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RAPID REPORTS AND PERSPECTIVES FROM THE FIELD

Are emergency services' emergency operation centres COVID-19 ready?

Alan McLean[1]

[1]Flinders University, Adelaide, South Australia

Abstract

Emergency operation centres (EOC) that provide triage, dispatch, command and control for ambulance, police or fire services are considered critical state infrastructure. They provide access to and control of life saving services and are required to be fully operational 24/7. Even minor disruptions to their operations of only a few minutes can potentially result in sever adverse outcomes or deaths within the community. As COVID-19 is caused by a novel virus it raises questions regarding the bio security preparedness of these facilities. In the absence of published research related EOC operations during a pandemic this paper looks at the emerging public health evidence and how this can be translated into EOC operations.

Keywords: Operations, centres, COVID-19, emergency, services

Introduction

Emergency operation centres (EOC) that provide triage, dispatch, command and control for ambulance, police or fire services are considered critical state infrastructure (1, 2). They provide access to and control of life saving services and are required to be fully operational 24/7. Even minor disruptions to their operations of only a few minutes can potentially result in sever adverse outcomes or deaths within the community.

EOC are secure restricted workspaces of varying sizes. In Australia EOC range in size from small to large facilities with an average sized facility having around 60 staff working in rotating shifts. These shifts vary in duration from 8 to 14 hours with rest breaks usually taken within the facility itself. The staff use shared workstations consisting of computer keyboards, mouse, interactive screens as well as radio and telephone systems. This results in a large number of staff working in limited spaces sharing equipment for prolonged periods. EOC are normally contained within a larger facility sharing much of the same infrastructure including access, staff break areas, toilets, and heating, ventilation, and air conditioning systems (HVAC). While an EOC may be a separate designated area within the larger facility it is usually still connected to the rest of the facility in some way, such as sewage and HVAC.

EOC are operated by a relatively small number of specially trained staff who perform a range of very specific functions. This makes their operations vulnerable to staffing availability as any absence can only be replaced from within a very specific skill set within this small group. While small numbers of staff absenteeism can normally be managed, the loss of a large part of a shift would present critical issues to the operations of the EOC and be challenging to maintain beyond one or two shifts.

The nature of the work they perform makes it impossible for staff to implement alternative working arrangements such as working from home or in another location. Likewise, staffing levels and shift times are set to meet demand and are not able to be altered for other purposes. As such the standard mitigation strategies that many organisations have put in place during the COVID-19 pandemic, such as working from home, moving staff to larger workspaces to enable physical distancing, or staggering worktimes are not possible in this setting.

While EOC have service continuity strategies a search of the literature found that these are mostly focused on IT or anti-terrorisms planning, with scant focus being paid to biosecurity issues. As the current COVID-19 pandemic is caused by a novel virus it raises questions regarding the biosecurity preparedness of these facilities. In the absence of published research related EOC operations during a pandemic this paper looks at the emerging public health evidence and how this can be translated to EOC operations.

SARS-CoV-2

COVID-19 is the disease caused by the SARS-CoV-2 virus (3). While COVID-19 may have been circulating for some time, at least since December 2019, the WHO only declared it a public-health emergency of international concern on January 30, 2020, and then a pandemic on March 11, 2020 (4). The actual virus causing the disease was quickly identified as a coronavirus that was similar to the virus that caused the original 2003 SARS-CoV-1 pandemic (3). As such it was assumed that the main routes of

transmission would be droplet or respiratory particles > 50 μm and contact. This resulted in a focus on symptom detection, isolation, physical distancing, cough etiquette, surface cleaning and hand hygiene as the means of containing the spread of the virus. However, as more evidence emerges it is clear that this approach has serious limitations in some situations.

Transmission of SARS-CoV-2

The prevailing advice from public health officials to date has been that hand and respiratory hygiene, surface decontamination, physical distancing and isolation of detected cases were sufficient to control the spread of the virus. While recommendations for mask wearing by the general public is gradually changing, this has not been universal, with the type and use of masks being very contentious. Currently the public health advice in Australia, apart from Victoria where mask wearing is compulsory when leaving your home, is that masks are only suggested to be used in crowed situations where physical distancing of 1.5 meters is not possible, such as public transport (5). This implies that respiratory particles < 50 μm, aerosols, are not a significant cause of transmission of SARS-CoV-2.

There is now emerging evidence and increasing debate that challenges this, with many arguing that the accepted transmission routes for SARS-CoV-2 should now include aerosols (6-9), also known as droplet nuclei, and that in some situations this may in fact be the main route of transmission (8).

Aerosols can flow in air currents over much larger distances than the larger droplet particles. This brings into question the effectiveness of physical distancing as a measure of containment, particularly in an enclosed space such as an EOC. The emerging consensus is that the rigid distinction between droplet and aerosol transmission is flawed and based on outdated evidence (6, 9). The evolving concept is that normal human activity produces a range of droplet sizes from 1 to 100 μm in size, and it should not be assumed that it is a one or the other concept (6, 10). Chia et al (2020), has reported that they were able to detect the presence of SARS-CoV-2 in particles sized from 1–4 μm, as well as >4 μm (10), with Lednicky et al (2020) able to find viable genome sequenced SARS-CoV-2 in air sampling up to 4.8 meters away from infected patients (11).

Aerosols can result from mechanisms other than just medical aerosol generating procedures. They can be created by normal breathing, talking, coughing, sneezing and sewage systems, or result from human activity such as walking across or cleaning a room, re-aerosolising material previously contaminated with SARS-CoV-2 (6, 7, 12).

Miller et al (2020) investigated a super spreading event that occurred during choir practice in Skagit Valley, Washington in the USA. Despite standard precaution being taken, there being no known cases of COVID-19 in Skagit County at that time, and that only 50% of the choir attended resulting in increased distancing between participants, 53 of the 61 members in attendance contracted COVID-19. They determined that the superspreading event was caused by aerosol transmission as it was unlikely that either fomite or airborne droplet transmission could explain the substantial proportion of cases amongst the participants (13).

As with SARS-CoV-1, SARS-CoV-2 has demonstrated the ability to spread from one room to another in multi-story buildings via the sewage system. In the case of SARS-CoV-1 this was found in the Amoy Gardens apartments in Hong Kong in 2003 (14), and in the case of SARS-CoV-2 in a call centre in South Korea in 2020 (15).

It is reasonable to conclude that given the appropriate conditions SARS-CoV-2 could be spread via aerosols, therefore standard precautions alone are inadequate in these situations. Even if there is a lack of scientific agreement on this, the lessons from the SARS commission in Canada which examined the SARS-CoV-1 outbreak in Toronto in 2003, was that we should not await scientific certainty before implementing workplace precautions (6).

Symptom checking and removing symptomatic people from the workplace can help reduce the risk of transmission. However, it cannot pick up presymptomatic or asymptomatic carriers of SARS-CoV-2. Mizumoto et al (2020) found that 17.9% of the people on board a cruise ship outbreak in February 2020 were asymptomatic (16), while Moghadas et al (2020) determined that between 17.9% and 30.8% of all COVID-19 infections were asymptomatic (17). Bandirali et al (2020) reviewed 175 chest x-rays performed one week after the 14 day quarantine period in Codongo Italy. The x-rays were performed on non-symptomatic patients or patients with vague symptoms, such as temperature less than 37.5°C and malaise. They found that 100 or 59% had abnormalities on their x-ray highly suspicious for COVID-19 pneumonia (18). A meta-analysis by Kronbichler et al (2020) also found that 62.2% of people who were asymptomatic of COVID-19 had an abnormal CT, most with ground glass opacities and that asymptomatic people tended to be younger and more socially active (19).

Making the EOC COVID-19 ready

As EOC are critical infrastructure there is a responsibility to ensure that all possible steps are taken to guarantee their continuing operation (2). There is also a legal duty of care under workplace health and safety (WHS) legislation to 'ensure, so far as is reasonably practicable, that the workplace, the means of entering and exiting the workplace and anything arising from the workplace are without risks to the health and safety of any person' (20). This duty of care requires operators of EOC;

(a) to eliminate risks to health and safety, so far as is reasonably practicable; and

(b) if it is not reasonably practicable to eliminate risks to health and safety, to minimise those risks so far as is reasonably practicable (20).

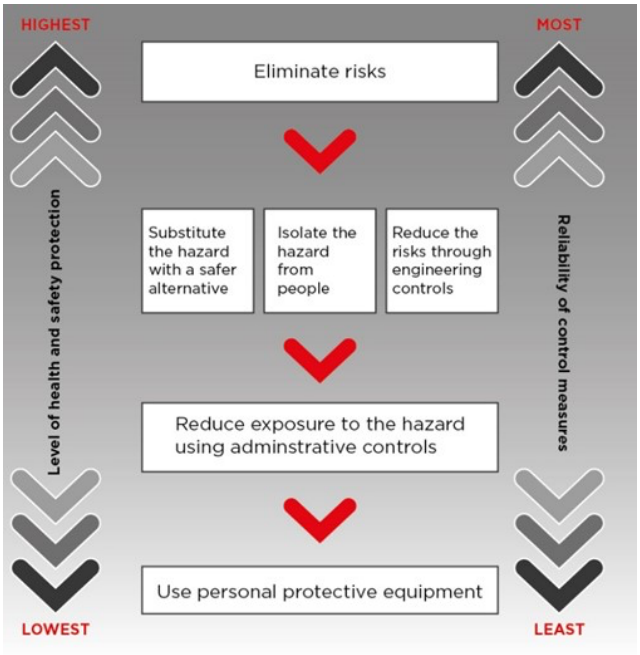
According to Safe Work Australia (2018) the accepted way to control WHS risks is to implement a hierarchy of risk control (21), referred to in Figure 1. This involves a four levelled approach with the highest level possible to be used. The highest and most effective level is to eliminate the hazard from the workplace. Where this is not possible lower levels attempt to minimise the risk, as such they are not as effective as the risk is still present. The first lower level includes substituting the hazard with something safer, isolating the hazard from people or the use of engineering controls. The next lower level is the use of administrative controls such as procedures that are designed to minimise or limit exposure time to a hazard. The lowest level of protection is the use of personal protective equipment (PPE).

Hazard control measure for SARS-CoV-2

The current public health control measures consist of hand and respiratory hygiene, surface decontamination, physical distancing, masks, symptom identification, isolation, testing and contact tracing.

Kurnitski et al (2020), Morawska et al (2020), Correia et al (2020) suggest that there are also engineering controls that should be considered. These include how HVAC are used (7, 9, 12), use of ultraviolet germicidal irradiation (UVGI) (9, 12), portable air cleaning devices (12) and how toilets are used and ventilated (6, 7, 12).

Figure 1. The hierarchy of risk control, Safe Work Australia (2018).



Implementing Controls

Each public health control measure for COVID-19 has been allocated to a control level according to its characteristics and then discussed.

Elimination

The elimination of SARS-CoV-2 from the workplace is not possible until an effective vaccination is fully rolled out, and even then, it is unlikely to be eliminated. It is currently unknow how effective a vaccination will be in terms of efficacy and ongoing immunity, and they may require multiple or regular administrations.

Substitution, isolation, and engineering

Substitution is not relevant in this situation. While isolating the hazard can be achieved via physical distancing it is impractical in most EOC due to limited space and is ineffective against aerosols. Isolation can also be achieved by working from home or moving staff to larger workspaces, however given the type of work involved these are not practical alternatives. Isolation of symptomatic or confirmed contacts is also possible yet is ineffective for pre or asymptomatic cases.

Engineering controls involving HVAC are an important consideration as airflow in buildings can be a source of transmission (7-9, 11, 12). HVAC should be designed so that air does not flow across groups of staff (8). While passive systems that direct air flow from the floor up could increase the suspension time of aerosols causing wider spread of any virus particles.

HVAC engineering controls include opening dampers on recirculating systems to include as much

fresh air as possible (9, 12). Where systems have limited ability to include fresh air windows should be opened to increase the mix of fresh air into the building (12). Both these measures have limitations during weather extremes as the HVAC may not be able to maintain temperatures within the critical limits required by both staff and equipment. Likewise, strong winds from open windows may cause airflow across staff.

Air flow within a building is a complex issue and is affected by things other than just the HVAC, including room layout, furniture and screens or partitions. These issues require an engineer with expertise in these matters to be consulted to conduct tests and design assessments.

Other engineering options include the use of filters and UVGI in HVAC. Filters on most HVAC are not capable of filtering out particles in the size rage of SARS-CoV-2 which is 60–140 nm (7, 12). This type of filtration requires the use of HEPA filters that are normally only found in isolation rooms, operating theatres, intensive care units or large commercial aircraft (7, 12). Their use in standard HVAC would likely be impracticable due to the airflow pressure drop they would cause and the requirement to design, manufacture and install special frames to fit them into the system (12).

The use of UVGI has been shown to be effective against coronavirus including SARS-CoV-1 and MERS-CoV (9). UVGI can be incorporated into some existing HVAC ducting systems (9, 12), or installed as upper-room lamp systems (9). The installation of such devices requires specialist technical design and advice (12) to ensure they provide irradiance in the range of 30 µW/cm2 to 50 µW/cm2, as well as meeting other guideline requirements (9).

While less effective the use of portable room air cleaners with HEPA or electrostatic filtration can be a useful short-term option (9, 12). These devices are only useful in smaller rooms as air flow through them is limited and the noise levels they produce can also be a constraining factor.

Administrative controls

Administrative controls include staggering worktimes, temperature and symptom monitoring, hand and respiratory hygiene, environmental cleaning, testing and contract tracing.

Staggering worktimes reduces the number of people in an area at the same time thereby reducing transmission risk. As EOC staffing numbers are mostly driven by demand this is not an option. An alternative may be to stagger shift changeover times to reduce the number of people in the EOC at any one time. Rather than an entire shift changing at the same time staff changeovers are staggered over a longer period.

Temperature and symptom monitoring have limited value in people who are in the early part of their infection, and none in pre or asymptomatic cases. With the risk of these cases being higher in younger people, any EOC where the average age of staff is in the under 30 range is at a higher risk of not being able to detect such cases.

Hand and respiratory hygiene practices and environmental cleaning are an appropriate control method, yet these require rigid compliance to be effective.

PPE

Masks are an effective way to minimise transmission of SARS-CoV-2 however, this requires the correct masks, appropriate training, fit testing and checking to be effective. While the wearing of masks in this setting is feasible it does present some technical issue for voice activated or sensitive devices, as well as the fatigue issues seen in other settings (22).

Conclusions

EOC are critical infrastructure and their continued operation is highly dependent on their ability to maintain adequate staffing levels. Should COVID-19 enter an EOC there is a substantial risk that an entire shift, or even more than one shift, could be affected, placing the facilities' operations at risk. Excluding COVID-19 from the EOC requires more than just standard public health measures. Reducing transmission risk in these settings during a pandemic requires the application of measures that are based on evidence, even if this evidence is not universally accepted. While the following recommendations are for emergency services EOC they can be equally applied to any command and control or call centre.

Recommendations

- The level of implementation of these measures can be guided by local community transmission rates, with the more stringent measures being implemented as local community transmission increases.
- Restrict entry to all but essential staff, where possible this should include not just the EOC but also any part of the facility that shares sewage, HVCA or common entry points
- Avoid rotating staff between the EOC and community contact work
- Check all staff for temperature and COVID-19 symptoms upon entry to any part of the facility, and at regular intervals during a shift
- Strictly enforced hand and respiratory hygiene practices with hand sanitisers at all entry points and workstations
- Regular decontamination of all surfaces throughout each shift, particularly high touch areas such as entry/exit points, rest, toilet, food preparation and communal areas
- Provide cleaning wipes to all workstations for regular decontamination of all equipment, especially before and after each handover of a workstation
- Maintain physical distancing of 1.5 meters and place dividers between workstations

- Increase air exchange rates and maximise fresh air intake into HVAC. Where this is not possible open windows to allow for intake of fresh air
- Have HVAC airflow examined to ensure that it is directed away from staff to avoid virus dispersion
- Where possible introduce HEPA filtration into HVAC
- Fit UVGI systems into HVAC ducting and or upper-room lamp systems
- Where possible isolate the EOC HVAC from other parts of the facility. Where this is not possible extend running times in the other areas to at least 2 hours pre and post use
- Place portable air cleaners with filtration systems in areas not well-ventilated with the existing system
- Ensure toilet seats have lids and require them to be close prior to flushing the toilet
- Ensure toilets are well ventilated with fresh air and extracted air is not recirculated or directed into the roof spaces
- Run toilet exhaust systems 24/7
- Regularly maintain all sewage floor and sink traps to ensure water seals are operating
- Implement compulsory mask wearing within the EOC
- Train staff in fit testing and checking of masks

Competing interests

The author(s) has/have no competing interests to declare.

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