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EVIDENCE SEARCH REPORT

RESEARCH QUESTION:	At what level of surge capacity do quality of care indicators suffer?	**UNIQUE IDENTIFIER:** CC120301-01 ESR
CONTEXT:	IF/WHEN SYSTEM IS OVER CAPACITY (100%?, 200%?) AND HOSPITALS MUST TRIAGE PATIENTS, WHAT LEVEL OF SURGE CAUSES CARE TO SUFFER?	

RESOURCES USED:

- Medline
- Embase
- Pubmed
- CDC database
- Google
- Google Scholar
- LitCovid
- MedRxiv
- PHAC website
- WHO Global Research
- ES Network (Ontario)
- SPOR COVID-19 Evidence Synthesis
- COVID Rapid Response Access Link
- National Health Library & Knowledge Service (Ireland)
- Ontario Medical Association, COVID-19 Ontario Government Communications Collection
- Newfoundland & Labrador Centre for Applied Health Research
- Australia and New Zealand Intensive Care Society (ANZICS)
- Agency for Clinical Innovation & New South Wales Government
- Oxford Centre for Evidence-Based Medicine
- National Collaborating Centre for Methods and Tools (McMaster)
- Royal College of Physicians and Surgeons of Canada
- Johns Hopkins Bloomberg School of Public Health, 2019 Novel Coronavirus Research Compendium
- BC CDC
- University of Edinburgh, Usher Institute, Usher Network for COVID-19 Evidence Reviews (UNCOVER)
- European Centre for Disease Prevention and Control, COVID-19 Resources
- COVID-19 Real-Time Learning Network
- Imperial College London, MRC Centre for Global Infectious Disease Analysis
- VA Evidence Synthesis Program
- Evidence Aid COVID-19

LIMITS/EXCLUSIONS/INCLUSIONS:	English	**REFERENCE INTERVIEW COMPLETED:**	December 3, 2020
DATE:	December 4, 2020		
LIBRARIAN:	Lukas Miller Brianna Howell-Spooner	**REQUESTOR:**	Dr. Sabira Valiani
TEAM: CRITICAL CARE			
SEARCH ALERTS CREATED: Y/N (MEDLINE, ETC.) N			

CITE AS: Miller, L; Howell-Spooner, B. At what level of surge capacity do quality of care indicators suffer? 2020 Dec 4; Document no.: CC120301-01 ESR. In: COVID-19 Rapid Evidence Reviews [Internet]. SK: SK COVID Evidence Support Team, c2020. 50 p. (CEST evidence search report)

LIBRARIAN NOTES/COMMENTS

Hello,

Though there did not seem to be any studies that directly addresses this issue, the search still produced quite a few titles & abstracts including the relevant terms which can be screened for use in the review by researchers.

Please let us know if there are any questions or concerns,
Lukas & Brianna

SEARCH RESULTS

To obtain full-text articles email library@saskhealthauthority.ca.

SUMMARIES, GUIDELINES & OTHER RESOURCES

Summaries

National Health Library & Knowledge Service (Ireland). What Are the Approaches to Modelling the COVID-19 Pandemic Within and Across Countries With a Specific Focus on Health Service Implications? How Are Countries Using Modelling to Inform the Response of Health Services to the Pandemic?. [2020, April 9]. https://hselibrary.ie/what-are-the-approaches-to-modelling-the-covid-19-pandemic-within-and-across-countries-with-a-specific-focus-on-health-service-implications-how-are-countries-using-modelling-to-inform-the-response-of/

MRC Centre for Global Infectious Disease Analysis. Modelling ICU capacity under different epidemiological scenarios of the COVID-19 pandemic in three western European countries. [2020, November 16] https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/report-36-icu-capacity/

Guidelines

Australia and New Zealand Intensive Care Society (ANZICS). COVID-19 Guidelines Version 3. [2020, October 20] https://www.anzics.com.au/wp-content/uploads/2020/10/ANZICS-COVID-19-Guidelines_V3.pdf

Tools

Rand Corporation. Interactive Critical Care Surge Response Tool. [2020, April 17] https://www.rand.org/pubs/tools/TLA164-1/tool.html#drQ2=10&drQ3=0&drQ4=0&drQ5=0&drQ6=0&drQ7=4&drQ9=0&drQ1=8&drQ8=6&nurseQ2=50&nurseQ3=0&nurseQ4=0&nurseQ5=0&nurseQ6=0&nurseQ7=3&nurseQ9=0&nurseQ1=1&nurseQ8=2&respQ2=20&respQ3=0&respQ4=0&respQ5=0&respQ6=0&respQ7=4&respQ9=0&respQ1=4&respQ8=3&ventQ2=150&ventQ4=0&ventQ5=0&ventQ6=0&ventQ1=1&bedQ2=130&bedQ4=0&bedQ5=0&bedQ6=0&bedQ1=1

MRC Centre for Global Infectious Disease Analysis. Hospital Planning Tool. [2020, April 17] https://www.imperial.ac.uk/media/imperial-college/medicine/mrc-gida/2020-04-17-COVID19-Report-15-hospital-planner.xlsm

ARTICLES

Note: References are sorted by year (newest to oldest)

1. Af Ugglas B, Skyttberg N, Wladis A, et al. Emergency department crowding and hospital transformation during COVID-19, a retrospective, descriptive study of a university hospital in Stockholm, Sweden. Scand J Trauma Resusc Emerg Med. 2020;28(1):107. DOI: 10.1186/s13049-020-00799-6

ABSTRACT: OBJECTIVES: COVID-19 presents challenges to the emergency care system that could lead to emergency department (ED) crowding. The Huddinge site at the Karolinska university hospital (KH) responded through a rapid transformation of inpatient care capacity together with changing working methods in the ED. The aim is to describe the KH response to the COVID-19 crisis, and how ED crowding, and important input, throughput and output factors for ED crowding developed at KH during a 30-day baseline period followed by the first 60 days of the COVID-19 outbreak in Stockholm Region. METHODS: Different phases in the development of the crisis were described and identified

retrospectively based on major events that changed the conditions for the ED. Results were presented for each phase separately. The outcome ED length of stay (ED LOS) was calculated with mean and 95% confidence intervals. Input, throughput, output and demographic factors were described using distributions, proportions and means. Pearson correlation between ED LOS and emergency ward occupancy by phase was estimated with 95% confidence interval. RESULTS: As new working methods were introduced between phase 2 and 3, ED LOS declined from mean (95% CI) 386 (373-399) minutes to 307 (297-317). Imaging proportion was reduced from 29 to 18% and admission rate increased from 34 to 43%. Correlation (95% CI) between emergency ward occupancy and ED LOS by phase was 0.94 (0.55-0.99). CONCLUSIONS: It is possible to avoid ED crowding, even during extreme and quickly changing conditions by leveraging previously known input, throughput and output factors. One key factor was the change in working methods in the ED with higher competence, less diagnostics and increased focus on rapid clinical admission decisions. Another important factor was the reduction in bed occupancy in emergency wards that enabled a timely admission to inpatient care. A key limitation was the retrospective study design.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33115521
DOI: 10.1186/s13049-020-00799-6

2. Agnoletti V, Russo E, Circelli A, et al. From Intensive Care to Step-Down Units: Managing Patients Throughput in Response to COVID-19. Int J Qual Health Care. 2020;08:11. DOI: 10.1093/intqhc/mzaa091
ABSTRACT: QUALITY PROBLEM: The ongoing COVID-19 pandemic may cause the collapse of healthcare systems because of unprecedented hospitalisation rates. INITIAL ASSESSMENT: 8.2 individuals per 1,000 inhabitants have been diagnosed with COVID-19 in our Province. The hospital predisposed 110 beds for COVID-19 patients: on the day of the local peak, 90% of them were occupied and intensive care unit (ICU) faced unprecedented admission rates, fearing system collapse. CHOICE OF SOLUTION: Instead of increasing the number of ICU beds, the creation of a step-down unit (SDU) close to the ICU was preferred: the aim was to safely improve the transfer of patients and to relieve ICU from the risk of overload. IMPLEMENTATION: A 9-bed SDU was created next to the ICU, led by intensivists and ICU nurses, with adequate personal protective equipment, monitoring systems and ventilators for respiratory support when needed. A second 6-bed SDU was also created. EVALUATION: Patients were clinically comparable to those of most reports from Western Countries now available in the literature. ICU never needed supernumerary beds, no patient died in the SDU, there was no waiting time for ICU admission of critical patients. SDU has been affordable from human resources, safety, and economic points of view. LESSONS LEARNED: COVID-19 is like an enduring Mass-Casualty Incident. Solutions tailored on local epidemiology and available resources should be implemented to preserve efficiency and adaptability of our institutions and provide adequate sanitary response.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32780867
DOI: 10.1093/intqhc/mzaa091

3. Al Mutair AAAAZASK, Schwebius D. Nursing Surge Capacity Strategies for Management of Critically Ill Adults with COVID-19. Nursing Reports. 2020;10:23-32.
ABSTRACT: Background: There is a vital need to develop strategies to improve nursing surge capacity for caring of patients with coronavirus (COVID-19) in critical care settings. COVID-19 has spread rapidly, affecting thousands of patients and hundreds of territories. Hospitals, through anticipation and planning, can serve patients and staff by developing strategies to cope with the complications that a surge of COVID-19 places on the provision of adequate intensive care unit (ICU) nursing staff—both in numbers and in training. Aims: The aim is to provide an evidence-based starting point from which to build expanding staffing models dealing with these additional demands. Design/Method: In order to address and develop nursing surge capacity strategies, a five-member expert panel was formed. Multiple questions directed towards nursing surge capacity strategies were posed by the assembled expert panel. Literature review was conducted through accessing various databases including MEDLINE, CINAHL, Cochrane Central, and EMBASE. All studies were appraised by at least two reviewers independently using the Joanna Briggs Institute JBI Critical Appraisal Tools. Results: The expert panel has issued strategies and recommendation statements. These proposals, supported by evidence-based resources in regard to nursing staff augmentation strategies, have had prior success when implemented during the COVID-19 pandemic. Conclusion: The proposed guidelines are intended to provide a basis for the provision of best practice nursing care during times of diminished intensive care unit (ICU) nursing staff capacity and resources due to a surge in critically ill patients. The recommendations and strategies issued are intended to specifically support critical care nurses incorporating COVID-19 patients. As new knowledge evidence becomes available, updates can be issued and strategies, guidelines and/or policies revised. Relevance to Clinical Practice: Through discussion and condensing research, healthcare professionals can create a starting point from which to synergistically develop strategies to combat crises that a pandemic like COVID-19 produces.

URL: https://www.mdpi.com/2039-4403/10/1/4/pdf

4. Auriemma CL, Molinero AM, Houtrow AJ, et al. Eliminating Categorical Exclusion Criteria in Crisis Standards of Care Frameworks. Am J Bioeth. 2020;20(7):28-36. DOI: 10.1080/15265161.2020.1764141
ABSTRACT: During public health crises including the COVID-19 pandemic, resource scarcity and contagion risks may require health systems to shift-to some degree-from a usual clinical ethic, focused on the well-being of individual patients, to a public health ethic, focused on population health. Many triage policies exist that fall under the legal protections afforded by "crisis standards of care," but they have key differences. We critically appraise one of the most fundamental differences among policies, namely the use of criteria to categorically exclude certain patients from eligibility for otherwise standard medical services. We examine these categorical exclusion criteria from ethical, legal, disability, and implementation perspectives. Focusing our analysis on the most common type of exclusion criteria, which are disease-specific, we conclude that optimal policies for critical care resource allocation and the use of cardiopulmonary resuscitation (CPR) should not use categorical exclusions. We argue that the avoidance of categorical exclusions is often practically feasible, consistent with public health norms, and mitigates discrimination against persons with disabilities.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32420822
DOI: 10.1080/15265161.2020.1764141

5. Aziz S, Arabi YM, Alhazzani W, et al. Managing ICU surge during the COVID-19 crisis: rapid guidelines. Intensive Care Med. 2020;46(7):1303-25. DOI: 10.1007/s00134-020-06092-5
ABSTRACT: Given the rapidly changing nature of COVID-19, clinicians and policy makers require urgent review and summary of the literature, and synthesis of evidence-based guidelines to inform practice. The WHO advocates for rapid reviews in these circumstances. The purpose of this rapid guideline is to provide recommendations on the organizational management of intensive care units caring for patients with COVID-19 including: planning a crisis surge response; crisis surge response strategies; triage, supporting families, and staff.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32514598
DOI: 10.1007/s00134-020-06092-5

6. Barrett K, Khan YA, Mac S, et al. Estimation of COVID-19-induced depletion of hospital resources in Ontario, Canada. CMAJ. 2020;192(24):E640-E6. DOI: 10.1503/cmaj.200715
ABSTRACT: BACKGROUND: The global spread of coronavirus disease 2019 (COVID-19) continues in several jurisdictions, causing substantial strain to health care systems. The purpose of our study was to predict the effect of the COVID-19 pandemic on patient outcomes and use of hospital resources in Ontario, Canada. METHODS: We developed an individual-level simulation to model the flow of patients with COVID-19 through the hospital system in Ontario. We simulated different combined scenarios of epidemic trajectory and hospital health care capacity. Our outcomes included the number of patients who needed admission to the ward or to the intensive care unit (ICU) with or without the need for mechanical ventilation, number of days to resource depletion, number of patients awaiting resources and number of deaths. RESULTS: We found that with effective early public health measures, hospital system resources would not be depleted. For scenarios with late or ineffective implementation of physical distancing, hospital resources would be depleted within 14-26 days, and in the worst case scenario, 13 321 patients would die while waiting for needed resources. Resource depletion would be avoided or delayed with aggressive measures to increase ICU, ventilator and acute care hospital capacities. INTERPRETATION: We found that without aggressive physical distancing measures, the Ontario hospital system would have been inadequately equipped to manage the expected number of patients with COVID-19 despite a rapid increase in capacity. This lack of hospital resources would have led to an increase in mortality. By slowing the spread of the disease using public health measures and by increasing hospital capacity, Ontario may have avoided catastrophic stresses to its hospitals.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32409519
DOI: 10.1503/cmaj.200715

7. Baugh JJ, Yun BJ, Searle E, et al. Creating a COVID-19 surge clinic to offload the emergency department. Am J Emerg Med. 2020;38(7):1535-7. DOI: 10.1016/j.ajem.2020.04.057
URL: https://www.ncbi.nlm.nih.gov/pubmed/32334896
DOI: 10.1016/j.ajem.2020.04.057

8. Branas CC, Rundle A, Pei S, et al. Flattening the curve before it flattens us: hospital critical care capacity limits and mortality from novel coronavirus (SARS-CoV2) cases in US counties. medRxiv. 2020. DOI: 10.1101/2020.04.01.20049759
ABSTRACT: BackgroundAs of March 26, 2020, the United States had the highest number of confirmed cases of Novel Coronavirus (COVID-19) of any country in the world. Hospital critical care is perhaps the most important medical system choke point in terms of preventing deaths in a disaster scenario such as the current COVID-19 pandemic. We therefore brought together previously established disease modeling estimates of the growth of the COVID-19 epidemic in the US under various social distancing contact reduction assumptions, with local estimates of the potential critical care surge response across all US counties. MethodsEstimates of spatio-temporal COVID-19 demand and medical system critical care supply were calculated for all continental US counties. These estimates were statistically summarized and mapped for US counties, regions and urban versus non-urban areas. Estimates of COVID-19 infections and patients needing critical care were calculated from March 24, 2020 to April 24, 2020 for three different estimated population levels - 0%, 25%, and 50%- of contact reduction (through actions such as social distancing). Multiple national public and private datasets were linked and harmonized in order to calculate county-level critical care bed counts that included currently available beds and those that could be made available under four surge response scenarios - very low, low, medium, and high - as well as excess deaths stemming from inaccessible critical care. ResultsSurge response scenarios ranged from a very low total supply 77,588 critical care beds to a high total of 278,850 critical care beds. Over the four week study period, excess deaths from inaccessible critical care ranged from 24,688 in the very low response scenario to 13,268 in the high response scenario. Northeastern and urban counties were projected to be most affected by excess deaths due to critical care shortages, and counties in New York, Colorado, and Virginia were projected to exceed their critical care bed limits despite high levels of COVID-19 contact reduction. Over the four week study period, an estimated 12,203-19,594 excess deaths stemming from inaccessible critical care could be averted through greater preventive actions such as travel restrictions, publicly imposed contact precautions, greater availability of rapid testing for COVID-19, social distancing, self-isolation when sick, and similar interventions. An estimated 4,029-11,420 excess deaths stemming from inaccessible critical care could be averted through aggressive critical care surge response and preparations, including high clearance of ICU and non-ICU critical care beds and extraordinary measures like using a single ventilator for multiple patients. ConclusionsUnless the epidemic curve of COVID-19 cases is flattened over an extended period of time, the US COVID-19 epidemic will cause a shortage of critical care beds and drive up otherwise preventable deaths. The findings here support value of preventive actions to flatten the epidemic curve, as well as the value of exercising extraordinary surge capacity measures to increase access to hospital critical care for severely ill COVID-19 patients.
URL: https://medrxiv.org/cgi/content/short/2020.04.01.20049759
DOI: 10.1101/2020.04.01.20049759

9. Butler CR, Wong SPY, Wightman AG, et al. US Clinicians' Experiences and Perspectives on Resource Limitation and Patient Care During the COVID-19 Pandemic. JAMA Netw Open. 2020;3(11):e2027315. DOI: 10.1001/jamanetworkopen.2020.27315
ABSTRACT: Importance: Little is known about how US clinicians have responded to resource limitation during the coronavirus disease 2019 (COVID-19) pandemic. Objective: To describe the perspectives and experiences of clinicians involved in institutional planning for resource limitation and/or patient care during the pandemic. Design, Setting, and Participants: This qualitative study used inductive thematic analysis of semistructured interviews conducted in April and May 2020 with a national group of clinicians (eg, intensivists, nephrologists, nurses) involved in institutional planning and/or clinical care during the COVID-19 pandemic across the United States. Main Outcomes and Measures: Emergent themes describing clinicians' experience providing care in settings of resource limitation. Results: The 61 participants (mean [SD] age, 46 [11] years; 38 [63%] women) included in this study were practicing in 15 US states and were more heavily sampled from areas with the highest rates of COVID-19 infection at the time of interviews (ie, Seattle, New York City, New Orleans). Most participants were White individuals (39 [65%]), were attending physicians (45 [75%]), and were practicing in large academic centers (>/=300 beds, 51 [85%]; academic centers, 46 [77%]). Three overlapping and interrelated themes emerged from qualitative analysis, as follows: (1) planning for crisis capacity, (2) adapting to resource limitation, and (3) multiple unprecedented barriers to care delivery. Clinician leaders worked within their institutions to plan a systematic approach for fair allocation of limited resources in crisis settings so that frontline clinicians would not have to make rationing decisions at the bedside. However, even before a declaration of crisis capacity, clinicians encountered varied and sometimes unanticipated forms of resource limitation that could compromise care, require that they make difficult allocation decisions, and contribute to moral distress. Furthermore, unprecedented challenges to caring for patients during the pandemic, including the need to limit in-person interactions, the rapid pace of change, and the dearth of scientific evidence, added to the challenges of caring for patients and communicating with families. Conclusions and Relevance: The

findings of this qualitative study highlighted the complexity of providing high-quality care for patients during the COVID-19 pandemic. Expanding the scope of institutional planning to address resource limitation challenges that can arise long before declarations of crisis capacity may help to support frontline clinicians, promote equity, and optimize care as the pandemic evolves.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33156349
DOI: 10.1001/jamanetworkopen.2020.27315

10. Cammarota G, Ragazzoni L, Capuzzi F, et al. Critical Care Surge Capacity to Respond to the COVID-19 Pandemic in Italy: A Rapid and Affordable Solution in the Novara Hospital. Prehosp Disaster Med. 2020;35(4):431-3. DOI: 10.1017/S1049023X20000692
ABSTRACT: The rapid insurgence and spread of coronavirus disease 2019 (COVID-19) exceeded the limit of the intensive care unit (ICU) contingency plan of the Maggiore della Carita University Hospital (Novara, Italy) generating a crisis management condition. This brief report describes how a prompt response to the sudden request of invasive mechanical ventilation (IMV) was provided by addressing the key elements of health care system surge capacity from contingency to crisis. In a short time and at a relatively low cost, a structural modification of a hospital aisle allowed to convert the general ICU into a COVID-19 unit, increasing the number of COVID-19 critical care beds by 107%.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32423513
DOI: 10.1017/S1049023X20000692

11. Coghlan N, Archard D, Sipanoun P, et al. COVID-19: legal implications for critical care. Anaesthesia. 2020;75(11):1517-28. DOI: 10.1111/anae.15147
ABSTRACT: The COVID-19 pandemic has caused an unprecedented challenge for the provision of critical care. Anticipating an unsustainable burden on the health service, the UK Government introduced numerous legislative measures culminating in the Coronavirus Act, which interfere with existing legislation and rights. However, the existing standards and legal frameworks relevant to critical care clinicians are not extinguished, but anticipated to adapt to a new context. This new context influences the standard of care that can be reasonably provided and yields many human rights considerations, for example, in the use of restraints, or the restrictions placed on patients and visitors under the Infection Prevention and Control guidance. The changing landscape has also highlighted previously unrecognised legal dilemmas. The perceived difficulties in the provision of personal protective equipment for employees pose a legal risk for Trusts and a regulatory risk for clinicians. The spectre of rationing critical care poses a number of legal issues. Notably, the flux between clinical decisions based on best interests towards decisions explicitly based on resource considerations should be underpinned by an authoritative public policy decision to preserve legitimacy and lawfulness. Such a policy should be medically coherent, legally robust and ethically justified. The current crisis poses numerous challenges for clinicians aspiring to remain faithful to medicolegal and human rights principles developed over many decades, especially when such principles could easily be dismissed. However, it is exactly at such times that these principles are needed the most and clinicians play a disproportionate role in safeguarding them for the most vulnerable.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32445581
DOI: 10.1111/anae.15147

12. Dahine J, Hebert PC, Ziegler D, et al. Practices in Triage and Transfer of Critically Ill Patients: A Qualitative Systematic Review of Selection Criteria. Crit Care Med. 2020;48(11):e1147-e57. DOI: 10.1097/CCM.0000000000004624
ABSTRACT: OBJECTIVES: To identify and appraise articles describing criteria used to prioritize or withhold a critical care admission. DATA SOURCES: PubMed, Embase, Medline, EBM Reviews, and CINAHL Complete databases. Gray literature searches and a manual review of references were also performed. Preferred Reporting Items for Systematic reviews and Meta-Analyses guidelines were followed. STUDY SELECTION: We sought all articles and abstracts of original research as well as local, provincial, or national policies on the topic of ICU resource allocation. We excluded studies whose population of interest was neonatal, pediatric, trauma, or noncritically ill. Screening of 6,633 citations was conducted. DATA EXTRACTION: Triage and/or transport criteria were extracted, based on type of article, methodology, publication year, and country. An appraisal scale was developed to assess the quality of identified articles. We also developed a robustness score to further appraise the robustness of the evidence supporting each criterion. Finally, all criteria were extracted, evaluated, and grouped by theme. DATA SYNTHESIS: One-hundred twenty-nine articles were included. These were mainly original research (34%), guidelines (26%), and reviews (21%). Among them, we identified 200 unique triage and transport criteria. Most articles highlighted an exclusion (71%) rather than a prioritization mechanism (17%). Very few articles pertained to transport of critically ill patients (4%). Criteria were classified in one of four emerging themes: patient, condition, physician,

and context. The majority of criteria used were nonspecific. No study prospectively evaluated the implementation of its cited criteria. CONCLUSIONS: This systematic review identified 200 criteria classified within four themes that may be included when devising triage programs including the coronavirus disease 2019 pandemic. We identified significant knowledge gaps where research would assist in improving existing triage criteria and guidelines, aiming to decrease arbitrary decisions and variability.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32858530
DOI: 10.1097/CCM.0000000000004624

13. Dale C, Starcher R, Chang SC, et al. Surge Effects and Survival to Hospital Discharge in Critical Care Patients with COVID-19 During the Early Pandemic: A Cohort Study. Research Square. 2020. DOI: 10.21203/rs.3.rs-111259/v1
URL: http://europepmc.org/abstract/PPR/PPR241372https://doi.org/10.21203/rs.3.rs-111259/v1
DOI: 10.21203/rs.3.rs-111259/v1

14. Dancy L, O'Gallagher K, Ryan M, et al. Predictive model of increased mortality and bed occupancy if thrombolysis becomes the initial treatment strategy for STEMI during the SARS-CoV-2 pandemic. Clin Med (Lond). 2020;20(5):e170-e2. DOI: 10.7861/clinmed.2020-0293
ABSTRACT: During the current SARS-CoV-2 pandemic the restructure of healthcare services to meet the huge increase in demand for hospital resource and capacity has led to the proposal that where necessary ST elevation myocardial infarction (STEMI) could be managed by intravenous thrombolysis in the first instance as a means of reducing the workforce requirements of a primary angioplasty service run at a heart attack centre. Our modelling, based on data from the UK, shows that contrary to reducing demand, the effect on both mortality and bed occupancy would be negative with 158 additional deaths per year for each 10% reduction in primary angioplasty and at a cost of ~8,000 additional bed days per year for the same reduction. Our analysis demonstrates that specialist services such as heart attack pathways should be protected during the COVID crisis to maximise the appropriate use of resource and prevent unnecessary mortality.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32719037
DOI: 10.7861/clinmed.2020-0293

15. Dauer M, Smith C, Iavicoli L, et al. 129 The Safety of Rapid Triage in a Coronavirus Epicenter. Ann Emerg Med. 2020;76 (4 Supplement):S51.
ABSTRACT: Study Objectives: The COVID-19 pandemic has strained health care systems with massive influxes of potentially infectious patients with a respiratory virus. As the epicenter of COVID-19 in the United States, NYC public hospitals were strained well past their limits. Rapid triage, assessment, and disposition is essential in providing safe and appropriate care in a disaster scenario. Multiple studies have shown length of stay times as well as patient elopements improved with a brief physician assessment in triage. Our objective was to determine if rapid assessment medical screening exams are safe and effective means to decompress overcrowded waiting rooms during a respiratory pandemic. Method(s): All patients presenting to Elmhurst Hospital Center during peak capacity were rapidly assessed by board certified emergency physicians in the waiting room in lieu of formal triaging processes. Each medical screening exam was expected to last no longer than 5 min. In an institutionally approved IRB study, demographic data, chief complaint, medical comorbidities, and a full set of vitals were collected and recorded. Patients were then triaged to the emergency department or instructed to return home to self-quarantine with a comprehensive quarantine instructional packet. Patients sent home were contacted by nursing staff periodically to monitor their health status. Data was collected on patient returns, clinical status, and ultimate disposition. Result(s): 219 patients were followed after a brief medical screening exam. 162 patients were discharged directly from the waiting room. Out of the discharged patients 14 (9%) returned to an HHC emergency department, and 3 (2%) of those patients ultimately required admission to the hospital. Conclusion(s): Based on preliminary data, rapid assessment by board certified emergency physicians appears to be a safe and effective means to risk stratify all comers during a respiratory pandemic scenario. Patients who appear well, do not have significant comorbidities, and present with oxygen saturations above 95% can reasonably be reassured and sent home. Such processes are easily reproducible and can be rapidly implemented in times of mass patient influxes. Copyright © 2020

16. Davoodi NM, Healy M, Goldberg EM. Rural America's Hospitals are Not Prepared to Protect Older Adults From a Surge in COVID-19 Cases. Gerontol Geriatr Med. 2020(6).
ABSTRACT: Rural communities with predominantly older adult populations could be especially vulnerable to poor outcomes from COVID-19 due to lacking intensive care unit (ICU) capacity. Our objective is to describe the scope of the problem by summarizing population totals of older adults in rural America and their community's ICU bed availability. We performed a

review of peer-reviewed literature, in addition to hand searching non–peer-reviewed and governmental/non-governmental agency reports, using the Kaiser Health News data report to assess the number of ICU beds in 10 predominantly rural states with the highest older adult populations. We found that while 19% of the U.S. population lives in rural counties, these counties contain only 1% of the ICU beds in the United States. Counties particularly at risk for inadequate ICU capacity include Crittenden, Arkansas; Cass, Minnesota; and Sagadahoc, Maine. Solutions include building new delivery systems, reopening previously closed rural hospitals, and calling on local businesses to create medical supplies. In summary, the 10 million older adults in rural communities in the United States may face challenges with obtaining critical care treatment due to the increased need of ICU beds during the COVID-19 pandemic.
URL: https://doi.org/10.1177/2333721420936168

17. Deasy J, Rocheteau E, Kohler K, et al. Forecasting Ultra-early Intensive Care Strain from COVID-19 in England, v1.1.4. medRxiv. 2020:2020.03.19.20039057. DOI: 10.1101/2020.03.19.20039057
ABSTRACT: The COVID-19 pandemic has led to unprecedented strain on intensive care unit (ICU) admission in parts of the world. Strategies to create surge ICU capacity require complex local and national service reconfiguration and reduction or cancellation of elective activity. These measures have an inevitable lag-time before additional capacity comes on-line. An accurate short-range forecast would be helpful in guiding such difficult, costly, and ethically challenging decisions.At the time this work began, cases in England were starting to increase. If this represents a true spread in disease then ICU demand could increase rapidly. Here we present a short-range forecast based on published real-time COVID-19 case data from the seven National Health Service (NHS) commissioning regions in England (East of England, London, Midlands, North East and Yorkshire, North West, South East and South West). We use a Monte Carlo approach to model the likely impact of current diagnoses on regional ICU capacity over a 14-day horizon under the assumption that the increase in cases represents the start of an exponential growth in infections. Our model is designed to be parsimonious and based on available epidemiological data from the literature at the moment.On the basis of the modelling assumptions made, ICU occupancy is likely to increase dramatically in the days following the time of modelling. If the current exponential growth continues, case numbers will be comparable to current ICU bed numbers within weeks. Despite variable growth in absolute patients, all commissioning regions are forecast to be heavily burdened under the assumptions used.Whilst, like any forecast model, there remain uncertainties both in terms of model specification and robust epidemiological data in this early prospective phase, it would seem that surge capacity will be required in the very near future. Our findings should be interpreted with caution, but we hope that our model will help policy decision makers with their preparations. The uncertainties in the data highlight the urgent need for ongoing real-time surveillance to allow forecasts to be constantly updated using high quality local patient-facing data as it emerges.Competing Interest StatementThe authors have declared no competing interest.Funding StatementNot externally funded Author DeclarationsAll relevant ethical guidelines have been followed; any necessary IRB and/or ethics committee approvals have been obtained and details of the IRB/oversight body are included in the manuscript.Yes All necessary patient/participant consent has been obtained and the appropriate institutional forms have been archived.Yes I understand that all clinical trials and any other prospective interventional studies must be registered with an ICMJE-approved registry, such as ClinicalTrials.gov. I confirm that any such study reported in the manuscript has been registered and the trial registration ID is provided (note: if posting a prospective study registered retrospectively, please provide a statement in the trial ID field explaining why the study was not registered in advance).Yes I have followed all appropriate research reporting guidelines and uploaded the relevant EQUATOR Network research reporting checklist(s) and other pertinent material as supplementary files, if applicable.Yes Source data is already publicly available. https://zenodo.org/badge/latestdoi/131309845
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DOI: 10.1101/2020.03.19.20039057

18. Devereaux A, Yang H, Seda G, et al. Optimizing Scarce Resource Allocation During COVID-19: Rapid Creation of a Regional Health-Care Coalition and Triage Teams in San Diego County, California. Disaster Med Public Health Prep. 2020:1-7. DOI: 10.1017/dmp.2020.344
ABSTRACT: Successful management of an event where health-care needs exceed regional health-care capacity requires coordinated strategies for scarce resource allocation. Publications for rapid development, training, and coordination of regional hospital triage teams to manage the allocation of scarce resources during coronavirus disease 2019 (COVID-19) are lacking. Over a period of 3 weeks, over 100 clinicians, ethicists, leaders, and public health authorities convened virtually to achieve consensus on how best to save the most lives possible and share resources. This is referred to as population-based crisis management. The rapid regionalization of 22 acute care hospitals across 4500 square miles in the midst of a pandemic with a shifting regulatory landscape was challenging, but overcome by mutual trust, transparency, and confidence in the

public health authority. Because many cities are facing COVID-19 surges, we share a process for successful rapid formation of health-care care coalitions, Crisis Standard of Care, and training of Triage Teams. Incorporation of continuous process improvement and methods for communication is essential for successful implementation. Use of our regional health-care coalition communications, incident command system, and the crisis care committee helped mitigate crisis care in the San Diego and Imperial County region as COVID-19 cases surged and scarce resource collaborative decisions were required.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32907684
DOI: 10.1017/dmp.2020.344

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ABSTRACT: People with disabilities are often at increased risk during infectious disease pandemics, due to complex biological and social factors. Synergistic biological interactions can lead to severe complications or reduced vaccine efficacy, while people with disabilities also tend to have lower access to health care, higher rates of poverty, might be institutionalized, and are frequently excluded from preparedness planning and crisis responses. Further, there are limited data from historical epidemics to inform public health efforts that address disability concerns. We provide novel evidence for disability-related disparities in influenza outcomes using data from Norwegian psychiatric hospitals and schools for children with disabilities during the 1918 influenza pandemic. Both students and patients suffered higher mortality compared to staff members. Recognition of differential risk factors for people with disabilities is essential for the development of equitable and effective pandemic preparedness policies. Copyright © 2020 The Author(s).

20. DiSilvio B, Virani A, Patel S, et al. Institutional COVID-19 Protocols: Focused on Preparation, Safety, and Care Consolidation. Crit Care Nurs Q. 2020;43(4):413-27. DOI: 10.1097/CNQ.0000000000000327
ABSTRACT: As the confirmed cases of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) continue to grow with over 1 million documented infections in the United States alone, researchers and health care workers race to find effective treatment options for this potentially fatal disease. Mortality remains high in patients whose disease course requires mechanical ventilation and admission to intensive care units. While focusing on therapies to decrease mortality is essential, we must also consider the logistical hurdles faced with regard to safely and effectively delivering treatment while limiting the risk of harm to hospital staff and other noninfected patients. In this article, we discuss aspects of surge planning, considerations in limiting health care worker exposure, the logistics of medication delivery in a uniform and consolidated manner, protocols for delivering emergent care in a rapidly deteriorating coronavirus disease-2019 (COVID-19) patient, and safe practices for transporting infected patients.
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ABSTRACT: Background The pressures exerted by the pandemic of COVID-19 pose an unprecedented demand on health care services. Hospitals become rapidly overwhelmed when patients requiring life-saving support outpace available capacities. We here describe methods used by a university hospital to forecast caseloads and time to peak incidence. Methods We developed a set of models to forecast incidence among the hospital catchment population and describe the COVID-19 patient hospital care-path. The first forecast utilized data from antecedent allopatric epidemics and parameterized the care path model according to expert opinion (static model). Once sufficient local data were available, trends for the time dependent effective reproduction number were fitted and the care-path was parameterized using hazards for real patient admission, referrals, and discharge (dynamic model). Results The static model, deployed before the epidemic, exaggerated the bed occupancy (general wards 116 forecasted vs 66 observed, ICU 47 forecasted vs 34 observed) and predicted the peak too late (general ward forecast April 9, observed April 8, ICU forecast April 19, observed April 8). After April 5, the dynamic model could be run daily and precision improved with increasing availability of empirical local data. Conclusions The models provided data-based guidance in the preparation and allocation of critical resources of a university hospital well in advance of the epidemic surge, despite overestimating the service demand. Overestimates should resolve when population contact pattern before and during restrictions can be taken into account, but for now they may provide an acceptable safety margin for preparing during times of uncertainty.
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DOI: 10.1101/2020.07.02.20143206

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ABSTRACT: A large number of inpatients with Coronavirus disease 2019 (COVID-19) in some regions of the United States may interfere with the ability of hospitals to take care of patients requiring treatment for other conditions. Nonetheless, many patients need surgery to improve their quality of life and to prevent deterioration in health. Curtailment of services also negatively affects the financial health of hospitals and health systems. Broad policies to prohibit all "elective" surgical procedures to ensure that there is sufficient hospital capacity for pandemic patients may be unnecessarily restrictive because, for many such procedures, patients are rarely admitted following surgery or only stay overnight. We studied all elective inpatient and ambulatory cases involving major therapeutic procedures performed in the state of Florida in 2018. We mapped the primary procedure to the corresponding Clinical Classification Software (CCS) category. We determined the distributions of lengths of stay overall and as stratified by CCS category, then calculated the percentage of cases that had a hospital length of stay of </=1 night (i.e., 0 or 1 day). A threshold of one night was selected because patients discharged home on the day of surgery have no effect on the inpatient census, and those staying overnight would either have a transient effect or no effect if observed overnight in the postoperative care unit. Among the 1,852,391 elective cases with one or more major therapeutic procedures, 65.2% (95% lower confidence limit [LCL] = 65.1%) of cases had a length of stay of 0 days and 72.9% (95% LCL = 72.8%) had stay </=1 day. There were 38 different CCS categories for which at least 95% of patients had a length of stay of </=1 day. There were 28 CCS codes that identified 80% of the patients who were discharged with a length of stay </=1 day, showing representation of multiple surgical specialties. Our results show that even in the face of constraints imposed by a high hospital census, many categories of major therapeutic elective procedures could be performed without necessarily compromising hospital capacity. Most patients will be discharged on the day of surgery. If overnight admission is required, there would be an option to care for them in the postanesthesia care unit, thus not affecting the census. Thus, policies can reasonably be based on allowing cases with a substantial probability of at most an overnight stay rather than a blanket ban on "elective" surgery or creating a carve-out for specified surgical subspecialties. Such policies would apply to at least 72% of elective, major therapeutic surgical procedures.
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ABSTRACT: Italy is fighting against one of the worst medical emergency since the 1918 Spanish Flu. Pressure on the hospitals is tremendous. As for official data on March 14th: 8372 admitted in hospitals, 1518 in intensive care units, 1441 deaths (175 more than the day before). Unfortunately, hospitals are not prepared: even where a plan for massive influx of patients is present, it usually focuses on sudden onset disaster trauma victims (the most probable case scenario), and it has not been tested, validated, or propagated to the staff. Despite this, the All Hazards Approach for management of major incidents and disasters is still valid and the "4S" theory (staff, stuff, structure, systems) for surge capacity can be guidance to respond to this disaster.
URL: https://dx.doi.org/10.1017/dmp.2020.64

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ABSTRACT: The COVID-19 Acute and Intense Resource Tool (CAIC-RT) is an interactive online tool capable of estimating the maximum daily number of incident COVID-19 cases that a healthcare system could manage given age-based case distribution and severity.Competing Interest StatementThe authors have declared no competing interest.Funding StatementThis work was not funded.Author DeclarationsAll relevant ethical guidelines have been followed; any necessary IRB and/or ethics committee approvals have been obtained and details of the IRB/oversight body are included in the manuscript.YesAll necessary patient/participant consent has been obtained and the appropriate institutional forms have been archived.YesI understand that all clinical trials and any other prospective interventional studies must be registered with an ICMJE-approved registry, such as ClinicalTrials.gov. I confirm that any such study reported in the manuscript has been registered and the trial registration ID is provided (note: if posting a prospective study registered retrospectively, please provide a statement in the trial ID field explaining why the study was not registered in advance).YesI have followed all appropriate research reporting guidelines and uploaded the relevant EQUATOR Network research reporting checklist(s) and other pertinent material as supplementary files, if applicable.YesStudy protocol and statistical code are described in the methods and available in Appendix 1 and 2. Data set: N/A. https://caic-rt.shinyapps.io/CAIC-RT/

URL: http://medrxiv.org/content/early/2020/03/25/2020.03.25.20043711.abstract
DOI: 10.1101/2020.03.25.20043711

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ABSTRACT: The coronavirus disease 2019 (COVID-19) has rapidly evolved into a worldwide pandemic. Preparing intensive care units (ICU) is an integral part of any pandemic response. In this review, we discuss the key principles and strategies for ICU preparedness. We also describe our initial outbreak measures and share some of the challenges faced. To achieve sustainable ICU services, we propose the need to 1) prepare and implement rapid identification and isolation protocols, and a surge in ICU bed capacity; (2) provide a sustainable workforce with a focus on infection control; (3) ensure adequate supplies to equip ICUs and protect healthcare workers; and (4) maintain quality clinical management, as well as effective communication.
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DOI: 10.1186/s13054-020-02916-4

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ABSTRACT: Objectives: Examine well-being, measured as burnout and professional fulfillment, across critical care healthcare professionals, ICUs, and hospitals within a health system; examine the impact of the coronavirus disease 2019 pandemic. Design: To complement a longitudinal survey administered to medical critical care physicians at the end of an ICU rotation, which began in May 2018, we conducted a cross-sectional survey among critical care professionals across four hospitals in December 2018 to January 2019. We report the results of the cross-sectional survey and, to examine the impact of the coronavirus disease 2019 pandemic, the longitudinal survey results from July 2019 to May 2020. Setting: Academic medical center. Subjects: Four-hundred eighty-one critical care professionals, including 353 critical care nurses, 58 advanced practice providers, 57 physicians, and 13 pharmacists, participated in the cross-sectional survey; 15 medical critical care physicians participated in the longitudinal survey through the coronavirus disease 2019 pandemic. Interventions: None. Measurements and Main Results: Burnout was present in 50% of ICU clinicians, ranging from 42% for critical care physicians to 55% for advanced practice providers. Professional fulfillment was less common at 37%, with significant variability across provider ($p = 0.04$), with a low of 23% among critical care pharmacists and a high of 53% among physicians. Well-being varied significantly at the hospital and ICU level. Workload and job demand were identified as drivers of burnout and meaning in work, culture and values of work community, control and flexibility, and social support and community at work were each identified as drivers of well-being. Between July 2019 and March 2020, burnout and professional fulfillment were present in 35% (15/43) and 58% (25/43) of medical critical care physician responses, respectively. In comparison, during the coronavirus disease 2019 pandemic, burnout and professional fulfillment were present in 57% (12/21) and 38% (8/21), respectively. Conclusions: Burnout was common across roles, yet differed across ICUs and hospitals. Professional fulfillment varied by provider role. We identified potentially modifiable factors related to clinician well-being that can inform organizational strategies at the ICU and hospital level. Longitudinal studies, designed to assess the long-term impact of the coronavirus disease 2019 pandemic on the well-being of the critical care workforce, are urgently needed.
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DOI: 10.1097/CCE.0000000000000233

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ABSTRACT: In response to the estimated potential impact of coronavirus disease (COVID-19) on New York City hospitals, our institution prepared for an influx of critically ill patients. Multiple areas of surge planning progressed, simultaneously focused on infection control, clinical operational challenges, ICU surge capacity, staffing, ethics, and maintenance of staff wellness. The protocols developed focused on clinical decisions regarding intubation, the use of high-flow oxygen, engagement with infectious disease consultants, and cardiac arrest. Mechanisms to increase bed capacity and increase efficiency in ICUs by outsourcing procedures were implemented. Novel uses of technology to minimize staff exposure to COVID-19 as well as to facilitate family engagement and end-of-life discussions were encouraged. Education and communication remained key in our attempts to standardize care, stay apprised on emerging data, and review seminal literature on respiratory failure. Challenges were encountered and overcome through interdisciplinary collaboration and iterative surge planning as ICU admissions rose. Support was provided for both clinical and nonclinical staff affected by the

profound impact COVID-19 had on our city. We describe in granular detail the procedures and processes that were developed during a 1-month period while surge planning was ongoing and the need for ICU capacity rose exponentially. The approaches described here provide a potential roadmap for centers that must rapidly adapt to the tremendous challenge posed by this and potential future pandemics.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32298146
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ABSTRACT: Importance: State crisis standards of care (CSC) guidelines in the US allocate scarce health care resources among patients. Anecdotal reports suggest that guidelines may disproportionately allocate resources away from patients with cancer, but no comprehensive evaluation has been performed. Objective: To examine the implications of US state CSC guidelines for patients with cancer, including allocation methods, cancer-related categorical exclusions and deprioritizations, and provisions for blood products and palliative care. Design, Setting, and Participants: This cross-sectional population-based analysis examined state-endorsed CSC guidelines published before May 20, 2020, that included health care resource allocation recommendations. Main Outcomes and Measures: Guideline publication before or within 120 days after the first documented US case of coronavirus disease 2019 (COVID-19), inclusion of cancer-related categorical exclusions and/or deprioritizations, provisions for blood products and/or palliative care, and associations between these outcomes and state-based cancer demographics. Results: Thirty-one states had health care resource allocation guidelines that met inclusion criteria, of which 17 had been published or updated since the first US case of COVID-19. States whose available hospital bed capacity was predicted to exceed 100% at 6 months (chi2 = 3.82; P = .05) or that had a National Cancer Institute-designated Comprehensive Cancer Center (CCC; chi2 = 6.21; P = .01) were more likely to have publicly available guidelines. The most frequent primary methods of prioritization were the Sequential Organ Failure Assessment score (27 states [87%]) and deprioritizing persons with worse long-term prognoses (22 states [71%]). Seventeen states' (55%) allocation methods included cancer-related deprioritizations, and 8 states (26%) included cancer-related categorical exclusions. The presence of an in-state CCC was associated with lower likelihood of cancer-related categorical exclusions (multivariable odds ratio, 0.06 [95% CI, 0.004-0.87]). Guidelines with disability rights statements were associated with specific provisions to allocate blood products (multivariable odds ratio, 7.44 [95% CI, 1.28-43.24). Both the presence of an in-state CCC and having an oncologist and/or palliative care specialist on the state CSC task force were associated with the inclusion of palliative care provisions. Conclusions and Relevance: Among states with CSC guidelines, most deprioritized some patients with cancer during resource allocation, and one-fourth categorically excluded them. The presence of an in-state CCC was associated with guideline availability, palliative care provisions, and lower odds of cancer-related exclusions. These data suggest that equitable state-level CSC considerations for patients with cancer benefit from the input of oncology stakeholders.
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29. Harris GH, Baldisseri MR, Reynolds BR, et al. Design for Implementation of a System-Level ICU Pandemic Surge Staffing Plan. Crit Care Explor. 2020;2(6):e0136. DOI: 10.1097/CCE.0000000000000136
ABSTRACT: Background: The current coronavirus disease 2019 pandemic is causing significant strain on ICUs worldwide. Initial and subsequent regional surges are expected to persist for months and potentially beyond. As a result of this, as well as the fact that ICU provider staffing throughout the United States currently operate at or near capacity, the risk for severe and augmented disruption in delivery of care is very real. Thus, there is a pressing need for proactive planning for ICU staffing augmentation, which can be implemented in response to a local surge in ICU volumes. Methods: We provide a description of the design, dissemination, and implementation of an ICU surge provider staffing algorithm, focusing on physicians, advanced practice providers, and certified registered nurse anesthetists at a system-wide level. Results: The protocol was designed and implemented by the University of Pittsburgh Medical Center's Integrated ICU Service Center and was rolled out to the entire health system, a 40-hospital system spanning Pennsylvania, New York, and Maryland. Surge staffing models were developed using this framework to assure that local needs were balanced with system resource supply, with rapid enhancement and expansion of tele-ICU capabilities. Conclusions: The ICU pandemic surge staffing algorithm, using a tiered-provider strategy, was able to be used by hospitals ranging from rural community to tertiary/quaternary academic medical centers and adapted to meet specific needs rapidly. The concepts and general steps described herein may serve as a framework for hospital and other hospital systems to maintain staffing preparedness in the face of any form of acute patient volume surge.

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DOI: 10.1097/CCE.0000000000000136

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ABSTRACT: Italy was the second country in the world to face a wide epidemic of Covid-19 after China. The ratio of the number of fatalities to the number of cases (case fatality ratio, CFR) recorded in Italy was surprisingly high and increased in the month of March. The older mean age of population, the changes in testing policy, and the methodological computation of CFR were previously reported as possible explanations for the incremental trend of CFR, a parameter theoretically expected to be constant. In this brief report, the official data provided by the Italian Ministry of Health were analyzed using fitting models and the linear fit method approach. This last methodology allowed us to reach two findings. The trend of the number of deaths followed a 1-3-day delay of positive cases. This delay was not compatible with a biological course of Covid-19 but was compatible with a health management explanation. The second finding is that the Italian number of deaths did not increase linearly with the number of positive cases, but their relationship could be modeled by a second-order polynomial function. The high number of positive cases might have a direct and an indirect effect on the number of deaths, the latter being related to the overwhelmed bed capacity of intensive care units.
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DOI: 10.1111/jgs.16896

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ABSTRACT: BACKGROUND: We aim to describe the basic demographics, clinical course and outcomes of critically ill patients with Covid-19 admitted to Avera McKennan Hospital and University Health Center Intensive Care Unit (ICU) between March 20 and May 4, 2020. METHODS: In this single centered, retrospective, observational study, we enrolled 37 critically ill adults with COVID-19 pneumonia admitted to the (ICU) between March 20 and May 4, 2020. Demographic data, admitting symptoms, laboratory values, co-morbidities, treatments and clinical outcomes were collected. Data was compared between survivors and non-survivors. We aim to describe our data and report the 28-day mortality as of June 1, 2020. RESULTS: Of 154 patients admitted with COVID-19 pneumonia during our study period, 37 (24 percent) were critically ill and required an ICU stay. The mean age was 58 years and 76 percent were men. Of these 37 patients, 28 (78 percent) had a chronic illness (diabetes in 43 percent, hypertension in 47 percent). In addition, 54 percent were associated with a local meat packing plant. Most common presenting symptoms were dyspnea (92 percent), cough (70 percent) and fever (68 percent). The mean PaO2/FiO2 ratio was 143 (67-362). Significant lab findings include the following: 54 percent of patients had lymphocytopenia, the mean ferritin was 850 ng/mL (10-3528), the mean D-Dimer was 4.09 FEU ug/mL and the mean IL-6 was 96.5 pg/mL. At 28 days, 24 percent (nine) had died. Twenty-five (68 percent) patients required mechanical ventilation, with 10 (27 percent) of those patients requiring initiation of neuromuscular blocking agents for ventilator compliance. Of those four (40 percent) did not survive. In addition, 20 patients (54 percent) were proned. Pneumomediastinum or pneumothorax occurred in five of the 37 (14 percent). Renal replacement therapy was required in 6 of the 37 patients, 4 of whom (66 percent) died. Steroids were used in 70 percent of patients, tocilizumab in 59 percent, and hydroxychloroquine in 27 percent. All patients received antibiotics. Convalescent plasma became available for our 5th patient. A total of 29 (78 percent) received convalescent plasma, (86 percent of survivors and 56 percent non-survivors). Median ICU length of stay was 11 days for both survivors (1-49) and non-survivors (1-21). There were no differences in age, body mass index (BMI), or initial PaO2/FiO2 (P/F) among those two groups. Non-survivors (nine) included the two immune compromised patients in our cohort, two patients with pre-existing DNR/DNI status, and one death within two hours of admit. Compared with survivors, more of the non-survivors received vasopressors (78 percent vs 46 percent), dialysis (44 percent vs 7 percent) and hydroxychloroquine (44 percent vs 21 percent). The first 5 patients treated in the ICU did not survive. One month after the initial case was reported in South Dakota, our ICU experienced a six-week surge. At its highest, COVID-19-related census reached 63 percent of the ICU capacity (15/24). CONCLUSION: Mortality of critically ill patients with COVID-19 is high. Multi-organ, advanced and prolonged critical care resources are needed. Interpretation of our data is

limited by a higher mortality of the earlier members of the cohort, a change in therapeutic practice over time and institution of social distancing.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32805781

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ABSTRACT: BACKGROUND: The COVID-19 pandemic necessitated a time-critical expansion of medical staff in intensive care units (ICU) and emergency rooms (ER). OBJECTIVE: This article describes the development, performance and first results of an interprofessional blended learning concept called hospital paramedics, qualifying paramedics and additional medical personnel to support ICUs and ERs. MATERIAL AND METHODS: The Protestant Hospital of the Bethel Foundation (EvKB), University Hospital OWL, University of Bielefeld in cooperation with the Study Institute Westfalen-Lippe, developed a 2-stage blended learning concept (stage 1 elearning with online tutorials, stage 2 practical deployment) comprising 3 modules: ICU, ER and in-hospital emergency medicine. At the beginning, the participants were asked about their sociodemographic data (age, gender, type of medical qualifications) and subjective feeling of confidence. At the end, a final discussion with the participant, the practice instructor and the supervising physician took place and an evaluation of the deployment by the head of the practice and the hospital paramedic was carried out using questionnaires. RESULTS: Within 6 weeks 58 (63%) of the 92 participants completed the online course and 17 (29%) additionally completed their traineeship. In the ICU they assisted with preparing catheter systems, medication and nursing, performed Manchester triage and initial care in the ER. After completion hospital paramedics were significantly more confident when working in a hospital, catheterization and tracheostoma care ($p < 0.05$). Of the supervisors 94% deemed the deployment as useful and 100% of the participants were prepared to be available at short notice in their areas as compensation for the COVID-19-pandemic in the event of a staff shortage. Through the provision of additional intensive care ventilators and monitoring units in the period from March to the beginning of May 2020 and the personnel management that was carried out, the EvKB was in a position to increase the number of previously provided ventilator beds by potentially >40 ventilation places. CONCLUSION: Blended learning concepts, such as hospital paramedics, can quickly qualify medical personnel for use in system-relevant settings, relieve nursing staff and thus create an expansion of intensive care capacities. Existing or pending pandemic and contingency plans should be complemented by such blended learning training so that they are immediately available in case of a second pandemic wave, future pandemics or other crisis situations.
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ABSTRACT: Confronted with the coronavirus disease 2019 (COVID-19) pandemic, New York City Health + Hospitals, the city's public health care system, rapidly expanded capacity across its eleven acute care hospitals and three new field hospitals. To meet the unprecedented demand for patient care, NYC Health + Hospitals redeployed staff to the areas of greatest need and redesigned recruiting, onboarding, and training processes. The hospital system engaged private staffing agencies, partnered with the Department of Defense, and recruited volunteers throughout the country. A centralized onboarding team created a single-source portal for medical care providers requiring credentialing and established new staff positions to increase efficiency. Using new educational tools focused on COVID-19 content, the hospital system trained twenty thousand staff members, including nearly nine thousand nurses, within a two-month period. Creation of multidisciplinary teams, frequent enterprisewide communication, willingness to shift direction in response to changing needs, and innovative use of technology were the key factors that enabled the hospital system to meet its goals.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32525704
DOI: 10.1377/hlthaff.2020.00904

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ABSTRACT: Since the Coronavirus Disease 2019 (COVID-19) was identified as a global pandemic, health systems have been severely strained, particularly affecting vulnerable populations such as patients with cancer. In response to the COVID-19 pandemic, a variety of oncology specialty societies are making recommendations for standards of care. These diverse standards and gaps in standards can lead to inconsistent and heterogeneous care among governments, cancer centers, and even among oncologists within the same practice. These challenges highlight the need for a common nomenclature and

crisis guidelines. For times of increased scarcity of resources, the National Academy of Medicine developed Crisis Standards of Care, defined as fairness, duty to care, duty to steward resources, transparency, consistency, proportionality, and accountability. However, we believe there is an urgent need to develop cancer-specific guidelines by convening a panel of experts from multiple specialties. These would be Crisis Oncology Standards of Care (COSCs) that are sensitive to both the individual cancer patient and to the broader health system in times of scarce resources, such as pandemic, natural disaster, or supply chain disruptions.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32708922
DOI: 10.3390/healthcare8030214

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ABSTRACT: The dynamic nature of coronavirus disease 2019 (COVID-19) pandemic requires us to be efficient and flexible in resource utilization. The strategical preparedness and response actions of the healthcare system are the key component to contain COVID-19 and to decrease its case fatality ratio. Depending on the epidemiological situation, each medical institution should systematically share the responsibility for patient screening, disposition and treatment according to clinical severity. To overcome fast-paced COVID-19 pandemic, the government should be rapidly ready and primed for action according to the specific transmission scenario.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32757499
DOI: 10.3947/ic.2020.52.3.389

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ABSTRACT: OBJECTIVE: Health system preparedness for coronavirus disease (COVID-19) includes projecting the number and timing of cases requiring various types of treatment. Several tools were developed to assist in this planning process. This review highlights models that project both caseload and hospital capacity requirements over time. METHODS: We systematically reviewed the medical and engineering literature according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We completed searches using PubMed, EMBASE, ISI Web of Science, Google Scholar, and the Google search engine. RESULTS: The search strategy identified 690 articles. For a detailed review, we selected 6 models that met our predefined criteria. Half of the models did not include age-stratified parameters, and only 1 included the option to represent a second wave. Hospital patient flow was simplified in all models; however, some considered more complex patient pathways. One model included fatality ratios with length of stay (LOS) adjustments for survivors versus those who die, and accommodated different LOS for critical care patients with or without a ventilator. CONCLUSION: The results of our study provide information to physicians, hospital administrators, emergency response personnel, and governmental agencies on available models for preparing scenario-based plans for responding to the COVID-19 or similar type of outbreak.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32907668
DOI: 10.1017/dmp.2020.332

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ABSTRACT: INTRODUCTION: On February 25, 2020, the first 2 patients were tested positive for severe acute respiratory syndrome coronavirus2 (SARS-CoV-2) in Tyrol, Austria. Rapid measures were taken to ensure adequate intensive care unit (ICU) preparedness for a surge of critically ill coronavirus disease-2019 (COVID-19) patients. METHODS: This cohort study included all COVID-19 patients admitted to an ICU with confirmed or strongly suspected COVID-19 in the State of Tyrol, Austria. Patients were recorded in the Tyrolean COVID-19 intensive care registry. Date of final follow-up was July 17, 2020. RESULTS: A total of 106 critically ill patients with COVID-19 were admitted to 1 of 13 ICUs in Tyrol from March 9 to July 17, 2020. Median age was 64 years (interquartile range, IQR 54-74 years) and the majority of patients were male (76 patients, 71.7%). Median simplified acute physiology score III (SAPS III) was 56 points (IQR 49-64 points). The median duration from appearance of first symptoms to ICU admission was 8 days (IQR 5-11 days). Invasive mechanical ventilation was required in 72 patients (67.9%) and 6 patients (5.6%) required extracorporeal membrane oxygenation treatment. Renal replacement therapy was necessary in 21 patients (19.8%). Median ICU length of stay (LOS) was 18 days (IQR 5-31 days), median hospital LOS was 27 days (IQR 13-49 days). The ICU mortality was 21.7% (23 patients), hospital mortality was 22.6%. There was no

significant difference in ICU mortality in patients receiving invasive mechanical ventilation and in those not receiving it (18.1% vs. 29.4%, p= 0.284). As of July 17th, 2020, two patients are still hospitalized, one in an ICU, one on a general ward. CONCLUSION: Critically ill COVID-19 patients in Tyrol showed high severity of disease often requiring complex treatment with increased lengths of ICU and hospital stay. Nevertheless, the mortality was found to be remarkably low, which may be attributed to our adaptive surge response providing sufficient ICU resources.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33170333
DOI: 10.1007/s00508-020-01764-0

39. Kleinpell R, Ferraro DM, Maves RC, et al. Coronavirus Disease 2019 Pandemic Measures: Reports From a National Survey of 9,120 ICU Clinicians. Crit Care Med. 2020;48(10):e846-e55. DOI: 10.1097/CCM.0000000000004521
ABSTRACT: IMPORTANCE: Recent reports identify that among hospitalized coronavirus disease 2019 patients, 30% require ICU care. Understanding ICU resource needs remains an essential component of meeting current and projected needs of critically ill coronavirus disease 2019 patients. OBJECTIVES: This study queried U.S. ICU clinician perspectives on challenging aspects of care in managing coronavirus disease 2019 patients, current and anticipated resource demands, and personal stress. DESIGN, SETTING, AND PARTICIPANTS: Using a descriptive survey methodology, an anonymous web-based survey was administered from April 7, 2020, to April 22, 2020 (email and newsletter) to query members of U.S. national critical care organizations. MEASUREMENTS AND MAIN RESULTS: Through a 16-item descriptive questionnaire, ICU clinician perceptions were assessed regarding current and emerging critical ICU needs in managing the severe acute respiratory syndrome coronavirus 2 infected patients, resource levels, concerns about being exposed to severe acute respiratory syndrome coronavirus 2, and perceived level of personal stress. A total of 9,120 ICU clinicians responded to the survey, representing all 50 U.S. states, with 4,106 (56.9%) working in states with 20,000 or more coronavirus disease 2019 cases. The 7,317 respondents who indicated their profession included ICU nurses (n = 6,731, 91.3%), advanced practice providers (nurse practitioners and physician assistants; n = 334, 4.5%), physicians (n = 212, 2.9%), respiratory therapists (n = 31, 0.4%), and pharmacists (n = 30, 0.4%). A majority (n = 6,510, 88%) reported having cared for a patient with presumed or confirmed coronavirus disease 2019. The most critical ICU needs identified were personal protective equipment, specifically N95 respirator availability, and ICU staffing. Minimizing healthcare worker virus exposure during care was believed to be the most challenging aspect of coronavirus disease 2019 patient care (n = 2,323, 30.9%). Nurses report a high level of concern about exposing family members to severe acute respiratory syndrome coronavirus 2 (median score of 10 on 0-10 scale). Similarly, the level of concern reached the maximum score of 10 in ICU clinicians who had provided care to coronavirus disease 2019 patients. CONCLUSIONS: This national ICU clinician survey identifies continued concerns regarding personal protective equipment supplies with the chief issue being N95 respirator availability. As the pandemic continues, ICU clinicians anticipate a number of limited resources that may impact ICU care including personnel, capacity, and surge potential, as well as staff and subsequent family members exposure to severe acute respiratory syndrome coronavirus 2. These persistent concerns greatly magnify personal stress, offering a therapeutic target for professional organization and facility intervention efforts.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32639413
DOI: 10.1097/CCM.0000000000004521

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ABSTRACT: BACKGROUND: In response to the disaster of coronavirus disease 2019 (COVID-19) pandemic, Seoul Metropolitan Government (SMG) established a patient facility for mild condition patients other than hospital. This study was conducted to investigate the operation and necessary resources of a community treatment center (CTC) operated in Seoul, a metropolitan city with a population of 10 million. METHODS: To respond COVID-19 epidemic, the SMG designated 5 municipal hospitals as dedicated COVID-19 hospitals and implemented one CTC cooperated with the Boramae Municipal Hospital for COVID-19 patients in Seoul. As a retrospective cross-sectional observational study, retrospective medical records review was conducted for patients admitted to the Seoul CTC. The admission and discharge route of CTC patients were investigated. The patient characteristics were compared according to route of discharge whether the patient was discharged to home or transferred to hospital. To report the operation of CTC, the daily mean number of tests (reverse transcription polymerase chain reaction and chest X-ray) and consultations by medical staffs were calculated per week. The list of frequent used medications and who used medication most frequently were investigated. RESULTS: Until May 27 when the Seoul CTC was closed, 26.5% (n = 213) of total 803 COVID-19 patients in Seoul were admitted to the CTC. It was 35.7% (n = 213) of 597 newly diagnosed patients in Seoul during the 11 weeks of operation. The median length of stay was 21 days (interquartile range, 12-29 days). A total of 191 patients (89.7%) were discharged to home after virologic remission

and 22 (10.3%) were transferred to hospital for further treatment. Fifty percent of transferred patients were within a week since CTC admission. Daily 2.5-3.6 consultations by doctors or nurses and 0.4-0.9 tests were provided to one patient. The most frequently prescribed medication was symptomatic medication for COVID-19 (cough/sputum and rhinorrhea). The next ranking was psychiatric medication for sleep problem and depression/anxiety, which was prescribed more than digestive drug. CONCLUSION: In the time of an infectious disease disaster, a metropolitan city can operate a temporary patient facility such as CTC to make a surge capacity and appropriately allocate scarce medical resource.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33075858
DOI: 10.3346/jkms.2020.35.e367

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ABSTRACT: OBJECTIVES: To assess the capacity of intensive care units (ICUs) in Australia to respond to the expected increase in demand associated with COVID-19. DESIGN: Analysis of Australian and New Zealand Intensive Care Society (ANZICS) registry data, supplemented by an ICU surge capability survey and veterinary facilities survey (both March 2020). SETTINGS: All Australian ICUs and veterinary facilities. MAIN OUTCOME MEASURES: Baseline numbers of ICU beds, ventilators, dialysis machines, extracorporeal membrane oxygenation machines, intravenous infusion pumps, and staff (senior medical staff, registered nurses); incremental capability to increase capacity (surge) by increasing ICU bed numbers; ventilator-to-bed ratios; number of ventilators in veterinary facilities. RESULTS: The 191 ICUs in Australia provide 2378 intensive care beds during baseline activity (9.3 ICU beds per 100 000 population). Of the 175 ICUs that responded to the surge survey (with 2228 intensive care beds), a maximal surge would add an additional 4258 intensive care beds (191% increase) and 2631 invasive ventilators (120% increase). This surge would require additional staffing of as many as 4092 senior doctors (245% increase over baseline) and 42 720 registered ICU nurses (269% increase over baseline). An additional 188 ventilators are available in veterinary facilities, including 179 human model ventilators. CONCLUSIONS: The directors of Australian ICUs report that intensive care bed capacity could be near tripled in response to the expected increase in demand caused by COVID-19. But maximal surge in bed numbers could be hampered by a shortfall in invasive ventilators and would also require a large increase in clinician and nursing staff numbers.
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DOI: 10.5694/mja2.50596

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ABSTRACT: Singapore's hospitals had prepared operations to receive patients (potentially) infected with SARS-CoV-2, planning various scenarios and levels of surge with a policy of isolating all confirmed cases as inpatients. The National University Hospital, adopted a whole of hospital approach to COVID-19 with three primary goals: zero hospital-acquired COVID-19, all patients receive timely necessary care, and maintenance of staff morale. These goals to date have been met. A large influx of COVID-19 cases emerged requiring a significant transformation of clinical and operational processes. Isolation room numbers almost tripled and dedicated COVID-19 cohort wards were established, elective care was postponed and Intensive Care Units were augmented with equipment and manpower. In the wake of the surge establishing a new normal for hospital care requires a considered balance of maintaining vigilance to detect endemic COVID-19, establishing contingency plans to ramp up in case of another surge, while returning to business as usual.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33179039
DOI: 10.1093/cid/ciaa1722

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ABSTRACT: There are many unknown questions and puzzle pieces that should describe the clinical course of COVID-19 and its complications, especially ARDS. We provide the initial immediate surge response to allow every patient in need of an ICU bed to receive one. Till our knowledge is improved, the most important intervention in the treatment of critically ill patients with COVID-19 seems to be the level of standard care and appropriate and early diagnosis and treatment. It seems that each center should have its protocol on the management of critically ill COVID-19 patients regarding prevention, diagnosis, and treatment. This treatment should now be performed regardless of the reason which lies behind the pathophysiology of this disease, which is yet unknown. In this report, we share our experience in the management of critically ill COVID-19 patients during the 2 months in our intensive care unit.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32944565

DOI: 10.5812/aapm.104900

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ABSTRACT: INTRODUCTION: In 2009, the Institute of Medicine published guidelines for implementation of Crisis Standards of Care (CSC) at the state level in the United States (US). Based in part on the then concern for H1N1 pandemic, there was a recognized need for additional planning at the state level to maintain health system preparedness and conventional care standards when available resources become scarce. Despite the availability of this framework, in the years since and despite repeated large-scale domestic events, implementation remains mixed. PROBLEM: Coronavirus disease 2019 (COVID-19) rejuvenates concern for how health systems can maintain quality care when faced with unrelenting burden. This study seeks to outline which states in the US have developed CSC and which areas of care have thus far been addressed. METHODS: An online search was conducted for all 50 states in 2015 and again in 2020. For states without CSC plans online, state officials were contacted by email and phone. Public protocols were reviewed to assess for operational implementation capabilities, specifically highlighting guidance on ventilator use, burn management, sequential organ failure assessment (SOFA) score, pediatric standards, and reliance on influenza planning. RESULTS: Thirty-six states in the US were actively developing (17) or had already developed (19) official CSC guidance. Fourteen states had no publicly acknowledged effort. Eleven of the 17 public plans had updated within five years, with a majority addressing ventilator usage (16/17), influenza planning (14/17), and pediatric care (15/17), but substantially fewer addressing care for burn patients (9/17). CONCLUSION: Many states lacked publicly available guidance on maintaining standards of care during disasters, and many states with specific care guidelines had not sufficiently addressed the full spectrum of hazard to which their health care systems remain vulnerable.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32907650
DOI: 10.1017/S1049023X20001089

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ABSTRACT: Pathology Autopsy and Mortuary Services have been front and center in the severe acute respiratory syndrome coronavirus 2 (SARS-Co-V-2) pandemic. The sheer number of fatalities from the pandemic have been unlike any other in recent memory and needed the rapid creation of new protocols and paradigms to manage the situation. This required rapidly escalating mortuary capacity to manage the increased fatalities from the pandemic with the establishment of lines of communication and networking with governmental entities, institution of new policies for patient flow, and implementation of worker infection control and well-being plans. Autopsies also assumed a crucial role, both to provide insight into the pathomechanisms of a novel disease and to allow tissue retrieval necessary to power research directed towards finding a vaccine. We here outline the plan adopted by the Yale Autopsy and Mortuary Services, in alignment with the institutional mission of high-quality patient care, education, research and health care worker safety and well-being, as the Corona Virus Disease of 2019 (COVID-19) pandemic surged in Connecticut. In the early response phase, ensuring sufficient mortuary capacity necessarily took center stage. As we enter the recovery and plateau phase of the pandemic, setting up a process for a rapid and safe autopsy, that will meet educational and research needs while ensuring the safety of our workforce is being implemented.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32649315
DOI: 10.1097/PAP.0000000000000274

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ABSTRACT: Background: A hospital-level pandemic response involves anticipating local surge in healthcare needs. Methods: We developed a mechanistic transmission model to simulate a range of scenarios of COVID-19 spread in the Greater Toronto Area. We estimated healthcare needs against 2019 daily admissions using healthcare administrative data, and applied outputs to hospital-specific data on catchment, capacity, and baseline non-COVID admissions to estimate potential surge by day 90 at two hospitals (St. Michaels Hospital [SMH] and St. Josephs Health Centre [SJHC]). We examined fast/large, default, and slow/small epidemics, wherein the default scenario (R0 2.4) resembled the early trajectory in the GTA. Results: Without further interventions, even a slow/small epidemic exceeded the citys daily ICU capacity for patients without COVID-19. In a pessimistic default scenario, for SMH and SJHC to remain below their non-ICU bed capacity, they

would need to reduce non-COVID inpatient care by 70% and 58% respectively. SMH would need to create 86 new ICU beds, while SJHC would need to reduce its ICU beds for non-COVID care by 72%. Uncertainty in local epidemiological features was more influential than uncertainty in clinical severity. If physical distancing reduces contacts by 20%, maximizing the diagnostic capacity or syndromic diagnoses at the community-level could avoid a surge at each hospital. Interpretation: As distribution of the city's surge varies across hospitals over time, efforts are needed to plan and redistribute ICU care to where demand is expected. Hospital-level surge is based on community-level transmission, with community-level strategies key to mitigating each hospital's surge. Keywords: COVID-19, pandemic preparedness, mathematical model, transmission model
URL: http://cmajopen.ca/content/8/3/E593.full
DOI: 10.1101/2020.04.20.20073023

47. Mittel AM, Panzer O, Wang DS, et al. Logistical Considerations and Clinical Outcomes Associated with Converting Operating Rooms into an Intensive Care Unit during the Covid-19 Pandemic in a New York City Hospital. Anesth Analg. 2020;28:28. DOI: 10.1213/ANE.0000000000005301
ABSTRACT: BACKGROUND: Covid-19 emerged as a public health crisis that disrupted normal patterns of health care in the New York City metropolitan area. In preparation for a large influx of critically ill patients, operating rooms (ORs) at NewYork-Presbyterian Hospital/Columbia University Irving Medical Center (NYP-Columbia) were converted into a novel intensive care unit area, the ORICU. METHODS: 23 ORs were converted into an 82-bed ORICU. Adaptations to the OR environment permitted the delivery of standard critical care therapies. Non-intensive-care-trained staff were educated on the basics of critical care and deployed in a hybrid staffing model. Anesthesia machines were repurposed as critical care ventilators, with accommodations to ensure reliable function and patient safety. To compare ORICU survivorship to outcomes in more traditional environments, we performed Kaplan-Meier survival analysis of all patients cared for in the ORICU, censoring data at the time of ORICU closure. We hypothesized that age, gender, and obesity may have influenced the risk of death. Thus, we estimated hazard ratios for death using Cox proportional hazard regression models with age, gender, and body mass index (BMI) as covariables and, separately, using older age (65 years and older) adjusted for gender and BMI. RESULTS: The ORICU cared for 133 patients from March 24 - May 14, 2020. Patients were transferred to the ORICU from other ICUs, inpatient wards, the Emergency Department, and other institutions. Patients remained in the ORICU until either transfer to another unit or death. As the hospital patient load decreased, patients were transferred out of the ORICU. This process was completed on May 14, 2020. At time of data censoring, 55 (41.4%) of patients had died. The estimated probability of survival 30 days after admission was 0.61 (95% CI 0.52 - 0.69). Age was significantly associated with increased risk of mortality (HR = 1.05, 95% CI 1.03 - 1.08, $p < 0.001$ for a 1 year increase in age). Patients who were 65 years or older were an estimated 3.17 times more likely to die than younger patients (95% CI 1.78 - 5.63, $p < 0.001$) when adjusting for gender and BMI. CONCLUSIONS: A large number of critically ill Covid-19 patients were cared for in the ORICU, which substantially increased ICU capacity at NYP-Columbia. The estimated ORICU survival rate at 30 days was comparable to other reported rates, suggesting this was an effective approach to manage the influx of critically ill Covid-19 patients during a time of crisis.
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DOI: 10.1213/ANE.0000000000005301

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ABSTRACT: Aim: To investigate and clarify the surge capacity of staff/equipment/space, and patient outcome in the first wave of COVID-19 in Japan. Methods: We analyzed questionnaire data from the end of May 2020 from 180 hospitals (total of 102,578 beds) with acute medical centers. Results: A total of 4,938 hospitalized patients with COVID-19 were confirmed. Of 1,100 severe COVID-19 inpatients, 112 remained hospitalized and 138 died. There were 4,852 patients presumed to be severe COVID-19 patients who were confirmed later to be not infected. Twenty-seven hospitals (15% of 180 hospitals) converted their ICU to a unit for COVID-19 patients only, and 107 (59%) had to manage both severe COVID-19 patients and others in the same ICU. Restriction of ICU admission was occurred in one of the former 27 hospitals and 21 of later 107 hospitals. Shortage of N95 masks was the most serious concern regarding personal protective equipment (PPE). As for issues which raised ICU bed occupancy, difficulty performing or progressing rehabilitation for severe patients (42%), and the improved patients (28%), long lasting severely ill patients (36%) and unclear isolation criteria (34%) were mentioned. Many acute medicine physicians assisted regional governmental agencies functioning as advisors and volunteer coordinator. Conclusion: The mortality rate of COVID-19 in this study was 4.5% of all hospitalized patients and 14% (approximately one

in 7) severe patients. The hospitals with dedicated COVID-19 ICUs accepted more patients with severe COVID-19 and had lower ICU admission restrictions, which may be helpful as a strategy in the next pandemic.
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ABSTRACT: OBJECTIVE: To describe the rapid implementation of an adult coronavirus disease 2019 (COVID-19) unit using pediatric physician and nurse providers in a children's hospital and to examine the characteristics and outcomes of the first 100 adult patients admitted. STUDY DESIGN: We describe our approach to surge-in-place at a children's hospital to meet the local demands of the COVID-19 pandemic. Instead of redeploying pediatric providers to work with internist-led teams throughout a medical center, pediatric physicians and nurses organized and staffed a 40-bed adult COVID-19 treatment unit within a children's hospital. We adapted internal medicine protocols, developed screening criteria to select appropriate patients for admission, and reorganized staffing and equipment to accommodate adult patients with COVID-19. We used patient counts and descriptive statistics to report sociodemographic, system, and clinical outcomes. RESULTS: The median patient age was 46 years; 69% were male. On admission, 78 (78%) required oxygen supplementation. During hospitalization, 13 (13%) eventually were intubated. Of the first 100 patients, 14 are still admitted to a medical unit, 6 are in the intensive care unit, 74 have been discharged, 4 died after transfer to the intensive care unit, and 2 died on the unit. The median length of stay for discharged or deceased patients was 4 days (IQR 2, 7). CONCLUSIONS: Our pediatric team screened, admitted, and cared for hospitalized adults by leveraging the familiarity of our system, adaptability of our staff, and high-quality infrastructure. This experience may be informative for other healthcare systems that will be redeploying pediatric providers and nurses to address a regional COVID-19 surge elsewhere.
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ABSTRACT: In January 2020, the Chinese authorities identified a new virus of the Coronaviridae family as the cause of several cases of pneumonia of unknown aetiology. The outbreak was initially confined to Wuhan City, but then spread outside Chinese borders. On 31 January 2020, the first case was declared in Spain. On 11 March 2020, The World Health Organization (WHO) declared the coronavirus outbreak a pandemic. On 16 March 2020, there were 139 countries affected. In this situation, the Scientific Societies SEMICYUC and SEEIUC have decided to draw up this Contingency Plan to guide the response of the Intensive Care Services. The objectives of this plan are to estimate the magnitude of the problem and identify the necessary human and material resources. This is to provide the Spanish Intensive Medicine Services with a tool to programme optimal response strategies.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32336551
DOI: 10.1016/j.medin.2020.03.006

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ABSTRACT: RATIONALE & OBJECTIVE: During the coronavirus disease 2019 (COVID-19) pandemic, New York encountered shortages in continuous kidney replacement therapy (CKRT) capacity for critically ill patients with acute kidney injury stage 3 requiring dialysis. To inform planning for current and future crises, we estimated CKRT demand and capacity during the initial wave of the US COVID-19 pandemic. STUDY DESIGN: We developed mathematical models to project nationwide and statewide CKRT demand and capacity. Data sources included the Institute for Health Metrics and Evaluation model, the Harvard Global Health Institute model, and published literature. SETTING & POPULATION: US patients hospitalized during the initial wave of the COVID-19 pandemic (February 6, 2020, to August 4, 2020). INTERVENTION: CKRT. OUTCOMES: CKRT

demand and capacity at peak resource use; number of states projected to encounter CKRT shortages. MODEL, PERSPECTIVE, & TIMEFRAME: Health sector perspective with a 6-month time horizon. RESULTS: Under base-case model assumptions, there was a nationwide CKRT capacity of 7,032 machines, an estimated shortage of 1,088 (95% uncertainty interval, 910-1,568) machines, and shortages in 6 states at peak resource use. In sensitivity analyses, varying assumptions around: (1) the number of pre-COVID-19 surplus CKRT machines available and (2) the incidence of acute kidney injury stage 3 requiring dialysis requiring CKRT among hospitalized patients with COVID-19 resulted in projected shortages in 3 to 8 states (933-1,282 machines) and 4 to 8 states (945-1,723 machines), respectively. In the best- and worst-case scenarios, there were shortages in 3 and 26 states (614 and 4,540 machines). LIMITATIONS: Parameter estimates are influenced by assumptions made in the absence of published data for CKRT capacity and by the Institute for Health Metrics and Evaluation model's limitations. CONCLUSIONS: Several US states are projected to encounter CKRT shortages during the COVID-19 pandemic. These findings, although based on limited data for CKRT demand and capacity, suggest there being value during health care crises such as the COVID-19 pandemic in establishing an inpatient kidney replacement therapy national registry and maintaining a national stockpile of CKRT equipment.
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DOI: 10.1053/j.ajkd.2020.07.005

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ABSTRACT: BACKGROUND: The COVID-19 pandemic has placed an unprecedented strain on health systems, with rapidly increasing demand for healthcare in hospitals and intensive care units (ICUs) worldwide. As the pandemic escalates, determining the resulting needs for healthcare resources (beds, staff, equipment) has become a key priority for many countries. Projecting future demand requires estimates of how long patients with COVID-19 need different levels of hospital care. METHODS: We performed a systematic review of early evidence on length of stay (LoS) of patients with COVID-19 in hospital and in ICU. We subsequently developed a method to generate LoS distributions which combines summary statistics reported in multiple studies, accounting for differences in sample sizes. Applying this approach, we provide distributions for total hospital and ICU LoS from studies in China and elsewhere, for use by the community. RESULTS: We identified 52 studies, the majority from China (46/52). Median hospital LoS ranged from 4 to 53 days within China, and 4 to 21 days outside of China, across 45 studies. ICU LoS was reported by eight studies-four each within and outside China-with median values ranging from 6 to 12 and 4 to 19 days, respectively. Our summary distributions have a median hospital LoS of 14 (IQR 10-19) days for China, compared with 5 (IQR 3-9) days outside of China. For ICU, the summary distributions are more similar (median (IQR) of 8 (5-13) days for China and 7 (4-11) days outside of China). There was a visible difference by discharge status, with patients who were discharged alive having longer LoS than those who died during their admission, but no trend associated with study date. CONCLUSION: Patients with COVID-19 in China appeared to remain in hospital for longer than elsewhere. This may be explained by differences in criteria for admission and discharge between countries, and different timing within the pandemic. In the absence of local data, the combined summary LoS distributions provided here can be used to model bed demands for contingency planning and then updated, with the novel method presented here, as more studies with aggregated statistics emerge outside China.
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ABSTRACT: Significant investment in planning and training has occurred across the Australian healthcare sector in response to the COVID-19 pandemic, with a primary focus on the medical and nursing workforce. We provide a short summary of a recently published article titled "Surge capacity of Australian intensive care units associated with COVID-19 admissions" in the Medical Journal of Australia and, importantly, highlight a knowledge gap regarding critical care specialised allied health professional (AHP) workforce planning in Australia. The unique skill set provided by critical care specialised AHPs contributes to patient recovery long after the patient leaves the intensive care unit, with management targeted at reducing disability and improving function, activities of daily living, and quality of life. Allied health workforce planning and preparation during COVID-19 must be considered when planning comprehensive and evidence-based patient care. The work by Litton et al. has highlighted the significant lack of available data in relation to staffing of critical care specialised AHPs in Australia, and this needs to be urgently addressed.
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ABSTRACT: INTRODUCTION: Acute stroke and acute myocardial infarction (AMI) treatments are time sensitive. Early data revealed a decrease in presentation and an increase in pre-hospital delay for acute stroke and AMI during the coronavirus disease 2019 (COVID-19) pandemic. Thus, we set out to understand community members' perception of seeking acute stroke and AMI care during the COVID-19 pandemic to inform strategies to increase cardiovascular disease preparedness during the pandemic. METHODS: Given the urgency of the clinical and public health situation, through a community-based participatory research partnership, we utilized a rapid assessment approach. We developed an interview guide and data collection form guided by the Theory of Planned Behavior (TPB). Semi-structured interviews were recorded and conducted via phone and data was collected on structured collection forms and real time transcription. Direct content analysis was conducted guided by the TPB model and responses for AMI and stroke were compared. RESULTS: We performed 15 semi-structured interviews. Eighty percent of participants were Black Americans; median age was 50; 73% were women. Participants reported concerns about coronavirus transmission in the ambulance and at the hospital, hospital capacity and ability to triage, and quality of care. Change in employment and childcare also impacted participants reported control over seeking emergent cardiovascular care. Based on these findings, our community and academic team co-created online materials to address the community-identified barriers, which has reached over 8,600 users and engaged almost 600 users. CONCLUSIONS: We found that community members' attitudes and perceived behavioral control to seek emergent cardiovascular care were impacted by the COVID-19 pandemic. Community-informed, health behavior theory-based public health messaging that address these constructs may decrease prehospital delay.

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DOI: 10.1016/j.jstrokecerebrovasdis.2020.105479

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ABSTRACT: BACKGROUND: Following the regional outbreak in China, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread all over the world, presenting the healthcare systems with huge challenges worldwide. In Germany the coronavirus diseases 2019 (COVID-19) pandemic has resulted in a slowly growing demand for health care with a sudden occurrence of regional hotspots. This leads to an unpredictable situation for many hospitals, leaving the question of how many bed resources are needed to cope with the surge of COVID-19 patients. OBJECTIVE: In this study we created a simulation-based prognostic tool that provides the management of the University Hospital of Augsburg and the civil protection services with the necessary information to plan and guide the disaster response to the ongoing pandemic. Especially the number of beds needed on isolation wards and intensive care units (ICU) are the biggest concerns. The focus should lie not only on the confirmed cases as the patients with suspected COVID-19 are in need of the same resources. MATERIAL AND METHODS: For the input we used the latest information provided by governmental institutions about the spreading of the disease, with a special focus on the growth rate of the cumulative number of cases. Due to the dynamics of the current situation, these data can be highly variable. To minimize the influence of this variance, we designed distribution functions for the parameters growth rate, length of stay in hospital and the proportion of infected people who need to be hospitalized in our area of responsibility. Using this input, we started a Monte Carlo simulation with 10,000 runs to predict the range of the number of hospital beds needed within the coming days and compared it with the available resources. RESULTS: Since 2 February 2020 a total of 306 patients were treated with suspected or confirmed COVID-19 at this university hospital. Of these 84 needed treatment on the ICU. With the help of several simulation-based forecasts, the required ICU and normal bed capacity at Augsburg University Hospital and the Augsburg ambulance service in the period from 28 March 2020 to 8 June 2020 could be predicted with a high degree of reliability. Simulations that were run before the impact of the restrictions in daily life showed that we would have run out of ICU bed capacity within approximately 1 month. CONCLUSION: Our simulation-based prognosis of the health care capacities needed helps the management of the hospital and the civil protection service to make reasonable decisions and adapt the disaster response to the realistic needs. At the same time the forecasts create the possibility to plan the strategic response days and weeks in advance. The tool presented in this study is, as far as we know, the only one accounting not only for confirmed COVID-19 cases but also for suspected COVID-19 patients. Additionally, the few input parameters used are easy to access and can be easily adapted to other healthcare systems.

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ABSTRACT: BACKGROUND: The COVID-19 pandemic represents an unprecedented challenge to healthcare systems and nations across the world. Particularly challenging are the lack of agreed-upon management guidelines and variations in practice. Our hospital is a large, secondary-care government hospital in Kuwait, which has increased its capacity by approximately 28% to manage the care of patients with COVID-19. The surge in capacity has necessitated the redeployment of staff who are not well-trained to manage such conditions. There was a great need to develop a tool to help redeployed staff in decision-making for patients with COVID-19, a tool which could also be used for training. METHODS: Based on the best available clinical knowledge and best practices, an eight member multidisciplinary group of clinical and quality experts undertook the development of a clinical algorithm-based toolkit to guide training and practice for the management of patients with COVID-19. The team followed Horabin and Lewis' seven-step approach in developing the algorithms and a five-step method in writing them. Moreover, we applied Rosenfeld et al's five points to each algorithm. RESULTS: A set of seven clinical algorithms and one illustrative layout diagram were developed. The algorithms were augmented with documentation forms, data-collection online forms and spreadsheets and an indicators' reference sheet to guide implementation and performance measurement. The final version underwent several revisions and amendments prior to approval. CONCLUSIONS: A large volume of published literature on the topic of COVID-19 pandemic was translated into a user-friendly, algorithm-based toolkit for the management of patients with COVID-19. This toolkit can be used for training and decision-making to improve the quality of care provided to patients with COVID-19.
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ABSTRACT: Coronavirus disease 2019 (COVID-19) was first identified in December 2019 in Wuhan, China as an infectious disease, and has quickly resulted in an ongoing pandemic. A data-driven approach was developed to estimate medical resource deficiencies due to medical burdens at county level during the COVID-19 pandemic. The study duration was mainly from February 15, 2020 to May 1, 2020 in the U.S. Multiple data sources were used to extract local population, hospital beds, critical care staff, COVID-19 confirmed case numbers, and hospitalization data at county level. We estimated the average length of stay from hospitalization data at state level, and calculated the hospitalized rate at both state and county level. Then, we developed two medical resource deficiency indices that measured the local medical burden based on the number of accumulated active confirmed cases normalized by local maximum potential medical resources, and the number of hospitalized patients that can be supported per ICU bed per critical care staff, respectively. Data on medical resources, and the two medical resource deficiency indices are illustrated in a dynamic spatiotemporal visualization platform based on ArcGIS Pro Dashboards. Our results provided new insights into the U.S. pandemic preparedness and local dynamics relating to medical burdens in response to the COVID-19 pandemic.
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ABSTRACT: OBJECTIVES: In the United States, home health agencies (HHAs) provide essential services for patients recovering from post-acute care and older adults who are aging in place. During the COVID-19 pandemic, HHAs may face additional challenges caring for these vulnerable patients. Our objective was to explore COVID-19 preparedness of US HHAs and compare results by urban/rural location. DESIGN: Cross-sectional study. SETTING/PARTICIPANTS: Using a stratified random sample of 978 HHAs, we conducted a 22-item online survey from April 10 to 17, 2020. METHODS: Summary statistics were computed; open-ended narrative responses were synthesized using qualitative methods. RESULTS: Similar to

national data, most responding HHAs (n = 121, 12% response rate) were for-profit and located in the South. Most HHAs had infectious disease outbreaks included in their emergency preparedness plan (76%), a staff member in charge of outbreak/disaster preparedness (84%), and had provided their staff with COVID-19 education and training (97%). More urban HHAs had cared for confirmed and recovered COVID-19 patients than rural HHAs, but urban HHAs had less capacity to test for COVID-19 than rural HHAs (9% vs 21%). Most (69%) experienced patient census declines and had a current and/or anticipated supply shortage. Rural agencies were affected less than urban agencies. HHAs have already rationed (69%) or implemented extended use (55%) or limited reuse (61%) of personal protective equipment (PPE). Many HHAs reported accessing supplemental PPE from state/local resources, donations, and do-it-yourself efforts; more rural HHAs had accessed these additional resources compared with urban HHAs. CONCLUSIONS/IMPLICATIONS: This survey reveals challenges that HHAs are having in responding to the COVID-19 pandemic, particularly among urban agencies. Of greatest concern are the declines in patient census, which drastically affect agency revenue, and the shortages of PPE and disinfectants. Without proper protection, HHA clinicians are at risk of self-exposure and viral transmission to patients and vulnerable family members.
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ABSTRACT: Background: The cororavirus disease 19 (COVID-19) pandemic has strained intensive care unit (ICU) material and human resources to global crisis levels. The risks of staffing challenges and clinician exposure are of significant concern. One resource, telecritical care (TCC), has the potential to optimize efficiency, maximize safety, and improve quality of care provided amid large-scale disruptions, but its role in pandemic situations is only loosely defined. Planning and Preparation Phase: We propose strategic initiatives by which TCC may act as a force multiplier for pandemic preparedness in response to COVID-19, utilizing a tiered approach for increasing surge capacity needs. The goals involved usage of TCC to augment ICU capacity, optimize safety, minimize personal protective equipment (PPE) use, improve efficiencies, and enhance knowledge of managing pandemic response. Implementation Phase: A phased approach utilizing TCC would involve implementing remote capabilities across the enterprise to accomplish the goals outlined. The hardware and software needed for initial expansion to cover 275 beds included $956,670 for mobile carts and $173,106 for home workstations. Team role deployment and bedside clinical care centering around TCC as critical care capacity expand beyond 275 beds. Surge capacity was not reached during early phases of the pandemic in the region, allowing refinement of TCC during subsequent pandemic phases. Conclusions: Leveraging TCC facilitated pandemic surge planning but required redefinition of typical ICU staffing models. The design was meant to workforce efficiencies, reduce PPE use, and minimize health care worker exposure risk, all while maintaining quality care standards through an intensivist-led model. As health care operations resumed and states reopened, TCC is being used to support shifts in volume and critical care personnel during the pandemic evolution. The lessons applied may help health care systems through variable phases of the pandemic.
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ABSTRACT: BACKGROUND: Pandemics disrupt traditional health care operations by overwhelming system resource capacity but also create opportunities for care innovation. OBJECTIVE: To describe the development and rapid deployment of a virtual hospital program, Atrium Health hospital at home (AH-HaH), within a large health care system. DESIGN: Prospective case series. SETTING: Atrium Health, a large integrated health care organization in the southeastern United States. PATIENTS: 1477 patients diagnosed with coronavirus disease 2019 (COVID-19) from 23 March to 7 May 2020 who received care via AH-HaH. INTERVENTION: A virtual hospital model providing proactive home monitoring and hospital-level care through a virtual observation unit (VOU) and a virtual acute care unit (VACU) in the home setting for eligible patients with COVID-19. MEASUREMENTS: Patient demographic characteristics, comorbid conditions, treatments administered (intravenous fluids, antibiotics, supplemental oxygen, and respiratory medications), transfer to inpatient care, and hospital outcomes (length of stay, intensive care unit [ICU] admission, mechanical ventilation, and death) were collected from electronic health record data. RESULTS: 1477 patients received care in either the AH-HaH VOU or VACU or both settings, with a median length of stay of 11 days. Of these, 1293 (88%) patients received care in the VOU only, with 40 (3%) requiring inpatient hospitalization. Of these 40 patients, 16 (40%) spent time in the ICU, 7 (18%) required ventilator support, and 2 (5%) died during their hospital admission. In total, 184 (12%) patients were ever admitted to the VACU, during which 21

patients (11%) required intravenous fluids, 16 (9%) received antibiotics, 40 (22%) required respiratory inhaler or nebulizer treatments, 41 (22%) used supplemental oxygen, and 24 (13%) were admitted as an inpatient to a conventional hospital. Of these 24 patients, 10 (42%) required ICU admission, 1 (3%) required a ventilator, and none died during their hospital admission. LIMITATION: Generalizability is limited to patients with a working telephone and the ability to comply with the monitoring protocols. CONCLUSION: Virtual hospital programs have the potential to provide health systems with additional inpatient capacity during the COVID-19 pandemic and beyond. PRIMARY FUNDING SOURCE: Atrium Health.
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ABSTRACT: Background Across the globe, elective surgeries have been postponed to limit infectious exposure and preserve hospital capacity for coronavirus disease 2019 (COVID-19). However, the ramp down in cardiac surgery volumes may result in unintended harm to patients who are at high risk of mortality if their conditions are left untreated. To help optimize triage decisions, we derived and ambispectively validated a clinical score to predict intensive care unit length of stay after cardiac surgery. Methods and Results Following ethics approval, we derived and performed multicenter validation of clinical models to predict the likelihood of short (</=2 days) and prolonged intensive care unit length of stay (>/=7 days) in patients aged >/=18 years, who underwent coronary artery bypass grafting and/or aortic, mitral, and tricuspid valve surgery in Ontario, Canada. Multivariable logistic regression with backward variable selection was used, along with clinical judgment, in the modeling process. For the model that predicted short intensive care unit stay, the c-statistic was 0.78 in the derivation cohort and 0.71 in the validation cohort. For the model that predicted prolonged stay, c-statistic was 0.85 in the derivation and 0.78 in the validation cohort. The models, together termed the CardiOttawa LOS Score, demonstrated a high degree of accuracy during prospective testing. Conclusions Clinical judgment alone has been shown to be inaccurate in predicting postoperative intensive care unit length of stay. The CardiOttawa LOS Score performed well in prospective validation and will complement the clinician's gestalt in making more efficient resource allocation during the COVID-19 period and beyond.
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ABSTRACT: Some nations in the world and some states in India have had more success in containing this pandemic. Recent efforts in strengthening the health sector have focused largely on reforms in modes of financing, but as the pandemic brings home to us, the main challenge in India remains the challenge of the organization of public services using a health systems understanding. A close to community comprehensive primary health care, quality assurance, and planned excess capacity in public health systems, a more robust disease surveillance systems that can integrate data on new outbreaks and the indigenous technological capacity to scale up innovation and manufacture of essential health commodities are some of our most important requirements for both epidemic preparedness and response.
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ABSTRACT: Background During the spring of 2020, the SARS-CoV-2 epidemic has caused significant resource strain in hospitals of Lombardy, Italy, with the demand for intensive care beds for COVID-19 patients exceeding the overall pre-crisis capacity. In this study, we evaluate the effect of healthcare strain on ICU admission and survival.Methods We used data on 43,538 patients admitted to a hospital in the region between February 20 and July 12, 2020, of which 3,993 (9.2%) were admitted to an ICU. We applied logistic regression to model the probability of being admitted to an ICU and the probability of survival among ICU patients. Negative binomial regressions were used to model the time between hospital and ICU admission and the length of stay in ICU.Results During the period of highest hospital strain (March 16 – April 22), individuals older than 70 years had a significantly lower probability of being admitted to an ICU and significantly longer times between hospital and ICU admission, indicating elective admission due to constrained resources. Healthcare strain did not have a clear effect on mortality, with the overall proportion of deaths declining from 52.1% (95%CI 49.8-54.5) for ICU patients

admitted to the hospital before March 16, to 43.4% (95%CI 41.5-45.6) between March 16 and April 22, to 27.6% (95%CI 20.0-35.2) after April 22.Conclusions These data demonstrate and quantify the adoption of elective admission to ICUs during the peak phase of the SARS-CoV-2 epidemic in Lombardy. However, we show that for patients admitted to ICUs, clinical outcomes progressively improved despite the saturation of healthcare resources.Competing Interest StatementM.A has received research funding from Seqirus. All other authors report no competing interests.Funding StatementPP, FT, GG, VM, and SM acknowledge funding from the European Commission H2020 project MOOD and from the VRT Foundation Trento project Epidemiologia e transmissione di COVID-19 in TrentinoAuthor DeclarationsI confirm all relevant ethical guidelines have been followed, and any necessary IRB and/or ethics committee approvals have been obtained.YesThe details of the IRB/oversight body that provided approval or exemption for the research described are given below:The institutional ethics board of Fondazione IRCCS Ca Granda Ospedale Maggiore Policlinico in Milan approved this study and due to the nature of retrospective chart review, waived the need for informed consent from individual patients.All necessary patient/participant consent has been obtained and the appropriate institutional forms have been archived.YesI understand that all clinical trials and any other prospective interventional studies must be registered with an ICMJE-approved registry, such as ClinicalTrials.gov. I confirm that any such study reported in the manuscript has been registered and the trial registration ID is provided (note: if posting a prospective study registered retrospectively, please provide a statement in the trial ID field explaining why the study was not registered in advance).YesI have followed all appropriate research reporting guidelines and uploaded the relevant EQUATOR Network research reporting checklist(s) and other pertinent material as supplementary files, if applicable.YesIndividual data used for the analyses will be made available in case of acceptance and published along with the manuscript.WHOWorld Health OrganizationIQRInterquartile rangeIRRIncidence rate ratioICUIntensive Care UnitOROdds ratio
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ABSTRACT: New York City has emerged as the global epicenter for the coronavirus disease 2019 (COVID-19) pandemic. The city's public health system, New York City Health + Hospitals, has been key to the city's response because its vulnerable patient population is disproportionately affected by the disease. As the number of cases rose in the city, NYC Health + Hospitals carried out plans to greatly expand critical care capacity. Primary intensive care unit (ICU) spaces were identified and upgraded as needed, and new ICU spaces were created in emergency departments, procedural areas, and other inpatient units. Patients were transferred between hospitals to reduce strain. Critical care staffing was supplemented by temporary recruits, volunteers, and Department of Defense medical personnel. Supplies needed to deliver critical care were monitored closely and replenished to prevent interruptions. An emergency department action team was formed to ensure that the experience of front-line providers was informing network-level decisions. The steps taken by NYC Health + Hospitals greatly expanded its capacity to provide critical care during an unprecedented surge of COVID-19 cases in NYC. These steps, along with lessons learned, could inform preparations for other health systems during a primary or secondary surge of cases.
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ABSTRACT: As COVID-19 cases continue to increase globally, fragile health systems already facing challenges with health system infrastructure, SARS-CoV-2 diagnostic capacity, and patient isolation capabilities may be left with few options to

effectively care for acutely ill patients. Haiti-with only two laboratories that can perform reverse transcriptase PCR for SARS-CoV-2, a paucity of hospital beds, and an exponential increase in cases-provides an example that underpins the need for immediate infrastructure solutions for the crisis. We present two COVID-19 treatment center designs that leverage lessons learned from previous outbreaks of communicable infectious diseases and provide potential solutions when caseload exceeds existing capacity, with and without access to SARS-CoV-2 testing. These designs are intended for settings in which health facilities and testing resources for COVID-19 are surpassed during the pandemic, are adaptable to local conditions and constraints, and mitigate the likelihood of nosocomial transmission while offering an option to care for hospitalized patients.
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ABSTRACT: BACKGROUND: The coronavirus disease 2019 (COVID-19) pandemic challenges hospital leaders to make time-sensitive, critical decisions about clinical operations and resource allocations. OBJECTIVE: To estimate the timing of surges in clinical demand and the best- and worst-case scenarios of local COVID-19-induced strain on hospital capacity, and thus inform clinical operations and staffing demands and identify when hospital capacity would be saturated. DESIGN: Monte Carlo simulation instantiation of a susceptible, infected, removed (SIR) model with a 1-day cycle. SETTING: 3 hospitals in an academic health system. PATIENTS: All people living in the greater Philadelphia region. MEASUREMENTS: The COVID-19 Hospital Impact Model (CHIME) (http://penn-chime.phl.io) SIR model was used to estimate the time from 23 March 2020 until hospital capacity would probably be exceeded, and the intensity of the surge, including for intensive care unit (ICU) beds and ventilators. RESULTS: Using patients with COVID-19 alone, CHIME estimated that it would be 31 to 53 days before demand exceeds existing hospital capacity. In best- and worst-case scenarios of surges in the number of patients with COVID-19, the needed total capacity for hospital beds would reach 3131 to 12 650 across the 3 hospitals, including 338 to 1608 ICU beds and 118 to 599 ventilators. LIMITATIONS: Model parameters were taken directly or derived from published data across heterogeneous populations and practice environments and from the health system's historical data. CHIME does not incorporate more transition states to model infection severity, social networks to model transmission dynamics, or geographic information to account for spatial patterns of human interaction. CONCLUSION: Publicly available and designed for hospital operations leaders, this modeling tool can inform preparations for capacity strain during the early days of a pandemic. PRIMARY FUNDING SOURCE: University of Pennsylvania Health System and the Palliative and Advanced Illness Research Center.
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ABSTRACT: Objectives: To determine whether patients admitted to an ICU during times of strain, when compared with its own norm (i.e. accommodating a greater number of patients, higher acuity of illness, or frequent turnover), is associated with a higher risk of death in ICUs with closed models of intensivist staffing. Design: We conducted a large, multicenter, observational cohort study. Multilevel mixed effects logistic regression was used to examine relationships for three measures of ICU strain (bed census, severity-weighted bed census, and activity-weighted bed census) on the day of admission with risk-adjusted acute hospital mortality. Setting: Pooled case mix and outcome database of adult general ICUs participating in the Intensive Care National Audit and Research Centre Case Mix Programme. Measurements and Main Results: The analysis included 149,310 patients admitted to 215 adult general ICUs in 213 hospitals in United Kingdom, Wales, and Northern Ireland. A relative lower strain in ICU capacity as measured by bed census on the calendar day (daytime hours) of admission was associated with decreased risk-adjusted acute hospital mortality (odds ratio, 0.94; 95% CI, 0.90–0.99; p = 0.01), whereas a nonsignificant association was seen between higher strain and increased acute hospital mortality (odds ratio, 1.04; 95% CI, 1.00–1.10; p = 0.07). The relationship between periods of high ICU strain and acute hospital mortality was strongest when bed census was composed of higher acuity patients (odds ratio, 1.05; 95% CI, 1.01–1.10; p = 0.03). No relationship was seen between high strain and ICU mortality. Conclusions: In closed staffing models of

care, variations in bed census within individual ICUs was associated with patient's predicted risk of acute hospital mortality, particularly when its standardized bed census consisted of sicker patients.
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ABSTRACT: Managing healthcare demand and capacity is especially difficult in the context of the COVID-19 pandemic, where limited intensive care resources can be overwhelmed by a large number of cases requiring admission in a short space of time. If patients are unable to access this specialist resource, then death is a likely outcome. In appreciating these 'capacity-dependent' deaths, this paper reports on the clinically-led development of a stochastic discrete event simulation model designed to capture the key dynamics of the intensive care admissions process for COVID-19 patients. With application to a large public hospital in England during an early stage of the pandemic, the purpose of this study was to estimate the extent to which such capacity-dependent deaths can be mitigated through demand-side initiatives involving non-pharmaceutical interventions and supply-side measures to increase surge capacity. Based on information available at the time, results suggest that total capacity-dependent deaths can be reduced by 75% through a combination of increasing capacity from 45 to 100 beds, reducing length of stay by 25%, and flattening the peak demand to 26 admissions per day. Accounting for the additional 'capacity-independent' deaths, which occur even when appropriate care is available within the intensive care setting, yields an aggregate reduction in total deaths of 30%. The modelling tool, which is freely available and open source, has since been used to support COVID-19 response planning at a number of healthcare systems within the UK National Health Service.
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DOI: 10.1007/s10729-020-09511-7

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ABSTRACT: Mass critical care caused by the severe acute respiratory syndrome corona virus 2 pandemic poses an extreme challenge to hospitals. The primary goal of hospital disaster preparedness and response is to maintain conventional or contingency care for as long as possible. Crisis care must be delayed as long as possible by appropriate measures. Increasing the intensive care unit (ICU) capacities is essential. In order to adjust surge capacity, the reduction of planned, elective patient care is an adequate response. However, this involves numerous problems that must be solved with a sense of proportion. This paper summarises preparedness and response measures recommended to acute care hospitals.
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ABSTRACT: OBJECTIVES: To compare methods to adjust for confounding by disease severity during multicenter intervention studies in ICU, when different disease severity measures are collected across centers. DESIGN: In silico simulation study using national registry data. SETTING: Twenty mixed ICUs in The Netherlands. SUBJECTS: Fifty-five-thousand six-hundred fifty-five ICU admissions between January 1, 2011, and January 1, 2016. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: To mimic an intervention study with confounding, a fictitious treatment variable was simulated whose effect on the outcome was confounded by Acute Physiology and Chronic Health Evaluation IV predicted mortality (a common measure for disease severity). Diverse, realistic scenarios were investigated where the availability of disease severity measures (i.e., Acute Physiology and Chronic Health Evaluation IV, Acute Physiology and Chronic Health Evaluation II, and Simplified Acute Physiology Score II scores) varied across centers. For each scenario, eight different methods to adjust for confounding were used to obtain an estimate of the (fictitious) treatment effect. These were compared in terms of relative (%) and absolute (odds ratio) bias to a reference scenario where the treatment effect was estimated following correction for the Acute Physiology and Chronic Health Evaluation IV scores from all centers. Complete neglect of differences in disease severity measures across centers resulted in bias ranging from 10.2% to 173.6% across scenarios, and no commonly used methodology-such as two-stage modeling or score standardization-was able to effectively eliminate bias. In scenarios where some of the included centers had (only) Acute Physiology and Chronic Health Evaluation II or Simplified Acute Physiology Score II available (and not Acute Physiology and Chronic Health Evaluation IV), either restriction of the analysis to Acute Physiology and Chronic Health Evaluation IV centers alone or multiple imputation of Acute Physiology and Chronic Health Evaluation IV scores resulted in the least amount of relative bias (0.0% and 5.1% for Acute

Physiology and Chronic Health Evaluation II, respectively, and 0.0% and 4.6% for Simplified Acute Physiology Score II, respectively). In scenarios where some centers used Acute Physiology and Chronic Health Evaluation II, regression calibration yielded low relative bias to (relative bias, 12.4%); this was not true if these same centers only had Simplified Acute Physiology Score II available (relative bias, 54.8%). CONCLUSIONS: When different disease severity measures are available across centers, the performance of various methods to control for confounding by disease severity may show important differences. When planning multicenter studies, researchers should make contingency plans to limit the use of or properly incorporate different disease measures across centers in the statistical analysis.
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ABSTRACT: In the twenty-first century, severe acute respiratory syndrome (SARS), 2009 A(H1N1) influenza, and Ebola have all placed strains on critical care systems. In addition to the increased patient needs common to many disasters, epidemics may further degrade ICU capability when staff members fall ill, including in the course of direct patient care. In a large-scale pandemic, shortages of equipment and medications can further limit an ICU's ability to provide the normal standard of care. Hospital preparedness for epidemics must include strategies to maintain staff safety, secure adequate supplies, and have plans for triage and prioritization of care when necessary.
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DOI: 10.1016/j.ccc.2019.06.001

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ABSTRACT: PURPOSE: To evaluate the associations between strained ICU capacity and patient outcomes. METHODS: Multi-center population-based cohort study of nine integrated ICUs in Alberta, Canada. Path-analysis modeling was adopted to investigate direct and indirect associations between strain (available beds </=1; occupancy >/=95%) and outcomes. Mixed-effects multivariate regression was used to measure the association between strain and acuity (APACHE II score), and both acuity and strain measures on ICU mortality and length of stay. RESULTS: 12,265 admissions comprise the study cohort. Available beds </=1 and occupancy >/=95% occurred for 22.3% and 17.0% of admissions. Lower bed availability was associated with higher APACHE II score (p<0.0001). The direct effect of </=1 available beds at ICU admission on ICU mortality was 11.6% (OR 1.116; 95% CI, 0.995-1.252). Integrating direct and indirect effects resulted in a 16.5% increased risk of ICU mortality (OR 1.165; 95% CI, 1.036-1.310), which exceeded the direct effect by 4.9%. Findings were similar with strain defined as occupancy >/=95%. Strain was associated with shorter ICU stay, primarily mediated by greater acuity. CONCLUSIONS: Strained capacity was associated with increased ICU mortality, partly mediated through greater illness acuity. Future work should consider both the direct and indirect relationships of strain on outcomes.
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DOI: 10.1016/j.jcrc.2017.08.032

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ABSTRACT: PURPOSE: This study investigated the availability of relevant structural and human resources needed for the clinical management of patients with severe acute respiratory infections and sepsis in critical care units in Vietnam. MATERIAL AND METHODS: A questionnaire survey was conducted by purposive sampling of 128 hospitals (36% of total hospitals in surveyed provinces), including 25 provincial and 103 district level hospitals, from 20 provinces in Vietnam. Data on availability of hospital characteristics, structural resources and health care workers was then analyzed. RESULTS: Most hospitals (>80%) reported having 60% of the relevant structural resources. Significant differences were observed between provincial hospitals when compared to district hospitals in regards to availability of central oxygen piping system (78.3% vs 38.7%, p=0.001) mechanical ventilation (100.0% vs 73.6%, p=0.003), mobile x-rays (80.0% vs 29.8%, p<0.001), carbapenem antibiotic (73.9% vs 17.4%, p<0.001) and norepinephrine (95.8% vs 56.3%, p<0.001). There was a limited availability of

arterial blood gas analyzers (13.7%), oseltamivir (42.2%) and N95 respirators (54.6%) across all hospitals surveyed. CONCLUSIONS: The limited availability of relevant structural and human resources in critical care units around Vietnam makes the implementation of quality critical care to patients with SARI and sepsis, according international guidelines, not universally possible.
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ABSTRACT: BACKGROUND: Increases in patient needs can strain hospital resources, which may worsen care quality and outcomes. This systematic literature review sought to understand whether hospital capacity strain is associated with worse health outcomes for hospitalized patients and to evaluate benefits and harms of health system interventions to improve care quality during times of hospital capacity strain. METHODS: Parallel searches were conducted in MEDLINE, CINAHL, the Cochrane Library, and reference lists from 1999-2015. Two reviewers assessed study eligibility. We included English-language studies describing the association between capacity strain (high census, acuity, turnover, or an indirect measure of strain such as delayed admission) and health outcomes or intermediate outcomes for children and adults hospitalized in highly developed countries. We also included studies of health system interventions to improve care during times of capacity strain. Two reviewers extracted data and assessed risk of bias using the Newcastle-Ottawa Score for observational studies and the Cochrane Collaboration Risk of Bias Assessment Tool for experimental studies. RESULTS: Of 5,702 potentially relevant studies, we included 44 observational and 8 experimental studies. There was marked heterogeneity in the metrics used to define capacity strain, hospital settings, and overall study quality. Mortality increased during times of capacity strain in 18 of 30 studies and in 9 of 12 studies in intensive care unit settings. No experimental studies were randomized, and none demonstrated an improvement in health outcomes after implementing the intervention. The pediatric literature is very limited; only six observational studies included children. There was insufficient study homogeneity to perform meta-analyses. DISCUSSION: In highly developed countries, hospital capacity strain is associated with increased mortality and worsened health outcomes. Evidence-based solutions to improve outcomes during times of capacity strain are needed.
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ABSTRACT: INTRODUCTION: Intensive Care Units (ICUs) provide life-supporting treatment; however, resources are limited, so demand may exceed supply in the event of pandemics, environmental disasters, or in the context of an aging population. We hypothesized that comprehensive national data on ICU resources would permit a better understanding of regional differences in system capacity. METHODS: After the 2009-2010 Influenza A (H1N1) pandemic, the Canadian Critical Care Trials Group surveyed all acute care hospitals in Canada to assess ICU capacity. Using a structured survey tool administered to physicians, respiratory therapists and nurses, we determined the number of ICU beds, ventilators, and the ability to provide specialized support for respiratory failure. RESULTS: We identified 286 hospitals with 3170 ICU beds and 4982 mechanical ventilators for critically ill patients. Twenty-two hospitals had an ICU that routinely cared for children; 15 had dedicated pediatric ICUs. Per 100,000 population, there was substantial variability in provincial capacity, with a mean of 0.9 hospitals with ICUs (provincial range 0.4-2.8), 10 ICU beds capable of providing mechanical ventilation (provincial range 6-19), and 15 invasive mechanical ventilators (provincial range 10-24). There was only moderate correlation between ventilation capacity and population size (coefficient of determination (R(2)) = 0.771). CONCLUSION: ICU resources vary widely across Canadian provinces, and during times of increased demand, may result in geographic differences in the ability to care for critically ill patients. These results highlight the need to evolve inter-jurisdictional resource sharing during periods of substantial increase in demand, and provide background data for the development of appropriate critical care capacity benchmarks.
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DOI: 10.1186/s13054-015-0852-6

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ABSTRACT: BACKGROUND: The matching of critical care service supply with demand is fundamental for the efficient delivery of advanced life support to patients in urgent need. Mismatch in this supply/demand relationship contributes to "intensive care unit (ICU) capacity strain," defined as a time-varying disruption in the ability of an ICU to provide well-timed and high-quality intensive care support to any and all patients who are or may become critically ill. ICU capacity strain leads to suboptimal quality of care and may directly contribute to heightened risk of adverse events, premature discharges, unplanned readmissions, and avoidable death. Unrelenting strain on ICU capacity contributes to inefficient health resource utilization and may negatively impact the satisfaction of patients, their families, and frontline providers. It is unknown how to optimally quantify the instantaneous and temporal "stress" an ICU experiences due to capacity strain. METHODS: We will perform a systematic review to identify, appraise, and evaluate quality and performance measures of strain on ICU capacity and their association with relevant patient-centered, ICU-level, and health system-level outcomes. Electronic databases (i.e., MEDLINE, EMBASE, CINAHL, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, Web of Science, and the Agency of Healthcare Research and Quality (AHRQ) - National Quality Measures Clearinghouse (NQMC)) will be searched for original studies of measures of ICU capacity strain. Selected gray literature sources will be searched. Search themes will focus on intensive care, quality, operations management, and capacity. Analysis will be primarily narrative. Each identified measure will be defined, characterized, and evaluated using the criteria proposed by the US Strategic Framework Board for a National Quality Measurement and Reporting System (i.e., importance, scientific acceptability, usability, feasibility). DISCUSSION: Our systematic review will comprehensively identify, define, and evaluate quality and performance measures of ICU capacity strain. This is a necessary step towards understanding the impact of capacity strain on quality and performance in intensive care and to develop innovative interventions aimed to improve efficiency, avoid waste, and better anticipate impending capacity shortfalls. SYSTEMATIC REVIEW REGISTRATION: PROSPERO, CRD42015017931.
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ABSTRACT: BACKGROUND: During pandemics of novel influenza and outbreaks of emerging infections, surge in health-care demand can exceed capacity to provide normal standards of care. In such exceptional circumstances, triage tools may aid decisions in identifying people who are most likely to benefit from higher levels of care. Rapid research during the early phase of an outbreak should allow refinement and validation of triage tools so that in the event of surge a valid tool is available. The overarching study aim is to conduct a prospective near real-time analysis of structured clinical assessments of influenza-like illness (ILI) using primary care electronic health records (EHRs) during a pandemic. This abstract summarises the preparatory work, infrastructure development, user testing and proof-of-concept study. OBJECTIVES: (1) In preparation for conducting rapid research in the early phase of a future outbreak, to develop processes that allow near real-time analysis of general practitioner (GP) assessments of people presenting with ILI, management decisions and patient outcomes. (2) As proof of concept: conduct a pilot study evaluating the performance of the triage tools 'Community Assessment Tools' and 'Pandemic Medical Early Warning Score' to predict hospital admission and death in patients presenting with ILI to GPs during inter-pandemic winter seasons. DESIGN: Prospective near real-time analysis of structured clinical assessments and anonymised linkage to data from EHRs. User experience was evaluated by semistructured interviews with participating GPs. SETTING: Thirty GPs in England, Wales and Scotland, participating in the Clinical Practice Research Datalink. PARTICIPANTS: All people presenting with ILI. INTERVENTIONS: None. MAIN OUTCOME MEASURES: Study outcome is proof of concept through demonstration of data capture and near real-time analysis. Primary patient outcomes were hospital admission within 24 hours and death (all causes) within 30 days of GP assessment. Secondary patient outcomes included GP decision to prescribe antibiotics and/or influenza-specific antiviral drugs and/or refer to hospital - if admitted, the need for higher levels of care and length of hospital stay. DATA SOURCES: Linked anonymised data from a web-based structured clinical assessment and primary care EHRs. RESULTS: In the 24 months to April 2015, data from 704 adult and 159 child consultations by 30 GPs were captured. GPs referred 11 (1.6%) adults and six (3.8%) children to hospital. There were 13 (1.8%) deaths of adults and two (1.3%) of children. There were too few outcome events to draw any conclusions regarding the performance of the triage tools. GP interviews showed that although there were some difficulties with installation, the web-based data collection tool was quick and easy to use. Some GPs felt that a minimal monetary incentive would promote participation. CONCLUSIONS: We have developed processes that allow capture and near real-time automated analysis of GP's clinical assessments and management decisions of people presenting with ILI. FUTURE WORK: We will develop processes to include other EHR systems, attempt linkage to data on influenza

surveillance and maintain processes in readiness for a future outbreak. STUDY REGISTRATION: This study is registered as ISRCTN87130712 and UK Clinical Research Network 12827. FUNDING: The National Institute for Health Research Health Technology Assessment programme. MGS is supported by the UK NIHR Health Protection Research Unit in Emerging and Zoonotic Infections.
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ABSTRACT: Natural disasters, industrial accidents, terrorism attacks, and pandemics all have the capacity to result in large numbers of critically ill or injured patients. This supplement provides suggestions for all of those involved in a disaster or pandemic with multiple critically ill patients, including front-line clinicians, hospital administrators, professional societies, and public health or government officials. The current Task Force included a total of 100 participants from nine countries, comprised of clinicians and experts from a wide variety of disciplines. Comprehensive literature searches were conducted to identify studies upon which evidence-based recommendations could be made. No studies of sufficient quality were identified. Therefore, the panel developed expert-opinion-based suggestions that are presented in this supplement using a modified Delphi process. The ultimate aim of the supplement is to expand the focus beyond the walls of ICUs to provide recommendations for the management of all critically ill or injured adults and children resulting from a pandemic or disaster wherever that care may be provided. Considerations for the management of critically ill patients include clinical priorities and logistics (supplies, evacuation, and triage) as well as the key enablers (systems planning, business continuity, legal framework, and ethical considerations) that facilitate the provision of this care. The supplement also aims to illustrate how the concepts of mass critical care are integrated across the spectrum of surge events from conventional through contingency to crisis standards of care.
URL: https://www.ncbi.nlm.nih.gov/pubmed/25144202
DOI: 10.1378/chest.14-0732

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ABSTRACT: BACKGROUND: Pandemics and disasters can result in large numbers of critically ill or injured patients who may overwhelm available resources despite implementing surge-response strategies. If this occurs, critical care triage, which includes both prioritizing patients for care and rationing scarce resources, will be required. The suggestions in this chapter are important for all who are involved in large-scale pandemics or disasters with multiple critically ill or injured patients, including front-line clinicians, hospital administrators, and public health or government officials. METHODS: The Triage topic panel reviewed previous task force suggestions and the literature to identify 17 key questions for which specific literature searches were then conducted to identify studies upon which evidence-based recommendations could be made. No studies of sufficient quality were identified. Therefore, the panel developed expert opinion-based suggestions using a modified Delphi process. Suggestions from the previous task force that were not being updated were also included for validation by the expert panel. RESULTS: The suggestions from the task force outline the key principles upon which critical care triage should be based as well as a path for the development of the plans, processes, and infrastructure required. This article provides 11 suggestions regarding the principles upon which critical care triage should be based and policies to guide critical care triage. CONCLUSIONS: Ethical and efficient critical care triage is a complex process that requires significant planning and preparation. At present, the prognostic tools required to produce an effective decision support system (triage protocol) as well as the infrastructure, processes, legal protections, and training are largely lacking in most jurisdictions. Therefore, critical care triage should be a last resort after mass critical care surge strategies.
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DOI: 10.1378/chest.14-0736

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ABSTRACT: INTRODUCTION: Pandemic influenza or other crises causing mass respiratory failure could easily overwhelm current North American critical care capacity. This threat has generated large-scale federal, state, and local efforts to prepare for a public health disaster. Few, however, have systematically engaged the public regarding which values are most

important in guiding decisions about how to allocate scarce healthcare resources during such crises. METHODS: The aims of this pilot study were (1) to test whether deliberative democratic methods could be used to promote engaged discussion about complex, ethically challenging healthcare-related policy issues and (2) to develop specific deliberative democratic procedures that could ultimately be used in a statewide process to inform a Maryland framework for allocating scarce healthcare resources during disasters. Using collaboratively developed focus group materials and multiple metrics for assessing outcomes, we held 5-hour pilot community meetings with a combined total of 68 community members in two locations in Maryland. The key outcomes used to assess the project were (1) the comprehensibility of the background materials and ethical principles, (2) the salience of the ethical principles, (3) the perceived usefulness of the discussions, (4) the degree to which participants' opinions evolved as a result of the discussions, and (5) the quality of participant engagement. RESULTS: Most participants were thoughtful, reflective, and invested in this pilot policy-informing process. Throughout the pilot process, changes were made to background materials, the verbal introduction, and pre- and post-surveys. Importantly, by holding pilot meetings in two distinct communities (an affluent suburb and inner city neighborhood), we discerned that participants' ethical reflections were framed in large part by their place-based life experiences. CONCLUSION: This pilot process, coupled with extensive feedback from participants, yielded a refined methodology suitable for wider-scale use and underscored the need for involvement of diverse communities in a statewide engagement process on this critical policy issue.
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DOI: 10.1513/AnnalsATS.201310-379OC

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ABSTRACT: BACKGROUND: This article provides consensus suggestions for expanding critical care surge capacity and extension of critical care service capabilities in disasters or pandemics. It focuses on the principles and frameworks for expansion of intensive care services in hospitals in the developed world. A companion article addresses surge logistics, those elements that provide the capability to deliver mass critical care in disaster events. The suggestions in this article are important for all who are involved in large-scale disasters or pandemics with injured or critically ill multiple patients, including front-line clinicians, hospital administrators, and public health or government officials. METHODS: The Surge Capacity topic panel developed 23 key questions focused on the following domains: systems issues; equipment, supplies, and pharmaceuticals; staffing; and informatics. Literature searches were conducted to identify evidence on which to base key suggestions. Most reports were small scale, were observational, or used flawed modeling; hence, the level of evidence on which to base recommendations was poor and did not permit the development of evidence-based recommendations. Therefore, the panel developed expert opinion-based suggestions using a modified Delphi process. Suggestions from the previous task force were also included for validation by the expert panel. RESULTS: This article presents 10 suggestions pertaining to the principles that should guide surge capacity and capability planning for mass critical care, including the role of critical care in disaster planning; the surge continuum; targets of surge response; situational awareness and information sharing; mitigating the impact on critical care; planning for the care of special populations; and service deescalation/cessation (also considered as engineered failure). CONCLUSIONS: Future reports on critical care surge should emphasize population-based outcomes as well as logistical details. Planning should be based on the projected number of critically ill or injured patients resulting from specific scenarios. This should include a consideration of ICU patient care requirements over time and must factor in resource constraints that may limit the ability to provide care. Standard ICU management forms and patient data forms to assess ICU surge capacity impacts should be created and used in disaster events.
URL: https://www.ncbi.nlm.nih.gov/pubmed/25144334
DOI: 10.1378/chest.14-0733

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ABSTRACT: Learning Objectives: A global pandemic may overwhelm ICU capacity, activating crisis standards of care (CSC) in which scarce resources will be diverted from selected patients to ensure maximum population survival. CSC ICU resource allocation algorithms (ALGs) exist for adults. Our goal was to evaluate a CSC pandemic ALG for children. Method(s): 150,000 records were obtained from the Virtual PICU Systems database, from which prediction equations for probability of death (POD) and duration of ventilation (DOV) were derived (SCCM Congress 2014, Abst 602). We estimated pandemic ICU activity by proportionally assigning peak weekly deaths caused by the 1918 influenza pandemic, using projected numbers in Ohio as an example. PICU capacity was taken as the number of surge beds in Ohio PICUs. Discrete Event Simulation (DES)

was used to all the mechanically ventilated patients are treated in the ICU. However, the epidemiological data of the patients who were treated outside the ICU has not been reported. The aim of this study was to clarify the epidemiological data of mechanically ventilated patients who were treated outside the ICU. Method(s): The data source was derived from the Quality Indicator/Improvement Project, which is a voluntary data administration project from more than 300 acute care hospitals in Japan. Data of mechanically ventilated patients treated in or outside the ICU from Apr 2010 to Mar 2012 were analyzed. Data of adult patients who were ventilated for more than 3 days was analyzed. Patients whose diagnosis was related to cancer were excluded. Patients' demographic data and the rate of standard critical care provided were compared. Result(s): In the study period, 17,775 mechanically ventilated patients were treated only outside the ICU (non-ICU group) while 20,516 patients were treated once in the ICU (ICU group) (46.4% vs 53.6%). The average age was higher in non-ICU group patients than ICU group patients (72.8 vs 70.2, p<0.001). The mean ventilation days were longer in non-ICU group patients than in ICU group patients (11.7 vs 9.5, p<0.001). Hospital mortality was higher in non-ICU group patients than in ICU group patients (41.4% vs 38.8%, p<0.001). Standard critical care, such as arterial line placement, enteral nutrition and stress ulcer prevention, were provided significantly less often in non-ICU group. Conclusion(s): We have described the current practices of the mechanically ventilated patients in Japan. Patients treated in the ICU have a better survival with a higher rate of critical care compared to those treated outside the ICU.

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ABSTRACT: BACKGROUND: Hospital surge capacity (HSC) is dependent on the ability to increase or conserve resources. The hospital surge model put forth by the Agency for Healthcare Research and Quality (AHRQ) estimates the resources needed by hospitals to treat casualties resulting from 13 national planning scenarios. However, emergency planners need to know which hospital resource are most critical in order to develop a more accurate plan for HSC in the event of a disaster. OBJECTIVE: To identify critical hospital resources required in four specific catastrophic scenarios; namely, pandemic influenza, radiation, explosive, and nerve gas. METHODS: We convened an expert consensus panel comprised of 23 participants representing health providers (i.e., nurses and physicians), administrators, emergency planners, and specialists. Four disaster scenarios were examined by the panel. Participants were divided into 4 groups of five or six members, each of which were assigned two of four scenarios. They were asked to consider 132 hospital patient care resources - extracted from the AHRQ's hospital surge model - in order to identify the ones that would be critical in their opinion to patient care. The definition for a critical hospital resource was the following: absence of the resource is likely to have a major impact on patient outcomes, i.e., high likelihood of untoward event, possibly death. For items with any disagreement in ranking, we conducted a facilitated discussion (modified Delphi technique) until consensus was reached, which was defined as more than 50% agreement. Intraclass Correlation Coefficients (ICC) were calculated for each scenario, and across all scenarios as a measure of participant agreement on critical resources. For the critical resources common to all scenarios, Kruskal-Wallis test was performed to measure the distribution of scores across all scenarios. RESULTS: Of the 132 hospital resources, 25 were considered critical for all four scenarios by more than 50% of the participants. The number of hospital resources considered to be critical by consensus varied from one scenario to another; 58 for the pandemic influenza scenario, 51 for radiation exposure, 41 for explosives, and 35 for nerve gas scenario. Intravenous crystalloid solution was the only resource ranked by all participants as critical across all scenarios. The agreement in ranking was strong in nerve agent and pandemic influenza (ICC= 0.7 in both), and moderate in explosives (ICC= 0.6) and radiation (ICC= 0.5). CONCLUSION: In four disaster scenarios, namely, radiation, pandemic influenza, explosives, and nerve gas scenarios; supply of as few as 25 common resources may be considered critical to hospital surge capacity. The absence of any these resources may compromise patient care. More studies are needed to identify critical hospital resources in other disaster scenarios.
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DOI: 10.1371/currents.dis.67c1afe8d78ac2ab0ea52319eb119688

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ABSTRACT: OBJECTIVES: The objective of this study was to assess hospital and emergency department (ED) pediatric surge strategies utilized during the 2009 H1N1 influenza pandemic as well as compliance with national guidelines. METHODS: Electronic survey was sent to a convenience sample of emergency physicians and nurses from US EDs with a pediatric volume of more than 10,000 annually. Survey questions assessed the participant's hospital baseline pandemic and surge preparedness, as well as strategies for ED surge and compliance with Centers for Disease Control and Prevention (CDC) guidelines for health care personal protection, patient testing, and treatment. RESULTS: The response rate was 54% (53/99). Preexisting pandemic influenza plans were absent in 44% of hospitals; however, 91% developed an influenza plan

as a result of the pandemic. Twenty-four percent reported having a preexisting ED pandemic staffing model, and 36% had a preexisting alternate care site plan. Creation and/or modifications of existing plans for ED pandemic staffing (82%) and alternate care site plan (68%) were reported. Seventy-nine percent of institutions initially followed CDC guidelines for personal protection (use of N95 masks), of which 82% later revised their practices. Complete compliance with CDC guidelines was 60% for patient testing and 68% for patient treatment. CONCLUSIONS: Before the H1N1 pandemic, greater than 40% of the hospitals in our study did not have an influenza pandemic preparedness plan. Many had to modify their existing plans during the surge. Not all institutions fully complied with CDC guidelines. Data from this multicenter survey should assist clinical leaders to create more robust surge plans for children.
URL: https://www.ncbi.nlm.nih.gov/pubmed/24168878
DOI: 10.1097/PEC.0b013e3182a9e613

91. Filice CE, Vaca FE, Curry L, et al. Pandemic planning and response in academic pediatric emergency departments during the 2009 H1N1 influenza pandemic. Acad Emerg Med. 2013;20(1):54-62. DOI: 10.1111/acem.12061
ABSTRACT: OBJECTIVES: The terrorist attacks of September 11, 2001, initiated a shift toward a comprehensive, or "all-hazards," framework of emergency preparedness in the United States. Since then, the threat of H5N1 avian influenza, the severe acute respiratory syndrome epidemic, and the 2009 H1N1 influenza pandemic have underscored the importance of considering infectious events within such a framework. Pediatric emergency departments (EDs) were disproportionately burdened by the 2009 H1N1 influenza pandemic and therefore serve as a robust context for evaluation of pandemic preparedness. The objective of this study was to explore pediatric ED leaders' experiences with preparedness, response, and postincident actions related to the H1N1 pandemic to inform future pandemic and all-hazards planning and policy for EDs. METHODS: The authors selected a qualitative design, well suited for exploring complex, multifaceted organizational processes such as planning for and responding to a pandemic and learning from institutional experiences. Purposeful sampling was used to recruit medical directors or their designated physician respondents from pediatric emergency medicine training institutions representing a range of geographic regions across the United States, hospital types, and annual ED volumes; snowball sampling identified additional information-rich respondents. Recruitment began in May 2011 and continued until thematic saturation was reached in January 2012 (n = 20). Data were collected through in-depth individual phone interviews that were recorded and professionally transcribed. Using a standard interview guide, respondents were asked open-ended questions about pandemic planning, response, and institutional learning related to the H1N1 pandemic. Data analysis was performed by a multidisciplinary team using a grounded theory approach to generate themes inductively from respondents' expressed perspectives. The constant comparative method was used to identify emerging themes. RESULTS: Five common themes characterized respondents' experiences with pandemic planning and response: 1) national pandemic influenza preparedness guidance has not fully penetrated to the level of pediatric emergency physician (EP) leaders, leading to variable states of preparedness; 2) pediatric EDs that maintained strong relationships with local public health and other health care entities found those relationships to be beneficial to pandemic response; 3) pediatric EP leaders reported difficulty reconciling public health guidance with the reality of ED practice; 4) although many anticipated obstacles did not materialize, in some cases pediatric EP leaders experienced unexpected institutional challenges; and 5) pediatric EP leaders described varied experiences with organizational learning following the H1N1 pandemic experience. CONCLUSIONS: Despite a decade of investment in hospital preparedness, gaps in pediatric ED pandemic preparedness remain. This work suggests that raising awareness of pandemic planning standards and promoting strategies to overcome barriers to their adoption could enhance ED and hospital preparedness. Helping hospitals better prepare for pandemic events may lead to strengthened all-hazards preparedness.
URL: https://www.ncbi.nlm.nih.gov/pubmed/23570479
DOI: 10.1111/acem.12061

92. Kanter RK. Pediatric mass critical care in a pandemic. Pediatr Crit Care Med. 2012;13(1):e1-4. DOI: 10.1097/PCC.0b013e3181fe390a
ABSTRACT: OBJECTIVES: Previous simulation studies suggest that temporary pediatric mass critical care approaches would accommodate plausible hypothetical sudden-impact public health emergencies. However, the utility of sustained pediatric mass critical care responses in prolonged pandemics has not been evaluated. The objective of this study was to compare the ability of a typical region to serve pediatric intensive care unit needs in hypothetical pandemics, with and without mass critical care responses sufficient to triple usual pediatric intensive care unit capacity. DESIGN, SETTING, PATIENTS, AND INTERVENTIONS: The Monte Carlo simulation method was used to model responses to hypothetical pandemics on the basis of national historical evidence regarding pediatric intensive care unit admission and length of stay in pandemic and nonpandemic circumstances. Assuming all ages are affected equally, federal guidelines call for plans to serve moderate and

severe pandemics requiring pediatric intensive care unit care for 457 and 5,277 infants and children per million of the population, respectively. MEASUREMENTS AND MAIN RESULTS: A moderate pandemic would exceed ordinary surge capacity on 13% of pandemic season days but would always be accommodated by mass critical care approaches. In a severe pandemic, ordinary surge methods would accommodate all the patients on only 32% of pandemic season days and would accommodate 39% of needed patient days. Mass critical care approaches would accommodate all the patients on 82% of the days and would accommodate 64% of all patient days. CONCLUSION: Mass critical care approaches would be essential to extend care to the majority of infants and children in a severe pandemic. However, some patients needing critical care still could not be accommodated, requiring consideration of rationing.
URL: https://www.ncbi.nlm.nih.gov/pubmed/21037504
DOI: 10.1097/PCC.0b013e3181fe390a

93. Morton MJ, Jeng K, Beard R, et al. Systematic review of interventions to mitigate the effect of emergency department crowding in the event of a respiratory disease outbreak. Acad Emerg Med. 2012;1):S64-S5.
ABSTRACT: Background: Seasonal influenza is a common cause of ED crowding; however, increased patient volumes associated with a true influenza pandemic will require additional planning and ED response resources. Objective(s): This systematic review aimed to describe the breadth and diversity of interventions that have been reported to improve patient flow during a respiratory outbreak. Secondarily, we qualitatively assessed the effectiveness of various types of interventions to determine which interventions may be most effective in different settings to mitigate surge during an outbreak. Method(s): We conducted a formal literature search including MEDLINE, EMBASE, Cochrane, PubMed, Global Health Library (WHO), ISI Web of Science, and CINAHL databases. Interventions to mitigate influenza or any known respiratory pathogen were included. Initial search results were screened by title and abstract; studies were excluded based on criteria listed in Table 1. Six intervention categories were identified a priori: Triage and Screening, Clinic-Based, Testing, Treatment, Isolation, and "Other" Interventions. Data on outbreak and intervention characteristics, facility characteristics, "triggers" for implementing interventions, and input / output measures were extracted. Result(s): 1761 articles were identified via the search algorithm. 1638 were excluded based on title and abstract. of the 173 articles remaining, full text was reviewed on 136 (full text not available on 37 articles); 24 articles were selected for the final review. For full results, see Table 2. Sixteen Triage and Screening Interventions, 12 Clinic-Based, 11 Isolation, 4 Testing, 4 Treatment, and 1 "Other" category intervention were identified. One intervention involving school closures was associated with a 28% decrease in pediatric ED visits for respiratory illness. Conclusion(s): Most interventions were not tested in isolation, so the effect of individual interventions was difficult to differentiate. Interventions associated with statistically significant decreases in ED crowding were school closures, as well as interventions in all categories studied. Further study and standardization of intervention input, process, and outcome measures may assist in identifying the most effective methods of (Table presented) mitigating ED crowding and improving surge capacity during an influenza or other respiratory disease outbreak.

94. Situations CoGfECSoCfUiD. Crisis Standards of Care: A Systems Framework for Catastrophic Disaster Response. Washington (DC): National Academies Press; 2012.
ABSTRACT: Catastrophic disasters occurring in 2011 in the United States and worldwide--from the tornado in Joplin, Missouri, to the earthquake and tsunami in Japan, to the earthquake in New Zealand--have demonstrated that even prepared communities can be overwhelmed. In 2009, at the height of the influenza A (H1N1) pandemic, the Assistant Secretary for Preparedness and Response at the Department of Health and Human Services, along with the Department of Veterans Affairs and the National Highway Traffic Safety Administration, asked the Institute of Medicine (IOM) to convene a committee of experts to develop national guidance for use by state and local public health officials and health-sector agencies and institutions in establishing and implementing standards of care that should apply in disaster situations-both naturally occurring and man-made-under conditions of scarce resources. Building on the work of phase one (which is described in IOM's 2009 letter report, Guidance for Establishing Crisis Standards of Care for Use in Disaster Situations), the committee developed detailed templates enumerating the functions and tasks of the key stakeholder groups involved in crisis standards of care (CSC) planning, implementation, and public engagement-state and local governments, emergency medical services (EMS), hospitals and acute care facilities, and out-of-hospital and alternate care systems. Crisis Standards of Care provides a framework for a systems approach to the development and implementation of CSC plans, and addresses the legal issues and the ethical, palliative care, and mental health issues that agencies and organizations at each level of a disaster response should address. Please note: this report is not intended to be a detailed guide to emergency preparedness or disaster response. What is described in this report is an extrapolation of existing incident management practices and principles. Crisis Standards of Care is a seven-volume set: Volume 1 provides an overview; Volume 2 pertains to state and local governments; Volume 3 pertains to emergency medical services; Volume 4 pertains to hospitals and acute

care facilities; Volume 5 pertains to out-of-hospital care and alternate care systems; Volume 6 contains a public engagement toolkit; and Volume 7 contains appendixes with additional resources.
URL: https://www.ncbi.nlm.nih.gov/books/NBK201060/
DOI: 10.17226/13351

95. Adeniji KA, Cusack R. The Simple Triage Scoring System (STSS) successfully predicts mortality and critical care resource utilization in H1N1 pandemic flu: a retrospective analysis. Crit Care. 2011;15(1):R39. DOI: 10.1186/cc10001
ABSTRACT: INTRODUCTION: Triage protocols are only initiated when it is apparent that resource deficits will occur across a broad geographical area despite efforts to expand or acquire additional capacity. Prior to the pandemic the UK Department of Health (DOH) recommended the use of a staged triage plan incorporating Sepsis-related Organ Failure Assessment (SOFA) developed by the Ontario Ministry of Health to assist in the triage of critical care admissions and discharges during an influenza outbreak in the UK. There are data to suggest that had it been used in the recent H1N1 pandemic it may have led to inappropriate limitation of therapy if surge capacity had been overwhelmed. METHODS: We retrospectively reviewed the performance of the Simple Triage Scoring System (STSS) as an indicator of the utilization of hospital resources in adult patients with confirmed H1N1 admitted to a university teaching hospital. Our aim was to compare it against the staged initial SOFA score process with regards to mortality, need for intensive care admission and requirement for mechanical ventilation and assess its validity. RESULTS: Over an 8 month period, 62 patients with confirmed H1N1 were admitted. Forty (65%) had documented comorbidities and 27 (44%) had pneumonic changes on their admission CXR. Nineteen (31%) were admitted to the intensive care unit where 5 (26%) required mechanical ventilation (MV). There were 3 deaths. The STSS group categorization demonstrated a better discriminating accuracy in predicting critical care resource usage with a receiver operating characteristic area under the curve (95% confidence interval) for ICU admission of 0.88 (0.78-0.98) and need for MV of 0.91 (0.83-0.99). This compared to the staged SOFA score of 0.77 (0.65-0.89) and 0.87 (0.72-1.00) respectively. Low mortality rates limited analysis on survival predictions. CONCLUSIONS: The STSS accurately risk stratified patients in this cohort according to their risk of death and predicted the likelihood of admission to critical care and the requirement for MV. Its single point in time, accuracy and easily collected component variables commend it as an alternative reproducible system to facilitate the triage and treatment of patients in any future influenza pandemic.
URL: https://www.ncbi.nlm.nih.gov/pubmed/21269458
DOI: 10.1186/cc10001

96. Lim SHC. Crisis standard of care. Annals of the Academy of Medicine Singapore. 2011;1):S10.
ABSTRACT: Following public health emergencies and disasters, surge capacity plans are set into action to prepare for patient surge. What happens when the healthcare demand outstrips supply? In a scarce resource environment, it will be unrealistic to expect similar outcomes. Some people with clinical conditions that are survivable under usual healthcare system conditions may have to forgo life-sustaining interventions owing to deficiencies in supplies or staffing. "Crisis standards of care" is defined as a substantial change in usual healthcare operations and the level of care it is possible to deliver, which is made necessary by pervasive (e.g. pandemic influenza) or catastrophic (e.g. earthquake, hurricane) disasters. This change in the level of care delivered is justified by specific circumstances. Controversy exist on whether there should be only "one standard" or "many standards". Issues that require address when developing crisis care protocols, some ethical and legal considerations will be shared and discussed.

97. Stephens D. Role and organisation of ICU in major disasters. Intern Med J. 2011;2):15.
ABSTRACT: The Intensive Care Unit is an integral part of management of major disasters and ICU capacity to manage the critically injured is an important rate limiting step in a hospital's capability to respond successfully to a major disaster. A detailed disaster plan that provides for a sustainable response is the key to success. Some elements of a disaster plan include: ICU Disaster Commander (IDC) The Intensive Care Unit disaster plan should include the role of IDC. The IDC coordinates the ICU disaster plan, attends command centre briefings, provides information to the command centre and oversees the processing of the patients through the Intensive Care Unit. The IDC does not take on responsibility for the care of individual patients but provides expert opinion if requested and supervision for less experienced doctors during the disaster. The IDC coordinates staffing and ensures staff welfare throughout the disaster. The IDC oversees the communication between ICU, the command centre, external agencies and the community. This role is crucial to the success of the ICU disaster response. Creating Additional Ventilated ICU Beds/Equipment In the real world of high occupancy and bed block, any disaster plan needs to contain details for the expansion of ICU capacity within the local context. The effective use of co-located private hospital staff, beds and equipment should be considered. Business continuity plans complement disaster management plans. Staffing Sustainable response is the key to staff planning. All craft groups are considered and

utilised according to their expertise during the disaster. Physicians have an important role to play. Setting Up The plan details the patient flow, supply of consumables, staffing allocation, communications and chain of command. The ICU needs to prepare for direct admission of critically ill patients for primary resuscitation where ED capacity is overwhelmed. Essential Services Contingency Plans There is potential for loss of power, potable water, gas supply and air conditioning in many disaster scenarios. The Disaster Response Period During the disaster the IDC manages the issues arising and ensures the response is sustainable. Communications between the ED, ICU and the operating theatres is critical. Feedback to management ensures that needs are known, potential risks are highlighted and that timely solutions to issues arising occur. Staff welfare is paramount to a sustainable response. The Aftermath Debriefing the events and learning lessons from each disaster response improves systems for future responses. A major disaster has lasting effects on the people involved. The team is affected by the intensity of the work, the nature of the injuries and the suffering and loss experienced by the people they have treated.

98. Van Cleve WC, Hagan P, Lozano P, et al. Investigating a pediatric hospital's response to an inpatient census surge during the 2009 H1N1 influenza pandemic. Jt Comm J Qual Patient Saf. 2011;37(8):376-82. DOI: 10.1016/s1553-7250(11)37048-1

ABSTRACT: BACKGROUND: On November 4, 2009, the 250-bed Seattle Children's Hospital (SCH) identified a surge in its census--245 inpatients, well above the average midnight census of 207. In response, SCH activated its pandemic influenza surge plan in an effort to decrease the inpatient census. Within 16 hours, 51 patients (20.4% of total bed capacity) had been discharged, and inpatient census at SCH decreased to 222 patients. METHODS: As part of a quality improvement project, SCH's response to the surge was investigated, with data drawn from interviews, a review of records created in the course of the surge plan implementation, an e-mail survey of attending physicians responsible for patient discharges, and models examining predictors of hospital discharges. FINDINGS: Analysis of three years of hospital data (2007-2009) indicated that the high census on November 4 was an uncommon but not unprecedented occurrence. In addition, there was a clear positive association between an evening's census and the number of discharges during the following 24 hours. SCH discharged essentially the same number of patients on November 4 as on previous high-census days when the surge plan was not activated, suggesting that the surge plan did not succeed in creating excess discharges. CONCLUSIONS: Increasingly, evidence indicates that care quality depends on the degree to which hospital resources are sufficient to meet demand. Reverse triage, at least as implemented by SCH on November 4, 2009, is unlikely to represent an effective solution to surge outside of a disaster setting because of its requirement for centralized decision making. SCH has incorporated the results of this review into the way that it collects and analyzes data, manages flow, and responds to inpatient surges.
URL: https://www.ncbi.nlm.nih.gov/pubmed/21874973
DOI: 10.1016/s1553-7250(11)37048-1

99. Hick JL, Christian MD, Sprung CL, et al. Chapter 2. Surge capacity and infrastructure considerations for mass critical care. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. Intensive Care Med. 2010;36 Suppl 1:S11-20. DOI: 10.1007/s00134-010-1761-4

ABSTRACT: PURPOSE: To provide recommendations and standard operating procedures for intensive care unit (ICU) and hospital preparations for a mass disaster or influenza epidemic with a specific focus on surge capacity and infrastructure considerations. METHODS: Based on a literature review and expert opinion, a Delphi process was used to define the essential topics including surge capacity and infrastructure considerations. RESULTS: Key recommendations include: (1) hospitals should increase their ICU beds to the maximal extent by expanding ICU capacity and expanding ICUs into other areas; (2) hospitals should have appropriate beds and monitors for these expansion areas; hospitals should develop contingency plans at the facility and government (local, state, provincial, national) levels to provide additional ventilators; (3) hospitals should develop a phased staffing plan (nursing and physician) for ICUs that provides sufficient patient care supervision during contingency and crisis situations; (4) hospitals should provide expert input to the emergency management personnel at the hospital both during planning for surge capacity as well as during response; (5) hospitals should assure that adequate infrastructure support is present to support critical care activities; (6) hospitals should prioritize locations for expansion by expanding existing ICUs, using postanesthesia care units and emergency departments to capacity, then step-down units, large procedure suites, telemetry units and finally hospital wards. CONCLUSIONS: Judicious planning and adoption of protocols for surge capacity and infrastructure considerations are necessary to optimize outcomes during a pandemic.
URL: https://www.ncbi.nlm.nih.gov/pubmed/20213417
DOI: 10.1007/s00134-010-1761-4

100. Krol M, Krol M. Is recursive belief inference the engine of mentalizing? J Neurosci. 2010;30(47):15711-2. DOI: 10.1523/JNEUROSCI.4917-10.2010

ABSTRACT: Hospital and emergency department overcrowding is a serious and growing problem nationwide. Although EDs are organized around the goals of rapid patient assessment, stabilization, and prompt admission to the hospital, an increasing number are being required to hold admitted floor and critical care patients for extended periods due to lack of vacant inpatient beds. Provision of acceptable patient care under such circumstances requires a fundamental reordering of ED priorities and procedures. Overcrowding is the result of inadequate funding for emergency health care services during a period of increasing demand. The initial focus of management strategies to resolve this problem is the inpatient area and includes evaluation of length of stay, 'intent to discharge' policies, flexible bed designations, restriction of in-house transfers, and the use of 'overcensus beds.' If in-hospital management strategies fail, modifications in ED management may include staffing contingency plans, definition of physician responsibility, inpatient charts, revised pharmacy formulary, new floor plans, and modified accounting systems. Successful resolution of hospital and ED overcrowding may be the greatest challenge facing emergency medicine today.

URL: https://www.ncbi.nlm.nih.gov/pubmed/21106810

DOI: 10.1523/JNEUROSCI.4917-10.2010

101. Lawless BW, Trpkovski J. Large-scale implementation of a critical care surge capacity management program. Critical Care. 2010;1):S96.

ABSTRACT: Introduction: In 2003 the outbreak of severe acute respiratory syndrome (SARS) in some jurisdictions around the world highlighted a number of areas in healthcare planning that could be improved for dealing with such disasters. In Canada, one of the noted system challenges was the significant impact that an increase in the number of critically ill patients had on access to care and to other hospital services. Many jurisdictions have undertaken large-scale pandemic planning; however, there is a paucity of tools available to help hospitals deal with the day to day challenges of surges in patient volumes. As part of a larger comprehensive Critical Care Strategy designed to improve access to care, improve the quality of care and improve health system integration, and in partnership with hospitals and healthcare workers, the Ontario Ministry of Health and Long-Term Care designed and implemented a critical care Surge Capacity Management Program. Method(s): A review of the literature was completed to determine existing models for surge capacity planning. Surges were then classified as minor, moderate or major, depending upon the increase in demand above available services and the length of time a surge situation persisted. A framework was built to incorporate surge planning on five key elements: management, physical space, human resources, equipment and technology, and processes. A demonstration project to test the model was carried out in 18 hospitals. Hospitals collected data on patient flow processes across the organization in conjunction with daily data capture in the Critical Care Information System. Based on initial success, the program was approved for a province-wide implementation. Result(s): Critical Care Surge Resource Teams that included front-line care providers, and a senior team sponsor and a physician champion were formed to implement surge capacity plans using the standardized framework and tools. Hospitals developed plans to handle minor surges that involved increasing to 115% above their normal operating capacity. This program has involved 201 critical care units in 150 hospitals across the province. Conclusion(s): This program represents one of the largest implementations of a standardized Surge Capacity Program for managing critical care resources in a time of crisis. The program has seen practical use during the recent experience with H1N1 with improved access to care for patients.

102. Miller RR, Brown S, Enfield KB, et al. Overestimation of mortality by a sofa-based influenza triage tool compared to intensive care unit mortality experienced during the early 2009 novel H1N1 influenza epidemic in utah. American Journal of Respiratory and Critical Care Medicine Conference: American Thoracic Society International Conference, ATS. 2010;181(1 MeetingAbstracts).

ABSTRACT: Rationale: Pandemic influenza triage tools allocate healthcare resources during periods of extreme demand for critical care services. The 2006 Canadian tool uses a threshold Sequential Organ Failure Assessment (SOFA) score >11 to exclude patients from hospital admission, thereby assuming near 100% mortality in that group. We hypothesized that when applied to the early 2009 novel H1N1 influenza A outbreak, the Canadian triage tool would overestimate 30-day mortality for ICU patients with highest acuity at presentation (SOFA score >11). Method(s): Patients with any positive test for influenza A who spent at least 6 hours in one of 12 intensive care units (ICUs) at 9 Utah hospitals between April 1 and August 31, 2009 (n=76) were included in the analysis. We evaluated day 1 and day 3 SOFA scores (using SaO2/FiO2 ratio when PaO2 was unavailable) as predictors of 30-day mortality using univariate logistic regression and estimated model fit with area under the curve (AUC). We also evaluated thresholds proposed by the Canadian group, comparing 30-day mortality among patients with SOFA <8, 8-11, and >11. Result(s): Seventy-six critically ill patients had a median age of 40

(IQR 25-53), and 58% were female. Median ICU length of stay was 3.2 (1.2-10.2) days. Median day 1 and day 3 SOFA scores were 6.0 (3.8-10.3) and 7.0 (4.0-11.0), respectively. Thirty-day mortality was 11% (8/76 patients) in the total cohort. Day 1 SOFA >11 predicted 30-day mortality of 27% (4/15) with 95% confidence interval of 1.3% to 52.0% (AUC 0.85, p=0.002). Day 3 SOFA >11 predicted 30-day mortality among 46 patients still in the ICU of 36% (4/11) (AUC 0.88, p=0.01). Thirty day mortality rates for SOFA scores <8 and 8-11 are reported in the Table. Conclusion(s): Observed ICU mortality in epidemic novel H1N1 influenza infection in Spring 2009 was significantly lower than expected according to a SOFA-based pandemic influenza triage tool. Eleven critically ill patients on day 1 who survived would have been denied hospital treatment according to the triage tool if we had reached the highest triage level. Full deployment of the pandemic influenza triage tool deserves close scrutiny. (Table presented).

103. Sprung CL, Cohen R, Adini B. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. Intensive Care Med. 2010;36(SUPPL. 1):S1-S3.

104. Stroud C, Altevogt BM, Goldfrank LR. Institute of Medicine's Forum on Medical and Public Health Preparedness for Catastrophic Events: current initiatives. Disaster Med Public Health Prep. 2010;4(2):174-7. DOI: 10.1001/dmphp.4.2.174
ABSTRACT: It is only possible to achieve a resilient community and an integrated, comprehensive, and resilient health system that can respond effectively to a public health emergency through active collaboration, coordination, and shared responsibility among a broad group of public and private stakeholders and the community itself. The Institute of Medicine established the Forum on Medical and Public Health Preparedness for Catastrophic Events in 2007 to provide a neutral venue for dialogue and collaboration among stakeholders in the preparedness field. In the Forum's first year, the members began to address topics such as medical countermeasures dispensing, crisis standards of care, and medical surge capacity. In the past 9 months, the Forum members have expanded their areas of interest in response to current events and national areas of focus. Current topics include individual, family, and community preparedness and resiliency; medical countermeasures from development through dispensing; and the response to the 2009 H1N1 influenza pandemic. Across all of the initiatives undertaken by the Forum, the common element is that they tackle problems, gaps, and future opportunities that can only be successfully addressed if multiple stakeholders work together.
URL: https://www.ncbi.nlm.nih.gov/pubmed/20526141
DOI: 10.1001/dmphp.4.2.174

105. Frolic A, Kata A, Kraus P. Development of a critical care triage protocol for pandemic influenza: integrating ethics, evidence and effectiveness. Healthc Q. 2009;12(4):54-62. DOI: 10.12927/hcq.2009.21054
URL: https://www.ncbi.nlm.nih.gov/pubmed/20057230
DOI: 10.12927/hcq.2009.21054

106. Khan Z, Hulme J, Sherwood N. An assessment of the validity of SOFA score based triage in H1N1 critically ill patients during an influenza pandemic. Anaesthesia. 2009;64(12):1283-8. DOI: 10.1111/j.1365-2044.2009.06135.x
ABSTRACT: Sequential Organ Failure Assessment (SOFA) score based triage of influenza A H1N1 critically ill patients has been proposed for surge capacity management as a guide for clinical decision making. We conducted a retrospective records review and SOFA scoring of critically ill patients with influenza A H1N1 in a mixed medical-surgical intensive care unit in an urban hospital. Eight critically ill patients with influenza A H1N1 were admitted to the intensive care unit. Their mean (range) age was 39 (26-52) years with a length of stay of 11 (3-17) days. All patients met SOFA score based triage admission criteria with a modal SOFA score of five. Five patients required invasive ventilation for a mean (range) of 5 (4-11) days. Five patients would have been considered for withdrawal of treatment using SOFA scoring guidelines at 48 h. All patients survived. We conclude that SOFA score based triage could lead to withdrawal of life support in critically ill patients who could survive with an acceptably low length of stay in the intensive care unit.
URL: https://www.ncbi.nlm.nih.gov/pubmed/19860754
DOI: 10.1111/j.1365-2044.2009.06135.x

107. Lum ME, McMillan AJ, Brook CW, et al. Impact of pandemic (H1N1) 2009 influenza on critical care capacity in Victoria. Med J Aust. 2009;191(9):502-6.
ABSTRACT: OBJECTIVE: To describe the demand for critical care hospital admissions in Victoria resulting from the rapid rise in the number of pandemic (H1N1) 2009 influenza cases, and to describe the role of modelling tools to assist with the response to the pandemic. DESIGN AND SETTING: Prospective modelling with the tools FluSurge 2.0 and FluAid 2.0 (developed by the United States Centers for Disease Control and Prevention) over 12 weeks from when the pandemic

"Contain" Phase was declared on 22 May 2009, compared with data obtained from daily hospital reports of pandemic (H1N1) 2009 influenza-related admissions and transfers to intensive care units (ICUs). MAIN OUTCOME MEASURES: The effect on hospitals as projected by the FluAid 2.0 model compared with observed hospital admissions and ICU admissions. RESULTS: Prospective use of the FluAid 2.0 model provided valuable health intelligence for assessment and projection of hospitalisation and critical care demand through the first 10 weeks of the pandemic in Victoria. The observed rate of hospital admissions for pandemic (H1N1) 2009 was broadly consistent with a 5% gross clinical attack rate, with 0.3% of infected patients being hospitalised. Transfers to ICUs occurred at a rate of 20% of hospital admissions, and were associated with vulnerable patient groups, and severe respiratory failure in 82% of patients admitted to ICUs. Most patients treated in ICUs (85%) survived after an average ICU length of stay of 9 days (SD, 6.5 days). Mechanical ventilation was required by 72% of patients admitted to ICUs, and extracorporeal membrane oxygenation (ECMO) was used for 7%. Pre-existing haematological malignancy accounted for half of all the deaths in patients admitted to ICUs with pandemic (H1N1) 2009 influenza. CONCLUSIONS: Prospective use of modelling tools informed critical decisions in the planning and management of the pandemic. Early estimation of the clinical attack rate, hospitalisation rates, and demand for ICU beds guided implementation of surge capacity. ECMO emerged as an important treatment modality for pandemic (H1N1) 2009 influenza, and will be an important consideration for future pandemic planning.
URL: https://www.ncbi.nlm.nih.gov/pubmed/19883346

108. Barr HL, Macfarlane JT, Macgregor O, et al. Ethical planning for an influenza pandemic. Clin Med (Lond). 2008;8(1):49-52. DOI: 10.7861/clinmedicine.8-1-49
ABSTRACT: A U.K. Pandemic Influenza Contingency Plan was developed in 2006 but little research has since been carried out as to how ethically acceptable it will be to society. A survey containing two hypothetical scenarios was distributed to 1,018 hospital staff. The survey considered their attitudes to the professional and ethical responsibilities of healthcare workers, and to resource allocation on the intensive care unit (ICU). Of those distributed, 406 (40%) surveys were returned. During a pandemic, 320 (79%) healthcare professionals would continue to work and 339 (83%) felt it would be unprofessional for doctors to leave work. Only 218 (54%) chose the same patient for the last ICU bed. Most staff surveyed felt they should (professionally) and would (voluntarily) work during a pandemic despite high personal risk. A wide diversity of opinion existed regarding resource allocation of ICU beds. These ethical issues require open debate to ensure U.K. pandemic plans are ethically acceptable and practically applicable.
URL: https://www.ncbi.nlm.nih.gov/pubmed/18335669
DOI: 10.7861/clinmedicine.8-1-49

109. Devereaux A, Christian MD, Dichter JR, et al. Summary of suggestions from the Task Force for Mass Critical Care summit, January 26-27, 2007. Chest. 2008;133(5 Suppl):1S-7S. DOI: 10.1378/chest.08-0649
ABSTRACT: This Supplement on the management of mass critical care for ill patients represents the consensus opinion of a multidisciplinary panel convened under the umbrella of the Critical Care Collaborative Initiative. Expert recommendations on this subject are needed. Most countries have insufficient critical care staff, medical equipment, and ICU space to provide timely, usual critical care to a surge of critically ill victims. If a mass casualty critical care event were to occur tomorrow, many people with clinical conditions that are survival under usual health-care system conditions may have to forgo life-sustaining interventions owing to deficiencies in supply or staffing. As a result, US and Canadian authorities^{1,2} have called for the development of comprehensive plans for managing mass casualty events, particularly for the provision of critical care. This Supplement includes the following: (1) a review of current US and Canadian baseline critical care preparedness and response capabilities and limitations, (2) a suggested framework for critical care surge capacity, (3) suggestions for minimum resources ICUs will need for mass critical care, and (4) a suggested framework for allocation of scarce critical care resources when critical care surge capacity remains insufficient to meet need. This Supplement is intended to aid clinicians and disaster planners in providing a coordinated and uniform response to mass critical care. Mass casualty events occur frequently worldwide.³ Fortunately, the vast majority of these do not generate overwhelming numbers of critically ill victims. Attention to mass critical care, however, has been stimulated by the severe acute respiratory syndrome epidemic of 2002-2003,^{4,5} recent natural disasters, concern for intentional catastrophes, and the looming threat of a serious influenza pandemic.^{1,6-11} To guide preparedness for such events, the Task Force for Mass Critical Care (hereafter referred to as the Task Force) was convened. It comprised 37 experts from fields including bioethics, critical care, disaster preparedness and response, emergency medical services, emergency medicine, infectious diseases, hospital medicine, law, military medicine, nursing, pharmacy, respiratory care, and local, state, and federal government planning and response. Several members of the Critical Care Collaborative (http://www.chestnet.org/institutes/cci/ccc.php) initiated the project and assembled a steering committee for project

development and administration. Members of this steering committee included representatives from the organizational members of the Critical Care Collaborative as well as several unaffiliated North American disaster experts. This steering committee then selected members of the broader Task Force on the basis of their expertise and experience.
URL: https://www.ncbi.nlm.nih.gov/pubmed/18460502
DOI: 10.1378/chest.08-0649

110. Felland LE, Katz A, Liebhaber A, et al. Developing health system surge capacity: community efforts in jeopardy. Res Brief. 2008(5):1-8.
ABSTRACT: Since Sept. 11, 2001, communities have responded to the federal call to enhance health care surge capacity–the space, supplies, staffing and management structure to care for many injured or ill people during a terrorist attack, natural disaster or infectious disease pandemic. Communities with varied experience handling emergencies are building broad surge capacity, including transportation, communication, hospital care and handling mass fatalities, according to a new study by the Center for Studying Health System Change (HSC). Communities rely on federal funding to help coordinate and plan across agencies and providers, conduct training and drills, recruit volunteers, and purchase equipment and stockpile supplies. The current federal focus on pandemic influenza has helped prepare for all types of emergencies, although at times communities struggle with fragmented and restrictive funding requirements. Despite progress, communities face an inherent tension in developing surge capacity. The need for surge capacity has increased at the same time that daily health care capacity has become strained, largely because of workforce shortages, reimbursement pressures and growing numbers of uninsured people. Payers do not subsidize hospitals to keep beds empty for an emergency, nor is it practical for trained staff to sit idle until a disaster hits. To compensate, communities are trying to develop surge capacity in a manner that supports day-to-day activities and stretches existing resources in an emergency. Many of these efforts--including integrating outpatient providers, expanding staff roles and adapting standards of care during a large-scale emergency--require greater coordination, guidance and policy support. As time passes since 9/11 and Hurricane Katrina, federal funding for surge capacity has waned, and communities are concerned about losing surge capacity they have built.
URL: https://www.ncbi.nlm.nih.gov/pubmed/18630400

111. Joynt GM, Gomersall CD. SARS, Bird Flu and other scares - Epidemic and pandemic preparedness in intensive care. Southern African Journal of Anaesthesia and Analgesia. 2008;14(1):74-8.
ABSTRACT: Intensive care units are expensive facilities and as a consequence intensive care units are usually maximally utilised. An additional requirement for intensive care facilities is likely to occur during an epidemic. Any additional requirement has the potential to overwhelm existing intensive care resources and therefore it may become necessary to rapidly increase the capability of existing intensive care facilities. The lack of preparedness and proper procedures to facilitate urgent expansion of intensive care unit (ICU) facilities during severe acute respiratory syndrome (SARS) was exposed during the outbreak, and several lessons have been learned. Recommendations for adequate expansion are made on the basis that a reasonable standard of ICU care will be maintained. An assessment of the need for additional staff is made, however, it is unlikely that expansion beyond an additional 60% of current capacity will be possible, based primarily on the necessity for suitably qualified nurses. There is a requirement for prospective training of anticipated additional staff, as well as the establishment of infection control procedures, good communication procedures and the resolution of anticipated ethical dilemmas. Certain other preparations for expansion should also be completed in advance. These specifically include the fit testing of negative pressure respirators, sourcing of material and designs that will allow physical modifications to the ICU and additional equipment supply sourcing, bearing in mind that supply companies will be under pressure from more than one end-user.

112. Lotstein D, Seid M, Ricci K, et al. Using quality improvement methods to improve public health emergency preparedness: PREPARE for Pandemic Influenza. Health Aff (Millwood). 2008;27(5):w328-39. DOI: 10.1377/hlthaff.27.5.w328
ABSTRACT: Many public health departments seek to improve their capability to respond to large-scale events such as an influenza pandemic. Quality improvement (QI), a structured approach to improving performance, has not been widely applied in public health. We developed and tested a pilot QI collaborative to explore whether QI could help public health departments improve their pandemic preparedness. We demonstrated that this is a promising model for improving public health preparedness and may be useful for improving public health performance overall. Further efforts are needed, however, to encourage the robust implementation of QI in public health.
URL: https://www.ncbi.nlm.nih.gov/pubmed/18628274
DOI: 10.1377/hlthaff.27.5.w328

113. Rebmann T. Preparing for pandemic influenza. J Perinat Neonatal Nurs. 2008;22(3):191-202; quiz 3-4. DOI: 10.1097/01.JPN.0000333919.22705.2e
ABSTRACT: Influenza is a highly contagious, acute febrile respiratory illness that results in global morbidity and mortality annually. Avian influenza (H5N1) has the potential to cause a pandemic. Avian influenza's epidemiology and clinical description, including common signs/symptoms, transmission, vaccination, and treatment, are presented. Recommended isolation practices for labor and delivery, and proper procedures for identifying and managing infected patients are provided. Potential maternal and newborn outcomes related to influenza and avian influenza are discussed. Pandemic planning issues are outlined, including hospital surge capacity, medical equipment and staffing availability, and the need for altered standards of care. Communities need to designate sites (whether in hospital or in alternative care centers) for labor and delivery services as part of their disaster plan. Pregnant women and newborns are vulnerable groups during routine times and are expected to be disproportionately affected during a pandemic in terms of morbidity and mortality. Therefore, it is essential that hospitals and communities take steps to protect these vulnerable groups as part of the disaster planning process. It is not known whether or when a pandemic will occur, but perinatal and neonatal nurses should become familiar with avian influenza's clinical description and proper infection control procedures to halt potential disease spread.
URL: https://www.ncbi.nlm.nih.gov/pubmed/18708870
DOI: 10.1097/01.JPN.0000333919.22705.2e

114. Stukel TA, Schull MJ, Guttmann A, et al. Health impact of hospital restrictions on seriously ill hospitalized patients: lessons from the Toronto SARS outbreak. Med Care. 2008;46(9):991-7. DOI: 10.1097/MLR.0b013e3181792525
ABSTRACT: BACKGROUND: Restrictions on non-urgent hospital care imposed to control the 2003 Toronto severe acute respiratory syndrome outbreak led to substantial disruptions in hospital clinical practice, admission, and transfer patterns. OBJECTIVES: We assessed whether there were unintended health consequences to seriously ill hospitalized patients. STUDY DESIGN, SETTING, AND POPULATION: Population-based longitudinal cohort study of patients residing in Toronto or an urban control region with an incident admission for 1 of 7 serious conditions in the 3 years before, or the 4 months during or after restrictions. OUTCOME MEASURES: Short-term mortality, overall readmissions, cardiac readmissions for acute myocardial infarction patients, serious complications for very low birth weight babies, and quality of care measures, comparing adjusted rates across time periods within regions. RESULTS: Mortality, readmission, and complication rates did not change for any condition during or after severe acute respiratory syndrome restrictions. Although rates of invasive cardiac procedures for acute myocardial infarction patients decreased 11-37% in Toronto, rates of nonfatal cardiac outcomes did not change. CONCLUSIONS: Restrictions on non-urgent hospital utilization and hospital transfers may be a safe public health strategy to employ to control nosocomial outbreaks or provide hospital surge capacity for up to several months, in large, well-developed healthcare systems with good availability of community-based care.
URL: https://www.ncbi.nlm.nih.gov/pubmed/18725855
DOI: 10.1097/MLR.0b013e3181792525

115. Challen K, Bentley A, Bright J, et al. Clinical review: mass casualty triage--pandemic influenza and critical care. Crit Care. 2007;11(2):212. DOI: 10.1186/cc5732
ABSTRACT: Worst case scenarios for pandemic influenza planning in the US involve over 700,000 patients requiring mechanical ventilation. UK planning predicts a 231% occupancy of current level 3 (intensive care unit) bed capacity. Critical care planners need to recognise that mortality is likely to be high and the risk to healthcare workers significant. Contingency planning should, therefore, be multi-faceted, involving a robust health command structure, the facility to expand critical care provision in terms of space, equipment and staff and cohorting of affected patients in the early stages. It should also be recognised that despite this expansion of critical care, demand will exceed supply and a process for triage needs to be developed that is valid, reproducible, transparent and consistent with distributive justice. We advocate the development and validation of physiological scores for use as a triage tool, coupled with candid public discussion of the process.
URL: https://www.ncbi.nlm.nih.gov/pubmed/17490495
DOI: 10.1186/cc5732

116. Asplin BR, Flottemesch TJ, Gordon BD. Developing models for patient flow and daily surge capacity research. Acad Emerg Med. 2006;13(11):1109-13. DOI: 10.1197/j.aem.2006.07.004
ABSTRACT: Between 1993 and 2003, visits to U.S. emergency departments (EDs) increased by 26%, to a total of 114 million visits annually. At the same time, the number of U.S. EDs decreased by more than 400, and almost 200,000 inpatient hospital beds were taken out of service. In this context, the adequacy of daily surge capacity within the system is clearly an

important issue. However, the research agenda on surge capacity thus far has focused primarily on large-scale disasters, such as pandemic influenza or a serious bioterrorism event. The concept of daily surge capacity and its relationship to the broader research agenda on patient flow is a relatively new area of investigation. In this article, the authors begin by describing the overlap between the research agendas on daily surge capacity and patient flow. Next, they propose two models that have potential applications for both daily surge capacity and hospitalwide patient-flow research. Finally, they identify potential research questions that are based on applications of the proposed research models.
URL: https://www.ncbi.nlm.nih.gov/pubmed/17015412
DOI: 10.1197/j.aem.2006.07.004

117. Parker MM. Critical care and disaster management. Crit Care Med. 2006;34(3 Suppl):S52-5. DOI: 10.1097/01.CCM.0000199988.96002.CC
ABSTRACT: BACKGROUND: In recent years, there has been a great deal of attention paid to preparing the healthcare system to handle disasters, in particular terrorist events. Most of the attention has focused on the first responders and the initial emergency management. Depending on the nature of the disaster, however, large numbers of patients may be critically ill. DISCUSSION: In a contagious event, there may be a continuous stream of new patients requiring critical care support, overwhelming our current intensive care unit capacity. Planning needs to start now to develop processes that will enable us to expand our intensive care unit capacity, and likely adapt our standard of care, in the event that a natural or man-made disaster results in two, three, or more times the number of critically ill patients than our system can currently handle. Using the processes and resources we are currently using to improve patient safety can provide a framework for developing the necessary processes. CONCLUSION: The Society of Critical Care Medicine (SCCM) can provide valuable expertise and educational programs to facilitate the needed disaster management planning.
URL: https://www.ncbi.nlm.nih.gov/pubmed/16477203
DOI: 10.1097/01.CCM.0000199988.96002.CC

118. Schull MJ, Stukel TA, Vermeulen MJ, et al. Surge capacity associated with restrictions on nonurgent hospital utilization and expected admissions during an influenza pandemic: lessons from the Toronto severe acute respiratory syndrome outbreak. Acad Emerg Med. 2006;13(11):1228-31. DOI: 10.1197/j.aem.2006.04.011
ABSTRACT: BACKGROUND: Current influenza pandemic models predict a surge in influenza-related hospitalizations in affected jurisdictions. One proposed strategy to increase hospital surge capacity is to restrict elective hospitalizations, yet the degree to which this measure would meet the anticipated is unknown. OBJECTIVES: To compare the reduction in hospitalizations resulting from widespread nonurgent hospital admission restrictions during the Toronto severe acute respiratory syndrome (SARS) outbreak with the expected increase in admissions resulting from an influenza pandemic in Toronto. METHODS: The authors compared the expected influenza-related hospitalizations in the first eight weeks of a mild, moderate, or severe pandemic with the actual reduction in the number of hospital admissions in Toronto, Ontario, during the first eight weeks of the SARS-related restrictions. RESULTS: Influenza modeling for Toronto predicts that there will be 4,819, 8,032, or 11,245 influenza-related admissions in the first eight weeks of a mild, moderate, or severe pandemic, respectively. In the first eight weeks of SARS-related hospital admission restrictions, there were 3,654 fewer hospitalizations than expected in Toronto, representing a modest 12% decrease in the overall admission rate (a reduction of 1.40 admissions per 1,000 population). Therefore, influenza-related admissions could exceed the reduction in admissions resulting from restricted hospital utilization by 1,165 to 7,591 patient admissions, depending on pandemic severity, which corresponds to an excess of 0.44 to 2.91 influenza-related admissions per 1,000 population per eight weeks, and an increase of 4% to 25% in the overall number of admissions, when compared with nonpandemic conditions. CONCLUSIONS: Pandemic modeling for Toronto suggests that influenza-related admissions would exceed the reduction in hospitalizations seen during SARS-related nonurgent hospital admission restrictions, even in a mild pandemic. Sufficient surge capacity in a pandemic will likely require the implementation of other measures, including possibly stricter implementation of hospital utilization restrictions.
URL: https://www.ncbi.nlm.nih.gov/pubmed/16807399
DOI: 10.1197/j.aem.2006.04.011

119. Menon DK, Taylor BL, Ridley SA, et al. Modelling the impact of an influenza pandemic on critical care services in England. Anaesthesia. 2005;60(10):952-4. DOI: 10.1111/j.1365-2044.2005.04372.x
ABSTRACT: The UK Influenza Pandemic Contingency Plan does not consider the impact of a pandemic on critical care services. We modelled the demand for critical care beds in England with software developed by the Centers for Disease Control (Flusurge 1.0), using a range of attack rates and pandemic durations. Using inputs that have been employed in UK

Department of Health scenarios (25% attack rate and 8-week pandemic duration) resulted in a demand for ventilatory support that exceeded 200% of present capacity. Demand remained unsustainably high even when more favourable scenarios were considered. Current critical care bed capacity in England would be unable to cope with the increased demand provided by an influenza pandemic. Appropriate contingency planning is essential.
URL: https://www.ncbi.nlm.nih.gov/pubmed/16179037
DOI: 10.1111/j.1365-2044.2005.04372.x

120. Anderson TA, Hart GK, Kainer MA, et al. Pandemic influenza-implications for critical care resources in Australia and New Zealand. J Crit Care. 2003;18(3):173-80. DOI: 10.1016/j.jcrc.2003.08.008
ABSTRACT: OBJECTIVES: To quantify resource requirements (additional beds and ventilator capacity), for critical care services in the event of pandemic influenza. MATERIALS AND METHODS: Cross-sectional survey about existing and potential critical care resources. Participants comprised 156 of the 176 Australasian (Australia and New Zealand) critical care units on the database of the Australian and New Zealand Intensive Care Society (ANZICS) Research Centre for Critical Care Resources. The Meltzer, Cox and Fukuda model was adapted to map a range of influenza attack rate estimates for hospitalisation and episodes likely to require intensive care and to predict critical care admission rates and bed day requirements. Estimations of ventilation rates were based on those for community-acquired pneumonia. RESULTS: The estimated extra number of persons requiring hospitalisation ranged from 8,455 (10% attack rate) to 150,087 (45% attack rate). The estimated number of additional admissions to critical care units ranged from 423 (5% admission rate, 10% attack rate) to 37,522 (25% admission rate, 45% attack rate). The potential number of required intensive care bed days ranged from 846 bed days (2 day length of stay, 10% attack rate) to 375,220 bed days (10 day length of stay, 45% attack rate). The number of persons likely to require mechanical ventilation ranged from 106 (25% of projected critical care admissions, 10% attack rate) to 28,142 (75% of projected critical care admissions, 45% attack rate). An additional 1,195 emergency ventilator beds were identified in public sector and 248 in private sector hospitals. Cancellation of elective surgery could release a potential 76,402 intensive care bed days (per annum), but in the event of pandemic influenza, 31,150 bed days could be required over an 8- to 12-week period. CONCLUSION: Australasian critical care services would be overwhelmed in the event of pandemic influenza. More work is required in relation to modelling, contingency plans, and resource allocation.
URL: https://www.ncbi.nlm.nih.gov/pubmed/14595570
DOI: 10.1016/j.jcrc.2003.08.008

SEARCH STRATEGIES

Ovid MEDLINE(R) ALL <1946 to December 03, 2020>

#	Searches	Results
1	(coronavirus/ or betacoronavirus/ or coronavirus infections/) and (disease outbreaks/ or epidemics/ or pandemics/)	39561
2	(nCoV* or 2019nCoV or 19nCoV or COVID19* or COVID or SARS-COV-2 or SARSCOV-2 or SARSCOV2 or Severe Acute Respiratory Syndrome Coronavirus 2 or Severe Acute Respiratory Syndrome Corona Virus 2).ti,ab,kf,nm,ox,rx,px.	78302
3	((new or novel or "19" or "2019" or Wuhan or Hubei or China or Chinese) adj3 (coronavirus* or corona virus* or betacoronavirus* or CoV or HCoV)).ti,ab,kf.	26009
4	((coronavirus* or corona virus* or betacoronavirus*) adj3 (pandemic* or epidemic* or outbreak* or crisis)).ti,ab,kf.	5179
5	((Wuhan or Hubei) adj5 pneumonia).ti,ab,kf.	277
6	SARS virus/ or Severe Acute Respiratory Syndrome/ or Middle East Respiratory Syndrome Coronavirus/	8291
7	(SARSCOV* or Severe Acute Respiratory Syndrome* or sudden acute respiratory syndrome* or SARS like or MERSCoV* or Middle East Respiratory or camel flu or EMC 2012).ti,ab,kf.	16063
8	((SARS or MERS) adj5 (virus* or coronavirus* or betacoronavirus* or CoV or CoV2 or HCoV or pandemic or epidemic or outbreak* or infect* or respiratory or pathogen*)).ti,ab,kf.	33056
9	*pandemics/	20413

10	pandemic*.ti.	25812
11	((flu or influenza*) adj3 (pandemic* or epidemic*)).ti,ab,kf.	14804
12	or/1-11	108000
13	Surge Capacity/	319
14	(surge capacity or overcapacity or "at capacity").ti,ab,kf.	802
15	((peak or max* or critical or over or beyond or exceed* or resource? or patient? or healthcare or health care or hospital or clinic* or ICU or CCU or critical care or intensive care or triage) adj2 capacity).ti,ab,kf.	26826
16	(surge adj2 (plan* or model* or frame* or policy or policies or procedure? or protocol? or response? or preparation? or preparedness)).ti,ab,kf.	311
17	((emerg* or crisis or disaster or pandemic or epidemic or hospital or ICU or CCU or critical care or intensive care or acute care or health system or healthcare) adj1 preparedness).ti,ab,kf.	4723
18	((critical care or intensive care or ICU or CCU or pandemic or epidemic) adj2 (resourcing or resource allocation or staffing or workforce or manpower or redeployment or ration* or (staff adj1 allocat*))).ti,ab,kf.	491
19	13 or 14 or 15 or 16 or 17 or 18	32804
20	exp Quality Indicators, Health Care/ or Outcome Assessment, Health Care/ or *"Quality of Health Care"/	129337
21	((quality adj2 indicator?) or (quality adj2 healthcare) or (quality adj2 care) or health metric? or healthcare metric? or (standard? adj2 care) or (assess* adj2 outcome?)).ti,ab,kf.	172021
22	20 or 21	276570
23	exp treatment outcome/	1077687
24	((patient or patient-relevant or treatment) adj outcome?).ti,ab,kf.	107023
25	(clinical effectiveness or clinical efficacy).ti,ab,kf.	48211
26	treatment fail*.ti,ab,kf.	31039
27	("length of stay" or fatal* ratio? or patient pathway? or (patient adj1 (flow or throughput))).ti,ab,kf.	63756
28	((critical care or intensive care or ICU or CCU or critical* ill*) adj2 (pathway? or framework? or protocol? or process* or standard* or benchmark*)).ti,ab,kf.	1476
29	23 or 24 or 25 or 26 or 27 or 28	1254411
30	12 and 19	1765
31	30 and 22	61
32	30 and 29	62
33	31 or 32	113
34	from 33 keep 1-2, 4-10, 16-17, 19, 21-22, 24...	62
35	contingency plan*.ti,ab,kf.	856
36	12 and 35	149
37	((intensive or critical) adj care).ti,ab,kf.	173452
38	(ICU or CCU or critical* ill*).ti,ab,kf.	101822
39	37 or 38	220813
40	36 and 39	21
41	from 34 keep 1-62	62
42	from 40 keep 1-2, 8-9, 11, 15-16, 19	8

Embase <1974 to 2020 December 03>

#	Searches	Results

1	sars-related coronavirus/	468
2	(coronavirinae/ or betacoronavirus/ or coronavirus infection/) and (epidemic/ or pandemic/)	10783
3	(nCoV* or 2019nCoV or 19nCoV or COVID19* or COVID or SARS-COV-2 or SARSCOV-2 or SARS-COV2 or SARSCOV2 or Severe Acute Respiratory Syndrome Coronavirus 2 or Severe Acute Respiratory Syndrome Corona Virus 2).ti,ab,kw,hw,ot.	75834
4	((new or novel or "19" or "2019" or Wuhan or Hubei or China or Chinese) adj3 (coronavirus* or corona virus* or betacoronavirus* or CoV or HCoV)).ti,ab,kw,hw,ot.	71886
5	((coronavirus* or corona virus* or betacoronavirus*) adj3 (pandemic* or epidemic* or outbreak* or crisis)).ti,ab,kw,ot.	4918
6	((Wuhan or Hubei) adj5 pneumonia).ti,ab,kw,ot.	329
7	(SARS coronavirus/ or severe acute respiratory syndrome/ or Middle East respiratory syndrome coronavirus/) and (epidemic/ or pandemic/)	4437
8	(SARSCOV* or Severe Acute Respiratory Syndrome* or sudden acute respiratory syndrome* or SARS like or MERSCoV* or Middle East Respiratory or camel flu or EMC 2012).ti,ab,kw.	16403
9	((SARS or MERS) adj5 (virus* or coronavirus* or betacoronavirus* or CoV or CoV2 or HCoV or pandemic or epidemic or outbreak* or infect* or respiratory or pathogen*)).ti,ab,kw.	33065
10	*pandemic/	19193
11	pandemic*.ti.	26889
12	((flu or influenza*) adj3 (pandemic* or epidemic*)).ti,ab,kw.	16714
13	or/1-12	111809
14	surge capacity/	468
15	(surge capacity or overcapacity or "at capacity").ti,ab,kw.	1055
16	((peak or max* or critical or over or beyond or exceed* or resource? or patient? or healthcare or health care or hospital or clinic* or ICU or CCU or critical care or intensive care or triage) adj2 capacity).ti,ab,kw.	36090
17	(surge adj2 (plan* or model* or frame* or policy or policies or procedure? or protocol? or response? or preparation? or preparedness)).ti,ab,kw.	370
18	((emerg* or crisis or disaster or pandemic or epidemic or hospital or ICU or CCU or critical care or intensive care or acute care or health system or healthcare) adj1 preparedness).ti,ab,kw.	5396
19	((critical care or intensive care or ICU or CCU or pandemic or epidemic) adj2 (resourcing or resource allocation or staffing or workforce or manpower or redeployment or ration* or (staff adj1 allocat*))).ti,ab,kw.	841
20	or/14-19	43299
21	exp *health care quality/	565240
22	((quality adj2 indicator?) or (quality adj2 healthcare) or (quality adj2 care) or health metric? or healthcare metric? or (standard? adj2 care) or (assess* adj2 outcome?)).ti,ab,kw.	267857
23	((patient or patient-relevant or treatment) adj outcome?).ti,ab,kw.	169652
24	(clinical effectiveness or clinical efficacy).ti,ab,kw.	73606
25	treatment fail*.ti,ab,kw.	48132
26	("length of stay" or fatal* ratio? or patient pathway? or (patient adj1 (flow or throughput))).ti,ab,kw.	118688
27	((critical care or intensive care or ICU or CCU or critical* ill*) adj2 (pathway? or framework? or protocol? or process* or standard* or benchmark*)).ti,ab,kw.	2508

28	or/21-27	1141000
29	contingency plan*.ti,ab,kw.	1147
30	(((intensive or critical) adj care) or (ICU or CCU or critical* ill*)).ti,ab,kw.	353652
31	29 and 30	73
32	13 and 20 and 28	181
33	31 or 32	250
34	limit 33 to medline	81
35	33 not 34	169

Other Strategies in Various Combinations:

(surge capacity|over capacity) AND ("quality of care" | care quality) AND strain AND COVID

(peak OR maximum OR critical OR beyond OR exceeding) capacity

(critical care OR intensive care OR ICU or CCU or critically ill or critical illness)

(quality indicators OR quality of care OR quality of healthcare OR standard of care)

(clinical outcomes OR treatment outcomes OR treatment failure OR fatal/fatality ratio? Or patient flow or patient pathway or patient throughput)

(resourcing OR staffing OR rationing OR manpower OR redeployment OR staff allocation OR resource allocation)

(emergency preparedness)