NATO PARLIAMENTARY ASSEMBLY

SCIENCE AND TECHNOLOGY COMMITTEE (STC)

COVID-19, INTERNATIONAL SECURITY, AND THE IMPORTANCE OF NATO'S SCIENCE AND TECHNOLOGY NETWORK

Special Report

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I. INTRODUCTION

1. The SARS-CoV-2[1] coronavirus epidemic, which was first identified in China in late 2019, has expanded to nearly every corner of the globe. The World Health Organization (WHO) assessed COVID-19 as a pandemic on 11 March 2020. The speed and the scale of the virus' global spread has been unprecedented; the disruptions it has caused are unparalleled. At the end of September 2020, the total number of confirmed cases is 34 million globally with more than one million persons having died of the disease (European Centre for Disease Prevention and Control, 2020).

2. Although the pandemic does not pose a direct military threat to member nations, it has severe implications for defence and security for the Alliance. The severe health, economic, financial, and other effects have shone a light on the weaknesses in Alliance resilience. The principle of resilience is essential to NATO; it is firmly enshrined in Article 3 of the Washington Treaty[2]. At the 2016 Summit in Warsaw NATO agreed on seven baseline requirements for resilience, which also identified the need to maintain effective health systems and sufficient medical supplies to deal with mass casualties as one requirement.

3. NATO militaries are making meaningful contributions to support national civilian efforts aimed at mitigating the effects of the COVID-19 pandemic. Most of the attention of NATO's contribution to tackling the current pandemic is focused on logistical issues and assistance. However, NATO's Science and Technology (S&T) network is also supporting the COVID-19 emergency response and its S&T network has the potential to tackle future crises of this kind. With its pool of defence scientists, engineers, and analysts – the largest such network in the world – NATO can play a major role in finding scientific and medical solutions to defeat the current pandemic and to help prepare for future crises in coordination with Partner Nations and Organisations (like the EU and the UN).

4. This special report provides a short overview of how technology is being used to tackle the COVID-19 pandemic and in particular what the Alliance is doing on the S&T front. It argues that the potential of NATO's S&T network could and should be leveraged more efficiently and effectively. The rapporteur also warns that easy access to technology is likely to increase the threat of bioterrorism and that the Alliance need to be prepared to deal with this risk.

II. COVID-19 EMERGENCY RESPONSE: THE CONTRIBUTION OF THE NATO SCIENCE AND TECHNOLOGY ORGANIZATION AND OF ALLIED MILITARIES

5. Since COVID-19 was recognised as a pandemic, the military forces of NATO member countries have played an important role in tackling the crisis. For example, NATO military forces have helped with logistics and planning, field hospitals, transport for patients, repatriation of citizens abroad, disinfection of public areas, and at border crossings (NATO, 2020c). NATO's Supreme Allied Commander Europe (SACEUR) has been tasked with leading military support efforts, supported, among others, by the Committee of the Chiefs of Military Medical Services in NATO (COMEDS), which is the senior body for military medical advice within NATO (NATO, 2020e). For example, during the COVID-19 pandemic, COMEDS is helping to coordinate the military medical aspects of the pandemic among members and partner countries in order to identify issues that require harmonisation, immediate attention, decisions, or action.

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1 Severe acute respiratory syndrome coronavirus 2.

2 Resilience is the ability of Allied countries to address and recover from a major shock to the system, either individually or through collective action. These shocks can take the form of either a natural disaster, a system failure or an armed attack. More generally, resilience is understood as the normalisation process in the aftermath of a shock, therefore, the ability of a society and / or a people to return to a normal life. Resilience is also best understood as the ability to withstand long-lasting changes resulting from the shock to the system (Hoogensen Gjørv, 2020).

6. More generally, NATO has taken a leading role in helping to facilitate the assistance of member countries amongst each other. The support provided by the Alliance also includes, among others, the coordination of requests and offers for assistance, including medical and financial support, through NATO's Euro-Atlantic Disaster Response Coordination Centre (EADRCC). The EADRCC has coordinated requests from the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) and 16 NATO and partner countries, garnering dozens of responses in return (NATO, 2020i). Delivery of over 1,100 tonnes of medical supplies to Allies has been organised by NATO's Strategic Airlift Capability (SAC) and the Strategic Airlift International Solution (SALIS) programmes (NATO, 2020j).

7. Moreover, NATO is also actively engaged in tackling the COVID-19 pandemic in the S&T realm. NATO promotes sophisticated projects through the active involvement of its S&T community. The NATO Science & Technology Organization (STO) is part and parcel of these efforts. It is the world's largest collaborative research forum in the field of defence and security and has a collaborative network of over 6,000 active scientists, engineers, analysts and associated research facilities.

8. To help tackle the COVID-19 pandemic, NATO has launched several initiatives to support international efforts. On 27 March 2020, the North Atlantic Council (NAC) agreed to a series of urgent tasks related to a range of potential responses to COVID-19. Within this context the STO reached out to its S&T network to share their experience and provide examples of science that is helping their national efforts in responding to COVID-19. To that end, the NATO Chief Scientist has launched the "NATO Chief Scientist Challenge", calling on NATO's extensive S&T network to share solutions in virus detection, improved situational awareness, decontamination, resilience and the post-COVID-19 future (NATO, 2020a). By early July 2020, more than 40 responses to the Challenge had been received. Among the responses that will be implemented in the context of NATO's collaborative programme of Science & Technology are those that investigate:

- Achieving a better understanding of disinformation about the pandemic, and how to counter it;
- Keeping Armed Forces healthy during a pandemic relief operation;
- Applying NATO scientists' analytic tools to planning for future pandemics;
- Making better use of technology to train military leaders in pandemic relief operations;
- Identifying lessons learnt from COVID-19 for National Defence Systems;
- Understanding the ethical dimension of military support to pandemic relief operations. (NATO, 2020g).

9. Moreover, the STO supports the COVID-19 response in other ways as well. It has set up a classified collaborative platform where scientists from Allied and partner nations can share contributions to the crisis response. Exchange of knowledge and potential solutions is also facilitated by the NATO Collaboration Support Office (CSO) in Paris, which coordinates relevant research, including virtual reality scenarios for emergency medical care, treatment of surfaces and fabrics with polymer coating, which reduces the lifespan of viruses, laser testing of saliva samples, etc.

10. In addition, the CSO has established an online portal to facilitate this effort. The portal allows shared access to COVID-19 research papers from international journals, together with information on nationally funded innovation calls for COVID-19 responses. Leveraging the scientific capacities of the STO network, helps to increase the efficiency and effectiveness of NATO's response to the pandemic. Here too, the focus is on collecting and sharing national efforts and on improving NATO's response to national requests by collating best practices, sharing innovative and rapidly applied tools to support medical and distribution efforts, and providing insights and advice through predictive analytics to help decision making.

11. Within the framework of its Science for Peace and Security (SPS) Programme NATO pursues a practical scientific project to develop new tools for a rapid and accurate diagnosis of SARS-CoV-2

infections. The project is led by scientists on the frontline of COVID-19 research from Italy's *Istituto Superiore di Sanità* (National Health Institute) and Tor Vergata University Hospital together with Switzerland's Basel University Hospital. The project will run for two years and aims to enhance the speed and efficiency of COVID-19 diagnosis through a multidisciplinary approach, by bringing together experts in the field of immunology, virology, and molecular biology. The results of the project will make an important contribution to tackling the COVID-19 pandemic and to furthering international scientific cooperation on dealing with future crises of this kind.

12. Overall, the NATO S&T network and NATO bodies are making meaningful and important contributions to tackling the COVID-19 pandemic. These activities are complementing member nations' efforts in tackling the corona crisis. The number of actors in the NATO S&T network that can initiate research projects could, however, in the longer-term limit the network's efficiency. To avoid duplication and overlap NATO's S&T efforts in tackling the COVID-19 pandemic should be more centralised.

III. COVID-19 - THE ROLE OF SCIENCE AND TECHNOLOGY IN TACKLING THE PANDEMIC

13. Science and technology play central roles in dealing with pandemics. It was the Canadian company BlueDot that informed its customers about the epidemic on 31 December 2019, six days before the US Center for Disease Control and Prevention issued its first warning. BlueDot operates a prognosis platform based on Artificial Intelligence (AI), which examines foreign-language news portals, blogs and forum contributions, airline data and reports on animal diseases for signs of an epidemic. By accessing worldwide ticket data from airlines, the platform predicted when and where infected people would travel.

14. Technology has played a crucial part in allaying the risks of the COVID-19 pandemic as well as its economic damage and health effects. Converging technologies like mobile, cloud, analytics, robotics, 4G/5G, and high-speed internet, have enabled innovative approaches to responding to the pandemic. The COVID-19 crisis has sparked global efforts by scientific and technology communities towards finding a vaccine or at least slowing the infection rate. The internet has facilitated social distancing and helped large parts of the population with online shopping and robot deliveries, digital and contactless payments, remote work, and distance learning.

15. Information technology can help prevent - or mitigate - the spread, as well as educate, warn, and empower those on the ground to be aware of the situation. The World Health Organization launched the WHO chatbot to disseminate information about the corona virus to the general public and provide answers to frequently asked questions about the sickness, such as current infection rates and self-protection measures.

16. Resource and knowledge sharing initiatives based on open source data have been devised to help health care centres gain access to the supplies they urgently need. For example, the COVID-19 tracking map by the Center for System Science and Engineering at Johns Hopkins University, is an open sources data centre which is widely used around the world to provide timely information and resources. The tool allows doctors, scientists and policy makers to keep up to date with the latest developments in terms of infection numbers and COVID-19-related deaths.

17. To address the shortage of ventilators, network communication platforms and channels were set up to share information about open source design for manufacturing ventilators with 3D printers. Open source projects like Nextstrain provide data, sequencing, and visualisations showing the evolution of the coronavirus and other pathogens, which helps epidemiologists understand how the virus evolves.

18. The search for therapies based on antibodies from patients who have recovered from COVID-19 has become possible with the use of machine learning models. For example, the

biotechnology company AbCellera's antibody discovery platform has used AI technology to analyse more than five million immune cells as they search for the cells that are able to produce antibodies and help patients recover. Thanks to artificial intelligence, 500 antibodies have already been identified as possible candidates for use in future COVID-19 therapies (Financial Post, 2020).

19. AI is playing an important role in identifying possible components of a vaccine by analysing viral protein structures. For example, teams at the Allen Institute for AI and Google DeepMind have created AI tools, shared data sets and research results. In January 2020, Google DeepMind introduced AlphaFold, a cutting-edge system that predicts the 3D structure of a protein based on its genetic sequence. The University of Texas at Austin and the National Institutes of Health used a biology technique to create the first 3D atomic scale map of the spike protein, the part of the corona virus that attaches itself to human cells and infects them (Manjunath, 2020).

20. Near real-time tracking of the development of COVID-19 infections is achieved using an interactive map developed by Johns Hopkins University (JHU). The map uses data from open source and large user communities (with permission) to provide frequent daily updates on the development of the pandemic.

21. Several countries in Asia have used smartphone apps to track the data of users who have tested positive for COVID-19. NATO member countries are also considering using tracing apps that use real-time phone data to pinpoint virus carriers and people they might have infected. However, the challenges of maintaining privacy in a digital and virtual world are profound. When it comes to ethics and confidentiality, there is no single global social norm regarding how personal data is used. In the West, populations are generally resistant to the use of their data by governments.

22. Numerous countries use drones to monitor the public's compliance with lockdown regulations and to encourage or enforce social distancing. Unmanned Aerial Vehicles (UAVs) have also been used to ferry vital personal protective equipment from the English mainland to British National Health Service staff on the Isle of Wight (McDill, 2020). During the crisis, the use of drones for medical deliveries has sharply increased. UAVs have already been used to carry medical supplies to remote areas that were hard to access in the past.

23. Technologies like remote health monitoring, autonomous disinfection, and contactless temperature guns can help prevent or slow down the spreading of viruses or lower the number of infections. Remote diagnostic solutions, virtual doctor visits, chatbots, and online patient engagement tools provide additional support for highly vulnerable groups of society and can lower the pressure on healthcare systems by reducing the number of people who need to visit a hospital. Interactive real-time mobile apps help prevent frontline workers from catching the infection and keep medical staff updated on infected patients and their treatment.

IV. THE POST-COVID-19 FUTURE AND THE ROLE OF EMERGING AND DISRUPTIVE TECHNOLOGIES IN PREDICTING, CONTAINING, AND TACKLING PANDEMICS

24. The STO's recent "Science & Technology Trends: 2020-2040" report identifies eight interrelated scientific realms as strategic disruptors over the next 20 years. This list also includes areas that are likely to play a major role in addressing pandemics. Biotechnology, Big Data and Advanced Analytics (BDAA)[3], and Artificial Intelligence are scientific areas which are either currently

[3] The STO's "Science & Technology Trends: 2020-2040" defines BDAA as "Data sets of a magnitude that are difficult to handle logistically (a definition that it must be noted changes yearly) due to increasing volume, velocity, variety, veracity and visualisation issues will present significant technical, organisational and interoperability challenges. Distributed sensors, autonomy, new communication technologies (e.g. 5G), increased use of space, virtual socio-cognitive spaces, digital twins and the development of new and expanded analytical methods will increase our ability to understand the human, physical and information spaces around us.

in nascent stages of development or are undergoing rapid revolutionary development and can play major roles in addressing the COVID-19 pandemic, and possibly also preventing, or at least mitigating future pandemics.

25. Data-driven and technology-enabled predictive practices will offer new opportunities in tackling and overcoming future pandemics. AI and BDAA are already being used in many ways in the fight against COVID-19, such as identifying and tracking outbreaks, diagnosing those with the virus, developing vaccines, calculating models to devise national shutdowns and policies, surveillance and contact tracing, facial recognition and fever detection. For example, a group of international scientists at Harvard are working on an infectious-disease model which may be able to predict Coronavirus outbreaks as early as two weeks before their occurrence, a model which could help countries implement timely responses and save millions of lives (Carey, 2020). The Defense Innovation Unit of the U.S. Defense Department is using artificial intelligence to analyse biometric data gathered from wearable devices to detect COVID-19 infections (Eversden, 2020).

26. Moreover, **artificial intelligence** will, in-concert with Big Data, contribute to the design of new drugs and vaccines, targeted genetic modifications, as well as direct manipulation of biochemical reactions, and living sensors (NATO STO, 2020). More generally, AI has the potential to assist in developing evidence-based clinical knowledge, evidence-based diagnostics, and treatment best practices.

27. The technology is evolving rapidly as latest developments in genetic engineering, the sequencing and exploitation of DNA, and bio-manufacturing demonstrate. To illustrate the speed of scientific progress it is useful to consider that the original human genome project took ten months and cost USD 3 billion in 2001. By contrast, today, it takes less than an hour to decipher a human genome and costs approximately USD 1,000 (NATO STO, 2020). AI, in-concert with BDAA and biotechnology, will therefore have a disruptive impact on the global economy and health. A combination of these technologies will go far in designing and discovering new drugs, genetics, and many other technologies. The use of AI to devise new biological agents has the potential to vastly expand our ability to develop pharmaceuticals that can be used to treat all kinds of diseases for which there is currently no cure.

28. Therefore, **synthetic biology**, in particular, appears a promising technology for tackling epidemics and pandemics in the future. It has matured towards a powerful technique that is likely to have a profound impact on scientific approaches to study viruses (Fan, 2020). Synthetic viruses including a clone of the virus that was responsible for the "Spanish flu" of 1918, have already provided valuable information on how to stop their spread. As viruses can be highly contagious, reconstructing viruses is regulated to a very few select institutions which have the highest-grade biosafety features and highly trained personnel. In 2016 already, the STO Human Factors and Medicine panel compiled a first of its kind international compendium on State-of-the-art in research on Medical Countermeasures against Biological Agents [HFM-186].

29. However, there are considerable ethical, legal and policy issues that arise with the rapid advancement of synthetic biology that need to be addressed. These issues include the use of genetic engineering; the treatment of personal medical-biological data and the ethical testing of new therapeutics and countermeasures. The more disruptive the impact of technology, the more important ethical issues surrounding the technology become. There is also a need for substantive public discourse as new, transformative, technology often raises governance issues.

30. Like most emerging and disruptive technologies, technological advances in biotechnology are primarily driven by the private sector. However, private companies pursue economic interests; improving a country's resilience against epidemics or pandemics is not their prime interest. Rather, building resilience is a governmental responsibility, it is always a collaborative effort initiated by

governments who encourage collaboration across sectors of society, with private pharmaceutical firms teaming up with public health agencies or university laboratories.

31. **Robots** have the potential to be deployed for disinfection, delivering medications and food, and measuring health conditions. Moreover, advanced robotics can make clinical care safer by helping with telemedicine and decontamination (e.g., by noncontact ultraviolet surface disinfection, improving logistics by delivering food or medicine etc., disposing of contaminated waste, and or by monitoring compliance with quarantines (Choset et al, 2020). Mobile robots could also be used.

32. While building resilience remains first and foremost the task of national governments, NATO's science and technology network can help to speed up the process of generating resilience and making it more effective. By sharing experiences and best practices, the STO could support NATO nations and Partners in identifying existing weaknesses and addressing gaps more effectively. For example, while mobile contact-tracing technology has emerged as a measure to track population movements as a means to limit the spread of a virus, large parts of the population in NATO member countries are deeply sceptical of this technology. However, for such apps to be effective approximately 60% of the population need to opt-in and use them. The STO HFM (Human Factors and Medicine) panel has started working on dis-information related to COVID-19, while engaging with NATO Strategic Communications.

V. COVID-19, PANDEMICS, AND THE DANGER OF BIOTERRORISM

33. Synthetic biology and related life sciences can be both a boon and a bane. Advancing these technologies can go a long way to defeat a pandemic or at least significantly mitigate its health effects. However, the same recent developments in life sciences have heightened concerns about the possible abuse of new technologies. Although a synthetic virus provides important insights into a virus and could help develop drugs, vaccines, and diagnostic tests it could also be used as a bioweapon. Publishing the technology roadmap allows us to improve international cooperation in understanding and defeating a virus. However, it also makes it possible for terrorists to apply the same technique to synthesise complex viruses or to develop a 'super virus' with extremely high infectivity, virulence, or vaccine-resistance (Fan, 2020).

34. In late February 2020, a team from the University of Bern published a relatively simple recipe to artificially design the virus that causes COVID-19 in a laboratory. For an experienced person the process to produce the virus was not much more difficult than baking sourdough bread from a self-made starter, it required only synthetic chunks of the virus' genomic instructions, which can be ordered online, and yeast (Fan, 2020).

35. As biological agents are relatively easy and inexpensive to obtain, they can be easily disseminated, and can cause widespread panic and disruption and could also become a weapon of choice for terrorist groups. In theory at least, genetic engineering could place a huge potential power in the hands of future bioterrorists. In fact, terror groups like Daesh have already attempted to obtain biological pathogens.

36. Bioterrorism is not a new phenomenon, and the risk of terrorist groups obtaining access to biological agents and actually using them should not be underestimated. For example, in 1984, a group of American religious extremists planted the bacteria *Salmonella typhimurium* in restaurants, thereby infecting several hundred people (Green et al, 2019). The Council of Europe's Committee on Counter-Terrorism (CDCT) stresses that the coronavirus pandemic increases the threat posed by bioterrorism. The Council of Europe is urging its 47 members to conduct training exercises that will allow for better preparedness in the eventuality of a biological threat (Brzozowski, 2020). While carrying out a bio-attack is difficult for non-state actors, as the weaponisation process of the

bio-agent is complicated, it is not impossible. However, if successful, a bioterrorist attack would generate panic among the population and could lead to mass casualties.

37. The increasing availability of and access to technology and the reduced costs involved, raise concerns as to how much regulation is needed to safeguard our societies from terrorist groups. Although chemical, biological, radiological, and nuclear technologies (CBRN) have been highly regulated to prevent proliferation, these regulations may be inadequate if anyone can set up a bio-engineering laboratory in a backyard or basement (NATO STO, 2020). Moreover, while most countries have regulations and safeguards in place for the handling and storage of dangerous pathogens in research laboratories, the security measures vary considerably in terms of the scope of these regulations and the extent of the safeguards.

38. Preventing dangerous pathogens and the technology to design them from falling into the hands of terrorist groups requires broad international cooperation. This international cooperation necessitates comprehensive exchange of information on potential bioterrorism threats and should include joint exercises which involve multiple countries. Moreover, NATO Allies should review existing regulations and safeguards and develop appropriate strategies that prevent terrorist groups from gaining access to sensitive technology and knowledge in this field.

39. The risks that biological pathogens fall into the hands of terrorist groups must be integrated into plans to prepare for future epidemics and pandemics. While it falls to the responsibility of national governments to prepare contingency plans, NATO, and the NATO STO in particular, can leverage its vast network to share intelligence, experiences, and best practices.

VI. CONCLUSIONS

40. For many years, pandemics have been on the list of security challenges of all NATO member countries. Despite this, no NATO Ally was fully prepared for the COVID-19 crisis. According to the 2019 Global Health Security Index, "national health security is fundamentally weak around the world" (Johns Hopkins Center for Health Security et al, 2019). The study also concluded that "no country is fully prepared for epidemics or pandemics, and every country has important gaps to address". As a result, the current crisis has undermined public confidence and trust in the ability of governments to deal with the threats of which the scientific and health communities have long been well aware.

41. It is impossible to know when another pandemic will break out in the future. However, it is clear that it will occur at some point and it is not excluded that a future microbial outbreak will be bigger and deadlier. The COVID-19 pandemic should therefore serve as a serious warning that we need to prepare our nations better and make them more resilient to mitigate the effects of future pandemics. It is obvious that NATO Allied and Partner nations need to apply the lessons learned, including notions on strategic independence and critical supply chains.

42. As outlined above, NATO is playing an important supporting role in tackling the COVID-19 pandemic. There are lessons to be learned which need to be included in the way the Alliance prepares for future security threats of this kind. As a first step, the Alliance should conduct an expert review of its response to COVID-19. This review should evaluate NATO's response and possible ways to better prepare for future pandemic contingencies. Moreover, the forward leaning reflection process under the banner "NATO 2030" provides an excellent opportunity to incorporate the findings of such a review in its recommendations.

43. The pandemic has underlined the importance of resilience. During their virtual meetings in April 2020, NATO Foreign and Defence Ministers agreed on a set of recommendations to strengthen Allies' resilience. These include updating baseline requirements for civil preparedness and working even more closely with international partners (NATO, 2020f). NATO's S&T capacity will be part and parcel of NATO's activities in these areas, particularly as technology is key in addressing the

COVID-19 crisis. NATO's STO and the S&T network already play a meaningful and positive supporting role in helping member states respond to health emergencies. NATO's S&T network will be instrumental in shared solutions for virus detection, improved situational awareness, decontamination, and resilience. However, this vast established network has much more to offer and Allies should exploit it more efficiently and effectively. In fact, NATO is working on a plan to address a second wave of the COVID-19 pandemic and a more long-term plan to cope with future pandemics (NATO, 2020, h).

44. To fully exploit its potential in increasing pandemic resilience, the capacities of NATO's S&T network should be increased. To this end, Allies should:

- seek to expand the existing S&T network by strengthening cooperation with other organisations, and the European Union in particular;
- develop a dialogue between NATO and international organisations on resilience, S&T, and civil emergency planning;
- provide additional resources to the Office of the Chief Scientist, which plays a critical role in coordination, including by endowing it with an advisory budget that can be used to expand the number of scientific experts in contingencies; and
- formalise the role of the Chief Scientist as the principal scientific adviser to NATO in emergencies.

45. The lesson of the COVID-19 pandemic is that NATO Allies will have to be better prepared for the next naturally occurring pandemic. More importantly, though, the Alliance needs to be much better prepared for the possibility of human-engineered biological agents designed to cause disruption on a massive scale. A major impediment to a rapid and efficient pandemic response has been the continued underinvestment in vaccine research and development. Many of the shortcomings are being addressed and the technological progress will allow more rapid development of vaccines and other means to deal with future pandemics more effectively. COVID-19 has put the resilience of Allies to the test, but if member nations maintain their focus, provide sufficient resources and use the NATO S&T network more effectively they will emerge stronger.

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