



## Concepts in Disaster Medicine

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**Corresponding author:** Evan Avraham Alpert, Email: [alperta@zmc.org.il](mailto:alperta@zmc.org.il)

# Maximizing the Role of Emergency Medical Services in COVID-19 Response

Roman Sonkin MD<sup>1</sup> , Evan Avraham Alpert MD<sup>2,4</sup> , David E. Katz MD, MPH<sup>3,4</sup> and Eli Jaffe PhD<sup>1,5</sup>

<sup>1</sup>Community Division, Magen David Adom, Or-Yehuda, Israel; <sup>2</sup>Department of Emergency Medicine, Shaare Zedek Medical Center, Jerusalem, Israel; <sup>3</sup>Department of Internal Medicine, Shaare Zedek Medical Center, Jerusalem, Israel; <sup>4</sup>Faculty of Medicine, Hebrew University of Jerusalem, Israel and <sup>5</sup>Department of Emergency Medicine, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel

### Abstract

The Centers for Disease Control and Prevention define 6 intervals of a pandemic: (1) investigation of cases, (2) recognition of the increased potential for ongoing transmission, (3) initiation of a pandemic wave, (4) acceleration of a pandemic wave, (5) deceleration of a pandemic wave, and (6) preparation for future pandemic waves. Each of these stages has 8 domains. Following China's coronavirus disease 2019 (COVID-19) outbreak announcement, Israel's National Emergency Medical Services (EMS) Organization immediately began working in conjunction with the Ministry of Health (MOH) to address the threat of the COVID-19 outbreak. This article will describe how a national EMS organization acted according to these pandemic intervals and domains. In the initial stages, EMS managed a checkpoint in the international airport voluntarily testing people for febrile symptoms. Calls to the dispatch centers that aroused the suspicion of COVID-19 resulted in EMS transport to the hospital with protective gear. During the period of first exposure, the scope of the medical emergency number was increased to include questions concerning coronavirus, telemedicine, and home sampling by protected EMS workers. In the contagion stages, epidemiological tests were conducted by the MOH, and EMS began operating dedicated telephone triage, mass drive-through sampling, and finally, administration of vaccinations.

Pandemics pose one of the greatest dangers to mankind during peacetime. Transmissibility and severity are the most critical factors in determining the effect that an epidemic will have globally.<sup>1</sup> Because these factors take time to be assessed, fully realizing the consequences of an outbreak may take time. During the assessment period, the transmission of the infection may reach global levels through public transportation including trains, subways, ships, and air travel. While early identification of the risk is difficult and takes time, containment and mitigation are crucial steps that can be implemented early on to control and stabilize the pandemic.

National preparedness plans include pharmacologic and nonpharmacologic steps.<sup>1</sup> Pharmacologic steps (vaccinations, treatments, etc.) require time, complex resources, and initially have uncertain results. On the one hand, nonpharmacologic measures (quarantines, shut-downs, border control, etc.) can be implemented quickly, use simple resources, and provide immediate benefit. If measures are not taken immediately, medical systems may find they are treating symptomatic individuals only after widespread contagion has occurred.<sup>2</sup> Border closing, school cancellation, lockdown instructions, social distancing, and stringent hygiene are all immediate and effective practices. These measures can be implemented in a pandemic before detailed knowledge about the characteristics of the virus is acquired. These drastic measures are deemed necessary to achieve the highest possible degree of containment and mitigation. The public's cooperation is required to gain the desired effect of these containment steps. Disseminating regulations to the public can be done through the media, and research shows that the dissemination of accurate and credible information helps in decreasing the pandemic spread.<sup>3</sup>

In December 2019, China alerted the World Health Organization (WHO) to several cases of unusual pneumonia in the central Hubei province. By January, officials announced they had identified a new virus that later became known as coronavirus disease 2019 (COVID-19). On January 22, 2020, the outbreak of coronavirus in China was confirmed, and on January 24, 2020, the Israeli Ministry of Health (MOH) first advised avoiding travel to the affected region in China. On January 30, 2020, the WHO announced a global public health concern, and the MOH requested that Magen David Adom (MDA)—the National Pre-Hospital Emergency Medical Services (EMS) Organization—serve as the national agent of prevention and public address for quarantine information, testing, and transport.

On March 11, 2020, the WHO Director-General pronounced the coronavirus outbreak a pandemic, urging countries to “detect, test, treat, isolate, trace, and mobilize their people in the response . . . (so) those with a handful of novel coronavirus cases can prevent those cases becoming clusters, and those clusters becoming community transmission.”<sup>4</sup> Mitigation attempts seek to: (1) slow viral spread, (2) reduce the surge in health-care use, (3) provide an appropriate level of care so that the majority of patients only require home isolation, (4) expand testing capability, and (5) monitor isolation so transmission is minimized.<sup>5</sup> To achieve these critical mitigation goals, medical agencies must work collaboratively.<sup>6</sup> Globally, prehospital EMS organizations are an integral part of public health systems. EMS can provide the first layer of rapid recognition and equipment to protect them from exposure.<sup>7</sup> During pandemics, the role of EMS in managing risk is a front-line position and a useful application and extension of its abilities and resources.<sup>8</sup> When EMS organizations stand at the frontline, operating the first response to the public, guiding and monitoring quarantines and isolations, this can minimize surges in emergency departments, stabilize contagion spread, and free crucial time for the government to increase preparedness. If EMS is also involved in the testing process, this can allow hospitals and MOHs to focus on treatment and potential vaccines.

MDA operates 8 regional dispatch centers staffed solely by paramedics and EMTs with an average of 30 dispatchers receiving thousands of calls daily. In both routine and large-scale events, MDA operates as the primary source of triage, dispatch, treatment, transport, public and governmental communications, as well as serving as a national database of prehospital medical and operational data. The public accesses MDA using a designated medical emergency number (1-0-1), as well as through a smartphone application with the option of video calls. Research shows that using mobile phones and internet-based portals have been applied successfully in health-related data collection.<sup>9</sup> MDA has leveraged the use of mobile phones beyond data collection, including automatic communications and notifications for public users as well as first responders and staff. MDA operates a sophisticated technological command and control (CC) platform that allows rapid triage and intake, telephone medical guidance, automatic ambulance dispatch, auditing and archiving, and automatic mobilization of the nearest first responders by means of the designated phone app. In times of typical need, these features are important, and in times of crisis, such as a pandemic, MDA’s technology enables rapid online updates and consultations of cases, as well as data flow and public communication. The data cited throughout the article were obtained from the MDA CC platform.

The Centers for Disease Control and Prevention (CDC) describes 6 intervals of a pandemic: (1) investigation of cases, (2) recognition of the increased potential for ongoing transmission, (3) initiation of a pandemic wave, (4) acceleration of a pandemic wave, (5) deceleration of a pandemic wave, and (6) preparation for future pandemic waves. Within each interval is the potential for 8 domains to organize pandemic response: incident management, surveillance and epidemiology, laboratory, community mitigation, medical care and countermeasures, vaccines, risk communication, and state/local coordination.<sup>10</sup> This standardized framework is used to describe MDA’s operations as Israel’s national EMS organization during the COVID-19 pandemic. The objective of this article is to describe how a national EMS system can use this framework to maximize its contribution to responding to COVID-19 and to identify lessons learned to be applied to the current and future pandemics.

## Stages of Pandemic Progression and EMS Operation

### *Interval 1: Investigation of Novel Virus Infection*

#### *The Outbreak of COVID-19 in China in January 2020, Through the First Confirmation of COVID-19 in Tourists in Israel (February 21-27, 2020)*

After what became known as COVID-19 was identified in early 2020, on January 24, 2020, the MOH advised Israeli citizens to avoid travel to the affected region of China. On January 30, 2020, the WHO announced a global public health concern.<sup>11</sup> This put Israel in a state of anticipatory pre-exposure without any confirmed cases. During this period, MDA acted on several fronts. Dispatchers who identified suspected COVID-19 patients based on clinical judgment who needed transport sent a team with full personal protective equipment, including an N-95 mask, face shield, gown, and gloves. From January 21 through February 22, 2020, there were a total of 121 suspected COVID-19 transports, with 44 having been identified by medical sources and 77 suspected by dispatchers. They also informed the receiving hospital of the need for contact precautions. For asymptomatic cases, the dispatchers advised home quarantine. Also, they set up a border checkpoint at the Ben-Gurion International Airport in Tel Aviv, which resulted in 156 travelers being checked. Of these, 87 were sent to home quarantine, 12 were transported to the hospital, 18 were refused entry, and 39 resulted in no further action.<sup>12</sup>

On February 21, 2020, MDA accompanied patients who returned to Israel from the Diamond Princess cruise ship that had suffered a widespread COVID-19 outbreak. Fifteen Israeli citizens returned, with 6 being found positive for COVID-19: 4 diagnosed on the ship and 2 in Israel. MDA transported the 6 positive patients for quarantine for 14 d at a designated facility at the Sheba Medical Center.<sup>13</sup>

On February 22, 2020, it became retroactively known that a group of South Korean tourists who had been in Israel for 8 d was infected with COVID-19. The group toured many sites in the country meeting large numbers of residents. On return to South Korea, their infection was discovered. The MOH published a list of dates, times, and locations visited by the group and announced that all people who came in contact with them must enter home quarantine. Thirty students were sent into quarantine for 14 d with instructions to note symptom development including fever, sore throat, and cough. From this point on, thousands of Israelis accessed telephone support regarding the possibility of becoming infected, the need for home quarantine, or requests for hospital transport due to severe symptoms of COVID-19.

#### *Dedicated COVID-19 Hotline*

The MOH requested that MDA expand its dispatch role and become incident command as the organization running a designated COVID-19 hotline providing answers, information, and guidelines. The goal of the COVID-19 hotline, which was initiated on February 23, 2020, was to prevent exposure by using telephone triage, instructing those at risk to enter home quarantine while sending protected MDA workers to homes of suspected cases to take samples.<sup>14,15</sup>

The phone protocol began by questioning to assess whether the caller had a medical emergency. Then the dispatcher assessed the risk of COVID-19, that is, whether the caller had been exposed to a person suspected of contagion, and/or had symptoms of a fever higher than 38°C, breathing difficulties, and cough. At this stage, exposure was defined as visiting countries listed by the MOH as pandemic (China, Thailand, South Korea, etc.) or contact with

the South Korean tourists (the only cases of confirmed patients in Israel at the time). Every case of suspected COVID-19 was flagged in the CC system, and the caller was instructed to enter home quarantine effective immediately and await a call from the hotline for further guidance.

### *Home Testing*

Home testing by EMS also began on February 23, 2020. Testing was performed only after the MOH's District Physician had reviewed the case and approved sampling. To minimize contact between the public and exposed/symptomatic individuals to confirmed cases, sampling was done by MDA at patients' homes. The actual swabbing and transport of samples were done by MDA workers after arranging an appointment by phone.

Paramedics were given a tutorial reinforcing the infectious patient protocol, including protective gear guidelines and protected sampling techniques. Home sampling teams went out daily, as frequently as needed.

### *Interval 2: Recognition of the Increased Potential for Ongoing Transmission of COVID-19*

#### *First Israeli Citizens Identified Locally With COVID-19 (February 27-March 19)*

On February 27, 2020, the first Israeli citizen carrying the coronavirus was identified locally. The person was an Israeli resident, owner of a local toy store, who had returned from a trip to Italy and had developed symptoms. He then called MDA, was questioned, sampled, and tested positive for COVID-19. The MOH performed an epidemiological search of his route and informed MDA of his places of contact, locations, times, and dates. On the following day, his wife tested positive for coronavirus, followed by another 5 people, 4 of them returning from Italy and one from the Japanese cruise ship.

On March 1, 2020, a female soldier who had worked at the store tested positive, and then on March 3, 2020, two other people who were at the toy store (a middle school student employee and a deputy school principal who stopped by) tested positive for the virus. This resulted in 1150 students entering into quarantine for 2 wk.

Throughout this period, the activities of the dedicated COVID-19 call center and home testing increased. Starting on March 4, 2020, the regular 1-0-1 MDA telephone dispatch system was fortified with 30 additional workers, designated for the COVID-19 hotline. After 2 d, this proved insufficient as the number of infected people and their epidemiological trails grew. A total of 500 MDA medical staff were trained to respond to COVID-19 issues and provide guidelines. The 1-0-1 call takers now briefly questioned all callers for COVID-19 and, in case of suspected exposure or contagion, instructed the caller to enter a 14-d home quarantine and await follow-up from MDA. Paramedics performed a secondary triage after closely studying the facts. Callers who were found not to fit the criteria were released from quarantine. Suspected COVID-19 patients were questioned in detail, and if suspicion was confirmed, MDA contacted a doctor from the patient's Health Maintenance Organization (HMO) (in Israel, by law all residents are members of an HMO). The doctor either requested transport to the hospital or requested sampling for COVID-19. All protective measures were taken during transport or sampling, the drive was registered in the CC system as COVID-19, and the hospital was alerted.

By March 11, 2020, there was an increase of 700% in incoming calls to 1-0-1 regarding coronavirus concerns, and 500 additional workers were added to the dispatch centers. This consisted of a combination of salaried workers and volunteers. Some of the volunteers were recruited as employees. A marquee was put up adjacent to National Headquarters and every room in the building was re-designated for coronavirus hotline calls. On March 12, 2020, the MOH ruled that cases displaying symptoms but without exposure to a known source/location of contagion would be home quarantined without sampling. If pneumonia was diagnosed, sampling was approved even without exposure.

### *Increased In-Home Testing*

Home sampling increased from a few dozen to a few hundred per day. The now more extensive home sampling was assigned to a designated national MDA team, allowing for centralization of resources and enabling focus on clustered sampling. Starting on March 15, 2020, the sampling team used the MDA app whose technology was effective in processing and monitoring the sampling process. The app connected the queue of patients waiting to be tested with the base of samplers. The locations and epidemiological routes could also be followed with the app. As the number of suspected cases increased, the number of MDA samplers grew to several hundred.

### *Interval 3: Initiation of a Pandemic Wave*

#### *Prime Minister Benjamin Netanyahu Declares a National State of Emergency (March 19, 2020, Until March 25, 2020)*

Due to the marked increase in positive COVID-19 cases, the Prime Minister of Israel declared a state of emergency on March 19, 2020. MDA started drive-through testing stations on March 20, 2020. Initially, there were 4 stationary centers in the major cities of Jerusalem, Tel Aviv, Haifa, and Beer Sheva, along with 8 mobile drive-in testing centers that traveled to the smaller cities. This increased to a total of 198 complexes. Patients who were stable and able to drive were instructed by SMS to proceed to one of the designated testing centers.

### *Interval 4: Acceleration of a Pandemic Wave*

#### *The Government Imposes Stricter Restrictions on Citizens' Movements (March 25, 2020, Until May 2, 2020)*

As a result of the increase in COVID-19 cases, the government restricted the populace from moving more than 100 meters from their homes and restricted private vehicles to 2 passengers and taxis to only 1 passenger. Essential workers needed to be checked for fever. There was a significant fine for those who violated the restrictions. On April 1, 2020, additional restrictions were proposed, including outlawing public gatherings and requiring face masks in public. During this time, the dedicated MDA COVID-19 call center and drive-through testing continued.

### *Interval 5: Deceleration of a Pandemic Wave*

#### *MDA Closes the Dedicated COVID-19 Call Center (May 2, 2020).*

#### *The Government Outlines a Program to Ease Restrictions (May 4, 2020, Until July 6, 2020)*

As the number of COVID-19 cases dropped, MDA decided to close its dedicated COVID-19 Call Center on May 2, 2020, after servicing over 2.2 million calls. Only several dedicated dispatchers remained to deal with questions from the public and coordinate transfers of verified patients to hospitals and isolation hotels.



**Figure 1.** Pandemic intervals framework: description of the 6 pandemic intervals based on the actions of Magen David Adom.

On May 4, 2020, the government began to ease the lockdown restrictions, including allowing outdoor gatherings of up to 20 people, the ability to venture more than 100 meters from home, and weddings with up to 50 people. On May 20, 2020, beaches and museums reopened.

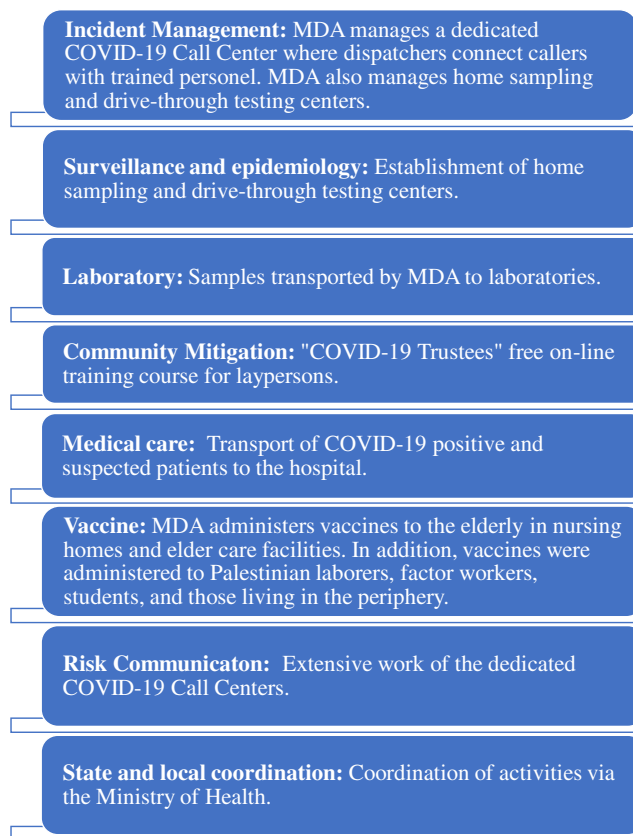
The number of drive-through centers started to decrease as fewer were needed. A total of 931,074 persons were sampled through the drive-through complexes: 46.9% in stationary complexes, and 53.1% in mobile complexes (data from March 20, 2020, through October 17, 2020).<sup>16</sup>

The basic premise of the deceleration phase was that the scope of routine travel would return to normal and there would be fewer ambulance transports. However, the need to protect staff in cases

of suspected COVID-19 was maintained. The diagnosed COVID-19 patients were identified in the computer system in real-time and the information was available to the on-call staff and volunteers.

To minimize the risk of shutting down stations due to the need to isolate the staff, employees continued to work in permanent “capsules.” Dispatchers did not work in the field, and the administrative staff worked shifts either in the field or at the dispatch center. The volunteers came to regular shifts as a “capsule.”

For efficient operation, protective equipment for ambulances was added, ambulance “sterilization” crews were placed next to hospitals, and these clean-up crews were equipped with reserve equipment for ambulances so that they did not have to reach the stations for packing.



**Figure 2.** Domains of action: description of the 8 domains of action based on the actions of Magen David Adom.

### Interval 6: Preparation for Future Pandemic Waves

*A Second Wave Occurred With New Restrictions From July 6, 2020, and a 3-Week Lock-Down From Friday, September 18 Until October 10, 2020. A Third Lockdown Was Declared on December 24, 2020, With the Easing of Restrictions on February 7, 2021*

Home testing and drive-through testing continued throughout the second and third waves. During the first COVID-19 wave, all EMS activities were documented at the departmental level, each with its relevant operating protocols. The operating protocols were studied and amended. This included a process improvement protocol for the drive-through testing and a global positioning system (GPS)-guided program to improve efficiency for home testing.

Another project that proved successful included using the national emergency phone number "1-0-1" for questions related to COVID-19. This allowed the dispatchers to place callers in isolation and then direct home sampling to their address. A pilot was initiated to send EMS to treat both COVID and non-COVID patients at home so that they would not come and overload the hospital. Preliminary results are promising, but this has yet to be fully implemented.

This organizational knowledge will be further studied and improved in preparation for future pandemics and other disasters. The list of essential equipment and suppliers will be maintained (Figure 1).

### Domains of Action

Throughout the pandemic intervals, MDA was involved in promoting the 8 domains of action to organize pandemic response: (1) incident management, (2) surveillance and epidemiology, (3) laboratory, (4) community mitigation, (5) medical care and countermeasures, (6) vaccines, (7) risk communication, and (8) state/local coordination.

MDA quickly and efficiently coordinated with the Israel Ministry of Health to establish "incident management" within 24 h. Initially, at the end of January 2020, MDA began training their dispatchers to identify patients with potential COVID-19 based on symptoms and epidemiologic features. By February 23, 2020, this developed into a dedicated COVID-19 call center where all suspected callers were routed to trained personnel. They also managed home sampling and drive-through testing centers. MDA participated in "surveillance and epidemiology" through the home sampling and drive-in testing centers. They also transported these samples to the "laboratory" for testing, although not performing the tests themselves. "Community mitigation" was a free 3-h, online program, translated from Hebrew as "COVID-19 Trustees" was created to educate and empower laypersons to safeguard their families and communities. "Medical care" was conducted by the transport of COVID-19-positive and -suspected patients to the hospital. This was done with full personal protective equipment, including an N-95 mask, face shield, coveralls (1-piece disposable suit), disposable bouffant cap, and gloves.

**Table 1.** COVID-19: Statistics for Israel and MDA activity

Activity	COVID-19 MDA Statistics	
	Date	Number evaluated/treated
Pre-exposure transports	January 21 to February 22, 2020	121 (44 identified by medical sources and 77 by MDA dispatchers)
Border-checkpoint activity	January 21 to February 22, 2020	156 travelers checked
Calls to dedicated COVID-19 Hotline	February 23 to May 1, 2020	2.2 million
Home testing	February 23 to March 21, 2021	527,371
Drive-through testing	March 20 to October 17, 2020	931,074
Administration of vaccinations	December 22, 2020, to March 18, 2021	1,388,976 including second dose (over 700,000 persons)

MDA was also involved in administering “vaccines.” Initially, they were charged with vaccinating the elderly in nursing homes and assisted living facilities. They succeeded in administering both doses of the Pfizer/BioNTech BNT162b2 to over 60,000 residents of geriatric facilities over two 20-d intervals from December 22, 2020, through January 31, 2021.<sup>17</sup> In total, by March 20, 2021, they were able to administer 1,300,000 vaccines (over 10% of the total administered in Israel at the time) including to factory workers, students, Palestinian laborers from the West Bank, those living in the periphery, and as an additional service for one of the health maintenance organizations.

“Risk communication” was exemplified by the extensive work of the COVID-19 dedicated call centers. “State and local coordination” existed from the start of MDA’s involvement in pandemic response as it was the MOH who initiated the involvement due to MDA’s status as the national EMS organization (Figure 2; Table 1).

## Conclusions

The immediate availability of a national centralized prehospital medical system, familiar to all residents of Israel, equipped with advanced training and technology, proved crucial to stemming the chaos and contagion caused by COVID-19. The MDA-dedicated COVID-19 call center was crucial in handling the national onslaught of concerns. By the end of April 2020, the MDA-dedicated COVID-19 hotline had received over 2 million calls. Centralizing calls in a guidance and triage hotline minimized public exposure by means of medical clinics and hospitals.

Acting as a nationally centralized source of quarantine guidelines, MDA was able to help control the transmission of COVID-19. Although spread did occur, it was in a gradual and digitally documented manner with confirmed cases identified and tracked in the CC system.

Due to the actions and operations of MDA, during the advent of the COVID-19 pandemic, Israel’s MOH was able to procure knowledge, equipment, and control of resources. MDA’s activities led to more organized mitigation of the pandemic allowing improved preparedness both on the governmental and individual level. The home testing and drive-through testing stations were vital for identifying COVID-19 carriers. MDA’s essential role in the mass administration of vaccinations to the elderly and others contributed to Israel’s initially becoming the country with one of the highest per-capita vaccine rates in the world.<sup>18,19</sup> From the beginning of vaccinations in December 2020 through June 4, 2021, Israel led the world in the percentage of population vaccinated at 62.12% (5.46 million).<sup>20</sup>

Cooperation and collaboration between a governmental agency (MOH) and an EMS agency (MDA) were critical to mitigate and

contain a pandemic. The versatility and transformation of a national EMS organization from being solely a dispatch, treatment, and transport service to one that rapidly and efficiently functioned through all of the pandemic intervals and domains has helped Israel finally start to return to normalcy. The lessons learned from this initiative can be incorporated at least partially, if not in whole, in other EMS systems.

**Author Contributions.** Drs. Sonkin and Alpert contributed equally to this work.

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