The Kamada company uses a singular technology to develop antibodies against Covid-19. Photo: Kamada

The Role of Advanced Technology in the Struggle against Covid-19

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The Covid-19 pandemic obligates the world to exercise creativity and initiative in the effort to combat and eradicate the virus. A variety of advanced technologies have played a key role in dealing with the pandemic. Some of these technologies were designed from the outset to treat civilians or address medical problems, while others were converted for the purpose as needed. The great reliance on technological solutions in the struggle highlights the need of the world's countries, Israel among them, to promote research, development, and the use of advanced technologies to deal with challenges. The pandemic also illustrates the challenges and opportunities involved in the development of technologies used by key players. This article seeks to examine what lessons Israel can learn from the local and international events, and what policy should be adopted in this sphere.

Keywords: Covid-19, pandemic, technology, force buildup, military

Background

The Covid-19 pandemic struck the world in 2020. The virus first appeared in China in late 2019, and quickly spread to almost all of the world's countries. It proved to be highly contagious, infected millions, and caused the death of hundreds of thousands within six months. On March 11, 2020, the World Health Organization (WHO) labeled the phenomenon a "pandemic."

Like other countries, Israel has been hit by the virus. Israel began preparing guidelines for preventing the spread of the virus in January, including rules for quarantine of people with symptoms and a ban on entry of tourists from various countries. When the virus surfaced in Israel in late February, the measures for combating it were stepped up. A total lockdown was imposed in March-April 2020 in what ultimately proved to be the first wave of the pandemic, and included the closure of schools, restrictions on activity, confinement to the immediate vicinity of one's home, and cancellation of events or gatherings with multiple participants.

The pandemic has had an unprecedented effect on the public in Israel in both the health and economic aspects, and consequently on national security as well. Many elements have been involved in dealing with the crisis, including the Ministry of Health, the Ministry of Finance, the Prime Minister's Office, the Mossad, the Ministry of Defense, and the IDF. The Ministry of Defense and the IDF provided administrative and logistical support staff, and also helped develop and produce technological solutions to cope with the pandemic. The civilian front contributed greatly to the effort to help develop new technologies and convert existing technologies for the immediate needs.

The use of various technologies in order to deal with the national (and international) crisis shows that they are essential for national security, not only in the "hard" and military sense of national security, but also in the "softer" aspects of national resilience, economics, and health. This article examines the challenges facing the promotion of technology and the means available to Israel for harnessing technology in building state power in general, and in dealing with a crisis in particular. With the Covid-19 pandemic as a test case, the article considers innovative or dual-use technologies tapped around the world to deal with the crisis, and examines how the IDF and other elements in Israel can use off-the-shelf technologies and employ them for dealing with civilian emergencies when necessary. In addition, it explores how, and in which areas, Israel should prepare to ensure that the technological tools suitable for dealing with a civilian crisis are readily available.

Technologies at the Forefront of the Struggle against Covid-19

State, commercial, and amateur entities have used a wide variety of technologies in the framework of the struggle against Covid-19. Some of these technologies were designed from the beginning for treatment of civilians or medical problems, while others were converted from various areas or developed in real time as needed, specifically for this purpose. An analysis of the use of technology in the crisis and the challenges that arose can help suggest the best policy for improving the handling of future crises. Table 1 shows a breakdown of various technologies and their respective uses against Covid-19.

Diagnosis

In the effort to harness technology for the detection and diagnosis of the disease, companies and private parties developed and trained artificial intelligence applications for identifying the virus. Terenz reported rapid training of an artificial intelligence application for detecting Covid-19 in chest X-rays, and said it had succeeded in detecting 98.14 percent of cases. In addition, an effort was made to diagnose patients by analyzing voice samples using artificial intelligence, but the trial was not proven effective. Nevertheless, it demonstrates

Table 1. Technologies in the struggle against Covid-19

Technology / Use	Artificial Intelligence	Robotics and Drones	Smartphone Location and Surveillance	Personalized Applications	Medical Technological Innovation
Diagnosis	✓				✓
Forecasting	✓				
Medical Research	✓				
Monitoring and Surveillance	✓	✓	✓	✓	
Treatment and Disinfection		✓		✓	✓
Management	✓			✓	

the move toward technological diagnosis without taking biological samples.

Another example is a Covid-19 breathalyzer test designed to replace the swab test with a simple test that can detect the disease in one minute. The same is true of the "artificial nose" designed to diagnose the disease in 30 seconds, based on odor molecules. These developments are products of the Directorate of Defense Research & Development (DDR&D) (MAFAT) in the Ministry of Defense. During the pandemic this unit converted radar in use on Israel's borders to radar used to take people's temperature, pulse, and respiratory rate from a distance of three meters.

Forecasting

A prominent case of early detection of the coronavirus through artificial intelligence is an algorithm developed by the Canadian company BlueDot. The company, which uses artificial intelligence to predict and track infectious diseases for the Canadian government, succeeded in detecting the outbreak of Covid-19 and issuing an alert about it a week before the announcement by the WHO.[1] Traditional epidemiology tries to trace the source of the outbreak by tracking where and when people came in contact with the virus. Artificial intelligence systems like that of BlueDot, on the other hand, create a model for the spread of the disease in the population through statistical analyses of various reports and news items, thereby making it possible to predict where outbreaks will occur, areas they will reach, and how fast they will spread.

Research

The realization that the knowledge and ability to deal with the pandemic are not located in one place led to the creation of "Challenges"—competitions organized by state or commercial agencies, or even private persons, aimed at finding solutions for a specific problem. One example is CORD-19, an open dataset that enables various parties to conduct research about the virus, how it spreads, and how to detect it, thereby possibly helping to eradicate the pandemic.

Monitoring and Surveillance

On March 17, 2020, the Israeli government approved emergency regulations permitting the Israel Police and the Israel Security Agency (General Security Service/Shin Bet) to use technological means and information from cellular phone companies for surveillance of Covid-19 carriers and those who came in contact with them. These regulations allow the security and law enforcement agencies to spy on civilians. According to the regulations, the ISA is authorized to receive, collect, and

process technological information about the location of patients and people who have been in close contact with them, and to disclose this information to the Ministry of Health. The ISA conducts this technological surveillance through cellular telephone location, with the location data used to warn the public and oversee compliance with quarantine rules. The Israel Police are also allowed to ask the cellular companies for information about patients and their location in order to warn the public and enforce quarantine. At the same time, special regulations have been approved enabling the ISA to use advanced technology reserved for anti-terrorism warfare in order to track anyone who was in contact with someone suspected of testing positive for Covid-19. In this case, use was made of any technological information other than the content of a call, such as subscriber contacts in calls or correspondence.

Israel is not the only country using technology for monitoring and surveillance. In South Korea, the government used an app called a "self health check," designed to monitor the situation of tourists in the country and South Koreans returning from abroad. In various Chinese provinces and cities, apps were inserted into the popular WeChat application[2] requiring daily documentation of temperature and the state of health of users in quarantine.

Other countries have also sought to use cellular and smartphone technologies in an attempt to supervise and deal with the pandemic. Thailand, Vietnam, Hong Kong, Taiwan, and Singapore are only some of the countries that have used these technologies, from creating a "virtual fence"—a system that issues an alert when a person leaves the area in which s/he is allowed to stay—to an obligation to send a message with a person's location in order to prove that a person in quarantine is at home. In England, cellular data were used to analyze people's location data anonymously in order to assess compliance with the social distancing regulations. In the United States, the administration consulted with Google, Facebook, and other companies about the possibilities for mapping the spread of the pandemic and identifying the movement patterns of people in the area.

Beyond the use of cellular and smartphone technologies, certain locales also used drones to monitor the population and its indexes, and in order to enforce the lockdown, such as in France and California, for example. The most prominent example was in China, where drones were used for surveillance of the population, to detect instances of forbidden assembly and prevent the gatherings, and to enforce a general lockdown. In Spain, drones were used to help enforce a lockdown, for example by addressing people by public loudspeaker.

Treatment and Disinfection

Various technological tools were used in the effort to reduce contact and in turn, the likelihood of infection, including medical and nursing robotics. A robot in use in Israel makes it possible for a human doctor to examine a patient remotely while connected medical devices, such as a stethoscope, thermometer, pulse oximeter, and so on relay results to the doctor. This is very similar to a robot used in ordinary times that enables doctors to circulate in a ward and conduct tests or communicate with patients or the medical staff when necessary when the doctor is not on site, or even at home. In Israel, a number of companies are developing robot assistants of this sort, for example, Temi, whose founders and owners are also the founders and owners of Roboteam, a company that manufactures military robots and has contracts with the IDF and the United States military. Another use of robots, which was present mainly in China, was for disinfection purposes. The robots used primarily special lighting or various pulses that have proved effective in destroying the virus, and in disinfecting surfaces or entire rooms.

Furthermore, Israel has used drones, ordinarily used for agricultural spraying, to spray disinfectants above municipal areas. In other

countries, drones have been used for delivery of medical material and for tests. An effort to conduct tests quickly in hospitals using drones was also begun in Israel in June 2020. Efforts by drug companies to expedite development of a vaccine and drugs using artificial intelligence applications have been reported, albeit with no success proven in clinical trials.

The health system is doing its best to use online means for treatment of Covid-19 patients and other patients during the pandemic. Remote patient management apps can potentially help patients in home hospitalization and those suffering from other diseases who have been told not to go to medical facilities in order to reduce their exposure to additional risk. At the same time, the leading Israeli HMOs (Clalit, Maccabi, and Meuhedet) offer online services to many patients—requests from doctors through their websites, consultation with family doctors and pediatricians, and more. With some of the consulting physicians, a medical test using an app is offered. Maccabi has also launched an application to chat with a doctor, based on medical artificial intelligence.

In addition, various technologies are used to attempt to solve problems created by bottlenecks in the health system. For example, the IDF Intelligence Corps technology unit (unit 81) has been developing a way of converting manual ventilating devices into automated ventilating devices, in part for use in ambulances, in order to avoid exposing the driver to patients.

Another example from abroad is the production and distribution of valves constituting part of a CPAP hood system at a cost of $1 using 3D printers. This activity, performed by a group of Italian volunteers, has helped relieve the severe shortage in hospitals in Italy.

Management

In combating the pandemic, the phrase "knowledge is power" is more appropriate than ever. The ability to manage on the basis of knowledge can help reduce infection to a significant extent and create suitable responses on short notice. Inter alia, it is necessary to manage the large quantity of information resulting from the epidemiological investigations in order to clarify the verified timetables and contacts of patients with other people, so that the chain of infection can be broken. It is also necessary to assist management within the medical system itself. A number of ad hoc developments were created for this purpose, for example, development of a cobweb system in cooperation with DDR&D. This system reads each patient's monitors in each hospital, and facilitates decisions based on information from the hospitals' databases, while prioritizing tasks for the medical staff. Unit 81 helped create an application designed to help the medical system in Israel keep track of information.

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Conclusions and Recommendations for Israel

The use of technologies in the framework of the struggle against the Covid-19 pandemic sheds light on the challenges and the opportunities in this field. The lessons that can be learned from the examples described here can help design a policy that will sharpen the ability to harness new and existing technologies for national needs in a future crisis.

Infrastructure and Policy for Storing and Sharing Data

Collecting and analyzing existing data from government and public agencies for the purpose of improving decision making proved difficult. Infrastructure and suitable tools for sharing data and a clear policy in this matter are lacking. One prominent example in this

context concerns the data possessed by the health system. The absence of a platform for transferring and sharing data between hospitals hampered the utilization of valuable medical data. Together with, and despite, the great importance of maintaining medical confidentiality, a comprehensive database of hospital patients is also important. A database of this kind can assist in creating a more accurate picture for decision makers and in researching the disease in order to better understand it and find effective treatment methods by using artificial intelligence to analyze the data. In addition to medical difficulties, the absence of a policy on collecting and sharing data has hampered an accurate assessment of the unemployment rate in Israel and efficient disbursement of grants. A proper data policy should therefore be formulated, and a national infrastructure system for storing and sharing data among government agencies should be created, with proper security measures and the use of tools for preserving the confidentiality of the information and privacy.

Although there are a number of government agencies dealing with technology, the absence of a single agency responsible for guiding the process of essential technology research and development, and defining the goals and the means for achieving them while adapting them to the nature of the crisis, stands out.

Balance between Efficiency and Social Implications

The Covid-19 crisis has highlighted the tension between the wish to safeguard people's health and safeguard their rights, such as protection of information, privacy, and confidentiality of information. The question was brought to the fore by public criticism of the use of tools for location and surveillance of people, which was perceived as a disproportionate violation of individual rights and raised concern about its misuse after the crisis wanes. The importance of privacy, including the confidentiality of relevant information, is critical, in order to facilitate safe use of confidential and essential data while improving decision making using artificial intelligence-based technologies. The moral consequences of using technology and how it affects society should therefore be considered and weighed against its effectiveness. Mechanisms should be created for balancing between these opposing considerations. Artificial intelligence technology, for example, can now be used to facilitate sharing of certain information while making private information anonymous, thereby both maintaining privacy and generating general value from the information.

The Need for a National Technology Agency and the Reliance on the IDF

Although there are a number of government agencies dealing with technology, the absence of a single agency responsible for guiding the process of essential technology research and development, and defining the goals and the means for achieving them while adapting them to the nature of the crisis, stands out. An ad hoc solution was found by setting up the national technology center for the struggle against Covid-19, led by DDR&D head Brig. Gen. (res.) Dr. Daniel Gold. While ordinarily responsible for research and development in defense, and primarily military technology, in the current emergency DDR&D became a body searching for a technological response to various immediate needs that are mostly civilian and primarily medical. Gold was responsible for coordinating the efforts to combat the virus with across-the-board cooperation between government ministries, hospitals, the Israel Innovation Authority, the IDF, the defense industries, startups, and researchers from academic institutions and research institutes. This is not the only case in which agencies from the defense establishment have had to intervene in the crisis. Parties from both the Home Front Command and combat units have

been enlisted for various actions from time to time, such as managing Covid-19 hotels, aiding the police in enforcement of the civilian lockdown, and helping to distribute food to people in various cities. In emergencies in Israel, the IDF is the first organization tapped, due to its extensive human resources, highly developed organizational capabilities, and other resources. In the technological context, its readiness for dealing with such situations should also be assessed from time to time, with an emphasis on its suitability or ability to convert its technologies to civilian use, providing that its operational fitness is not affected. This requires a slightly different view of technological questions in the framework of traditional force buildup processes.

Maintaining and Strengthening the Technological Ecosystem in Israel

The technological ecosystem in Israel, which includes the army, industry, and academic institutions, assists in various spheres in the context of the pandemic. Each element of the ecosystem has acted separately, with different parts cooperating with each other on occasion. Together with the national technology center, commercial concerns seeking to utilize their technological capabilities for the immediate needs through private initiatives and by joining with public bodies also played a part. These important initiatives illustrate the quality of the Israeli technological community. The connection between these concerns, and their ability to work together to solve problems within short time periods should be reinforced through bottom-up processes in the framework of initiatives guided by the relevant state agencies. At the same time, the effort to solve various problems using specific technological means has been criticized from time to time, given that the results of the some of the technological developments were inadequate because content personnel from the sector itself (epidemiology, in this case) were not involved in the development and trials. Particularly in a crisis, it is important to make sure that all the relevant parties are involved in the work, and to expand the circles to include people who are not necessarily part of the technological-defense milieu.

No Magic Solution

The use of technology in combating the Covid-19 pandemic shows that such technology has the potential to make a significant contribution to state security in both the "hard" and military sense of the concept and in the "softer" sense, while taking into account the influence of the non-military national-civilian entities. Strengthening the technological capabilities in the various bodies subordinate to the decision makers is essential for preserving and consolidating Israel's national power and resilience. The use of various technologies in a crisis, however, such as artificial intelligence, has proven that they are no magic solution. Prolonged processes of study and adaptation of technologies for the individual crisis are imperative, including consultation with experts from the relevant fields, in order to deal with the situation more effectively. In order to launch this process from the outset, however, strong technological infrastructure is necessary, with information sharing and off-the-shelf technologies that can be adapted for use in a civilian crisis. There is a need to devise and apply a policy in the area for this purpose, while considering the problem of using military technologies in a civilian crisis, including devoting thought to this question as part of the force buildup processes.

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Notes

1 The company warned consumers about the outbreak on December 31, 2019, while the Centers for Disease Control and Prevention (CDC) and the WHO began to report the matter only on January 6, 2020.

2 The application facilitates sending messages and video clips, and payment via mobile phone.