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Strategies to prevent pandemics similar to COVID-19

By Mario COCCIA [†]

Abstract. Strategies to prevent pandemics can be based on manifold policy responses, not limited to health system. This study shows main aspects of different policy responses based on lessons learned from COVID-19 to constrain the emergence of novel viral agents and the diffusion of other similar infectious diseases in society.
Keywords. COVID-19, Fatality rates, Health strategy, Air pollution, Sustainability, Crisis management, Policy response, Testing, Country monitoring, Pandemic response, Preventing transmission, Preparedness.
JEL. G2, G10, F21, F68, O53, K23.

1. Introduction

Coronavirus disease 2019 (COVID-19) is caused by the novel Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), which appeared in late 2019 (Coccia, 2020). COVID-19 and its variants have generated a pandemic with high numbers of infected individuals and deaths in manifold countries worldwide (Seligman *et al.*, 2021). In this context, it is basic to design strategies of crisis management to cope with/prevent pandemics of the COVID-19 and similar infectious diseases. The concept of strategy has a critical role in a framework of crisis management. Strategy is a current mode of cognition and action to enable the organization to take advantage of important opportunities or to cope with consequential problems and/or environmental threats in society, such as pandemics. Nations and their institutions have to prepare long-run strategies and specific plans of crisis management for pandemic threats to support the application of timely and effective processes of decision making to solve consequential problems in society. Strategies of crisis management should deal with pandemic threat before the emergence and, if necessary, cope with consequential problems and effects in society of the evolution of different pandemic waves (Groh, 2014). The main goal of these strategies is to reduce the risks of emergence of pandemics and solve the problems of pandemic threats and crises with effective and rapid decisions for reducing uncertainty and supporting as soon as possible the recovery of socioeconomic systems. In particular, strategies of countries for unforeseen pandemic crisis can be (Bundy *et al.*, 2017):

[†] CNR, National research Council of Italy & Yale University School of Medicine, 310 Cedar Street, Lauder Hall, Suite 118, New Haven, CT 06520, USA.
☎. + 85287-4804 ✉. mario.coccia@cnr.it

- *Responsive* based on the application of a previous plan of interventions ready to be used that endeavors to solve all consequential problems of pandemic crisis.
- *Preventive* based on the reduction of risk factors associated with the emergence of pandemics and the design of effective solutions for problems generated by a pandemic threat/crisis, pre-paring rapid strategic actions to stop or reduce negative effects in society in the short run.

The logical structure of these strategies of crisis management is based on following vital aspects:

- Analysis of the causes, risk factors and effects of pandemic threat (problem) in society, and possible solutions.
- Analysis of a limited number of variables associated with proposed solutions for achieving and sustaining specific goals given by the reduction of risk factors of the emergence of pandemics and negative effects in society.
- Analysis of different solutions to pandemic threats and crises and evaluation of pros and cons
- Choice of the satisfying solution in a context of limited rationally and turbulent environment of policymakers
- Application of the critical decision of problem solving for achieving the goals and evaluating expected results in a short period of time to refine and improve decision making with continuous learning processes.

2. Strategies of crisis management for on-going pandemic threats similar to COVID-19

Nicoll and Coulombier (Nicoll & Coulombier, 2009 p.3ff) show two main strategies to cope with pandemics:

- *Containment strategies* that endeavor to stop the diffusion of pandemics and epidemics in society. These interventions are directed to prevent vast chains of transmission and outbreaks, with public polices of quarantine and full lockdown associated with an accurate tracing of infections, isolation of infected people and timely treatments of patients.
- *Mitigation strategies* are based on social distancing, school closures, facemasks, etc. that endeavor to decrease the pandemic diffusion and the pressure of high hospitalization and admission to Intensive Care Units as well as protecting elderly and other people with high vulnerability (e.g., having cancer and other serious diseases).

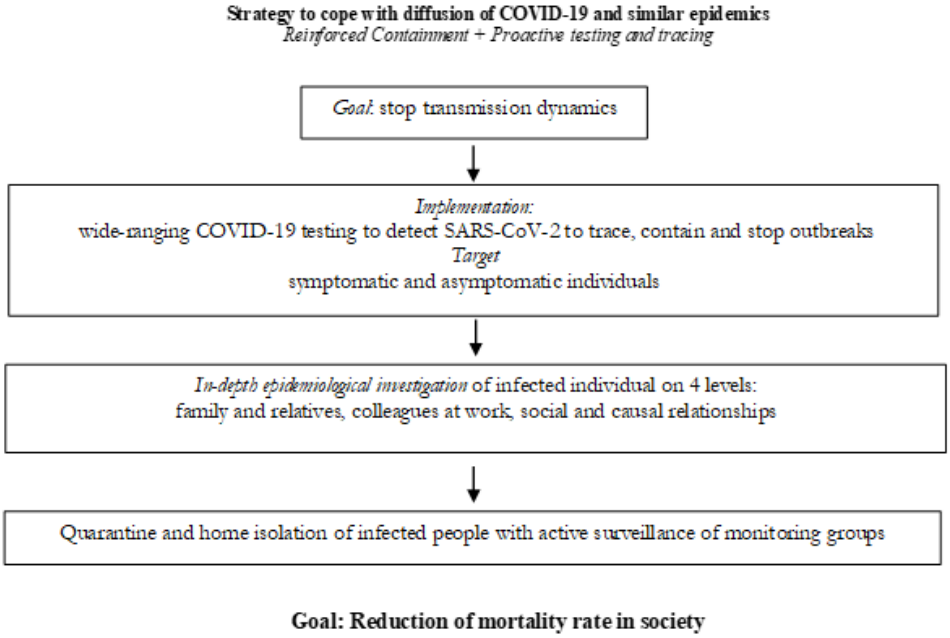

Figure 1. *Strategic responses to cope with COVID-19 pandemic crisis and similar epidemics in future*

In the presence of COVID 19 crisis and similar pandemics, many countries initially proposed a containment policy (quarantine and general lockdown) and subsequently mitigation measures, such as social distancing, disinfection of buildings, face masks, travel restrictions, etc. (Kucharski *et al.*, 2020; Walensky & DelRio, 2020). The study by Renardy *et al.* (2020) shows that a longer duration of lockdown that postpone the reopening of stores and the circulation of people does not decrease confirmed cases of infections and inter-related negative effects on public health, but longer duration of lockdown only defers these problems in a not too distant future. Instead, specific mitigation polices directed to diminish contacts among people can effectively lower the peak of pandemic waves and negative effects in society. Scholars also maintain that specific public places creating groups for social activities can generate a high risk of infections (e.g., pub, bar, etc.) (Chang *et al.*, 2020). A selected strategy to control the groups of people in these public places and the application of nonpharmaceutical measures of protection (e.g., facemasks) are more effective strategies to reduce confirmed cases than full lockdown of social and economic activities (Chang *et al.*, 2020).

In general, non-pharmaceutical measures are public health policies having the goals to lower the peak of pandemic wave and the high load on health system (Fong *et al.*, 2020; Prem *et al.*, 2020). However, Brooks *et al.*, (2020) report: "negative psychological effects of quarantine including post-traumatic stress symptoms, confusion, and anger. Stressors included longer quarantine duration, infection fears, frustration, boredom, inadequate supplies, inadequate information, financial loss, and stigma."

3. Strategies for prevention of pandemics

Specific strategies can reduce risk factors of pandemic crises for preventing the emergence of pandemics and negative effects in society. This perspective focuses on health, environmental and instructional strategies.

3.1. Health strategies

Daszak *et al.,* (2020) highlight some critical aspects of strategies for prevention of pandemics, such as:

1) control among wildlife to detect the transportation of dangerous pathogens
2) control the interaction between population and wildlife to detect as soon as possible spillover effects
3) control wildlife trade for enhancing biosecurity in domestic and international markets.

In addition, an intense activity of prevention has to be directed to control and appropriate application of biosafety protocols in public and private laboratories of virology that analyze viruses, pathogens and novel viral agents to minimize the possibility of accidental diffusion in environment and society with subsequent socioeconomic issues. The scientific collaboration among international laboratories plays a critical role to support the sharing of vital data and information for helping policymakers to apply plans to prevent/reduce the risk factors of future pandemics that can create socioeconomic issues worldwide (Coccia, 2020). This strategy of prevention can be driven by increasing levels of investments in health sector and R&D, as well as levels of health expenditure per capita. In fact, these preventive measures can control the emergence of pandemics and negative effects in society of future pandemics similar to COVID-19 (Coccia, 2020). In this context, Kapitsinis (2020) argues that investments in health sector are critical strategies to develop hospital efficiency in admissions of infected people, innovative treatments for novel infectious diseases and new technology driven by R&D labs supporting scientific advances directed to new vaccines, antivirals and other innovative drugs that can avoid and/or control future pandemic threats in countries (Coccia, 2020; Ardito *et al.*, 2021; Coccia, 2018; Coccia, 2019; Coccia, 2019a; Coccia & Watts, 2020).

3.2. Environmental strategies

Studies find that sustainable environment plays a vital role to reduce risk factors of epidemics and prevent pandemics similar to COVID-19; scholars maintain that a low rate of fatality is associated with a low level of air pollution in environment (Coccia, 2020; Coccia, and Watts, 2020; Coccia, 2020b; Coccia, 2021; Coccia, 2021a). Studies also show that countries with 72% of population exposed to levels exceeding WHO guideline value of air pollution have fatality rates of COVID-19 lower than countries with 98% population exposed to similar levels of air pollution. Coccia (2020) demonstrates that polluted cities should not exceed forty-eight days per year

of air pollution, in the presence of climate conditions having little wind. In particular, when days of air pollution is higher than 100 days per year, the reduction of air quality and other factors can damage the health of population and support the acceleration of transmission dynamics of infectious diseases with consequential socioeconomic problems (Coccia, 2021; Coccia, 2021a).

3.3. Institutional strategies

Resilient systems to pandemic shocks must have strong institutions and governance driven by adequate and effective leadership that supports population needs. Efficient governance has to support preparedness to pandemic threats with constant investments in health system to reduce mortality, morbidity and stress among population, and promote economic recovery (Coccia, 2021; Coccia, 2021a; Coccia, 2021c; Klug *et al.*, 2020). Sagan *et al.* (2020) confirm that in Europe, a good governance in countries has played a critical role to support a resilient response of health system in the presence of COVID-19 pandemic crisis. In particular, Sagan *et al.*, (2020) consider a broad concept of governance, not limited to health system alone, that creates the institutional background to support economic and social systems of the nation and its government to work properly for preventing and/or coping with pandemic threats. Sagan *et al.*, (2020) pinpoint that the prevention of pandemic threats is also based on: 1) appropriate and effective governance of institutions and 2) skilled human capital with interdisciplinary technical capacity of crisis management to respond in a short period of time.

Other factors for effective strategies to prevent and/or reduce risks of future pandemic crises can be:

- Leveraging operational levels based on medical personnel, epidemiologists, biologists, emergency managers, and other professionals for coping with the pandemic's threat.
- Creating a network of innovators with a great variety of expertise and capability in different fields to support policy decisions and their timely implementation (Jenkins-Smith *et al.*, 2018).
- Fostering academic institutions and leading scholars that play a vital role in supporting rational decisions of governments (Cairney, 2016; Weible *et al.*, 2020).
- Creating stable collaborations across different structures, such as academic and administrative institutions to accelerate learning process to prevent and/or to cope with pandemic threat/crisis (Crow *et al.*, 2018).

Overall, then, success or failure of strategies to prevent pandemic threats and crises depend on effective decision making in the presence of uncertainty, turbulent environment and highly restricted time (Coccia, 2021a). Studies show that general guidelines for a strategy to cope with pandemic threats have to support health expenditures and R&D investments for effective policy responses, and a policy directed to long-term

sustainability that decreases air pollution and as a consequence negative effects on population and environment (Coccia, 2020; Coccia, 2021a; Coccia 2021b). Figure 2 shows these critical aspects for preventing and/or controlling the risk factors of future pandemics.

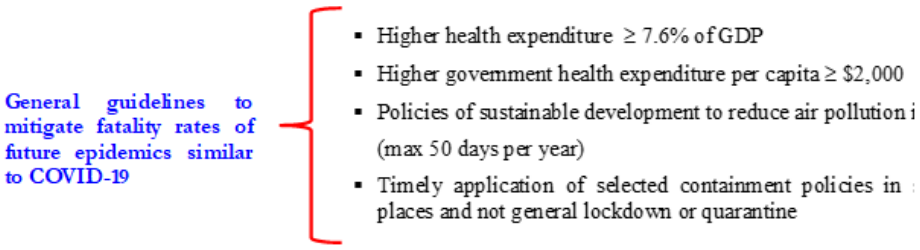

Figure 2. *Factors determining a strategies to prevent negative effects of pandemic threats.*

Finally, proposed ambidexterity strategies of crisis management for more prosperous or less favored countries are:

- *Rich countries* can focus in the short run on measures of containment of shorter duration because of a stronger healthcare sector based on high expenditures (as % of GDP), whereas in the long run these countries should support sustainable policies for reducing air pollution.
- *Developing countries* have to focus in the short run on measures of containment of a longer duration because of a weak healthcare sector based on low expenditures (as % of GDP) and in the long run they have to support public policies for enhancing health system and reducing air pollution.

4. Conclusions and prospects

Strategies of crisis management to prevent COVID-19 pandemic and similar epidemics are based on effective multi-level governance, combining both national, regional and urban strategies to provide timely policy responses for improving health safety in society (Anttiroiko, 2021). The experience of COVID-19 suggests that future infectious diseases of novel viruses can generate, more and more, a serious pandemic threat to public health of countries and their economies. New pandemics, similar to COVID-19, can emerge and spread rapidly and it is basic timely gathering and sharing of information and samples of novel viral agents for appropriate interventions to stop the emergence of epidemics. The preventive strategies have also to support the process of R&D directed to effective vaccines and subsequent production and distribution as soon as possible across countries to mitigate fatality rates and deterioration of economic growth and overall socioeconomic systems in the long run.

Nations have to design a crisis management team for managing strenuous situations given by pandemic threats and for making critical decisions to

resolve, as far as possible, them. Successful crisis management teams understand the specificity of pandemic crisis and are thoroughly prepared for solving all problems and problematic situations. Moreover, in a crisis, leaders are expected to reduce uncertainty, providing an authoritative account of problems, solutions and difficulties. Moreover, leaders have to formulate a strategy and critical decisions to cope with pandemic crises that have to be accepted by other parties that have other positions and interests and are likely to suggest various alternative solutions and actions.

The global response to COVID-19 pandemic has pushed the boundaries on new and rapid pandemic responses in several areas, including healthcare system, vaccine research, health technologies, environment as well as development, manufacturing, distribution, allocation, and administration of innovative drugs and vaccines. These strategic actions of pandemic management have to trigger learning processes to support preparedness efforts of countries to advance timely public responses and efficient investments in R&D processes of innovative drugs and new pandemic vaccines (Ardito *et al.*, 2021; Coccia, 2019; Coccia & Watts, 2020).

Hence, strategies for pandemic threats have to be based on efficiency, flexibility, responsiveness and resiliency for decreasing negative effects of infectious diseases and in general of pandemics. Efficient crisis management in the presence of a pandemic threat is directed to three strategic goals:

- application of technological innovations and new technologies for improving actions to prevent the emergence of pandemics and/or to contrast vast diffusion of epidemics or pandemics
- acceleration of R&D of effective vaccines
- finally, production on a vast scale of new vaccines and innovative drugs for countries worldwide to minimize socioeconomic issues and support recovery.

In the next years countries have to increase investments in equipment, organized infrastructures and education of human resources for improving preparedness activity to timely react in the presence of inevitable pandemics, also reinforcing international collaboration with key subjects for reducing negative effects on public health and economy (US Department of Healt, 2021). Nations with international collaborations should also support scientific and technological paradigm shift to treat infectious diseases based on novel type of vaccines, such as messenger RNA vaccines, known as mRNA vaccines for high levels of protection by preventing diffusion of infection diseases in society. This new approach is different from classical approaches to vaccination. The scientific breakthrough of mRNA vaccines is founded on concept that the infective process itself is effective in raising an immune response and genetic engineering and biotechnologies can be utilized to construct virus-like particles from the capsid and envelope proteins of viruses. COVID-19 global pandemic crisis has accelerated the transition towards these innovative types of mRNA vaccines and leading companies in pharmaceutical sector are now focusing human and economic resources on vectored, subunit, RNA, and DNA platforms, respectively. The

messenger RNA (mRNA) vaccines can jump the socioeconomic barriers of developing traditional vaccines, such as producing noninfectious viruses. Moreover, mRNA vaccines eliminate a lot of phases in manufacturing process for the development of these new drugs because rather than having viral proteins injected, the human body uses the instructions provided to manufacture viral proteins itself. mRNA molecules are also simpler to treat in labs than proteins. In short, mRNA vaccines are produced and manufactured by chemical rather than biological synthesis, as a consequence the process of development is much faster than conventional vaccines to be redesigned, scaled up and mass-produced. mRNA vaccines are being tested for other viral agents, such as Zika virus, and novel influenza, and as a consequence mRNA vaccine tools can be viable and quickly tailored for future epidemics similar to COVID-19.

Hence, in responding to constant pandemic threat of novel coronavirus in future, the international communities have to reinforce prevention and preparedness. In particular, nations and international organizations have to design and implement vital strategic actions, given by the improvement of the early warning system and timely containment operations. Moreover, the preparedness activities should reinforce the coordination of global science and research to accelerate the R&D and diffusion of effective pandemic vaccines and innovative antiviral drugs.

The strategic actions to prevent pandemic threats can be systematize as follows:

- Reinforce the early warning systems in the international community using existing infrastructures to ensure rapid detection of suspected cases in humans based on rapid and reliable international laboratories that receive all data and clinical specimens needed for an accurate evaluation of an emergence of pandemic risk
- Rapid containment policies to prevent that novel viruses increase the spread in human society or, whenever possible, delay its transmission dynamics in international community. New studies show that selected restrictions in specific places are better policy responses than full lockdown. Health policy should apply crisis management team and use global and regional stocks of antiviral drugs and other similar drugs to contain negative effects in society.
- Verify that all countries have designed and tested pandemic response plans and that international organizations are able to assume a leadership and provide clear guideline to coordinate nations during a pandemic. Developing countries having limited resources have to be supported in the development of pandemic plans to reduce gaps in basic capacities for improving an equally and coordinated global response to a pandemic.
- Finally, nations should jointly invest and coordinate global R&D to produce pandemic vaccines and antiviral drugs that are rapidly and widely available as soon as the emergence of a pandemic and/or the diffusion of the novel virus. In particular, nations should identify

priority research areas and foster funding to public- and private firms involved in R&D of innovative drugs. It is also important to gather and analyze more data on the use of established and new anti-viral drugs and vaccines for a safe administration of treatment and prophylaxis in all population. Foster partnerships among governments, regulatory authorities, universities, research laboratories, incumbent and new entrant firms can support R&D of novel drugs and in particular a timely vaccine manufacturing capacity that ensure equitable access across all nations. Moreover, R&D investments have to be directed to new vaccines conferring long-lasting protection against novel viruses and their variants. Finally, organizations and nations should foster scientific networks and laboratories to ensure that new scientific knowledge about an evolving pandemic and treatments has a rapid and wide-spread communication in real time worldwide.

These strategic actions have to achieve and sustain the main goal of reducing risk fac-tors of epidemics and, in the presence of pandemics, providing whenever possible a vast immunological protection of people before they are exposed to a novel viral agents. Hence, the challenge is the environmental and social policies of prevention and the production of appropriate and safe vaccines that meet global needs shortly after the emergence of a pandemic to provide equitable access to all nations. In this context, nations have to support scientific institutions for R&D of new vaccines and the applications of new technologies that could prevent chains of trans-mission, increase vaccine supplies, timely vaccine delivery for a broad-spectrum and enduring protection against pandemics across population worldwide. These aspects are basic for a strategic approach to cope with pandemic threats and Evans & Bahrami (2020) suggest actions directed to super-flexibility and resilience (Janssen & Voort, 2020). Moreover, complex and unforeseen problems of pandemic crises should be treated with strategies of dissolution directed to eliminate sources of pandemic threats in society and improving the capacity of reaction of nations (Coccia, 2021a; Ackoff and Rovin, 2003; Coccia, 2021d). These strategies to prevent and cope with novel infectious diseases have to apply plans and decisions based on ecological rationality considering the specific context over time and space with a comparative evaluation of performance with leading countries applying alternative interventions. This comparative analysis can improve collective learning processes for effective decision making across countries in turbulent environments with pandemic crisis (Gigerenzer & Todd, 1999; Kahneman *et al.*, 1982).

In short, the development of these capacities can improve the world's ability collectively to defend itself against many emerging and epidemic-prone diseases. International experience for COVID-19 pandemic crisis has shown that well-planned public policies, scientific and economic coordination policies are effective interventions for reducing high-risk aspects during an outbreak.

Overall, then, a comprehensive strategy of crisis management for pandemic threats has to be based on environmental and socioeconomic factors, and new technology, and not only on parameters related to medicine, to help policymakers to evaluate manifold aspects to reduce institutional and social vulnerabilities to epidemics and design appropriate short-run and long-run plans to prevent and/or to contain the negative impact of future infectious diseases on public health, economy and society (Coccia, 2019; Coccia, 2015; Coccia & Bellitto, 2018). To conclude, in the presence of a constant pandemic threat, a comprehensive strategy to prevent future epidemics similar to COVID-19 has to be designed considering manifold factors of sustainability, e nvironmental and socioeconomic sciences, and not only aspects related to life sciences, such as biology and medicine.

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