Rapid Review Report

Review Title:	**At what level of surge capacity do quality of care indicators suffer?**
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Key Findings

- No studies directly evaluated the association between level of surge capacity and quality of care indicators for COVID-19 patients. However, in more broad studies, the findings suggest that mortality and other adverse events increase when the strain on the intensive care capacity increases.
  - A tiered staffing strategy is recommended to meet surge capacity needs in the ICU: High critical care nurse to patient ratios (1:1 or 1:2) are recommended to provide high quality patient care.
- There is a lack of high-quality evidence to support ICU triage protocols tailored for patients with COVID-19. Nevertheless, the protocols must be flexible, adaptable according to the availability of local resources, and effective for

inter-hospital patient transfer.

- While the Crisis Standards of Care (CSC) guidelines (e.g., Saskatchewan's Critical Care Resource Allocation Framework, published on September 2020) can be used to triage newly admitted COVID-19 patients requiring critical care, there is contradicting evidence about using the Sequential Organ Failure Assessment (SOFA) score for ICU triage of patients with COVID-19.
- The literature suggests the use of mathematical modeling to support capacity planning (e.g., very low, low, medium, and high intensity patient surge response)
- To relieve pressure from ICUs, other types of units (e.g., Step Down Unit [SDU] or Surge Clinic) can be implemented.

Limitations

- This rapid review focused on medical comorbidities as decision criteria for hospitalization and ICU resource allocation. Other factors including socioeconomic status, people with disabilities, rural or urban residence, and access to health care system were out of the scope of this review.
- Some studies were available as pre-prints and had not been peer reviewed.
- Due to the nature of rapid review, the methodology or findings of the studies were not critically appraised.

GRADE of Evidence:

Select - This field is mandatory

Select - This field is mandatory

For more information about how this rating was determined, visit https://www.essentialevidenceplus.com/product/ebm_loe.cfm?show=grade

A formal assessment of the quality of the evidence has not been performed for this review. Users are advised to consider this additional limitation when considering the key findings.

Background/Context

The surges in the number of patients with COVID-19 infection has strained health care systems around the world. Appropriate screening and triage to determine which patients need hospitalization, in particular intensive care, and which patients need ambulatory or outpatient care (e.g., self-isolation and public health monitoring) is essential in providing safe care and allocating scarce intensive care unit resources appropriately to patients most in need. Triage should be considered as a last resort when all available options including moving patients to areas with resources have been leveraged. The principles of critical care triage should be ethical and appreciate the complexity of decision-making in limited resource situations. One area to be explored is the impact of surges in the number of critically ill patients on the standard and quality of care provided to the patients who are or may become critically ill.

Purpose

The review was requested to understand when or if the health care system is over capacity (e.g., 200% or 300% over capacity) and health care facilities must triage COVID patients, at what level of surge the care suffers? The focus of the review is on adults and the medical conditions leading to hospitalizations. The review seeks for allocation frameworks when the critical care resources and ICU admissions are limited.

Review Question(s)

At what level of surge capacity do quality of care indicators suffer?
Is there any scoring system for admitting patients with COVID when the surge capacity happens?

Method

For each Rapid Review, the initial question is posed by a decision-maker in the health care system seeking the evidence base for a specific policy decision. According to the subject of the question, the Evidence Task Group Intake Committee allocates this question to the appropriate Working Group. Each Working Group comprises a librarian, researcher, 1-2 clinicians, 1-2 subject matter experts, and a group leader. The Working Group and the decision-maker first discuss the question to ensure it was articulated in a clear, searchable manner. The search strategy is developed and executed by a team of medical librarians. The search is conducted in biomedical databases and also includes extensive grey literature searching. Reference lists are also reviewed for articles that may have been missed in the primary search. See Appendix for more details on the search strategies. An Evidence Search Report is thereby created. A Rapid Review of the identified literature is then performed by the researcher using the methods of a systematic review, but without a double review or meta-analysis and in a more rapid fashion. Relevant evidence is summarized in both tabular and narrative form, key findings and limitations articulated, and the quality of the body of evidence evaluated using the GRADE hierarchy. The draft Rapid Review is reviewed and edited by the Working Group clinicians, experts, and leader. Once revisions are complete, the Rapid Review is submitted to the requesting decision-maker and placed in the COVID-19 Repository. For certain topics with rapidly changing evidence, after a period of time an updated evidence search is performed, the review process repeated, and an updated Rapid Review released.

Summary of Evidence

After the initial literature search and environmental scan, 124 articles, 4 guidelines, 4 tools, and 2 summaries (i.e., 134 sources of evidence) were considered for the rapid review. Of 133 resources, 55

were evaluated in more detail since they were related to COVID-19 pandemic and/or their contents were relevant to the research question of this rapid review.

Many jurisdictions have defined the relation between surge capacity and triage levels based on their local needs and contexts (1-7). It is anticipated that during a standard surge, hospitals can tolerate up to a 20% increase in critical care needs with minimal impact (8,9). However, the standard of care suffers when the critical care needs increase drastically (e.g., 200% of normal capacity), especially when the expansions in resources such as space, equipment, and staff have not been foreseen (8-10). If this happens, critical care triage is needed (10, 11). In Saskatchewan, Valiani et al have developed Saskatchewan's Critical Care Resource Allocation Framework with four triage stages when the strain on the ICU capacity ranges from 100 to >250% of the baseline (3). Saskatchewan's framework is largely based on the Ontario Health Plan for an Influenza Pandemic (OHPIP) (12) and considers relative scarcity of resources in including or excluding patients from ICU care (3). Another example is the Emergency Triage in a Pandemic: Ventilator Allocation Framework published by the British Columbia Critical Care Services, in which the surge levels are stratified into three categories: Low (up to 15% above full census), Medium (up to 25% above full census), and High (25% to 40% above full census) (7). The Emergency Triage Status will be then used when the surge capacity is at High level (40%). Ontario Health in its Clinical Triage Protocol for Major Surge in COVID Pandemic categorizes the surge capacities into three classes: minor (conventional) from 100 to 115%; moderate (contingency) from 115 to 130%; and major (crisis) from 130 to 200% surge of normal capacity (Figure 1). The 200% limit of capacity is arbitrary and can fluctuate due to availability of staff, space, and equipment. They describe three levels of triage during the major surge (i.e., 130 to 200% of normal capacity) (6). As the surge capacity reaches to its limit (200%), the level of triage and the degree of restriction increase.

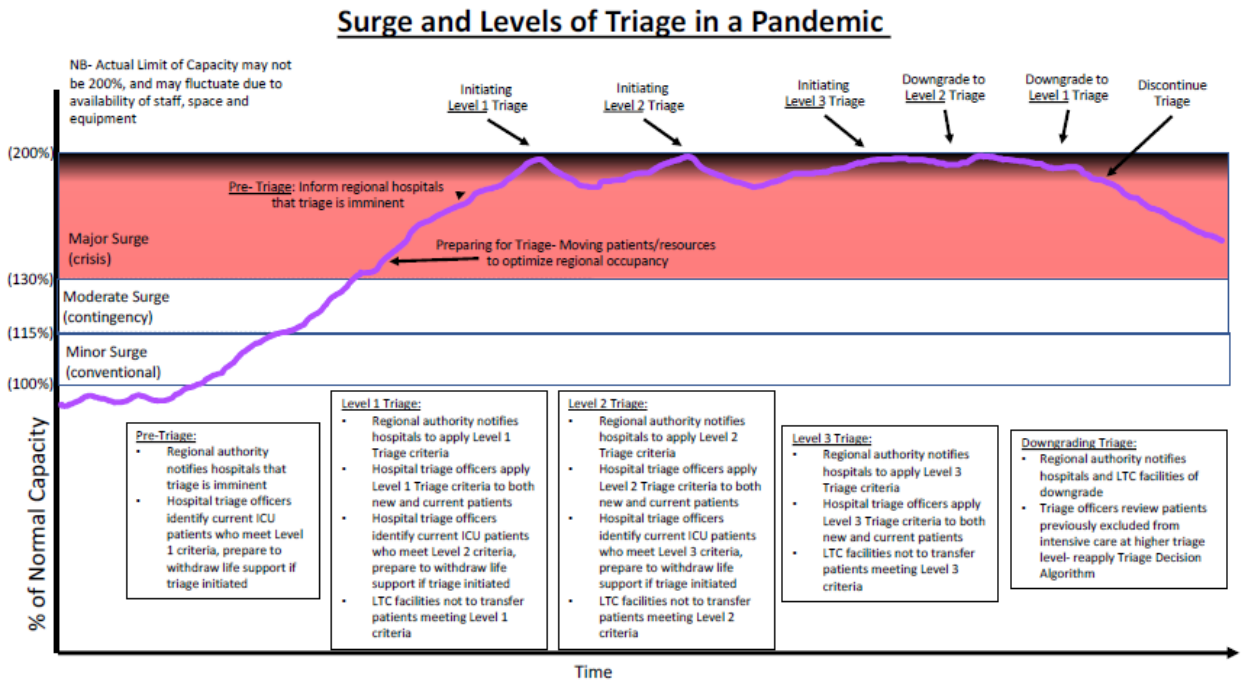

Figure 1 Ontario Health: Surge and Levels of Triage in a Pandemic

The level 1 triage scenario aims to exclude people with >~80% predicted mortality, while the level 2 and 3 triage scenarios aim to exclude people with >~50% and >~30% predicted mortality, respectively. For more details about the triage criteria, please review the corresponding references (3, 6, 7).

Various studies recommend the use of Crisis Standards of Care (CSC) guidelines during times the health care system is under stress caused by situations such as the COVID-19 pandemic (13-20). These guidelines change the conventional criteria used to prioritize or withhold critical care admissions. For example, the Adult and Pediatric Critical Care Algorithms (Figure 2) developed by the Washington State Department of Health are to be used by "Triage Teams" during the declaration of crisis standards of care. The Algorithm should be used alongside the accompanying Worksheet to determine appropriate inclusion or exclusion criteria for ICU admissions. A "Triage Team" should consist of senior medical personnel, preferably not the ones directly involved in the individual's care (3, 20). The Saskatchewan Critical Care Resource Allocation Framework recommends 2 intensivists and an ethicist, ideally representing at least 2 geographic locations, be included in the Triage Teams (3). It is recommended that the Triage Team meet at least daily (21). In terms of nursing staffing, a ratio of 1:1 or 1:2 (1 ICU-trained nurse: 2 patients) has been recommended in the ICU during the COVID-19 pandemic (22). If this staffing approach is not feasible, then finding alternate staff from other disciplines such as nurses from the Surgical ICU, Endoscopic units, Post Anesthesia Care Unit (PACU), or even external resources including nurses transitioned to ambulatory care settings or nurses from community care settings can be explored (22).

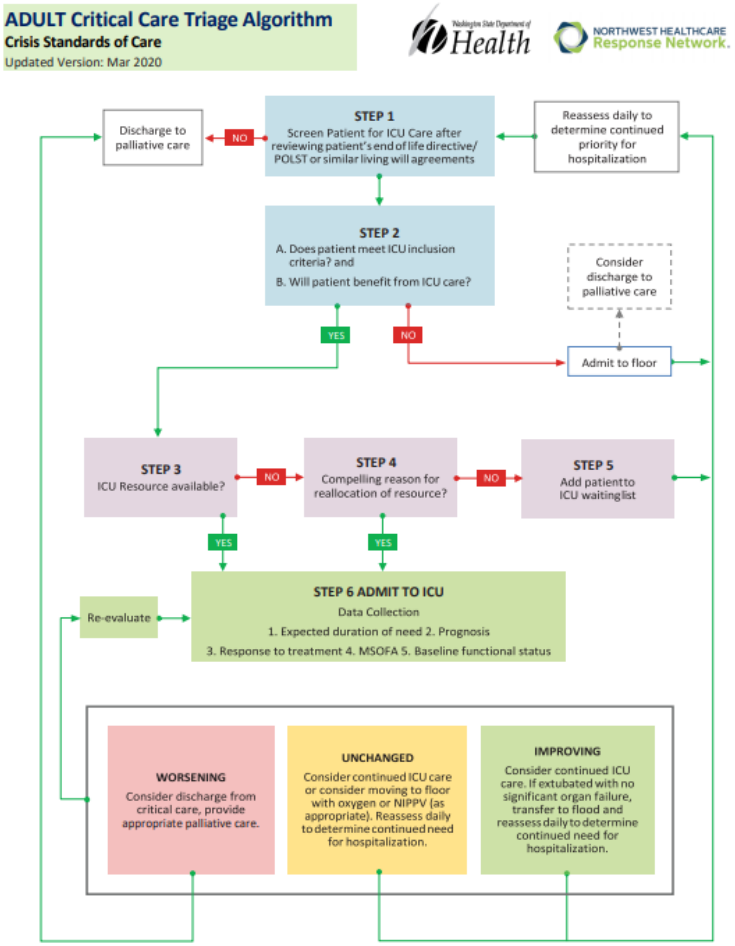

Figure 2 ADULT Critical Care Triage Algorithm

A systematic review identified 200 criteria with four themes (patient/patient preference, context/epidemics, physician/prognosis, and condition/diagnosis) for the triage or transport of patients to a critical care facility (16). Another study described a treatment protocol (clinical symptoms, comorbidities, and lab findings) of critically ill COVID-19 patients admitted to an ICU (23). It is worth mentioning that the Australia and New Zealand Intensive Care Society (ANZICS) has published comprehensive COVID-19 guidelines on October 20, 2020 (5). The Minnesota Department of Health has developed strategies for scarce resource situations (24). However, their guidelines are not specific to COVID-related situations. In the available literature, critical care for pediatric patients with COVID-19 was not fully assessed. Based on earlier pandemic studies (e.g., H1N1 pandemic), the pediatric EDs did not fully incorporate pandemic preparedness guidelines into their ED practices even years after the pandemic periods (25, 26).

Although some literature suggests using the Sequential Organ Failure Assessment (SOFA) score to include or exclude patients from critical care resources (3, 7, 21, 27), other studies do not recommend the SOFA scoring in the setting of COVID (14) or H1N1 pandemics (28-30). Regarding the reassessment periods for patients in ICUs, studies have proposed a variety of timeframes (every 48 hours (7), every 72 hours (3), or days 2 and 5 (27)). Regarding the "first come, first served" approach, the literature contains a variety of recommendations (7, 31). While one source advocates a random allocation process be followed for patients with similar prognoses and no difference be considered between patients with

COVID-19 and those with other medical conditions (32), the other source recommends "first come, first served" approach considering Tripartite Allocation & Triage Team (TATT)'s ethical decision-making process. One study suggests use of "ceiling to care/treatment" as a proxy for appropriate ICU allocations (31).

The impact of health care strain including the availability of ICU services on the quality of care for COVID-19 patients has not been assessed thoroughly. For example, the impact of ICU strain on mortality rates in patients with COVID-19 is unclear (33, 34). Nevertheless, previous non-COVID specific systematic reviews assessing the impact of hospital or ICU capacity strain on inpatient outcomes or quality of care measures show that capacity stains result in increased mortality, nosocomial infections, length of stay, premature discharges, and unplanned readmissions (35, 36).

Quality measures must be flexible and adaptive (34). It is suggested that quality indicators be reprioritized for COVID-19 pandemic context including psychological safety, mental health, end-of-life decisions, care experience, healthcare associated infections, preventable harm, admission, and readmission (37). Other quality of care indicators may include nonlethal adverse events (e.g., aspiration pneumonia, MRSA infection, C. Diff infection), hospital, ICU, or postoperative length of stay (LOS), cardiac readmissions for acute myocardial infarction patients, and serious complications for very low birth weight babies (35, 36 ,38). Standard ICU management as well as patient data forms can be developed to assess ICU surge capacity impacts on quality of care (39).

Data modeling and surge capacity forecasting have been used to help policy decision makers with their preparations (14, 40-48). The prospective use of modeling tools can help make informed critical decisions in the management and preparedness of pandemics. However, the findings of modeling should be interpreted with caution. Some of the caveats are lack of age-stratified parameters, simplified hospital patient flow, bed occupancy exaggeration, late predicted peak, and service demand overestimation (43, 49). There is a free interactive critical care surge response tool developed by the RAND Corporation (50). This tool helps decision makers to assess current critical care capacity and to explore strategies for increasing it.

Studies have proposed using other types of units including Step Down Units (SDUs) (1, 51), Surge Clinics (52), operating rooms converted to intensive care unit (ORICU) (53), adult COVID-19 treatment unit within a children's hospital (54), or TeleCritical Care (TCC) (55), instead of conventional ICUs when resources are scare. The admission criteria to SDUs were described in the corresponding reference (14), For ORICU management, patients were transferred from other ICUs, inpatient wards, the Emergency Department, and other institutions and remained in the ORICU until either transfer to another unit or death (53).

Conclusions

To the best of our knowledge, there is currently no well-recognized ICU triage protocol tailored for the patients with COVID-19 when the critical care resources are limited. The impact of surge capacity on the quality of care is to be studied, yet the family of quality care indicators for patients with COVID-19 is to be defined. The research shows adapting the concept of "Crisis Standards of Care" with local triage protocols can affect patient outcomes as well as resource allocations. Clinical judgement should supplement these criteria.

Glossary

(Optional, but useful if there are clinical/statistical terms being referenced in the document.)

Table 1: Summary of Literature

Ref	Sample/population	Method	Primary outcome measure	Additional findings	Quality of study
1.			[change column headings to reflect the outcome measure reported]		

Please see the Excel spreadsheet

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Appendix: Evidence Search Details

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

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#	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	33065

	pathogen*)).ti,ab,kw.	
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)

Sources

- Ovid MEDLINE, Ovid Embase, Google, Google Scholar, LitCovid/PubMed
- Refer to the evidence search report for extensive sources. Be sure to include any additional resources not referenced in the evidence search report.

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