hanfling, D., Kissoon, N., Dichter, J.R., Devereaux, A.V., and Christian, M.D. (2014). Surge Capacity Principles: Care of the Critically Ill and Injured During Pandemics and Disasters: CHEST Consensus Statement. Chest. 2014;146(4_suppl):e1S-e16S.

Ten suggestions associated with the principles of surge capacity and immediate bed availability are summarized by the authors, who also stress the importance of scenario-based planning and the development of disaster-related management and patient data forms.

*Hick, J.L., Koenig, K.L., Barbisch, D., and Bey, T.A. (2008). Surge Capacity Concepts for Health Care Facilties: The CO-S-TR Model for Initial Incident Assessment. (Abstract only.) Disaster Med Public Health Preparedness. 2008;2(Suppl 1):S51–S57.

The authors provide a framework and checklist for initial surge actions and areas of attention for a hospital in the first hour after a mass casualty incident.

*Institute of Medicine. (2012). Crisis Standards of Care: A Systems Framework for Catastrophic Disaster Response. Washington, DC: National Academies Press.

Chapter 7 of the framework, Hospitals and Acute Care Facilities, provides a high level of detail related to implementing surge strategies, including immediate bed availability.

Joint Commission on Accreditation of Healthcare Organizations. (2006). Surge Hospitals: Providing Safe Care in Emergencies. Washington, DC: The Joint Commission.

The authors provide an overview of planning for and operating surge hospitals followed by five case studies of surge hospitals that were stood up after Hurricane Katrina.

Kaji, A., K.L. Koenig, and Bey, T. (2006). Surge Capacity for Healthcare Systems: A Conceptual Framework. Acad Emerg Med. 2007 Jan;14(1):22.

The difference between daily and disaster surge is highlighted by the authors who also provide an overview of the essential components of surge capacity and related planning tips.

*Moser, R., Jr., Connelly, C., Baker, L., Barton, R., Buttrey, J., Morris, S., Saffle, J., and Whitney, J.R.. (2006). Development of a state medical surge plan, Part II: Components of a medical surge plan. Disaster Manag Response. 2006 Jan-Mar;4(1):19-24.

The authors summarize the main components of Utah's medical surge plan and provide information on immediate bed availability, plan activation and response, and communications.

*NYC Health. (2013). Patient Surge in Disasters: A Hospital Toolkit for Expanding Resources in Emergencies. Queens, NY: NYC Department of Health and Mental Hygiene.

This toolkit provides links to templates and other surge tools that can help hospital staff determine their surge planning, staffing, and supply needs.

*Richards, G.A. and Sprung, C.L. (2010). Chapter 9. Educational process. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. (Abstract only.) Intensive Care Med. 2010 Apr;36 Suppl 1:S70-9.

This article focuses on intensive care unit surge and lists recommended standard operating procedures for staff assigned with managing patient flow.

*U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response. (2013). Hospital Preparedness Program (HPP) Healthcare Preparedness Capability Review National Call: Capability 10: Medical Surge and Immediate Bed Availability (IBA).

During this national call, speakers shared information about medical surge and how hospital staff can use immediate bed availability to operationalize Capability 10.

*Watson, S., Rudge, J., and Coker, R. (2013). Health Systems' "Surge Capacity": State of the Art and Priorities for Future Research. Milbank Q. 2013 Mar; 91(1): 78–122.

The authors share the results of a literature review that included surge capacity, and conclude that more work needs to be done in the area of generating strong frameworks and data collection methods.

Agencies and Organizations

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response, Hospital Preparedness Program: Guidance, Reports and Research.

U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response, Crisis Standards of Care Communities of Interest: Immediate Bed Availability.

U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality, Hospital Surge Model, Version 1.3 Sponsored by U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response.

This ASPR TRACIE Topic Collection was comprehensively reviewed in April 2015 by John Hick, MD, HHS ASPR and Hennepin County Medical Center.

Additional assistance provided by Alicia Livinski, Biomedical Librarian, HHS National Institutes of Health and Anthony McIntyre, MD, George Washington University.