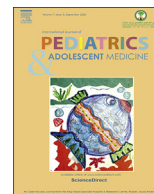


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## Challenge of COVID-19 crisis managed by emergency department of a big tertiary centre in Saudi Arabia

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### ABSTRACT

**Background:** The Kingdom of Saudi Arabia was hit hard by the COVID-19 pandemic wave. King Faisal Specialist Hospital and Research Centre, Riyadh dealt with the crisis in a proactive way with the emergency department (ED) playing a pivotal role.

**Patients and methods:** We searched the international literature to review the processes adopted by healthcare institutions and also used our experience of managing a previous epidemic to devise safe processes for our ED patients.

**Results:** The interventions done by ED, led to safer patient care, avoidance of unnecessary admissions, reduced risk of cross infection and enhanced staff safety.

**Conclusions:** Integrated ED processes helped streamline Covid-19 patients.

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## 1. Introduction

COVID-19 was first reported on December 31, 2019 in China. The Kingdom of Saudi Arabia (KSA) had its first confirmed case on March 2, 2020 [1]. It was declared a pandemic by World Health Organization (WHO) on March 11, 2020. As of June 8, 2020, there are a total of 6,799,713 confirmed cases with 377,388 deaths in 216 countries. KSA has reported 98,869 confirmed cases with 676 deaths [2] as of this writing.

Majority of the world's advanced emergency systems got quickly overwhelmed to a breaking point with the COVID-19 crisis [3]. The overcrowded emergency departments (EDs) ran the risk of succumbing with these highly infectious patients [4].

Various emergency strategies were adopted worldwide to cope with this major disaster [5–7]. Our ED adopted measures aligned with the international recommendations. Our objective was to search the medical literature to look for specific emergency processes implemented internationally and to share the steps taken by our ED to deal with the COVID-19 crisis.

### 1.1. Search strategy

We searched the US National library website (NCBI) with the underlying search strategy using keywords (covid, emergency department, steps, and processes). We retrieved 724 articles, of which 25 were relevant to our question, after reading their abstracts. We went through the full text of the selected articles, which are included as references.

“covid [All Fields] AND (“emergency service, hospital”[MeSH Terms] OR (“emergency”[All Fields] AND “service”[All Fields] AND “hospital”[All Fields]) OR “hospital emergency service”[All Fields] OR (“emergency”[All Fields] AND “department”[All Fields]) OR “emergency department”[All Fields]) AND process [All Fields] AND steps [All Fields]”

## 2. ED steps and processes in response to COVID-19

King Faisal Specialist Hospital and Research Centre is the largest tertiary care center in KSA, treating the highest number of cancer and transplant patients. Its ED is consequently geared up for managing advanced sepsis, in complex clinical scenarios. It was at the forefront of managing the lethal “Middle East Respiratory Syndrome” (MERS CoV-1) from 2012 to 2016, which originated in KSA [6]. Continuing from its lessons learnt from that smaller epidemic, it bolstered itself to deal with the monstrous Covid-19 challenge. The following were the key steps taken by our ED in

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Clinical Signs and Symptoms and Medical History:		
Fever or recent history of fever	<input type="radio"/> Yes <input type="radio"/> No	
Shortness of breath (new or worsening)	<input type="radio"/> Yes <input type="radio"/> No	
Cough (new or worsening)	<input type="radio"/> Yes <input type="radio"/> No	
Nausea, vomiting, and/or diarrhea	<input type="radio"/> Yes <input type="radio"/> No	
Chronic renal failure, CAD/heart failure, Immunocompromised patient	<input type="radio"/> Yes <input type="radio"/> No	
Exposure Risks:		Number of Exposure
A history of travel abroad during the 14 days prior to symptom onset	<input type="radio"/> Yes <input type="radio"/> No	<input type="text"/>
Visiting or being a resident of a high-risk area for COVID-19 in the kingdom during the 14 days prior to symptom onset*	<input type="radio"/> Yes <input type="radio"/> No	* (Riyadh, Holy City of Makkah, Madinah, Jeddah, Al-Hofuf & AL-Qatif)
A close physical contact with a confirmed case of COVID-19 or MERS-CoV in the past 14 days	<input type="radio"/> Yes <input type="radio"/> No	
An exposure to camel or camel's products (direct or indirect **) in the past 14 days	<input type="radio"/> Yes <input type="radio"/> No	** Patient or household
Working in a healthcare facility	<input type="radio"/> Yes <input type="radio"/> No	
Total SARI Score	<input type="text"/>	
<p>A score = 4 or above, ask the patient to perform hand hygiene, wear a surgical mask, direct the patient through the respiratory pathway and inform MD for assessment.  MERS-CoV OR COVID-19 testing should be only done according to case definitions</p> <p>* This screening form DOES NOT replace Physician assessment and decision-making  ** Consult with Infection Control &amp; Hospital Epidemiology (ICHE) as required</p>		
Patient/Sitter Instructions		
<b>Patient Instructions: Action Taken</b> <input type="checkbox"/> MD informed of SARI screening result <input type="checkbox"/> Patient given surgical mask to wear <input type="checkbox"/> Patient placed in negative pressure room	Additional Comments	<input type="text"/>
<b>Sitter/Accompanying Person Screened</b> <input type="radio"/> N/A <input type="radio"/> Yes <input type="radio"/> No	Additional Comments	<input type="text"/>

Fig. 1. Adult SARI tool.

the wake of COVID-19 pandemic:

### 2.1. Screening at the ED entrances

All the entrances leading to the Emergency Medical Services (EMS) building were manned by nurse assistants, screening all entering personnel. They checked temperature with non-touch devices, provided surgical masks, and hand sanitization.

### 2.2. Covid safety measures in the ED waiting room

Posters and electronic monitors displayed the audiovisual safety information. Seating arrangement was altered according to the "social distancing principles." A separate respiratory seating area was designated in the waiting room. Number of patient attendants were limited to one.

### 2.3. Prehospital staff

The hospital ambulance staff were provided simulated training about the recognition of symptoms, structured pre-alerts and transfer of a suspected COVID-19 case to ED. The ambulances were advised to strictly follow recommended disinfection procedures during transport.

### 2.4. Decontamination tent outside ED

In preparation for a mass presentation of COVID-19 cases, a tent was erected to screen patients outside the ED premises. This tent had portable oxygen supply and facility to take diagnostic swabs.

### 2.5. Front end ED screening area

All new patients were screened for infectious disease before booking at the registration desk. Severe Acute Respiratory Index (SARI) was used to risk stratify patients (Fig. 1). The patients scoring high on this accredited tool were transferred to the negative pressure cubicles, which had direct access through the screening area.

### 2.6. Suspected patients at triage

Experienced triage nurses were deployed to immediately cordon a suspected case, slipping the screening net. They were immediately allocated an appropriate clinical space and brought to the attention of the ED physician.

### 2.7. Clinical space allocation

ED allocated four purpose built negative pressure rooms for COVID-19 patients. Other cubicles were also equipped with portable "HEPA-filters." The examination cubicles displayed

airborne precautions on their doors and instructed the healthcare provider to use appropriate protective gear, before entering.

2.8. Respiratory diagnostic and treatment area

Eleven cubicles, outside the main ED were equipped and designated “respiratory screening area,” where suspected COVID-19 ambulatory patients were transferred through a safe route for diagnostic tests. Their disposition was based on clinical symptomatology with majority of them discharged home, pending COVID-19 test results.

2.9. Provision of rapid PCR testing for COVID-19 patients in ER

The turnaround time for this test was kept at 70 min. This was meant for quick transfer of admitted patients to their inpatient beds from ED, provided their test was negative. The positive patients were sent to the designated COVID-19 hospital wing, under a dedicated team. Point of Care Diagnostic Testing (POCT) for COVID-19 was also validated for ED. The chest X-rays were organized within the examination cubicles and one CT scanner was dedicated for COVID-19 patients only.

2.10. ED staff

All staff were fit tested in house, for N95 respirator masks or “Powered Air Purifying Respirators” (PARP). The shortage of the N95 masks was also predicted and controlled distribution of these

masks was initially triggered. The N95 masks within the department were kept for the ED staff and the specialties were encouraged to bring their own masks from their local areas. Staff instructions to wear suitable protective gear during aerosol procedures were clearly displayed, outside the ED cubicles. These protective processes were also discussed in the daily staff huddles. Suspected ED staff were prioritized for COVID-19 screening. Any affected expatriate staff were isolated in a designated housing complex.

2.11. ED physicians

Our consultant-based ED helped organize on floor simulations for the junior physicians and allied staff. There were joint ED and ICU endotracheal intubation drills in the designated cubicles. A modified cardiopulmonary resuscitation protocol was also rehearsed for COVID-19 patients. ED consultants completed an online critical training course for “non-ICU physicians” in preparation for “hospital surge plan” (Fig. 2). As the COVID-19 patient numbers soared, the asymptomatic patients and the ones with minor symptoms were advised to isolate at home. A dedicated COVID-19 virtual shift was launched for that purpose, where a dedicated ED consultant spoke to the COVID-19 positive patients discharged from ED in the last 12 h. They triaged them based on their symptomatology. With buildup of another clinical team for this role, the responsibility of this physician was changed to provide consultations for sick COVID-19 patients only (Fig. 3).

DEPARTMENT OF EMERGENCY MEDICINE  
COVID 19 SURGE PLAN (ADULT EMERGENCY MEDICINE)

SURGE LEVELS	DEFINITION	TRIGGER	RESPONSE LEVEL
I. Pre-Surge	Cases reported at KSA or Risk imported cases	Risk but no cases	<ul style="list-style-type: none"> <li>Risk assessment initially and periodically</li> <li>Follow case definition</li> <li>Screening area pre-registration of patients and Ambulances</li> <li>Follow the hospital endemic sub-plan for Emergency Room</li> </ul>
II. Minor Surge	Low number of cases in ER Max 1 case intubated	2-5 cases in ER	<ul style="list-style-type: none"> <li>Positive Patients assigned to NPR in Main ER</li> <li>Clear Resuscitation Area from other patients and lock it</li> <li>Change Physician schedule to (12 hours)</li> <li>Re-assign residents to Adult Zone and L1</li> <li>Move admitted patients to Adult zone, Zone 4, Fast track and CDU</li> <li>Keep Rooms 1 to 21 vacant from regular patients and ready to be used for positive or high risk cases</li> </ul>
III. Moderate Surge	Moderate number of cases in ER	5-10 cases in ER More than 1 intubated	As level II, and; <ul style="list-style-type: none"> <li>Move Screening and Triage to outside ER</li> <li>Divert CAT 4&amp;5 to another facility</li> <li>Call extra staff to cover Resus (add 1 physician)</li> <li>Involve ICU early for possible assignment in ER</li> </ul>
IV. Major Surge	Large number of cases in ER	10-20 cases in ER	As level III and <ul style="list-style-type: none"> <li>Divert CTAS 3 and stable to another facility</li> <li>Clear adult zone and move patients up to CDU/ FT</li> <li>Call extra staff for coverage (add 1 physician)</li> <li>Including staff from other department through MCA ( ansth, meds)</li> <li>DEM admin in ER 24/7 to oversee operation</li> </ul>
V. Large Scale Emergency	Large number of cases in ER	> 20 cases in ER	As level IV and <ul style="list-style-type: none"> <li>Close ER to any patients expect Resuscitation</li> <li>Extra staff to be called in</li> <li>Divide staff to team A and B</li> <li>Consider using Pediatrics area and Zone 4</li> <li>Consider using Hallway</li> </ul>

\*Diverting patients to another health care facility or closing ER is decided based on the department situation (Adult and Pediatric)

Fig. 2. Adult EM COVID-19 Surge plan DEM.

# COVID Reporting Physician

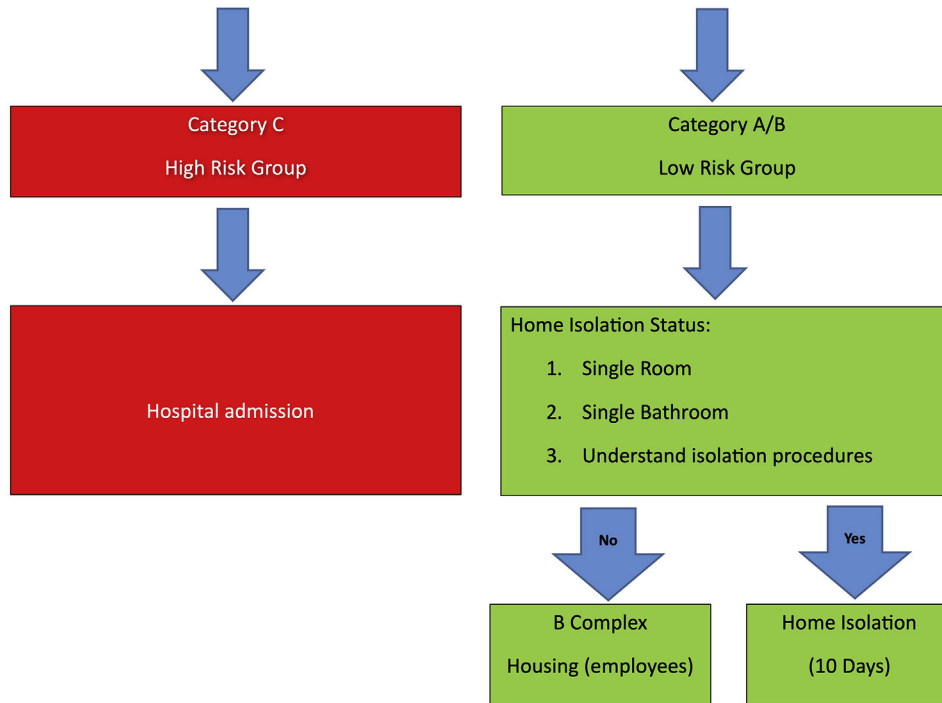
- Coverage 0800 – 1700
- Assessment of Medical Condition/Isolation Status by Phone

**Symptoms and Severity:**

Category A (Asymptomatic)  
 Category B (Mild Symptoms): Fever, Myalgia, HA, Sore Throat, GI symptoms, Mild Cough  
 Category C (Pneumonia-Sick): SOB, Severe HA, Chest Pain

**Medical Problems and Risk Factors:**

HTN, DM, Cardiac, Immunocompromised (Cancer/Transplant), Organ Failure (renal/Liver/Heart)



- EMS COVID-19 MD will be the point of contact after 1700 for Family Medicine physician if patient condition changed, or needed admission
- If Patient in isolation deteriorate:
  - B-Complex >> Paramedics will evaluation and transfer to East Wing coordination with EMS COVID-19 MD

Fig. 3. COVID-19 reporting MD

2.12. Miscellaneous steps

ED consultants’ discretion was used to allow attendants, with the COVID-19 positive patients.

Security presence was heightened to stop any untoward occurrences, due to movement restrictions.

ED coordinators (nonclinical managers) were kept available on the floor to answer any questions from the patient’s relatives.

2.13. ED covid meetings/webinars

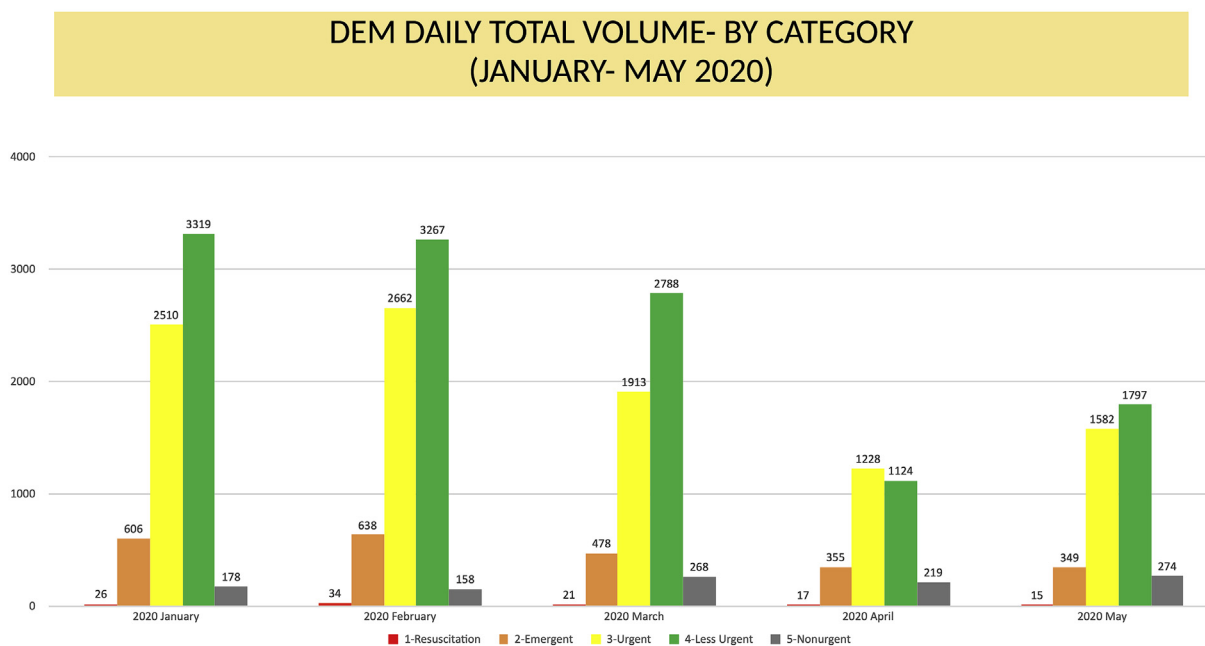
A separate weekly staff online meeting was set up by the ED

chairman for raising awareness and discussing strategies and ideas to manage the constantly changing situation. There were also regular COVID-19 updates from the hospital management.

**3. Steps to reduce COVID-19 patient numbers in ED**

3.1. Patient awareness

After the declaration of COVID-19 as a pandemic, the ED patient numbers started to increase with the “fear factor.” Later on, with the online public awareness campaign through media, the Ministry of Health (MOH) website and imposition of curfew significantly



**Fig. 4.** DEM monthly total volume.

decreased the ED patient number (Fig. 4).

### 3.2. Drive through Covid-19 testing

The stable patients and employees were screened through this process, bypassing ED.

### 3.3. Start of virtual clinics

The hospital cancelled all the scheduled outpatient clinics, for a period of two months. This measure decreased ED influx in two ways. It stopped the inward flow from clinics to ED (e.g., admitted patients sent due to the lack of hospital beds). The telephonic consults also increased patients' awareness, that face to face clinical encounter is not always required.

### 3.4. Access to clinic hotline

Hospital patients were given direct phone access of their relevant primary clinic to discuss nonemergent issues.

### 3.5. Establishment of Covid-19 clinic

This was established to follow up daily the COVID-19 patients who were considered suitable for home isolation.

### 3.6. Designated Covid-19 hospital wing

This was a geographically segregated area, well suited to accommodate and manage the COVID-19 patients, who needed inpatient treatment. It also had a secluded ICU for the patients needing ventilatory care. The COVID-19 patients being observed at home could directly be transported to their allocated bed, if their clinical condition worsened.

### 3.7. Dedicated microbiologist and infectious disease consultant

This was to provide expert advice particularly to the frontline

staff, expedite diagnostic tests, and treatment decisions.

## 4. Discussion

COVID-19 is a serious life-threatening condition. It has a relative lower mortality than MERS CoV-1 (10% vs 34.4%), but much higher transmissibility [7,8]. Both conditions also share the same mode of transmission. We applied the principles learnt from MERS CoV-1 for managing the COVID-19 crisis. Successful previous experiences, go a long way in managing surges [9].

“Major disaster plan” in ED, triggers a joint institutional response to a mass incident [10,11]. COVID-19 crisis, not only triggered a response on disaster footings, but also led to a major transformation in the existing hospital emergency systems [12–14]. A “command & control center” was based next to our ED, which was guided by the “COVID-19 task force” made up of key players from each department. All major departments broke barriers and made collaborative plans to help improve ED patient flow. This joint approach, in mass casualty situations translates to a successful outcome [14,15].

ED modified its “Cardio-Pulmonary Resuscitation” (CPR) and other emergency procedures for COVID-19 patients, based on international recommendations. The modified plans took into consideration, the risk of droplet & air borne transmission caused by this disease; e.g. decision of early endotracheal intubation without initial bag and mask ventilation. Adopting evidence based clinical practices reduces risk of transmitting infection [16,17].

We took a proactive approach of screening all our ED patients for COVID-19 who presented with fever, because of their high vulnerability. We implemented a joint standard operating procedure (SOP), whereby the patients' admission by the specialties would not be delayed, once the “decision to admit” was made by the ED. Anticipatory approach, through learning of the disease pattern, can help tailor a proportionate response [18,19].

Our ED's patient mortality stayed unchanged, with no recorded COVID-19-related safety incident, during the crisis period. This could be because of ED preparedness, the involvement of most senior physicians, robust transfer process and the ready availability

of inpatient beds. The ED boarding was significantly decreased with the above processes, which had a positive impact on patients' mortality [20].

The availability of skillful ED workforce is vital in managing major disasters [21].

The successful screening, appropriate space allocation, barrier nursing, rapid testing, and treatment helped save lives.

ED protected its workforce by giving them clear protocols, personal protective equipment, regular drills, and daily updates about the dynamic situation [22]. As a result, majority of the ED staff were found to be in compliance with the departmental SOPs on weekly audits.

Our institution tailored its strategy, according to changing circumstances. The hospital "command and control" center kept the ED situation at the heart of its planning. This helped decant ED effectively and any sudden patient influx was dealt with efficiently. The priorities set by leaders and managing the health system can have a major impact in controlling surge [23].

COVID-19 has changed ED staff behaviors. It has inducted habits of safe distancing, regular hand hygiene, and the use of personal protective equipment. It has also created the sense of mental and physical preparedness for any similar eventuality.

EDs' resilience, commitment, and an integrated approach helped fight this new challenge. These good practices helped slow down the propagation of COVID-19, which is likely to stay with us over the coming months and years [24].

## 5. Limitations

These processes were implemented in the ED of a big tertiary center, with a peculiar case mix, which may not apply to smaller EDs.

## 6. Conclusions

Effective ED processes go a long way in managing any crisis situation. There should always be thoughtful planning and an integrated approach in managing a challenging situation like COVID-19. The process and practices adopted by the Emergency staff can be helpful for any similar future situations.

## Ethical statement

The article has been written keeping in mind all the international ethical requirements.

## Declaration of competing interest

The authors declare that they have no conflicts of interests.

## References

[1] Ma X, Vervoort D, Reddy CL, Park KB, Makasa E. Emergency and essential surgical healthcare services during COVID-19 in low-and middle-income countries: a Perspective. *Int J Surg* 2020;79:43–6. July 2020.

[2] World Health Organization (Who). COVID-19 update. Accessed, <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. [Accessed 8 June 2020].

[3] Wang J, Wang Z. Strengths, weaknesses, opportunities and threats (Swot) analysis of China's prevention and control strategy for the covid-19 epidemic. *Int J Environ Res Publ Health* 2020 Jan;17(7):2235.

[4] Paganini M, Conti A, Weinstein E, Della Corte F, Ragazzoni L. Translating COVID-19 pandemic surge theory to practice in the emergency department: how to expand structure. *Disaster medicine and public health preparedness*. 2020 Mar 27. 1–0.

[5] Bikson M, Hanlon CA, Woods AJ, Gillick BT, Charvet L, Lamm C, et al. Guidelines for TMS/tES clinical services and research through the COVID-19 pandemic. *Brain Stimul*. 2020 May 12;13(4):1124–49. July–August 2020.

[6] Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, et al. Impact of the coronavirus (COVID-19) pandemic on surgical practice-Part 2 (surgical prioritisation). *Int J Surg* 2020 May 12;79:233–48. July 2020.

[7] Alabdali A, Almkhalas K, Alhusain F, Albaiz S, Almutairi K, Aljerian N. The Middle East respiratory Syndrome coronavirus (MERS-CoV) outbreak at king Abdul-aziz medical city-riyadh from emergency medical services perspective. *Prehospital Disaster Med* 2020 May 20:1–8.

[8] World Health Organization (Who). MERS update. <http://www.emro.who.int/health-topics/mers-cov/mers-outbreaks.html>. [Accessed 8 June 2020].

[9] Bredmose PP, Diczbalis M, Butterfield E, Habig K, Pearce A, Osbakk SA, et al. Decision support tool and suggestions for the development of guidelines for the helicopter transport of patients with COVID-19. *Scand J Trauma Resuscitation Emerg Med* 2020 Dec;28(1):1–8.

[10] Shammil M, Bodrud-Doza M, Islam AR, Rahman MM. COVID-19 pandemic, socioeconomic crisis and human stress in resource-limited settings: a case from Bangladesh. *Heliyon* 2020 May 22:e04063.

[11] Alhazzani W, Møller MH, Arabi YM, Loeb M, Gong MN, Fan E, et al. Surviving Sepsis Campaign: guidelines on the management of critically ill adults with Coronavirus Disease 2019 (COVID-19). *Intensive Care Med* 2020 Mar 28:1–34.

[12] Komenda M, Bulhart V, Karolyi M, Jarkovský J, Mužík J, Májek O, et al. Complex reporting of the COVID-19 epidemic in the Czech republic: use of an interactive web-based app in practice. *J Med Internet Res* 2020;22(5):e19367.

[13] Bansal P, Bingemann TA, Greenhawt M, Mosnaim G, Nanda A, Oppenheimer J, et al. Clinician wellness during the COVID-19 pandemic: extraordinary times and unusual challenges for the allergist/immunologist. *J Allergy Clin Immunol: In Pract* 2020 Apr 4;8(6):1781–1790.e3. June 2020.

[14] Moradian N, Ochs HD, Sedikies C, Hamblin MR, Camargo CA, Martinez JA, et al. The urgent need for integrated science to fight COVID-19 pandemic and beyond. *J Transl Med* 2020 Dec;18(1):1–7.

[15] Baveja A, Kapoor A, Melamed B. Stopping Covid-19: a pandemic-management service value chain approach. *Ann Oper Res* 2020 May 14:1.

[16] Shah AU, Safri SN, Thevadas R, Noordin NK, Abd Rahman A, Sekawi Z, et al. COVID-19 outbreak in Malaysia: actions taken by the Malaysian government. *Int J Infect Dis* 2020 Jun 2;97:108–16. August 2020.

[17] Liu Y, Wang H, Chen J, Zhang X, Yue X, Ke J, et al. Emergency management of nursing human resources and supplies to respond to coronavirus disease 2019 epidemic. *Int J Nurs Sci* 2020 Apr 4;7(2):135–8. 10 April 2020.

[18] Schwedhelm MM, Herstein JJ, Watson SM, Mead AL, Maddalena L, Liston DD, et al. Can you catch it? Lessons learned and modification of ED triage symptom-and travel-screening strategy. *J Emerg Nurs* 2020 Apr 16. <https://doi.org/10.1016/j.jen.2020.03.006>. Published:April 24, 2020.

[19] AGALAR C, ENGIN DÖ. Protective measures for COVID-19 for healthcare providers and laboratory personnel. *Turk J Med Sci* 2020 Apr 21;50(SI-1):578–84.

[20] Kwon KT, Ko JH, Shin H, Sung M, Kim JY. Drive-through screening center for COVID-19: a safe and efficient screening system against massive community outbreak. *J Kor Med Sci* 2020 Mar 16;(11):35.

[21] Li Y, Zeng L, Li Z, Mao Q, Liu D, Zhang L, et al. Emergency trauma care during the outbreak of corona virus disease 2019 (COVID-19) in China. *World J Emerg Surg* 2020 Dec;15. 1–0.

[22] Cao Y, Li Q, Chen J, Guo X, Miao C, Yang H, et al. Hospital emergency management plan during the COVID-19 epidemic. *Acad Emerg Med* 2020 Apr;27(4):309–11.

[23] Chang HJ, Huang N, Lee CH, Hsu YJ, Hsieh CJ, Chou YJ. The impact of the SARS epidemic on the utilization of medical services: SARS and the fear of SARS. *Am J Publ Health* 2004 Apr;94(4):562–4.

[24] Guest JL, del Rio C, Sanchez T. The three steps needed to end the COVID-19 pandemic: bold public health leadership, rapid innovations, and courageous political will. *JMIR Public Health Surveill*. 2020;6(2):e19043.