



Final Statement on COVID-19

New insights on causes, actions, and consequences and implications for science and health policy



Abstract

The Pontifical Academy of Sciences (PAS) expresses concern over the fact that COVID-19 adversely impacts especially the poor, and further increases inequality between countries and between generations. The PAS and its partners have identified some thematic areas for science and health policies that can serve all people. Understanding the sources and pathophysiological mechanisms of the disease is essential. The potential continued presence of SARS-CoV-2 – and that of future new infectious diseases – must be considered. New insights from science in the fields of vaccine development and treatments are impressive and promising, and new experiences and approaches in terms of health policy actions must be shared freely.

Fair access to vaccines must be guaranteed, given that the lack of vaccines in poor countries has created a morally indefensible inequity. Further, low vaccination coverage increases the risk of new variants emerging. Vaccine inequity and vaccine nationalism by wealthy countries must end, and the COVAX program – the most important vaccine-related global initiative – must receive much more support. Innovations in diagnostics, testing, and therapies are also promising, but need to be made available across the world.

The optimal management of pandemics in public health systems must remain a priority at the national and international level. The key role of international cooperation in the framework of the WHO is to be strengthened. Care systems are essential in COVID-19 management, and effects on

other sectors such as food, education, and public health must be considered. The long-term effects of COVID-19 (Long COVID) are of major concern and necessitate intensive research as well as targeted public health actions. The effects of the infection on children and the psychological consequences of social isolation on the cognitive development of the young need to be considered in related research.

Science has already saved many in the pandemic. Quality of science must be protected from COVID-19 stress. Confronting misinformation and conspiracies about pandemics and vaccines is an important task for science, education, policy, (social) media, and religious communities.

Human dignity should be the starting point of reflections on the scientific aspects of the pandemic, and the focus in guiding actions. Inclusive healthcare policies need to be based on truth, justice, solidarity, and fraternity, in keeping with Pope Francis' encyclical *Fratelli Tutti*.

Speakers

- [Jose Manuel Barroso](#), Board Chair of GAVI, the Vaccine Alliance, Co-Chair Commission Reform for Resilience – Healthy Growth, Former President of the European Commission and former Prime Minister of Portugal.
- [Joachim von Braun](#), President of Pontifical Academy of Sciences (PAS); Prof. for Economic and Technological Change, Bonn University.
- [Chien-Jen Chen](#), PAS Academician and Distinguished Professor, Genomics Research Center, Academia Sinica
- [Francis Collins](#), PAS Academician, Director of the National Institutes of Health
- [H.E. Msgr. Paul R. Gallagher](#), Secretary for Relations with States, Secretariat of State, Holy See
- [David L. Heymann](#), Department of Infectious Disease Epidemiology, London School of Hygiene and Tropical Medicine
- [Salim Abdool Karim](#), Director, CAPRISA, Durban, South Africa
- [Masashi Mizokami](#), former Director General, National Center for Global Health and Medicine, Japan
- [Madhukar Pai](#), Canada Research Chair of Epidemiology & Global Health, McGill University, Montreal, Canada
- [K. Srinath Reddy](#), President, Public Health Foundation of India
- [H.E. Msgr. Marcelo Sánchez Sorondo](#), Chancellor of Pontifical Academy of Sciences (PAS)
- [Soumya Swaminathan](#), World Health Organization, chief scientist, India
- [Yik Ying Teo](#), Dean of School of Public Health, National University of Singapore, Singapore
- [Malcolm Turnbull](#), Co-Chair Commission Reform for Resilience – Healthy Growth, Former Prime Minister of Australia, 2015-2018
- [Ann E. Woolley](#), Div. of Infectious Diseases, Brigham and Women's Hospital, Boston and Harvard Medical School

- [Eng Kiong Yeoh](#), Director of Center for Health Systems and Policy Research, Chinese University of Hong Kong, HKSAR, China
- Shao Yiming, physician and immunologist, the Chinese Center for Disease Control and Prevention
- [Michael S. Zandi](#), National Hospital for Neurology and Neurosurgery, Queen Square, London

Preface

As of November 2021, an estimated 250 million people have been infected by COVID-19, at least 5 million of whom are recorded to have died from or with COVID-19. Moreover, there are model estimates showing that over 16 million so-called excess deaths occurred in the context of COVID-19. The pandemic situation remains very serious with a daily increase of 0.4 million confirmed cases and 7,000 deaths around the world. The socioeconomic impact of COVID-19 has reduced GDP growth and damaged social care.

Vaccinations per day were above 40 million worldwide in July/August 2021 but have declined to about 25 million. By the workshop date, 50% of the world population had received at least one dose of a COVID-19 vaccine. A huge and unjust disparity between rich and poor countries remains a serious block to achieving global results on overcoming poverty, hunger and diseases. Only 4% of people in low-income countries have received at least one dose. The lack of global fraternity and solidarity is evident.

In addition, the dearth of information on Covid-19 vaccine research and development, manufacturing, contracts, and deployment – and the hoarding of vaccines by high-income countries – leads to inequitable distribution and high purchasing prices in low- and middle-income countries. COVID-19 Vaccines Global Access (COVAX) has shipped over 486 million doses of COVID-19 vaccines (6% of 7.31 billion doses administered worldwide) to 144 participants, which is far below its target. The Pontifical Academy of Sciences had already expressed concern over the fact that COVID-19 adversely impacts especially the poor. Pope Francis specifically emphasized this in [his message to our Academy](#) when we had COVID-19 on the agenda of our 2020 Plenary Session.

The basic science strategy of dealing with the pandemic comprises causal agent, clinical characteristics, diagnostics, vaccines and therapeutics. Public health strategies, however, need to embrace implementation research, for instance factoring in human behavior related to vaccines, public education building confidence, and dissemination of evidence-based information. The reform of post-COVID resilience requires the concerted efforts of sociocultural, economic, environmental and health sciences.

The Pontifical Academy of Sciences (PAS) invited leading scientists and policy advisors to join PAS Academicians in this workshop to assess the state of affairs of science and actions on COVID-19, and to identify the scope for a change of direction. The PAS and its partners thus

identified ten thematic areas with sets of implications for new science agendas and for science and health policies that can serve all people, inclusive of the poor segments of societies, and those particularly vulnerable to the virus, such as health workers, the aged, and immunocompromised patients.

1. Understanding the sources and causes and potentially continued presence of SARS-CoV-2 and future new infectious diseases is essential. The study of infectious diseases caused by bacteria, viruses, or parasites that spread from animals to humans was and is an important research area.

a. The virus that started this pandemic in Wuhan, China was rapidly identified and named “severe acute respiratory syndrome coronavirus 2” (SARS-CoV-2). The illness caused by SARS-CoV-2 was then named “coronavirus disease 2019” (COVID-19) by the World Health Organization. The coronavirus is a zoonotic virus thought to be transmitted cross-species to humans from bats, possibly with an as-yet unidentified intermediate host. This origin of SARS-CoV-2 in 2019 seems likely, based on the molecular evolutionary analysis using its genomic sequences in GISAID database. [See presentation by [Masashi Mizokami](#). The [GISAID Initiative](#) promotes the rapid sharing of data from all influenza viruses and the coronavirus causing COVID-19]

b. The sources of pandemics, such as the current COVID-19, need to be identified by independent international entities – the WHO in particular – in full cooperation with governments and national science partners, based on principles of transparency and evidence, otherwise knowledge may be compromised. In a pandemic it is essential to strengthen trust in public health and science systems, instead of undermining it. [See presentation by [Chien-Jen Chen](#)]

c. The SARS-CoV-2 genome is characterized by its high mutation potential when the virus is so widespread, especially in immunocompromised persons. Variants and mutant strains are appearing in various parts of the world depending on a combination of virus gene mutation, degree of accumulation of the mutation, insertion, deletion, and recombination, as well as the immune pressure of the infected host.

d. The Delta variant has become the dominant global variant, because of its higher viral load, being infectious for 5 additional days, with a high risk of re-infection in previously infected people. The next variants of concern may emerge in the presence of widespread vaccination with the future trajectory depending on the waning of vaccine immunity and the viral vaccine-escape capacity. SARS-CoV-2 may become a permanent part of our lives. We need to maintain strong research efforts on viruses and epidemics, and ways of dealing with them.

2. Emerging scientific developments and new insights are promising. Science and new experiences with health policy actions are quickly accumulating and need to be shared freely and

internationally.

a. Science entered a steep learning curve during the pandemic and the benefits of science became apparent in this pandemic like never before. The rapid identification of SARS-CoV-2 and publication of its gene sequence facilitated the rapid development of diagnostics, antivirals and vaccines. Researchers were able to develop COVID vaccines in record time. We recognize that science has made major breakthroughs, especially with mRNA-based and adenovirus vaccines. Spike protein subunit vaccines may also emerge to relevance.

b. Science during a pandemic is different in terms of opportunities and challenges. Science that matters in the short term has high priority, but actionable science needs careful ethical consideration. Science must also consider and explore strategic, long-term consequences. It must not be forgotten that the main scientific breakthroughs with vaccines in this pandemic are based on decades of earlier basic research and related large investments. Strengthening strategic science in the midst of a pandemic is critical for evidence-based preventive approaches. Recently there have also been promising developments with COVID treatment drugs, in particular Molnupiravir and Paxlovid, under final testing and release in many countries, including emerging economy countries, where they will need to be manufactured cheaply under licenses. [See also presentations by [Francis Collins](#) and [K. Srinath Reddy](#)]

c. Digital technology, artificial intelligence, internet of things, machine learning, and big data analysis have been widely used for the containment of the pandemic through the prediction of viral spread, identification of variants, border control and quarantine, hospital infection control and resource allocation, e-health and telecare, contact tracing and testing, home isolation and quarantine, and crowd control in many countries.

d. We call for multi-disciplinary sciences to address the COVID-19 crisis. The medical profession, together for example with physics, mathematics, and biology, can get involved in modelling, data analysis and developing technologies for rapid imaging diagnostics and new therapies. Social and political scientists need to investigate the social and psychological impacts of the disease and propose options for policies for the betterment of everybody's life.

3. Fair access to vaccines, vaccine innovations, and response limitations must be addressed

a. COVID-19 vaccines are currently saving millions of lives and offering us hope to end this pandemic, if we can distribute them equitably. Other opportunities include repurposing COVID-19 innovations to address other global health challenges. For example, mRNA vaccine technology could be used for a variety of infectious diseases. We note the significant progress with vaccine developments not only in Europe and USA but also in emerging economies like China and India, including mRNA and inactivated vaccines. [See also presentation by [K. Srinath Reddy](#) and Abstract by Shao Yiming]

b. More than 3.5 billion people are still waiting for vaccines that have been developed, but for which the scaling up of production and fairness in distribution have failed. The global health system needs to be much more inclusive of poor and low-income countries. Vaccine inequity and vaccine nationalism by wealthy countries increase the risk of variants in poor countries. Lack of vaccination coverage at a global level carries the risk of flashback effects because of probability of new variants emerging in underserved regions and circling back to vaccinated regions. The COVAX program is the most important global initiative and needs much more incremental financial support. The expanding “green” ESG financing approaches including the private finance sectors need to expand their focus to ESG+H, i.e. Health. [See also presentation by [José Manuel Barroso](#)]

c. WHO is collaborating with the Ministries of Health of Columbia, Mali and the Philippines to launch co-sponsored [Solidarity Trial Vaccines](#). This is an international, randomized clinical trial platform designed to rapidly evaluate the efficacy and safety of promising new candidate vaccines selected by an independent vaccine prioritization advisory group composed of leading scientists and experts.

d. We note that response to vaccines is not equal among populations. For instance, vaccine response is impaired among cancer patients and patients with transplanted organs. They too need special attention in a fair functioning public health system. [See also presentation by [Ann E. Woolley](#)]

e. Vaccine hesitancy and misinformation remains a major challenge to the increase in vaccination coverage in many developed and emerging economy countries. Innovative approaches to provide fact-based reliable information are necessary, perhaps including more direct information to individuals in their contexts.

4. Innovations in diagnostics and testing are promising

a. Various COVID-19 diagnostic tests including PCR, rapid antigen and antibody tests with different accuracy, testing time and cost have been developed for patient diagnosis and management. Their distribution, however, is primarily skewed toward high-income countries. Their efficacy and cost-effectiveness may vary by variants infected.

b. The emergence of SARS-CoV-2 variants with increasing infectivity and virulence and potential immunity-escape capability needs attention. Assessing alternative ways of implementation under diverse circumstances is an urgent field of science and implementation research.

c. Innovations in COVID-19 testing and related needs and opportunities for low-income countries are evolving, and practical approaches and best fits for diverse countries need to be shared and scaled. Countries can design their own best approaches with combinations of tests of varying complexity and costs, such as symptoms observations, rapid antigen and PCR tests. [See

also presentation by [David Heymann](#)]

5. Optimal management of pandemics in public health systems must remain a priority

a. International cooperation in science and public health policy is crucial. The key role of cooperation in the framework of the WHO, international non-governmental organizations and science bodies is to be strengthened. Sharing science and sharing manufacturing capacities need further exploration. Equity in accessibility to personal protection equipment, diagnostics, antivirals, and vaccines, especially in low-income countries, is essential. [See also presentations by [Soumya Swaminathan](#) and [Malcolm Turnbull](#)] Maintaining the cold chain requirements for vaccines is a challenge in many countries. They need international support to scale-up their cold chain capabilities.

b. The concept of “herd immunity” may not be readily applicable to COVID-19. The emerging situation is better described as “population immunity”, because current vaccines are not as effective in preventing infection as other vaccines associated with herd immunity such as measles and rubella. The final destiny of SARS-CoV-2 remains uncertain because of the variants that develop as the virus reproduces itself in humans. [See also presentation by [K. Srinath Reddy](#)]

c. As the pandemic remains unpredictable, sound scenario analyses considering risks and uncertainties are helpful to prepare health systems responses. However, they need to be carefully communicated as being scenarios and not forecasts. A best-case scenario may be that the virus will get no worse than Delta and we are able to achieve a high vaccine coverage, leading “back to normal” with low endemic transmission and homologous boosters. A worst-case scenario may entail continual new variants (including vaccine escape) and patchy vaccination coverage, leading to ongoing public health measures in repeated waves of infection, and need for heterologous boosters. [See presentation by [Salim Abdool Karim](#)]

d. Modelling pandemics must not only focus on virus behaviors but include human behaviors and consider resilience to shocks. Pandemic-related disruptions of health and social care systems need to be included in resilience strengthening of public health systems in general, anticipating pandemic disruptions to health systems. Digital technology and artificial intelligence may help facilitate non-pharmaceutical interventions including masking, border control, home quarantine, social distancing and avoidance of gatherings. Innovative e-health, smart hospital and telecare may increase the efficiency of health and social care systems during a pandemic.

6. Care systems are essential in COVID-19 management, and COVID-19 has intersectoral effects.

a. Pandemics put whole health and social care systems under stress. In many instances, elective surgery and non-urgent services were postponed because of resources constraints.

Patients that should have been seeking treatment did not seek it for fear of infection. Healthcare systems need to become more resilient. A better preparedness plan must be established, with built-in surge capacity for patients that need clinical management during pandemics while protecting “normal” hospital services. Surveillance and local monitoring are necessary to identify hotspots and their drivers early. [See also presentations by [Eng Kiong Yeoh](#) and [Yik Ying Teo](#)]

b. There are major health impacts arising from COVID’s disruption of other sectors, e.g. food systems, and care of major diseases such as TB, AIDS and malaria. Incremental morbidity and mortality due to impact of COVID on malnutrition is also a reality which should be considered when setting public health policy priorities and research agenda.

c. Health workers, medical professionals and scientists must be equipped to make morally and ethically responsible decisions in pandemics. Philosophy, ethics, religion and the humanities need to engage in world health issues. Human rights protection and transparency are important in the research and development of evidence-based interventions.

d. There is progress in the knowledge about vaccination of children. The BionTech-Pfizer vaccine has been shown to be safe and effective for children aged 5-11, and adolescents aged 12-17 have been approved to receive the vaccine since May 2021. Science must also focus its attention on vaccination and appropriate treatment and care for children under 5. The effects of isolation under lockdowns and school closures also need studying.

7. **“Long COVID” and long-term effects of COVID-19** are still emerging as a major field of research and of public health actions.

a. COVID-19 has serious neurological and psychological impacts. “Long COVID” requires much more consideration in science and in public health. More attention should be paid to the long-term effects on immunocompromised and other vulnerable individuals, but Long COVID can also happen to previously healthy individuals. The evidence for brain injury as a consequence of COVID-19 also needs examining. [See also presentation by [Michael Zandi](#)]

b. We should also take a long-term view. Pandemics will happen again. Transparency and openness to share early outbreaks of any emerging infectious disease in their country of origin are essential to contain the disease domestically and prevent further spread internationally.

c. Post-COVID resilience requires comprehensive improvement in the health of humans, animals and environment. Food systems and, in particular, animal production systems, need reshaping to reduce the risks of zoonotic breeding grounds.

d. The impact of climate change and global warming on the emergence of new zoonotic diseases deserves further exploration to prevent future pandemics. The interactions between

ecological systems changes, land use change incl. deforestation, and health risks call for more multidisciplinary research taking a *One Health* approach.

8. **Confronting misinformation about pandemics and vaccines** is an important task for science, education, policy and (social) media. Examples of conspiracies that have no basis in research of any sort are that vaccines have chips in them to track individuals after immunization; vaccines will make you magnetic; vaccines will make you infertile.

a. Uncovering and disclosing the intentional creation and spread of misinformation and conspiracies requires the cooperation of policy, legal system, research and (social) media. The scale and consequences of these misinformation campaigns have been underestimated. International collaboration to combat cross-country misinformation is crucial.

b. The behavioral consequences of misinformation, for instance related to vaccine resistance, have not been sufficiently addressed by public, private and science partnerships. The reservations of a significant percentage of the population against vaccinations calls for behavioral science. Sound communication of the benefits of vaccines to the public remains important, as is education. It may improve the efficacy and efficiency of pandemic containment.

9. **Science quality must be protected from COVID-19 stress.** The problems of low-quality research and conspiracies, and their dissemination by media and policy makers, increased during the pandemic.

a. Misinterpretation of pre-publications and picking up alleged findings from predatory journals or ill-informed experts are part of the problem, as well as the fast expansion of funding that may have overstretched sound grant peer-review processes. Political decisions under time pressures may have interfered with science processes. Science communities must engage with policy and media to keep science systems and science communications evidence-based and sound. Fake news and misinformation may result in reluctance or hesitance to practice non-pharmaceutical interventions and immunization. A pandemic must not break the evidence pipeline in science, and a pandemic is no reason to lower normal scientific standards. Science ethics needs to be protected.

b. Also, some fields of important health research are being lured away from their primary area of expertise to the pandemic response. Scientific communities, governments, funders, universities, and journals should be mindful of the risks of “Covidization” and should not forget that diversity in research will prepare us better for the next crisis. [See also presentation by [Madhukar Pai](#)] Academies of sciences are well positioned to address this issue of balance, including the relevance of health science serving equity.

10. **Human dignity should be the starting point of reflections on the scientific aspects of the**

pandemic, and should also guide actions

a. The pandemic challenges us to rethink our understanding of the meaning of our life and activities as human beings. While COVID-19 can impact anyone, the pandemic adversely impacts especially the weak, the aged, and the poor. Pope Francis stressed this in [his message](#) to our PAS Conference in 2020. The pandemic has brought out the best of solidarity in many communities, hospitals and families. As Pope Francis points out, "...What is needed above all are people who have the courage to say 'I' in a spirit of responsibility and not selfishness, and make it clear by their own lives that we can greet each day with confidence and hope". [[Message by Pope Francis on meeting for Friendship among people](#), 19 Aug. 2021]

b. It is essential to forge a newly strengthened alliance between science and humanism: The two should be integrated, not separated or, even worse, opposed, for on them depend the health and the economic and social development of our community. Inclusive healthcare policies fundamentally need to be based on truth, justice and fraternity, in keeping with *Fratelli Tutti* – entailing effort, action and personal freedom. It is essential to reflect calmly, to examine in depth what has happened and to pave the path toward a better future for all. [See [Archbishop Paul Gallagher](#), address to the workshop]