Emerging Evidence on COVID-19
Summary of Infection Prevention and Control (IPAC) & Healthcare Response

Introduction:

This report summarises and appraises emerging research on COVID-19 applicable to healthcare settings. COVID-19 literature relevant to Infection Prevention and Control (IPAC) and Healthcare response published up to April 7, 2020, identified by Daily scans of COVID-19 scientific publications, are included

What's New This Week?

- 46 relevant publications, including primary evidence and guidance on clinical management of suspect and confirmed COVID-19 cases, were identified since the previous report
- Ma and colleagues test the efficacy of viral particle removal using non-alcohol based hand hygiene techniques (i.e. wet towel soaked in 1.00% soap powder, 0.05% active chlorine, or 0.25% active chlorine from sodium hypochlorite) and homemade masks (4 layers of kitchen paper and 1 layer of cloth). The authors recommend BOTH effective hand hygiene and mask wearing be adopted in community settings to slow the exponential spread of COVID-19.[1]
- Two commentaries summarize pharmacy service needs and experiences in China during the COVID-19 pandemic.[2, 3] The commentary by Meng and colleagues describes pharmacy services offered at field hospitals (i.e. square cabin hospitals) setup in Wuhan, China during the peek of the epidemic.[3]
- Multiple reports on field hospitals setup to house and managed COVID-19 cases in Italy, China, and Korea appear in this week's literature. These documents are listed in the, Field Hospitals and Temporary Facilities Setup to Manage COVID-19 Cases, section of Table 1.
- An analysis of patient management data from a COVID-19 fever clinic in China suggest such clinics prevented the spread of COVID-19 in hospital settings and reduced the demand on ER services.[4]
- A predictive model by Branas and colleagues estimate the number of excess deaths due to inaccessible critical care than can be avoided across the United States, between March and April 2020. This model estimates approximately 12,203-19,594 excess deaths can be avoided through public health interventions and COVID-19 control measures (e.g. social distancing, self-isolation, rapid testing). An additional 4,029-11,420 excess deaths can be avoided through

aggressive critical care surge response and preparations (e.g. high ICU and non-ICU critical care bed clearance and using a single ventilator for multiple patients).[5]

- Hierro-Recio examines leading indicators for predicting COVID-19 case healthcare demands using data from Spain. The authors report the most robust leading indicators for predicting COVID-19 ICU admissions is the number of cases eight days before, and the best predictor of COVID-19 mortality to be the number of infections five days before.[6]
- American Hospital Association 2018 survey data is used to identify total inpatient beds, adult intensive care unit (ICU) beds, and airborne isolation room availability across US hospitals. The report suggests current healthcare availability in the US will be met if 0.2% (0.2-0.3% IQR) of a state's general population is infected with COVID-19 and require hospitalization, or if 1.4% of a state's older adult population requires hospitalization as a result of the infection.[7]
- Multiple publications on data-driven resource allocation models describe strategies for 1) ICU bed and overall critical care capacity across National Health Services trusts in the context of ICU patient transfers[8], and 2) ventilator inventory allocation in the US.[9] Moreover, an open source scenario based model (informed by hospital data from the UK) is made publically available to planners and decision makers so they can interpret capacity-dependent COVID-19 deaths and plausible interventions.[10]
- Pressure-Regulated Ventilator Splitting (PReVentS) Yale University protocol is presented as a possible option for vent splitting - two patients are effectively ventilated on a single ventilator. Proof of principle human studies to be conducted in the coming days and weeks.[11]
- Environmental surfaces and health care worker PPE from an isolation ward housing an asymptomatic infant COVID-19 patient were tested for surface contamination. Despite close contact between healthcare workers and the infant during feeding and care, the tested PPE surfaces (i.e. face shield, N95 mask, and waterproof gown) were NOT contaminated with SARS-CoV-2. However, all three sampled environmental surfaces (e.g. bedding, cot rails, and change table) were SAR-CoV-2 positive. Authors assume this is likely due to indirect contamination from infant to environmental surfaces via healthcare worker hands and soiled linens.[12]

Key Points:

- Multiple predictive models aim to estimate healthcare resource needs based on infection rate projections in various regions at various time points. A brief overview of these publications are provided in the Healthcare Resource Needs and Preparedness section.
- Patient screening and triage at admission and suspension of non-essential services were widely implemented in hospital and healthcare settings across China, especially Wuhan, during the peak of COVID-19 infections.

- Postponing non-essential and elective medical procedures, restricting visitors, and online medical consultations are strategies adopted to reduce healthcare system burdens during COVID-19 response.
- SARS-CoV-2 virus can remain viable up to 4hrs following aerosolization, and up to 4hrs on copper, 24hrs on cardboard, and 2-3 days on plastic and steel surfaces.[13]
- Alcohol-based hand rubs (ABHR), recommend by the World Health Organization (AHO) ARE effective against SARS-CoV-2 virucides.[14]
- Studies find healthcare workers, especially frontline healthcare workers, working in regions greatly impacted by COVID-19 to be in need of psychological support and care due to heightened levels of depression and anxiety.

Overview:

One hundred and sixty-eight (n=168) published documents on COVID-19 that apply to healthcare settings and healthcare workers are captured in this evidence summary. Primary evidence on SARS-CoV-2 infection prevention and transmission from healthcare settings are included in the relevant sections of this report.

Table 1, lists guidance documents, commentaries, and "Letters to the Editor" that provide information on clinical management of patients with COVID-19. Documents are grouped by hospital department or setting where possible. A full list of references tagged as relevant to healthcare settings since the beginning of the COVID-19 outbreak are compiled in a RefWorks database accessible at this **link**.

HEALTHCARE RESOURCE NEEDS AND PREPAREDNESS

PREDCITIVE MODELS ON HEALTHCARE CAPACITY AND NEED

Predictive models aim to estimate timelines when need for healthcare resources will reach available capacities due to COVID-19 case burden while factoring in different assumptions and scenarios.

- Hierro-Recio proposes model based leading indicators for predicting COVID-19 ICU needs and mortality using data from Spain. The authors report the best predictor of ICU admission is the number of cases eight days before, while the best predictor of death to be the number of infections five days before.[6]
- Massounnaud and colleagues estimate COVID-19 cases, hospitalizations, deaths and short-term ICU bed needs for COVID-19 referral hospitals in France. Applying a Susceptible-Exposed-Infectious-Removed (SEIR) model time points when COVID-19 case demand will exceed ICU capacities in France range from end of March to end of April (under different reproductive number (R0) assumptions). In the best case scenario (i.e. basic reproductive R0 1.5) ICU bed capacities would not meet demand in a single region, whereas in the worst case scenario (i.e. R0 3) all regional ICU bed needs would exceed capacity by mid April.[15]
- Covid-19 based critical care surge capacities in Italy are modeled applying susceptible, infectious, recovered (SIR) model under different R0 scenarios. The model estimates Italy's critical case capacity to exceed need by early March and case counts to peek around early April.[16]
- A predictive algorithm for the allocation of ICU beds and overall critical care capacity across National Health Services trusts in the US is described in the context of ICU patient transfers. The authors advocate for the adoption of a load sharing process and discusses benefits and limitations of the load sharing approach.[8]
- A stochastic optimization model by Mehrotra and colleagues provide a data driven strategy for ventilator inventory allocation in the US. The study suggests the additional ventilators that will be required by the state of New York during the peek of COVID-19 case burden can be set aside for other states when COVID-19 case demand decreases.[9]
- An open source scenario based model (informed by hospital data from the UK) is publically available to planners and decision makers so that they may interpret capacity-dependent COVID-19 deaths and plausible interventions.[10] This model offers inputs aligned to levers available to planners with key outputs including duration of time at maximum capacity (to inform workforce requirements), peak daily deaths (for mortuary planning), and total deaths (as an ultimate marker of intervention efficacy).

- An exponential grown model of COVID-19 admissions by Zhang an colleagues projects, bed, ICU bed and ventilator capacity will surpass need in the next 3 weeks (i.e. mid April) (for an acute medical center with 100 IC beds, 75 ventilators and 80% patient occupancy, assuming a patient doubling time of 6 days). Model projected census rates over time are included as figures in the article. [17]
- Predictive models by Murray examine COVDI-19 ICU and ventilator use in the United States. These models estimate COVID-19 case demand for these resourced will peek around the third week of April. With need being variable by state[18] Similar timelines are projected by Ferstad.[19]
- A predictive model by Qui suggests doubling the number of hospital beds prior to infection peek would have reduced COVID-19 infection rates by 28% in Wuhan, China[20]
- A predictive model by Verelst and colleagues demonstrate many European countries will soon be in situations where healthcare pressures exceed hospital capacities. The healthcare system pressures (based on hospital bed capacity and availability) on Spain, Luxembourg, Switzerland, the Netherlands, and France (intensity-approach), or in Iceland, Denmark, Norway, Sweden, Spain, Switzerland, and Slovenia (magnitude-approach) will reach Italy's levels[21]

CASE FATALITY BASED ANALYSES

Analyses have linked COVID-19 mortality to availability of healthcare resources and healthcare system preparedness.

- A predictive model by Branas and colleagues estimates spatio-temporal COVID-19 critical care demand and the number of excess deaths due to inaccessible critical care than may be avoided across the United States between March and April 24, 2020. The model estimates approximately 12,203-19,594 excess deaths can be avoided through public health interventions and COVID-19 control measures (e.g. social distancing, self-isolation, rapid testing, and travel restrictions). An additional, 4,029-11,420 excess deaths that can be avoided through aggressive critical care surge response/preparations (e.g. high ICU and non-ICU critical care bed clearance and using a single ventilator for multiple patients). Insights regarding US regions where critical care bed capacities will exceed demand based on various contact reduction scenarios 0%, 25%, and 50% are presented.[5]
- A systematic review finds COVID-19 case fatality in Wuhan (9.5%; [95% CI, 5.2-13.8%]) to be significantly higher than case fatality rates outside of Wuhan (0.2%; [95% CI, 0-0.5%]).[22] Analyses suggest the initial insufficiency of healthcare resources led to the rapid rise in cases and large increase in case fatality and case severity rates in Wuhan at the start of the epidemic[22, 23].
- Analysis of case fatality ratios in Wuhan, Hubei, and Mainland China link increasing health care resources in Hubei through 1) deployment of healthcare workers from less severely hit regions, 2) allocation of acute care beds, 3) construction of new hospitals and retrofitting large buildings

as hospitals for mild cases exponentially reduced COVID-19 mortality rate and improved recovery and survival.[24]

- An analysis comparing healthcare utilization data from the two cities of Wuhan and Guangzhou, supports implementation of timely public health control measures are linked to reduced healthcare burden. For instance, in Wuhan, at the peak of the epidemic, 19,425 patients (24.5 per 10,000 adults) were hospitalized, 9,689 (12.2 per 10,000 adults) were considered to be in serious condition, and 2,087 patients (2.6 per 10,000 adults) needed critical care per day. Whereas in Guangzhou, where control measures such as social distancing, contact tracing, and quarantine protocols were implement during early he early importation of cases. And Guangzhou COVID-19 burden was substantially less at 15 patients in critical condition and 38 patients in serious condition during the peak period. [25]

SIMUALATION BASED ANALYSES

Simulation and dry run studies attempt to identify operational issues and mitigate infection transmission risks ahead of COVID-19 case surge.

- Authors develop and present a novel approach, termed the Pressure-Regulated Ventilator Splitting (PReVentS) Yale University protocol, and a ventilator circuit adaption to facilitate vent splitting - two patients are effectively ventilated on a single ventilator. Proof of principle human studies to be conducted in the coming days and weeks.[11]
- Publications report on different simulation and dry-run studies that examine Intensive Care Unit (ICU) and Operation Room (OR) preparedness for caring for covid-19 patients.[26-28] Reported deficiencies identified by these simulations include, gaps in communication and coordination across departments and breaches in IPAC (e.g. lack of dedicated trollies for COVID-19 patients, navigating patient trollies in narrow corridors leading to inadvertent contamination of surfaces, lapses in PPE donning and doffing processes, PPE integrity, and missed steps in hand hygiene). These deficiencies often led to delays in patient care, transfer of patients and necessary equipment.[26-28]

INFECTION TRANSMISSION

Predictive risk models estimate SARS-CoV-2 infection risk among and to healthcare workers in various healthcare settings and scenarios. These models offer strategies to mitigate nosocomial transmission to healthcare workers caring for COVID-19 patients.

- A retrospective analysis and modeling of healthcare worker data from a COVID-19 outbreak at a neurology department in Wuhan (n=12) finds decreasing average contact among HCWs (by a factor of 1.35), providing reasonable assignment of workload or immediate stress relief for HCWs, can avoid COVID-19 outbreaks in healthcare settings.[29]
- A formulated risk model finds limiting the average number of patient encounters per hour to 3, frontline interactions occurring in uncrowded areas where social distancing can be properly implemented (i.e. 10% crowd density), frequent cleaning of work spaces, compartmentalizing patient rooms in open spaces, effective PPE use to reduce COVID-19 transmission risk to front-line healthcare workers.[30] Another model finds alternating between two healthcare worker teams at 7day intervals to be an effective in reducing infection risk within this population.[31]

PERSONAL PROTECTIVE EQUIPMENT (PPE)

SOURCING AND REPROCESSING

- The editorial Sourcing Personal Protective Equipment during the COVID-19 Pandemic summarizes recommendations and considerations for PPE conservation and management submitted through JAMA call for ideas.[32]
- Evidence points to effective reprocessing and sterilization of N95 respirators and other PPE using UV and Hydrogen peroxide vapour.[33, 34] Effective UV sterilization of surgical masks and N95 respirators using biosafety cabinets with manufacturer reported fluence of 100 µW/cm^2 at 15-20 minutes per side of PPE may be applicable in scenarios when PPE reserves are low.[34] Another study confirms Hydrogen peroxide vapour is an effective virucide when reprocessing N95 respirators for multiple use.[33] However, a study investigating gamma radiation and reprocessing of N95 respirators finds respirator filter integrity is comprised during this sterilization process.

SIMULATION STUDIES

- Ma et al., report homemade masks consisting of 4 layers of kitchen paper and a single layer of cloth can effectively block out 95.15% of avian Influenza virus particles (considered similar to SARA-CoV-2) in aerosols. As such, the filtration efficacy of these homemade masks are in range

with N95 masks (block 99.98% of virus particles) and medical masks (block 97.14% of virus particles). The authors recommend effective hand hygiene along with the use of medical masks or the described homemade masks (when commercial mask supplies are low) to reduce infection transmission in community settings. The authors do NOT recommend homemade mask use in healthcare settings.[1]

- A simulation study found cough-generated droplets spread a mean distance of 2.91 (+/-1.09 SD) meters during high-flow nasal cannula procedures, and a maximum distance of 4.50 meters. This evidence emphasizes the necessity of appropriate PPE for healthcare workers and preforming cough inducing procedures in isolation and negative pressure rooms.[35]

USE AND EFFICACY

- A survey of healthcare workers (n=542) working in a hospital in Hubei during the COVID-19 epidemic found donning of PPE (e.g. N95, goggles) for longer than 6 hours and wearing gloves for extended periods increased self-reported skin damage in sites such as the nasal bridge, hands, cheek and forehead. Skin damage linked to PPE use was largely prevalent (97%) among responding healthcare workers.[36] These finding are echoed in another larger survey of frontline healthcare workers (n=2901) across China.[37]
- A survey of healthcare workers in Hong Kong (n=158) finds staff in emergency departments wore PPE for longer durations (a daily average of 7 hrs (SD 2.2) than staff in medical ICU or isolation wards. Additionally, de novo PPE associated headaches were more frequent (81%) among survey responders reporting PPE use greater than 4rs per day.[38]
- Current evidence does not suggest there is variability in SARS-CoV-2 infection transmission risk to healthcare workers based on N95 respirator or surgical mask use. This evidence is consistent with past evidence synthesis on viral respiratory infections like Influenza.[39, 40] A contact tracing exercise of 41 healthcare workers (85% in surgical masks and 15% in N95 respirators) who cared for a patient infected with COVID-19 (prior to confirmation of infection) requiring intubation, found there was no difference in infection transmission based on surgical masks vs. N95 respirators. All healthcare workers were found to be free of virus and symptoms 14 days following this exposure.[41]
- A study comparing N95 respirators to NOT wearing masks in a Chinese hospital during the initial epidemic phase of COVID-19 found N95 to be effective in preventing SARS-CoV-2 transmission to healthcare workers. COVID-19 infection rates among healthcare workers NOT wearing any personal protective masks is reported to be 4.6% (n=10/213).[42]
- A retrospective analysis of healthcare workers suspected to be infected with COVID-19 through healthcare interactions (n=72) finds working in high-risk departments (e.g. ICU, surgery, respirology, infectious diseases) longer duty hours, and suboptimal hand hygiene to be associated with increased risk of COVID-19 infections.[43]

SARS-COV-2 CONTAMINATION AND VIABILITY

Researchers have specifically investigated the viability of SARS-CoV-2 on various surfaces, since the emergence of the novel virus.

- Various environmental surfaces and health care worker PPE from an isolation ward of an asymptomatic infant case of COVID-19 were tested for surface contamination. Despite close contact between healthcare workers and the infant during feeding and care, the tested PPE surfaces (i.e. face shield, N95 mask, and waterproof gown) were NOT contaminated. However, all three sampled environmental surfaces (e.g. bedding, cot rails, and change table) were SAR-CoV-2 positive. Authors assume this is likely due to indirect contamination from infant to environmental surfaces via healthcare worker hands and soiled linens.[12]
- Studies of aerosol deposits confirm viable SARS-CoV-2 virus particles to be present in aerosols up to 4hrs post aerosolization, and aerosols to play a key role in the contamination of healthcare surfaces.[13, 44, 45]
- A study investigating the extent of healthcare surface contamination of SARS-CoV-2 at a Wuhan hospital found ICU and isolation wards treating COVID-19 patients to be the most contaminated areas. The objects most contaminated were self-service printers, keyboards, healthcare worker gloves, and hand sanitizer dispensers.[46] The study suggests these objects can readily act as fomites in the chain of infection transmission.
- Van Doremalen and colleagues confirm SARS-CoV-2 virus viability to be similar to other human corona viruses, and viable on copper surfaces for 4hrs, cardboard for 24hrs, and 2-3 days on plastic and steel surfaces.[13]
- A study investigating SARS-CoV-2 contamination of healthcare surfaces during the treatment of COVID-19 patients in Airborne Infection Isolation Rooms (AIIR) found air-outlet fans in isolation rooms can be come contaminated. This evidence suggests small virus-laden droplets can displace in hospital ventilation systems (if AIIR airflow is not to the outside).[45] It is worth noting all environmental surfaces tested in the study were negative for SARS-CoV-2 post cleaning and disinfection with sodium dichloroisocyanurate.[45, 47]
- Corman and colleagues report negligible risk of SAR-CoV-2 transmission through blood components as such infection is unlikely to be transmitted through blood spills or items contaminated with blood or blood products[48]

SARS-COV-2 DISINFECTION

Chlorine-containing disinfectants (1000 mg/L and/or 500 mg/L), 75% ethanol, hydrogen peroxide are commonly recommended chemical disinfectants for SARS-CoV-2. Specific disinfection details from Chinese guidance are included in Appendix 1

- In addition to mask filtration efficacy, Ma and colleagues also investigated viracial activity of three non-alcohol based hand hygiene techniques against avian Influenza virus particles (virus particles similar to SARS-CoV-2). Each effectively removed 96-99% of virus particles from hand surfaces.[1]
    - Wet towel soaked in 1.00% soap powder (98.36% of virus particles removed)
    - Wet towel soaked in 0.05% active chlorine (96.62% of virus particles removed)
    - Wet towel soaked in 0.25% active chlorine from sodium hypochlorite (99.98% of virus particles removed)

- In-vitro experiments demonstrates SARS-CoV-2 is inactivated following 30 seconds of exposure to these alcohol disinfectants.[14] This is the first confirmatory evidence for these alcohol agents being SARS-CoV-2 virucides.
    - 85% ethanol (40-80%) * WHO recommended
    - 75% isopropanol (min concentration 30%) * WHO recommended
    - 30% ethanol or 2-propanol
- An Italian hospital reports all hospital surfaces that were tested, door handles, sink handles, wall surfaces, waste container covers, therapy trolleys in staff lounge areas and/or PPE donning buffer zones, computer key boards, mobile phones of healthcare workers) were free of SARS-CoV-2 virus following standardized cleaning and disinfection processes. These included cleaning with sodium hypochloride at the concentration of 1,000 ppM of free chlorine (0.1%) daily and 5,000 ppM of free chlorine (0.5%) in terminal sanitization.[49]
- In a Canadian hospital, the patient's room was terminally cleaned using 0.5% hydrogen peroxide, twice after the index COVID-19 patient was discharged from the Toronto hospital.[50]

EXPERIENCE OF HEALTHCARE WORKERS

Multiple cross-sectional surveys investigate knowledge and experiences of healthcare workers responding to the COVID-19 epidemic. This research can support our understanding of healthcare worker mental health stressors when working long hours under strained resources, and support the planning of mental health support and services during COVID-19 response.

MENTAL HEALTH

- Surveys on physiological and emotional impacts, found anxiety, psychological distress, and fear to be prevalent among healthcare workers, and self-efficacy to be inversely correlated with feelings of isolation and loneliness. [51-59] These feelings were more profound among front-line staff reporting direct contact with COVID-19 patients.[51-54, 58]
- Possible COVID-19 infection risk to colleagues and family members were primary reasons for stress and concern for healthcare workers.[51]
- A survey of 1257 healthcare workers in China finds responders to report symptoms of depression, anxiety, insomnia and distress. These symptoms were more profound in the Wuhan region and among frontline healthcare workers.[58]
- A survey of chines healthcare workers (n=4679) administered between Feb 17-24, 2020 finds feelings of psychological distress 15. 9% (95% CI 14. 8-16. 9), anxiety 16.0% (95% CI 15.0-17.1), and depression 34. 6% (95% CI 33.2-35. 9) to be prevalent. Mental health care support was also deemed to be less accessible to healthcare workers at increased risk.[60]
- Healthcare worker family member survey in Ningbo, China found depressive symptoms and anxiety to be frequently reported among this group (29-33%). Such feelings were more prominent among family members of healthcare workers with direct patient contact.[61]
- A General hospital in Nanjing China reflects on the emergency management and response strategy put in place to respond to COVID-19. The authors report no nosocomial infections occurred in their facility due to medical care or among healthcare workers. However, a staff questionnaire found 6.4% of staff were depressed and 9.87 had anxiety during the epidemic.[62]
- Multiple commentaries discusses the utility of on-line virtual and telehealth mental health support for healthcare workers, including online cognitive behavioural therapy for depression, anxiety, and insomnia, during COVID-19[63, 64]
- Three dimensions of social support - objective support, subjective support, and support utility (term not defined in the article) were found to have a positive impact on healthcare worker anxiety, depression, and sleep disorders during COVID-19 response.[56]
- Practical recommendations against moral injury experienced by healthcare workers during the care and management of COVID-19 patients are discussed. Moral injury is defined as the

profound psychological distress, resulting from actions or the lack of actions, that violate one's moral or ethical code. The commentary also provides recommendations for clinicians providing physiological support for healthcare workers (and others) impacted my moral injury during and after the pandemic.[65]

KNOWLEDGE

- Surveys of healthcare workers in Pakistan find healthcare knowledge about COVID-19 infection prevention and control to be insufficient.[66, 67]
- A survey of an international sample of healthcare workers (n= 529) report 61% of responding healthcare workers obtained the information on COVID-19 from social media sources.[68]
- A national sample of primary care physicians (n=1751) across China were found to be knowledgeable about COVID-19 and stated to have provided information about the infection to local communities through on-line consultations.[69]

PATIENT ASSESSMENT AND SCREENING FOR COVID-19

Articles outline patient risk scoring processes and clinical triage rules implemented at various hospitals.

- Patient assessments include screening of patients for respiratory symptoms and identification of epidemiological links based on travel to endemic regions or contact with other cases of COVID-19 in the previous 14 days, at initial presentation.
- Chest CT scans and laboratory confirmation via SARS-CoV-2 nucleic acid amplification testing of respiratory tract specimens are recommend for patients suspected at risk of infection through patient screening.
- An analysis of patient management data across fever clinics used during the COVID-19 epidemic phase in China suggest such clinics prevented spreading of COVID-19 in hospital settings and reduced the demand on ER services.[4]
- Rapid triaging and testing processes for suspect COVID-19 cases presenting at hospitals are presented. [70-72] These processes suggest the use of risk-based screening and triage of patients to distinct high, medium, low risk waiting areas for additional testing, diagnosis, and care. Identify- Isolate-Inform (3I) tool adapted for COVID-19 to support healthcare workers in the management of suspect or confirmed cases is the most recently identified tool.[73] In all of the approaches, high-risk triage areas are often located outdoors, and patient diagnosis and testing process are based on upon screened in risk. Some authors presents the use of telephone and virtual follow-ups for case management.[70, 74]

- Zhang and colleagues reviewed clinical profiles of patients presenting at fever clinics in Wuhan, China. The authors recommend C-reactive protein levels and impaired immunity (lymphopenia) be considered during patient screening and triage for COVID-19.[75]
- Lu and colleagues reviewed clinical data and developed a short-term mortality risk score for COVID-19 cases based age and C-reactive protein levels. Patients classified as Grade 3 are at highest of short-term mortality following COVID-19 infection; Grade 3 (age ≥ 60 years and CRP ≥ 34 mg/L); Grade 2 (age ≥ 60 years and CRP < 34 mg/L OR age < 60 years and CRP ≥ 34 mg/L); Grade 1 (age < 60 years and CRP < 34 mg/L.[76]
- Adapted Traffic Control Bundling (TCB) implemented in Taiwanese hospitals to reduce infection transmission risk to healthcare workers is presented as an effective strategy.[77] In TCB screening and triage of patients takes place outdoors and patients who test positive, demonstrate atypical symptoms or have inconclusive results are directed to isolation or quarantine wards respectively. These patients move within the healthcare facilities via designated routes AND healthcare workers done necessary PPE prior to crossing from the clean barrier to isolation/quarantine wards or routes.[77]
- Reeves and colleagues discuss their experience with establishing an electronic patient record system for identifying, triaging and managing patients with COVID-19 at a large academic hospital in San Diego, California, US.[78]

CLINICAL MANAGEMENT OF PATIENTS

Numerous guidance documents, commentaries and "Letters to the Editor" provide recommendations on the clinical management of patients with COVID-19. Any relevant documents identified to date are grouped by hospital department or setting in Table 1.

A full list of references tagged applicable to healthcare settings since the beginning of the outbreak are compiled in a RefWorks database accessible at this **link**.

RECCOMENDATIONS COMMON AMONG GUIDANCE DOCUMENTS:

- Establishing effective communication and coalition across hospitals, local public health and government authorities
- Establishing training programs for healthcare workers that focus on COVID-19 infection prevention (e.g. hand hygiene, respiratory etiquette, monitoring of symptoms, effective personal protection equipment donning and duffing).
- Centralizing COVID-19 response management, coordination and communication within hospital(s) or department(s)

- Minimizing the number of non-essential patient visits, when possible implementing on-line medical consultations
- Active screening of patients for suspect and confirmed COVID-19 case identification through various triage processes
- Restricting the number of healthcare workers who care for suspect or confirmed COVID-19 patients, and monitoring healthcare workers for respiratory symptoms following patient care
- Postponing invasive non-critical and/or elective procedures among suspect and confirmed cases
- If procedures that increase nosocomial infection transmission risk (e.g. intubation, ventilation, surgery) are necessary for suspect or confirmed COVID-19 patients, these procedures are to be preformed 1) in consultation/collaboration with multidisciplinary teams, 2) in isolation within negative pressure rooms/wards/designated hospitals, 3) with dedicated equipment and appropriate healthcare worker personal protective equipment (i.e. airborne/droplet/contact precautions).
- Following the procedures, effective room disinfection (e.g. disinfecting solution containing 1 000 mg / L of available chlorine), environmental cleaning, equipment reprocessing, and waste management process are to be followed (e.g. special infection marking on medical waste and used medical instruments).

CANADIAN GUIDANCE DOCUMENTS

Guidance documents providing insights on the clinical management of COVID-19 within the Canadian health system are highlighted below.[50, 79, 80]

- Wax and Christian review practical recommendations on patient screening, personal protective equipment including powered air purifying respirators (PAPR), and critical care unit operations planning in the Canadian context. The recommendations apply experiences and lessons learned through 2003 SARS response in Toronto, Canada.[79]
- Marchand-Senécal and colleagues report on the diagnosis and management of the first case of COVID-19 in Canada.[50] This patient, admitted to an Airborne Infection Isolation Room (AIIR) at a Toronto hospital, was discharged following the resolution of fever and recovered at home. No nosocomial transmissions of infection to healthcare workers occurred during patient care.
- Hendin and colleagues at the Ottawa Hospital provide a decision-making framework on end of life care in the Emergency Department for COVID-19 Patients.[80]

TABLE 1: GUIDANCE DOCUMENTS ON CLINICAL MANAGEMENT OF PATIENTS WITH SUSPECT OR CONFIRMED COVID-19 INFECTIONS

Note: A full list of references tagged applicable to healthcare settings since the beginning of the outbreak are compiled in a RefWorks database accessible at this link.

Reference	Report Title
General	
Dehnavieh & Kalavani., 2020 (81)	Management-supportive measures for managers of healthcare organization during the COVID-19 epidemic
Kirk-Bayley et al., 2020 (82)	The use of Povidone Iodine nasal spray and mouthwash during the current COVID-19 pandemic may protect healthcare workers and reduce cross infection Evidence based protocol for Iodine Nasal spray and Mouthwash provided
Liu et al., 2020 (2)	Providing pharmacy services during the coronavirus pandemic
National Health Commission & State Administration of Traditional Chinese Medicine	Diagnosis and Treatment Protocol for Novel Coronavirus Pneumonia (Trial Version 7 – Release March 3, 2020) Released by Available here
Starace & Ferrara, 2020 (83)	How to surge to face SARS-CoV-2 outbreak. Lessons learned from Lumbardy, Italy
Wang et al., 2020 (84)	Guidance on the **disinfection of patient homes and health care settings** Based on information published in the *Program for Disinfection Technology in Special Places*
Primary Care Settings	

Greenhalgh, Koh, & Car, 2020 (74)	Covid-19: a remote assessment in **primary care**
Surgical Procedures and Settings	
Burke et al., 2020 (85)	The Coronavirus Disease 2019 Global Pandemic: A **Neurosurgical** Treatment Algorithm
Brindle & Gawande, 2020 (86)	Managing COVID-19 in **Surgical** Systems
Chang Liang, Wang, Murphy, & Po Hui, 2020 (87)	Novel Coronavirus and **Orthopaedic Surgery** Early Experiences from Singapore
Dexter, Parra, Brown, & Loftus, 2020 (88)	Perioperative COVID-19 Defense: An Evidence-Based Approach for Optimization of Infection Control and Operating Room Management
Di Saverio et al., 2020 (89)	Coronavirus pandemic and Colorectal surgery: practical advice based on the Italian experience
Montero Feijoo et al., 2020 (90)	Practical recommendations for the **perioperative** management of the patient with suspension or serious infection by coronavirus SARS-CoV-2
Tan et al., 2020 (91)	Preliminary Recommendations for Surgical Practice of Neurosurgery Department in the Central Epidemic Area of 2019 Coronavirus Infection
Tao et al., 2020 (92)	Recommendations for **general surgery** clinical practice in novel coronavirus pneumonia situation
Ti, Ang, Foong & Ng., 2020 (93)	What we do when a COVID-19 patient needs an operation: **operating room (OR) preparation and guidance**
Yu, Lou, & Zhang., 2020 (94)	Several suggestions for **operation for colorectal cancer** under the outbreak of Corona Virus disease 19 in china

Anesthesia Procedures and Settings	
Chen et al., 2020 (95)	Safety and Efficacy of Different **Anesthetic Regimens** for Parturients with COVID-19 Undergoing **Cesarean Delivery**: a case series of 17 patients
Kim, Ko, & Kim, 2020 (96)	Recommendations for **Anesthesia** in Patients Suspected of Coronavirus 2019-nCoV Infection
He et al., 2020 (97)	**Anesthetic Management of Patients Undergoing Aortic Dissection** Repair With Suspected Severe Acute Respiratory Syndrome Coronavirus-2 Infection
Lie, Wong, Wong, Wong, & Chong, 2020 (98)	Practical considerations for performing regional **anesthesia:** lessons learned from the COVID-19 pandemic
Wax & Christian, 2020 (79)	Practical recommendations **for critical care and anesthesiology teams** caring for novel coronavirus (2019-nCoV) patients
Zhang et al., 2020 (99)	Response of Chinese **Anesthesiologists** to the COVID-19 Outbreak
Critical Care and Emergency Medicine Procedures and Settings	
Alhazzani et al., 2020 (100)	Surviving Sepsis Campaign: guidelines on the **management of critically ill** adults with Coronavirus Disease 2019 (COVID-19)
Carenzo et al., 2020 (101)	Hospital surge capacity in a tertiary **emergency referral centre** during the COVID-19 outbreak in Italy
Chinese Society of Extracorporeal, Life Support, 2020 (102)	Recommendations on **extracorporeal life support for critically ill patients** with novel coronavirus pneumonia
Hendin et al., 2020 (80)	**End-of-life care in the Emergency Department** for the patient imminently dying of a highly transmissible acute respiratory infection (such as COVID-19)

Koonin et al., 2020 (103)	Strategies to Inform **Allocation of Stockpiled Ventilators** to Healthcare Facilities During a Pandemic
Meng et al., 2020 (104)	**Intubation and Ventilation** amid the COVID-19 Outbreak: Wuhan's Experience
Murthy, Gomersall, & Fowler, 2020 (105)	Care for **Critically Ill** Patients With COVID-19
Poston, Patel, & Davis, 2020 (106)	Management of **Critically Ill Adults** With COVID-19
Qing et al., 2020 (107)	**Emergency management**, prevention and control of novel coronavirus pneumonia in specialized branches of hospital
Ramanathan et al., 2020 (108)	Planning and provision of **ECMO services** for severe ARDS during the COVID-19 pandemic and other outbreaks of emerging infectious diseases
Sorbello et al., 2020 (109)	The Italian coronavirus disease 2019 outbreak: recommendations from clinical practice
Swiss Academy Of Medical Sciences	Recommendations for t00he admission of patients with COVID-19 to **intensive care and intermediate care units (ICUs and IMCUs)** Accessed here COVID-19 pandemic: triage for intensive-care treatment under resource scarcity Accessed here
Zhao et al., 2020 (110)	Anesthetic Management of Patients with COVID 19 Infections during Emergency Procedures
Zuo et al., 2020 (111)	Expert Recommendations for **Tracheal Intubation in Critically ill Patients** with Novel Coronavirus Disease 2019 - Chinese Society of Anaesthesiology
Oncology Procedures and Settings	

Coles et al., 2020 (112)	International Guidelines on **Radiation Therapy for Breast Cancer** During the COVID-19 Pandemic
Filippi, Russi, Magrini, & Corvò., 2020 (113)	COVID-19 Outbreak in Northern Italy: First Practical Indications for **Radiotherapy Departments**
Ramirez et al., 2020 (114)	COVID-19 Global Pandemic: Options for Management of Gynecologic Cancers
You et al., 2020 (115)	The official French guidelines to protect patients with cancer against SARS-CoV-2 infection
Cardiology Procedures and Settings (Guidance specific to Cath labs listed in Diagnostic Imaging)	
Han et al., 2020 (116)	CSC Expert Consensus on Principles of Clinical Management of Patients with **Severe Emergent Cardiovascular Diseases** during the COVID-19 Epidemic
Si, Sun, Zhong, Yue, & Fu., 2020 (117)	Countermeasures and Treatment for **Aortic Acute Syndrome** With Novel Coronavirus Pneumonia Recommendations for patients with aortic emergencies
Thurairatnam et al., 2020 (118)	Triage assessment of **cardiorespiratory risk** status based on measurement of the anaerobic threshold, and estimation by patient-reported activity limitation
Respirology Procedures and Settings (Additional relevant guidance may be listed in Critical Care and Emergency Medicine Section)	
Chronic obstructive pulmonary disease group of Chinese Thoracic & Chronic obstructive pulmonary disease committee of Chinese Association of Chest, 2020 (119)	Medical Management and Prevention Instruction of **Chronic Obstructive Pulmonary Disease (COPD)** During the Coronavirus Disease 2019 Epidemic
Cook et al., 2020 (120)	Consensus guidelines for **managing the airway** in patients with COVID-19

Interventional Respiratory Medicine Group of Chinese Thoracic Society, 2020 (121)	Expert consensus for **bronchoscopy** during the clinical care of patients with 2019-nCoV
Pan et al., 2020 (122)	**Non-invasive Respiratory Support** for New Coronavirus Pneumonia: Stop It
Respiratory care committee of Chinese Thoracic Society, 2020 (123)	Expert Consensus on Preventing Nosocomial Transmission **During Respiratory Care** for Critically Ill Patients Infected by 2019 Novel Coronavirus Pneumonia Treatment guidance for COVID-19 pneumonia patients
Gastroenterology Care Procedures and Settings (Additional relevant guidance may be listed in the Diagnostic Imaging and Radiology/Ultrasound section)	
Chen & Peng., 2020 (124)	Treatment strategy for **gastrointestinal tumor management and surgery** under the outbreak of novel coronavirus pneumonia in china.
Ma, Hu, & Tian., 2020 (125)	Surgical treatment strategy for **digestive system malignancies** during the outbreak of novel coronavirus pneumonia
Parez-Cuadrado Martanez., 2020 (126)	Recommendations by the SEPD and AEG, both in general and on the operation of **gastrointestinal endoscopy and gastroenterology units**, concerning the current SARS-CoV-2 pandemic.
Wu et al., 2020 (127)	Discussion on the diagnosis and treatment of **hepatobiliary malignancies** during the outbreak of novel coronavirus pneumonia in Chinese
Urology Procedures and Settings	
Ficarra et al., 2020 (128)	**Urology practice** during COVID-19 pandemic In Italian
Diagnostic Imaging and Radiology/Ultrasound Procedures and Settings	
An, 2020 (129)	Management strategy of novel coronavirus (COVID-19) pneumonia in the **radiology department**: a Chinese experience

Ang et al. 2020 (130)	Chapter of Gastroenterologists Professional Guidance on Risk Mitigation for Gastrointestinal **Endoscopy** During COVID-19 Pandemic in Singapore
Buonsenso, Pata, & Chiaretti., 2020 (131)	COVID-19 outbreak: less stethoscope, more ultrasound
Chandy et al., 2020 (132)	**Interventional radiology** and COVID-19: evidence-based measures to limit transmission
Chiu et al., 2020 (133)	Practice of **endoscopy** during COVID-19 pandemic: position statements of the Asian Pacific Society for Digestive Endoscopy (APSDE-COVID statements)
Czernin et al., 2020 (134)	**Imaging clinic** operations in the times of COVID-19: Strategies, Precautions and Experiences.
International Society of Professionals in Ultrasound for Obstetrics and Gynecology	ISUOG Consensus Statement on organization of routine and specialist obstetric ultrasound services in the context of COVID-19(135). Accessed here ISUOG Safety Committee Position Statement: safe performance of **obstetric and gynecological scans** and equipment cleaning in the context of COVID-19 Accessed here ISUOG Interim Guidance on 2019 Novel Coronavirus Infection During **Pregnancy** and Puerperium: Information for Healthcare Professionals Accessed here
Lim et al., 2020 (27)	**Obstetrics** in the Time of Coronavirus: A Tertiary Maternity Centre's Preparations and Experience During the COVID-19 Pandemic
Mossa-Basha et al., 2020 (136)	**Radiology Department Preparedness** for COVID-19: Radiology Scientific Expert Panel Discusses steps taken by four different radiology departments in the US on responding to COVID-19

Society for Cardiovascular Angiography and Interventions Emerging Leader Mentorship (137)	Considerations for **Cardiac Catheterization Laboratory** Procedures During the COVID-19 Pandemic
Tarantini et al., 2020 (138)	Italian Society of Interventional Cardiology (GISE) Position Paper for **Cath lab-specific** Preparedness Recommendations for Healthcare providers in case of suspected, probable or confirmed cases of COVID-19
Welt et al., 2020 (139)	**Catheterization Laboratory Considerations** During the Coronavirus (COVID-19) Pandemic: From ACC's Interventional Council and SCA Joint statement from the American College of Cardiology's (ACC) Interventional Council and the Society of Cardiovascular Angiography and Intervention (SCAI)
Otolaryngology Care Procedures and Settings	
Vukkadala, Qian, Holsinger, Patel, & Rosenthal., 2020 (140)	COVID-19 and the otolaryngologist? Preliminary evidence-based review
Xu, Lai, & Liu., 2020 (141)	Suggestions for prevention of 2019 novel coronavirus infection in **otolaryngology head and neck surgery** medical staff
Burn and Wound Care Procedures and Settings	
Li, Liu, Chen, & Liao., 2020 (142)	Management Strategy of Novel Coronavirus Pneumonia in **Burn and Wound** Care Ward
Dermatology Care Procedures and Settings	
Radi, Diotallevi, Campanati, & Offidani., 2020 (143)	Global Coronavirus Pandemic (2019-nCOV): Implications for an Italian Medium Size **Dermatological Clinic** of a Level II Hospital
Tao et al., 2020 (144)	Emergency management for preventing and controlling nosocomial infection of 2019 novel coronavirus: implications for the **dermatology department**
Ophthalmology Care Procedures and Settings * Increased risk in Ophthalmology settings as COVID-19 may cause conjunctivitis	
Lai, Tang, Chau, Fung, & Li., 2020 (57)	Stepping up infection control measures in **ophthalmology** during the novel coronavirus outbreak: an experience from Hong Kong

	Based on enhanced infection control measures adopted in an ophthalmology clinic in Honk Kong
Zhang, Xie, Xu, & Cao., 2020 (145)	Suggestions for disinfection of ophthalmic examination equipment and protection of **ophthalmologist** against 2019 novel coronavirus infection
Palliative care Procedures and Settings	
Calton, Abedini, & Fratkin, 2020 (146)	Telemedicine in the Time of Coronavirus just-in-time tips to support palliative care clinicians and program leaders
Psychiatry Procedures and Settings	
Starace & Ferrara., 2020 (147)	COVID-19 disease Emergency Operational Instructions for Mental Health Departments issued by the Italian Society of Epidemiological Psychiatry
Dental Care Procedures and Settings	
Li & Meng., 2020 (148)	The prevention and control of a new coronavirus infection in department of stomatology
Meng, Hua, & Bian., 2020 (149)	Coronavirus Disease 2019 (COVID-19): Emerging and Future Challenges for Dental and Oral Medicine Authors provide experience-based guidance on COVID-19 nosocomial infection transmission in dental settings in China
Haematology Settings and Procedures	
Pagano et al., 2020 (150)	Prepare to adapt**: Blood supply and transfusion support** during the first 2 weeks of the 2019 Novel Coronavirus (COVID-19) pandemic affecting Washington State
Willan, King, Hayes, Collins, & Peniket, 2020 (151)	Care of **haematology** patients in a COVID-19 epidemic
Hemodialysis Procedures and Settings	
Kliger & Silberzweig, 2020 (152)	Mitigating Risk of COVID-19 in **Dialysis** Facilities

Ikizler & Kliger, 2020 (153)	Minimizing the risk of COVID-19 among patients on dialysis
Rombolà et al., 2020 (154)	Practical indications for the prevention and management of SARS-CoV-2 in **ambulatory dialysis patients**: lessons from the first phase of the epidemics in Lombardy
Rehabilitation Procedures and Settings	
Koh & Hoenig, 2020 (155)	How Should the **Rehabilitation** Community Prepare for 2019-nCoV?
McNeary, Maltser, & Verduzco-Gutierrez, 2020 (156)	Navigating Coronavirus Disease 2019 (Covid-19) in Physiatry: A CAN report for Inpatient **Rehabilitation Facilities**
Diagnostic Laboratory Procedures and Settings	
Henwood., 2020 (157)	Coronavirus disinfection in **histopathology**
Tan et al., 2020 (158)	Practical **laboratory** considerations amidst the COVID-19 outbreak: early experience from Singapore
Geriatrics and Long-term Care Procedures and Settings	
D'Adamo, Yoshikawa, & Ouslander, 2020 (159)	Coronavirus Disease 2019 in Geriatrics and Long-term Care: The ABCDs of COVID-19
(Kunz & Minder, 2020 (160)	COVID-19 pandemic: palliative care for elderly and frail patients at home and in residential and nursing homes accessed
Rios et al., 2020 (161)	Guidelines for preventing respiratory illness in older adults aged 60 years and above living in **long-term care** A rapid review of clinical practice guidelines

Field Hospitals and Temporary Facilities setup to manage COVID-19 cases	
Asperges et al., 2020 (162)	Rapid response to COVID-19 outbreak in Northern Italy: how to convert a classic infectious disease ward into a COVID-19 response centre
Chen & Zhao., 2020 (163)	Makeshift hospitals for COVID-19 patients: where health-care workers and patients need sufficient ventilation for more protection
Chen, He, Li, Yin, & Chen, 2020 (164)	**Mobile field hospitals**, an effective way of dealing with COVID-19 in China: sharing our experience
Liu et al., 2020 (165)	Laboratory diagnostics within **a modular hospital** at the time of Coronavirus disease 2019 (COVID-19) in Wuhan
Meng et al., 2020 (3)	Providing pharmacy services at **cabin hospitals** at the coronavirus epicenter in China
Park et al., 2020 (166)	Out-of-Hospital Cohort Treatment of Coronavirus Disease 2019 Patients With Mild Symptoms in Korea: An Experience From a Single Community Treatment Center
Zhang & Li 2020 (167)	Guidance for health protection in **square cabin hospitals** during the epidemic of new coronavirus pneumonia
Zhang, L., Lv, Y., Hong, L., et al 2020 (168)	Combating the 2019-nCoV: Management Guidelines of **Square Cabin Hospitals** in Wuhan, China

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APPENDIX - 1

Appendix 1 : Disinfection methods for commonly contaminated objects, outlined in *Program for Disinfection Technology in Special Places*

TABLE 1. Disinfection methods for commonly contaminated objects in the epidemic focus.

Object	Disinfection method
Indoor air	peroxyacetic acid, chlorine dioxide, hydrogen peroxide, etc.ultra-low volume spray
Contaminants (blood, secretions, etc. from patient)	Water absorbent material carrying disinfectant (5,000–10,000 mg/L chlorine-containing disinfectant) for 30 min, or disinfectant dry wipes achieving high level of disinfection
Container for contaminants	Soaking with 5,000 mg/L chlorine-containing disinfectant for 30 min and then cleaning
Feces and sewage	Separate septic tank: adding chlorine-containing disinfectant and 10 mg/L the total residual chlorine after 1.5 h. Excreta in container: soaking with 20,000 mg/L chlorine-containing disinfectant for 2 hours when the ratio of fecal to disinfectant is 1:2. Massive dilution of excreta in container: disinfecting with 70%–80% dry bleaching powder for 2 h when the ratio of fecal to disinfectant is 20:1
Ground wall	Wiping and spraying with 1,000 mg/L chlorine-containing disinfectant or 500 mg/L Chlorine dioxide disinfectant for no less than 30 min, the range of spray volume from 100 mL/m^2 to 300 mL/m^2
Surface of objects	Spraying, wiping, or soaking with 1,000 mg/L chlorine-containing disinfectant or 500 mg/L chlorine dioxide disinfectant for 30 min and then wiping with clean water
Clothing, bedding and other textiles	Circulating vapor or boiling for 30 min, soaking with 500 mg/L chlorine-containing disinfectant for 30 min, and then washing
Hand	Rubbing with quick-drying hand disinfectants containing alcohol or alcohol compound (first choice), wiping with 75% ethanol, rubbing with quaternary ammonium salt hand disinfectant, or soaking or wiping hands with 0.05% chlorine-containing or 3% hydrogen peroxide hand disinfectant, or wiping with 0.5% polyvidone iodine
Skin	Wiping with 0.5% polyvidone iodine or 3%hydrogen peroxide disinfectant for 3–5 min
Mucous membrane	Flushing saline or 0.05% polyvidone iodine
Tableware	Soaking with 500 mg/L chlorine-containing disinfectant for 30 min 500 mg/L or boiling
Transported and transferred tools	Spraying with 1,000 mg/L chlorine-containing disinfectant or 500 mg/L chlorine dioxide disinfectant for 30 min and then wiping with clean water
Domestic waste of patients	Treating as medical wastes
Medical wastes	Treating as medical wastes
Corpse	Filling the wound with 3,000–5,000 mg/L chlorine-containing disinfectant or cotton ball or gauze soaked with 0.5 % peroxyacetic acid,wrapping the corpse with double sheet soaked the disinfectant, and then putting it in the double corpse bags