



Pandemic response protocol of a non-frontline specialty in a multispecialty tertiary health care centre—a pilot model in orthopaedics

Girinivasan Chellamuthu¹ · Sathish Muthu²

Received: 13 April 2020 / Accepted: 12 May 2020
© SICOT aisbl 2020

Abstract

Background 3,181,642 cases and 224,301 deaths in 212 regions of the world—this is the status of COVID-19 (Coronavirus Disease 2019) pandemic as of May 1, 2020. This pandemic has managed to overwhelm the health care system of the most advanced countries in the world. As the whole of the medical fraternity stands robed as health care professionals to fight against COVID-19, specialty emergencies like trauma continue to pester the already overburdened health care community. This situation calls for the need for a *pandemic response protocol* (PREP) in each specialty that helps the doctors to manage specialty emergencies without chaos and at the same time allowing them to play their part in pandemic management.

Conclusion PREP as an integrated pragmatic approach is essential in containing pandemics as they need international cooperation at various levels starting from knowledge sharing to monetary support. PREP which is in line with the WHO action plan, will be an essential minimum response of a non-frontline pandemic response specialty like orthopedics to combat and curtail the effects of a pandemic in a multispecialty tertiary health care centre.

Keywords COVID · Pandemic response · Orthopedics · Pandemic preparedness · Non-frontline specialty

Background

3,181,642 cases and 224,301 deaths in 212 regions of the world—this is the status of COVID-19 (Coronavirus Disease 2019) pandemic as of May 1, 2020 [1]. This pandemic has managed to overwhelm the health care system of the most advanced countries in the world. As the whole of the medical fraternity stands robed as health care professionals to fight against COVID-19, specialty emergencies like trauma continue to pester the already overburdened health care community [2]. This situation calls for the need for a *pandemic response protocol* (PREP) in each specialty that helps the doctors to manage specialty emer-

gencies without chaos and at the same time allowing them to play their part in pandemic management.

The PREP should allow a non-frontline pandemic specialist like an orthopaedician to be alert and trained to evolve as a frontline health care provider, as and when the situation demands, on the lines of development of a pandemic. We intend to formulate a response protocol based on the current guidelines from various national orthopaedic associations [3–5] and international orthopaedic organizations [6, 7] along with available relevant COVID literature that will help us to be well prepared for the upcoming pandemics or the second wave of COVID-19 if at all one comes.

Before any protocol that has to be designed for a pandemic situation, there are certain factors to be considered in their design. They include:

1. Phase of the pandemic in question.
2. Modes of transmission of the micro-organism.
3. Available health resources (infrastructure, protective equipment, etc.)
4. Available frontline manpower for pandemic management.
5. Available manpower in the allied specialty.

✉ Sathish Muthu
drsathishmuthu@gmail.com

Girinivasan Chellamuthu
giri.c.nivasan@gmail.com

¹ Department of Orthopedic Trauma Surgery, Ganga Hospitals, Coimbatore, Tamil Nadu, India

² Government Hospital, Velayuthampalayam, Karur, Tamil Nadu, India

Aim of PREP

The aim of PREP is to tide over the pandemic crisis as an efficient health care workforce in the most effective way.

Goals of orthopedic PREP

1. Attend to orthopaedic emergencies.
2. Patient and healthcare worker protection.
3. Conserve and educate the orthopedic workforce on pandemic control.
4. Rise to the occasion as a frontline pandemic control team when needed.

Pandemic response protocol

The World Health Organization (WHO) divided the development of pandemic into six phases in 1999. This was further revised in 2005 and 2009 after the H1N1 flu pandemic [8] (Table 1). The phases were devised in such a way that they apply to the whole world providing a global framework to help countries in pandemic preparedness and response planning [8]. A specialty PREP should closely evolve in stages with WHO phases of development of pandemic to achieve its aim as shown in Table 1. The PREP activation should begin ideally when a country enters phase 2 of pandemic and continue until the beginning of the post-pandemic phase. The various stages of orthopaedic PREP are summarized in Fig. 1.

Stages of PREP

Stage I

This stage begins with phase 2 of the pandemic. Awareness about the pandemic is important and the national orthopedic forum should take up this responsibility and be in close lines with the WHO action plan. It should impart the information including signs and symptoms of possible pandemic and personal protective measures needed to combat the pandemic through scientific media to its fellow members. This prepares an orthopaedic surgeon to be socially more responsible and pick up the initial cases that he may come across. This also alerts him to be more responsive to the next stage of pandemic.

Institutes should take adequate steps to ensure a continuous and adequate supply of personal protective equipment (PPE) for pandemic response. They should ensure the availability of adequate isolation beds and wards.

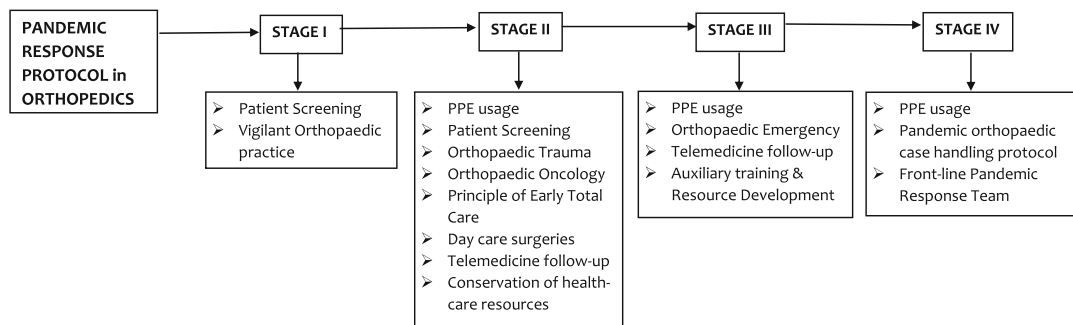
Stage II

This stage begins with phase 3 of the pandemic. At this stage, essentially, the orthopaedic surgeons would have to become a part of the pandemic response task force which includes the entire health care workforce. Our primary aim must be the prevention of human-to-human transmission thereby averting impending pandemic [9] while we balance orthopaedic care to the general public.

Table 1 Phases of pandemic and corresponding stages of orthopaedic pandemic response protocol

| Phase of pandemic | Phase description | Stages of orthopedic PREP |
|--------------------------------|--|---------------------------------------|
| Phase 1, pre-pandemic period | No virus circulating among animals has been reported to cause infection in humans. | Stage O, research & development stage |
| Phase 2, pandemic threat phase | An animal virus circulating in domesticated or wild animals is known to have caused infection in humans. | Stage I |
| Phase 3 | An animal or human-animal reassortant virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreak. | Stage II |
| Phase 4 | Human-to-human transmission of an animal or human-animal reassortant virus able to sustain community-level outbreaks has been verified. | Stage III |
| Phase 5 | The same identified virus has caused sustained community-level outbreaks in 2 or more countries in one WHO region. | Stage IV |
| Phase 6 | In addition to phase 5, the same identified virus has caused sustained community-level outbreaks in at least one other country in another WHO region. | Stage IV |
| Post-peak period | Levels of pandemic activity in most countries with adequate surveillance have dropped below peak levels. | PREP step-down |
| Possible new wave | Level of pandemic activity in most countries with adequate surveillance rising again. | PREP step-up |
| Post-pandemic period | Levels of disease activity have returned to the levels seen for seasonal activity in most countries with adequate surveillance. | Stage O, research & development stage |

PREP pandemic response protocol, WHO World Health Organization



PPE – Personal Protective Equipment

Fig. 1 Stages of orthopaedic pandemic response protocol (PREP)

Teaming up

At this stage, the orthopaedic workload is not expected to decrease yet. However, as a containment measure, it is essential to split up the orthopaedic workforce into two dedicated teams including one inpatient and one outpatient team which alternate every week without a reduction in workforce. These teams do not come in contact with each other.

Outpatient vigilance

The doctors in the outpatient department are those that are about to pick up initial positive or suspect cases of the ongoing pandemic. So, they must hold a high vigil and at the same time be armed with adequate PPE.

It is essential to have an institute specific history form to be filled in by all outpatients that warn the hospital of those with relevant travel history or symptoms. Symptomatic cases should be categorized as either suspect or non-suspect cases according to national or international guidelines [10, 11] and should be treated accordingly. The use of removable casts and splints should be maximized to reduce follow-up requirements.

Surgical care

Patients requiring emergency/early orthopaedic intervention must be attended to immediately as in normal scenarios. These include patients with orthopaedic oncology, trauma, and non-traumatic paediatric and spine conditions requiring immediate attention [12]. Day care procedures can still be carried out as they do not affect the inpatient beds available for pandemic preparedness. Day care procedures include arthroscopy surgery and simple procedures like implant removals which require < 23 h of hospital care [12].

Elective procedures in high-risk patients such as joint replacement procedures and spinal decompression procedures in the elderly should be avoided completely. Adequate analgesics including intra-articular analgesic injections or nerve root blocks can be provided to prevent their frequent hospital

visits. Documented evidence shows elderly patients with comorbid conditions and low physiologic reserves succumb to pandemic diseases [13–15]; hence, they should be advised of the potential threat and their surgery should be deferred.

Inpatient management

Orthopaedic trauma and oncological patients taken up for inpatient surgical care must be provided with prompt consultant driven surgical and anaesthetic care whenever possible which might aid in reducing the period of hospital stay. Principles of early total care in trauma patients whenever possible are to be followed. Rehabilitative services may be provided on a home-based approach through various online tools to aid in expedited discharges in reasonably quick time to have the manpower and beds available for the ongoing pandemic. We should avoid advising non-essential follow-ups. Local or telemedicine follow-up of post-operative patients, home visits, and local refilling of essential medications should be implemented where ever possible. Inpatient visitor's records should be maintained. Only one visitor for a patient should be allowed. Visitors should also be asked to fill the history form and must be screened for symptoms.

International patients

The institutes and departments must strictly follow the directives of the health ministry of the country and the WHO while handling the international patients.

Referrals

The department must set standard protocols to handle interdepartmental referrals. Each referral must be categorized into a suspect and non-suspect referral and handled accordingly by a dedicated team.

Training

The orthopaedic training for registrars and post-graduates in the department during this phase must essentially include daily updated knowledge on the nature of pandemic, the rationale behind PPE, and method of robing and disrobing PPE among others. This can be through video lectures or interdepartmental lectures if manpower is available.

Stage III

This stage begins with phase 4 of the pandemic. Phase 4 of the pandemic with documented human-to-human transmission needs extreme containment measures [9].

Teaming up

The department must be split into four groups. Specialty specific workload is expected to be reduced due to national/regional lockdown.

1. Management of outpatient department
2. Management of theaters and inpatients
3. Training in intensive care/pandemic preparedness
4. Shifts in screening pandemics

Outpatient care

The institute must cancel all the outpatient appointments with clear notice to the patient through their phone numbers. Only non-postponable paediatric outpatient procedures like casting for congenital deformity like clubfoot, vertical talus, and hip dysplasia can be addressed to avoid complex surgery with unsuccessful outcomes in the future. Other inevitable services like routine chemotherapy regimens can be administered at the nearest possible primary health centres under supervision. If such measures are not feasible, they can be given as a day care service in the hospital. Telemedicine must be encouraged whenever possible. Follow-up X-rays if needed can be advised to be taken near the locality of the patient and e-mailed to the institute. The institute must have a standard set of physiotherapy videos that can be advised to the patient through telemedicine.

Surgical care

Only emergency trauma surgeries and non-postponable spine and paediatric surgery like slipped capital femoral epiphyses (SCFE) fixation, growth rod lengthening, and growth modulation procedures should be taken up with as minimal hospital stay as possible. History forms should be maintained. Each

patient should be categorized as suspect/non-suspect before being admitted.

Theater protocol

Operating rooms with a negative-pressure environment, frequent air exchange, and separate access are needed. When the airborne spread of the pandemic is a concern during aerosol-generating procedures such as drilling, intubation, or extubation, it is important to have proper PPE and protocols in place to limit the spread of infection in this setting [16]. Ante-rooms in which to put on and remove protective equipment should be available or even constructed adjacent to the operating room [17]. The operating room must work with minimal staff pattern. Adequate time between procedures is needed for decontamination. A senior-most surgeon on call should be advised to perform all the procedures. Surgical time and blood loss must be kept to minimal as far as possible. Regional and local anaesthesia is preferred to general anaesthesia when the pandemic is suspected to be airborne [11]. With the decrease in need of residents and fellows in operation theaters as the senior consultants perform most of the procedures, we should wisely engage the seemingly excess workforce. More number of them should be deployed in emergency rooms and casualties to relieve emergency physicians for a more responsible role in handling pandemic emergencies. Routine anaesthesia and intensive care postings of the residents should be preponed in the initial phase of the pandemic so that they get trained when the need arises and at the same complete their curriculum.

Psychological counseling

The psychological trauma to the doctors during the time of pandemic is multifactorial including the inability to fulfill their standards of patient care, separation from family, inability to fulfill the family needs, isolated working pattern, the spread of infection to colleagues, fear of the spread of infection, and long working hours [18]. The institute must put in place adequate measures to avert psychological trauma due to all of these issues.

Auxiliary training and resource development

This is the single most important part of PREP. A group of surgeons must take part in formal training in non-surgical skills like handling ICU equipment. They should have first-hand knowledge of screening and treatment of patients of the pandemic. They should be prepared to step up as the frontline pandemic response team when the situation demands [19].

Stage IV

This stage begins with phase 5 of the pandemic. The surgical group should be split into two teams: one to handle the orthopaedic workload and the other for pandemic response. The fluency of specialty people to get transformed into the front-line pandemic workforce will have positive psychological and health impacts in pandemic mitigation [19]. This will satisfy the ultimate aim of our response protocol.

Pandemic orthopaedic case handling protocol [3–5, 20, 21]

Emergencies

1. Polytrauma, pelvi-acetabular fractures with major haemorrhage, compartment syndrome, and exsanguinating injuries should be prioritized for early surgical management.
2. Dislocations should be attended immediately.
3. Septic arthritis and prosthetic joint infections should be attended immediately.
4. Localized abscesses without signs of sepsis should be drained in the emergency department.
5. Orthopaedic infections without collection and sepsis should be managed by suppressive antibiotic therapy orally where ever possible.

Open injuries

1. Complex fractures fixations are planned in such a way to minimize the hospital stay and if a staged approach is used, the aim is to discharge and re-admit the patient whenever possible.
2. Primary soft tissue cover in the form of local flaps and skin grafts should be considered.
3. Early amputations should be considered when the limb salvage is uncertain.

Upper limb, spine, and paediatric condition

1. Most upper limb fractures like clavicle fractures, proximal humerus, shaft of humerus fractures, and wrist fractures should be treated conservatively. Even the resulting upper limb non-unions can be managed in a delayed manner.
2. Simple procedures such as forearm plating should be managed as a day care procedure if the resources permit.
3. Spine trauma without cauda equina syndrome should be treated with braces.
4. Cauda equina syndrome and discs with acute neurological deterioration should be treated as a priority with surgical care.

5. Paediatric fractures are managed conservatively or with minimal interventions whenever possible.
6. Paediatric emergencies like SCFE, hip dysplasia reduction, and non-postponable surgery like growth modulation must be carried out as and when needed with a minimal hospital stay.

Lower limb trauma

1. Simple periarticular fractures of the lower limb can be treated as day care procedures.
2. Periarticular fractures of hip and femur shaft fractures need definitive surgery.
3. Cemented hemiarthroplasty can be done in place of total hip replacement for the neck of femur fractures which reduces surgical time and offers early patient mobilization.
4. Dynamic hip screw fixation should be considered where ever possible in place of proximal femoral nailing.
5. The use of absorbable sutures should be encouraged whenever possible to avoid a visit for suture removal.

Pre-pandemic and post-pandemic stages of PREP

Stage 0: pre-pandemic stage

The twentieth century saw 3 influenza pandemics. Thus, the pre-pandemic stage typically lasts for years together. This phase should be used for research, development, and testing of pandemic response protocols which should also follow the lines of research and development of WHO pandemic response. Annual pandemic response mock drills should be a routine in every country.

Post-pandemic stage

This stage corresponds to the post-peak phase and possible new wave phase of a pandemic by the WHO [8]. In case of favourable regional scenario, stepping down of pandemic response to Stage 3 and then to Stage 2 should be carried out. Resting a part of the exhausted workforce is essential. Quasi emergency procedures that have been postponed because of pandemic response like a highly painful disc herniation on analgesics should be timed during this period. Every patient posted for surgery must be screened for the pandemic infection and necessary consent must be obtained for change in treatment options depending upon the results of the screening. Once the elective surgeries are resumed, the hospital must follow a priority list of waitlisted patients made based on the severity of the condition and age of the patient. We should,

however, be prepared to step up the pandemic response if the second wave of pandemic occurs.

Discussion

Unfolding its deadliness in more than 200 regions of the world, this COVID-19 pandemic has made it clear the importance of pandemic preparedness. One good example is the Disease Outbreak Response System Condition (DORSON) of Singapore [12, 22]. This was developed after the 2003 Severe Acute Respiratory Syndrome (SARS) infection in Singapore. This system is a nation-wide color-coded guidance protocol to alert the health care system depending on the level of threat by the epidemic. Effective implementation of DORSON resulted in effective COVID-19 containment in Singapore [23]. Though WHO and most of the national health care agencies have their pandemic control strategies, they will not invoke the desired effects at the grass-root level unless they are supported coherently by departmental pandemic response systems. National associations and international organizations drawing new guidelines every fortnight in the middle of a pandemic will only create confusion among their members. Hence, a pre-defined PREP model prevents chaos, instills order, and provides moral support in the to-be stressed up health care system. We hope such a PREP model will evoke a better coherent response against the pandemic.

Future directives

This pandemic response protocol is just a pilot model in this direction. The inclusion of pandemic response knowledge in the academic training of all specialties is a must. Additive knowledge of centuries is essential to deal with these once-in-lifetime catastrophes. So, literature must be analyzed, review articles must be published, and evidence-based changes should be made to the protocol in line with international pandemic preparedness protocols. A basic infrastructure that every institute or department should include must be standardized and improved.

Limitations of the model

This model applies to a full-fledged orthopaedic department in a multispecialty corporate or tertiary care teaching hospital. This does not apply to a dedicated orthopaedic specialty hospital or small-town multispecialty center where the scenario and resources are quite different. The efficiency of disaster management in any region is dependent on the availability of resources. It falls on the shoulders of the administration and national governing bodies to make sure adequate resources are available to meet the demands. Protocols like PREP makes difference in their ability to help us utilize the

available limited resources to the maximum to mitigate the pandemic. Some customization of the protocol for every pandemic is going to be essential and unavoidable.

Conclusion

Integrated pragmatic approach under the WHO is essential in containing pandemics as they need international cooperation at various levels starting from knowledge sharing to monetary support [24]. PREP as the one described above in line with the WHO action plan will be an essential minimum response in a non-frontline pandemic response specialty like orthopaedics to combat and curtail the effects of a pandemic.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. World Health Organisation.(2020) Coronavirus disease (COVID-19) Situation Dashboard. Retrieved from <https://covid19.who.int/> (Accessed 2 May 2020)
2. American College of Surgeons Committee on Trauma. (2020) Maintaining trauma center access & care during the COVID-19 pandemic: guidance document for trauma medical directors. Retrieved from <https://www.facs.org/quality-programs/trauma/maintaining-access> (Accessed 2 April 2020)
3. Indian Orthopedic Association Guidelines COVID 19 Guidelines. (2020) Retrieved from <https://www.ioaindia.org/COVID-19IOAguidelines.pdf> (Accessed 2 April 2020)
4. American Academy of Orthopaedic Surgeons. (2020) COVID-19 Member Resource Centre. Retrieved from <https://www.aaos.org/about/covid-19-information-for-our-members/> (Accessed 2 April 2020)
5. British Orthopaedic Association. (2020) Management of patients with urgent orthopaedic conditions and trauma during the coronavirus pandemic. 24 March 2020. Retrieved from <https://www.boa.ac.uk/resources/covid-19-boasts-combined.html> (Accessed 2 April 2020)
6. AO Approach to COVID 19 (2020) Retrieved from https://www.aofoundation.org/who-we-are/about-ao/news/2020/2020_02_covid-19 (Accessed 2 April 2020)
7. Orthopedic Trauma Association (2020) Statement from the OTA Health Policy Committee. Retrieved from <https://ota.org/sites/files/2020-03/HPC%20comments%20on%20COVID.pdf> (Accessed 2 April 2020)
8. World Health Organisation (2020) Pandemic influenza preparedness and response. Retrieved from https://www.who.int/influenza/resources/documents/pandemic_guidance_04_2009/en/ (Accessed 2 April 2020)
9. Qualls N, Levitt A, Kanade N et al (2017) Community mitigation guidelines to prevent pandemic influenza — United States, 2017. *MMWR Recomm Rep* 66(1):1–32. <https://doi.org/10.15585/mmwr.r6601a1>
10. Public health England - COVID 19: (2020) investigation and initial clinical management of possible cases. Retrieved from <https://www.gov.uk/government/publications/wuhan-novel-coronavirus->

- initial-investigation-of-possible-cases/investigation-and-initial-clinical-management-of-possible-cases-of-wuhan-novel-coronavirus-wn-cov-infection (Accessed 2 April 2020)
11. NHS (2020) Specialty guides for patient management during the coronavirus pandemic: Clinical guide for the perioperative care of people with fragility fractures during the coronavirus pandemic. Retrieved from https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/C0086_Specialty-guide_Fragility-Fractures-and-Coronavirus-v1-26-March.pdf (Accessed 2 April 2020)
 12. Chang Liang Z, Wang W, Murphy D, Po Hui JH. (2020) Novel coronavirus and orthopaedic surgery: early experiences from Singapore. *JBJS. Latest Articles*. doi:<https://doi.org/10.2106/JBJS.20.00236>
 13. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Xia J, Yu T, Zhang X, Zhang L (2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 395(10223):507–513
 14. CDC COVID-19 Response Team. Severe outcomes among patients with coronavirus disease 2019 (COVID-19) - United States, February 12-March 16, 2020. *MMWR Morb Mortal Wkly Rep.*;69(12):343-346. doi:<https://doi.org/10.15585/mmwr.mm6912e2>
 15. Porcheddu R, Serra C, Kelvin D, Kelvin N, Rubino S (2020) Similarity in case fatality rates (CFR) of COVID-19/SARS-COV-2 in Italy and China. *J Infect Dev Ctries* 14(2):125–128. <https://doi.org/10.3855/jidc.12600>
 16. Public health England - COVID 19: (2020) Personal protection equipment (PPE) Retrieved from <https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control/covid-19-personal-protective-equipment-ppe> (Accessed 2 April 2020)
 17. Vannabouathong C, Devji T, Ekhtiari S, et al. (2020) Novel coronavirus COVID-19: current evidence and evolving strategies. *JBJS Latest Articles* doi:<https://doi.org/10.2106/JBJS.20.00396>
 18. American Medical Association (2020) Managing Mental Health during COVID 19 Retrieved from <https://www.ama-assn.org/delivering-care/public-health/managing-mental-health-during-covid-19> (Accessed 2 April 2020)
 19. Xie J, Tong Z, Guan X, Du B, Qiu H, Slutsky AS. (2020) Critical care crisis and some recommendations during the COVID-19 epidemic in China. *Intensive Care Med.* 1-4. doi:<https://doi.org/10.1007/s00134-020-05979-7>
 20. NHS (2020) Specialty guides for patient management during the coronavirus pandemic: clinical guide for the management of trauma and orthopaedic patients during the coronavirus pandemic. Retrieved from <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/specialty-guide-orthopaedic-trauma-and-coronavirus-v1-16-march-2020.pdf> (Accessed 2 April 2020)
 21. The Surgical Royal Colleges of the United Kingdom and Ireland (2020) Guidance for surgeons working during the COVID-19 pandemic. 20th March. Retrieved from <https://www.rcseng.ac.uk/coronavirus/joint-guidance-for-surgeons-v1/> (Accessed 2 April 2020)
 22. Singapore Ministry of Health (2020) What do the different DORSCON levels mean. Retrieved from <https://www.gov.sg/article/what-do-the-differentdorscon-levels-mean> (Accessed 2 April 2020)
 23. Ng Y (2020) Evaluation of the effectiveness of surveillance and containment measures for the first 100 patients with COVID-19 in Singapore — January 2–February 29. *MMWR Morb Mortal Wkly Rep* 2020:69. <https://doi.org/10.15585/mmwr.mm6911e1>
 24. WHO (2005) International Health Regulations Retrieved from http://whqlibdoc.who.int/publications/2008/9789241580410_eng.pdf?ua=1 (Accessed 2 April 2020)

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.