AH1N1 and SARS-CoV-2: Pandemics of the Twenty-First Century. Causes and Lessons Learned

AH1N1 y SARS-CoV-2: las pandemias en el siglo XXI. Causas y lecciones aprendidas

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Abstract:
In this article are analyzed the similarities between the pandemics of 2009, generated by influenza AH1N1, and 2020, generated by SARS-CoV-2, the responsible for COVID-19, as well as the experience acquired during the first and the way in which what was learned in it has been used, in Mexico, to handle the most recent one. It is also reviewed the response of the society.

Resumen:
En el artículo se analizan las similitudes entre las pandemias de 2009, generada por la influenza AH1N1, y la de 2020, producida por el SARS-CoV-2, agente causal de la covid-19, así como la experiencia adquirida tras la primera y la manera en que lo aprendido en ella se ha utilizado en México para manejar la más reciente. Asimismo, se analiza la respuesta de la sociedad mexicana.

Key Words:
Pandemic, SARS-CoV-2, vaccines, health system, prevention, health emergencies.

Palabras clave:
Pandemia, SARS-CoV-2, vacunas, sistema de salud, prevención, emergencias sanitarias.

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Introduction

Human beings originally formed communities to protect themselves from natural disasters and attacks by animals and other groups of hostile humans. These communities then formed governments to maintain internal order and agreed to pay their leaders a percentage of their income (so-called taxes), primarily in exchange for security and services. Naturally, these services include everything related to healthcare, meaning public health is a good that governments are required to guarantee. Healthcare and security are therefore legitimate demands for societies to make of their governments.

Like us, microorganisms are entitled to use the planet. From an evolutionary standpoint, it is logical to assume the first living creatures were one-celled organisms, so it should come as no surprise that epidemics had already occurred before our era and that people had discovered ways of surviving diseases. There are records of epidemics occurring in India and very primitive forms of vaccination being practiced 1500 years before our time. There is also evidence to suggest the Egyptians had found a way of inoculating themselves against microorganisms, while Thucydides says in reference to a "plague" that "it was with those who had recovered from the disease that the sick and the dying found most compassion. These knew what it was from experience, and had now no fear for themselves; for the same man was never attacked twice

—never at least fatally".[1] From this, we can deduct that people who were infected and did not die from the disease in question acquired immunity, much as occurs with vaccination.

Globalization has had an impact on public health. Diseases that could previously be contained in a specific zone now spread much wider at a much faster rate, as illustrated by severe acute respiratory syndrome (SARS), the Middle East respiratory syndrome (MERS), avian flu and AH1N1 influenza. There can surely be no better example of this than the SARS-CoV-2 pandemic and the disease it causes, COVID-19. Today, health issues literally affect every person on the planet, making medical, pharmacological, epidemiological, biomedical and other fields of research more important than ever, whether to develop new medicines, vaccines, prophylactic or diagnostic methods and regardless of where this research is conducted. The scientific community is working against the clock to address the current crisis and its findings will be of benefit to us all.

Unlike in December 2019, we now (February 2021) have more knowledge of how the virus is spread and its effects. For example, we know that it not only causes inflammation of the respiratory system, but creates clots that reduce the amount of oxygen in the patient's blood, leading to asphyxia or respiratory arrest. We also know how to better treat the seriously ill, but many aspects of the disease remain a mystery and society is demanding answers. One of these demands is to develop vaccines to protect us, so we can return to our pre-pandemic lifestyles. People are asking why it is taking science so long to come up with a solution.

Throughout history, there have been a number of diseases that have either seriously affected public health or that have had the potential to do so. We will be analyzing some of these from an ethical perspective and what we will see is that when the delicate balance of coexistence between microorganisms and human beings is upset, the outcome is frequently devastating and almost always detrimental to humans.

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[1] Thucydides, *Historia de la guerra del Peloponeso*, Book 2, quoted in Jorge Dagnino S., "¿Qué fue la plaga de Atenas?" in *Revista Chilena de Infectología*, vol. 28, no. 4, August 2011, 377, at *https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0716-10182011000500013* (date of reference: February 22, 2021).

Vaccines and vaccination

Several diseases deemed to be under control or well-contained, such as tuberculosis, whooping cough, the measles, malaria, diphtheria and viral hepatitis, have been spreading worldwide in the early twenty-first century. This is because man is sometimes his own worst enemy. Immunization is our best weapon against many communicable diseases of bacterial or viral origin, but the international anti-vaccination campaign has had serious consequences. The modern-day version of this movement began with an article that was later declared to be false, but that had far-reaching repercussions because it made many people distrustful of vaccines. The article in question appeared in The Lancet, but when the deceit was discovered, the journal retracted it and admitted that it should never have been published. The author, a pseudoscientist by the name of Andrew J. Wakefield,[2] lost his medical license in the United Kingdom, but emigrated to the United States, where he continued to practice.[3] In the context of the current pandemic, anti-vaccination groups have circulated a plethora of contradictory information. This glut of information, true or false, published by mistake or with the intended purpose of misinforming the public in order to sway decision-making in a specific direction, is the reason the World Health Organization (WHO) supports Verified,[4] a website that analyzes the information circulating on social media and certain printed media so as to separate reliable, verifiable information from that which is neither. It has been said that the solution is perhaps not to generate more information, but to analyze

[2] Brian Deer (2020). An account of Wakefield's infamies can be found in Brian Deer, *The Doctor Who Fooled the World. Science, Deception, and the War on Vaccines*, Baltimore, Johns Hopkins University Press, 2020.

[3] A. J. Wakefield, S. H. Murch, A. Anthony *et al.*, "RETRACTED: Ileal-Lymphoid-Nodular Hyperplasia, Non-Specific Colitis, and Pervasive Developmental Disorder in Children", in *The Lancet*, vol. 351, no. 9103, February 28, 1998, 637-641, at *https://doi.org/10.1016/S0140-6736(97)11096-0* (date of reference: February 22, 2021).

[4] See *https://www.shareverified.com/es*.

the information environment and address the social factors that contribute to the dissemination of fake news.[5]

AH1N1 and other respiratory viruses

In 2003, a disease emerged that caught the world's attention and put it on alert: avian flu or AH5N1 influenza, which, to date, has not been eradicated. Outbreaks have been reported in 17 countries, but globalization necessitates epidemiological surveillance. According to the most recent statistics available, only 861 people were infected between 2003 and October 2020, which might lead us to think it is not a serious problem, but what is most worrisome is the high incidence of mortality: of the 861 people infected, 455 died, which translates into a lethality of 52.85%.[6]

In the case of Mexico, the most serious pandemic prior to the arrival of the SARS-CoV-2 virus was AH1N1 influenza in 2009. Regarding the lessons learned globally during and after this pandemic, then-Director-General of the World Health Organization (WHO) Margaret Chan said at a high-level meeting in Cancun, Quintana Roo, on July 2, 2009:

> Between the extremes of panic and complacency lies the solid ground of vigilance. This meeting is all about vigilance: taking stock of what we have learned, and preparing for whatever surprises this capricious new virus delivers next. Constant, random mutation is the survival mechanism of the microbial world. Like all influenza viruses, H1N1 has the advantage of surprise on its side. We have the advantages of science, and of rational and rigorous investigation, on our side, supported today by tools for data collection, analysis, and communication that are unprecedented in their power. We have another

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5 The Lancet, "The Truth Is Out There, Somewhere", in *The Lancet*, vol. 396, no. 10247, August 1, 2020, 291, at *https://doi.org/10.1016/S0140-6736(20)31678-0* (date of reference: February 22, 2021).

6 "Cumulative Number of Confirmed Human Cases of Avian Influenza A(H5N1) Reported to WHO, 2003-2020" at *https://www.who.int/influenza/human_animal_interface/2020_OCT_tableH5N1.pdf* (date of reference: February 22, 2021).

> advantage on our side, as exemplified by this meeting: collaboration and solidarity. It is my sincere wish that this meeting will take us some big steps forward in building our collective defences against a threat shared by all.[7]

The International Health Regulations (IHR, 2005) are an international legal instrument that is binding on almost 200 countries and whose purpose is to help protect States Parties against the international spread of diseases, including risks to public health and public health emergencies. The IHR came into force in WHO Member States in 2006. In Mexico, the Legislature ratified them in June 2007, assigning them a constitutional status.

The purpose and scope of the IHR are very broad: "to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade".[8]

Published in 2005, the WHO Global Influenza Preparedness Plan[9] describes several sequential phases: alert (as to atypical behaviors or the appearance of new viruses); estimation (of the impact on the population and health services); assessment (of the interventions applied); monitoring (of circulating viruses, their mutations and their sensitivity to drugs); and classification (of viral strains for the composition of vaccines).[10]

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7 Margaret Chan, "Influenza A(H1N1): Lessons Learned and Preparedness" in ReliefWeb, July 2, 2009 at *https://reliefweb.int/report/world/influenza-ah1n1-lessons-learned-and-preparedness* (date of reference: February 22, 2021).

8 WHO, *Reglamento Sanitario International Health (2005). Breve introducción a su aplicación en la legislación nacional*, WHO/HSE/IHR/2009.2, Geneva, WHO, January 2009.

9 WHO, *Plan Mundial de la OMS de preparación para una pandemia de influenza. Función y recomendaciones de la OMS para las medidas nacionales antes y durante las pandemias*, WHO/CDS/CSR/GIP/2005.5, Geneva, WHO, 2005.

10 Alethse de la Torre, Hugo López-Gatell, Celia M. Alpuche, Alejandro E. Macías, "Centinelas de la influenza pandémica en México: perspectivas de la vigilancia epidemiológica y el control" in *Revista Digital Universitaria*, vol. 11, no. 4, April 1, 2010 at *https://www.revista.unam.mx/vol.11/num4/art40/art40.pdf* (date of reference: February 22, 2021).

Since 2006, Mexico has used the sentinel model for the detection of influenza-like diseases.[11] This model provides very valuable initial information when out-of-expected-range increases are seen for the reference season. However, despite its usefulness, in view of the limited number of observation centers, it became clear in 2009 that this surveillance system needed to be reinforced with the inclusion of health centers and hospitals staffed by doctors experienced in the early detection and handling of outbreaks of diseases of this type—a point the health authorities should take special note of.[12] Nonetheless, despite the experience of 2009, the sentinel surveillance system has changed very little since.

In an article published in 2017, several Mexican doctors analyzed the lessons that could potentially be learned from the 2009 pandemic.[13] One of their recommendations was that each country implement a continuous surveillance system to monitor influenza, preferably the sentinel system. They then explained the importance of surveilling other flu-like and acute respiratory diseases, and stressed the importance of laboratory reports. Special attention, they said, should be paid to the reports of clinicians at regional hospitals, who need to have a direct line of communication with the health authorities, since they would be the first to detect a possible outbreak of respiratory disease. The following are the main recommendations the group put forward to prepare for outbreaks of influenza (and, by extension, similar respiratory diseases):

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11 The sentinel model uses very detailed data to compile a representative sample of cases in the country and generate quality information that can be used to estimate the severity of the disease, document its distribution and spread, and describe its natural history. Based on this information, plans and strategies to address the problem can be devised.

12 Elsa Sarti, Gabriel Manuell-Lee, Juan L. Mosqueda *et. al.*, "La influenza AH1N1 (2009): el recuento al declararse el término de la contingencia en México" in *Revista de Investigación Clínica*, vol. 62, no. 4, July-August, 2010, 289-298.

13 José A. Córdova-Villalobos, Alejandro E. Macías, Mauricio Hernández-Ávila *et. al.*, "The 2009 Pandemic in Mexico: Experience and Lessons Regarding National Preparedness Policies for Seasonal and Epidemic Influenza" in *Gaceta Médica de México*, vol. 153, no. 1, January-February 2017, 102-110, at *https://www.medigraphic.com/pdfs/gaceta/gm-2017/gm171n.pdf* (date of reference: February 22, 2021).

- Preparedness, which implies
  - Incident command
  - Communication
  - Legal aspects
- Surveillance, including pandemic and interpandemic periods.
- Case studies, including diagnostic capacity, epidemiological research, clinical handling and infection control.
- Prevention of the spread of the disease among the community, including public health and personal hygiene measures, community infection control, physical distancing, quarantine, vaccination programs and the use of antivirals.
- Maintenance of essential services, including health and other essential services (power, food, transportation, etc.).
- Research and evaluation.
- Implementation, testing and revision of the national plan.

The 2009 pandemic showed that, for the sentinel surveillance system to be effective, a great deal of information needs to be collected and the best way of obtaining it is to have a series of health units for the monitoring of influenza (USMI), because the number of samples taken is limited due to the characteristics of the system: samples are taken in 100% of serious cases, but in only 10% of ambulatory cases. Consequently, an enormous number of cases go undetected and to boost the effectiveness of the system, a sufficiently representative number of USMIs are required.

Mexico was the first country to have occasion to implement the International Health Regulations in 2009. At the time, the country had approximately 584 USMI[14] and the results they produced fell short of expectations. In fact, a document published by doctors from the Mexican Social Security Institute (IMSS) states that "it should be taken into account that official reports

[14] Arturo Revuelta Herrera and Gisela Barrera Badillo, "Vigilancia epidemiológica de influenza en México (SISVEFLU)" [2], at *https://www.sarinet.org/sites/default/files/media/Meetings%20&%20Minutes/14._irag_panama_mayo_2014_final_dr_revuelta.pdf* (date of reference: February 22, 2021).

underestimate the burden of the disease".[15] The summary of this same document says that "confirmed cases in the epidemiological surveillance system are just a small proportion of the population infected and of symptomatic cases, something that should be factored in when treating the disease in the future".[16] Notwithstanding, by 2020, the number of USMI in the sentinel surveillance system had fallen to just 475 units.[17] The Undersecretary of Health Prevention and Promotion, Hugo López-Gatell Ramírez, even said during his evening press conference on April 8, 2020 that there are now less than 375, pointing to a drastic reduction in the number of surveillance units.[18]

One point the authors of the document published by the IMSS touch on and that is hugely relevant to present circumstances is communication, to which they dedicate an entire paragraph (during the 2009 pandemic, Hugo López-Gatell Ramírez was Deputy Director-General of Epidemiology at the Health Ministry, a position he held from 2008 through April 2012, *i.e.* he was directly responsible for communications generated during the AH1N1 pandemic). The document goes on to state that:[19]

> Based on our experience during the 2009 pandemic in Mexico, effectively communicating the risks with transparency and on a timely basis is essential to informing the public. This holds especially true when the country is the epicenter of the pandemic, because panic

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[15] Víctor Hugo Borja Aburto, Concepción Grajales Muñiz, Margot González León and Juan Manuel Mejía Aranguré, "Estimación de la incidencia de influenza pandémica A(H1N1) 2009 en derechohabientes del Instituto Mexicano del Seguro Social" in *Gaceta Médica de México*, vol. 147, no. 4, July-August, 2011, 310.

[16] *Ibid*., 303.

[17] Health Ministry, "Covid-19 México. Comunicado Técnico Diario. Fase 3," Sunday, May 3, 2020, [23], at *https://www.gob.mx/cms/uploads/attachment/file/550279/CP_Salud_CTD_coronavirus_COVID-19__03may20.pdf* (date of reference: February 22, 2021).

[18] Mexican Presidency, "Versión estenográfica. Conferencia de prensa. Informe diario sobre coronavirus covid-19 en México," April 8, 2020, at *https://www.gob.mx/presidencia/es/articulos/version-estenografica-conferencia-de-prensa-informe-diario-sobre-coronavirus-covid-19-en-mexico-239987* (date of reference: February 22, 2021).

[19] Health Ministry, "Dr. Hugo López-Gatell Ramírez" at *https://www.gob.mx/salud/estructuras/dr-hugo-lopez-gatell-ramirez* (date of reference: February 22, 2021).

> spreads easily and can cause as much harm as the disease itself. Clearly, the information should not be exaggerated and the health authorities should appoint and train, in advance, spokespersons who have an understanding of the art of conveying the truth without creating alarm. People can perceive if the government is telling the truth in its press releases and this affords health officials the necessary credibility to take the lead in critical situations like an outbreak of influenza.[20]

Bearing this in mind, there are contradictions between what López-Gatell signed as co-author of the article in question and what he has said on several occasions in his current capacity as Health Undersecretary—enough to fill a book like the one recently published by Alejandro Rosas and Julio Patán on the pandemic.[21] It should be stressed that when it comes to security/biosecurity issues, the unknown should be treated like the most serious of threats. As it turned out, the government's efforts to play down the threat resulted in failure by the public to properly follow instructions as to the individual and social behaviors required to help mitigate the impact of the pandemic. In February 2020, the Mexican authorities responsible for managing COVID-19 stated that SARS-CoV-2 behaved like a respiratory disease of moderate to low severity, that it was less dangerous than seasonal influenza, and that the reason it had gained such notoriety was because it was an emerging disease, "but the proportion of deaths is similar or even lower than the influenza death rate. Specialized hospitals are not required".[22] The course the pandemic has taken has proven quite the opposite.

Furthermore, even though Doctor Michael Ryan, Executive Director of the WHO Health Emergencies Programme, said at a press conference

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20 J. A. Córdova-Villalobos, A. E. Macías, M. Hernández-Ávila *et. al., op. cit*., 108.

21 Alejandro Rosas and Julio Patán, *Pandemia bizarra*, Mexico, Planeta, 2020.

22 Redacción AN/GH "Atención del coronavirus no necesita hospitales especializados: López-Gatell" in Aristegui Noticias, February 11, 2020 at *https://aristeguinoticias.com/1102/mexico/atencion-del-coronavirus-no-necesita-hospitales-especializados-lopez-gatell/* (date of reference: February 22, 2021).

on November 30, 2020 that "as regards the use of masks, leaders should set an example", this has not generally been the case in Mexico.[23] Neither have the Mexican authorities complied with social distancing recommendations.

Lessons learned from the 2009 pandemic

All this illustrates the importance of heeding the lessons of the 2009 pandemic, given that:

- Instead of shoring up the sentinel surveillance system with more USMIs, these were reduced. An effective way of gathering quality, timely data, this system is based on indicators and methodically gathers data from a limited number of surveillance sites. Ideally, sites representative of the population should be chosen so that the information collected can be applied to the entire population.[24]
- The sentinel model has its limitations and if the number of surveillance sites is reduced, there will come a point where it ceases to be useful, hence the importance of strengthening and reorienting it. Some academics claim existing USMI are currently not representative of the Mexican population and recommend they be relocated to take into account demographic changes that have occurred between the AH1N1 and SARS-CoV-2 pandemics.[25]
- All respiratory diseases are extremely dangerous because they can easily be passed from person to person. According to PAHO and the

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[23] On October 27, 2020, Undersecretary López-Gatell said that the efficacy of masks was "overestimated," casting doubt on WHO recommendations.

[24] PAHO/WHO, *Guía operativa para la vigilancia centinela de la infección respiratoria aguda grave (IRAG)*, Washington D.C., PAHO, September 2014, 15, at *https://www.paho.org/revelac-i/wp-content/uploads/2015/10/2015-cha-guia-operativa-vigilancia-centinela-irag.pdf* (date of reference: February 22, 2021).

[25] Ernesto Ulloa, Jesús Arroyo, Natalie Gasca *et al*., "Descifrando el modelo centinela" in Puntodecimal, July 14, 2020 at *https://puntodecimal.mx/ciencia/descifrando-el-modelo-centinela* (date of reference: February 22, 2021).

WHO, "some of the lessons gleaned from the 2009 pandemic include the need to collect data on serious cases and use a standard methodology to compile information so historic data is available to assess current influenza activity in the context of preceding seasons".[26] We must therefore assume that any new respiratory disease, like SARS-CoV-2, will be more dangerous than its predecessors, so we have the capacity to prevent and are better prepared to deal with the health emergencies of the present and the future.

- Effectively communicating the risks with transparency and in a timely manner is essential to keeping the public informed and getting their support for any measures that need to be adopted in a contingency.[27]
- Testing for COVID-19, the disease caused by the SARS-CoV-2 virus, is required to determine the incidence of the disease, so the authorities can take appropriate containment and resilience measures. Not testing means the magnitude of the problem remains unknown, which can lead to a false sense of security, with the population assuming that the disease is either not serious or worse, that it simply does not exist:

> Security protocols for collecting, transporting, handling and using samples are essential in order to obtain accurate, interpretable results. Complementing specific molecular tests that detect the SARS-CoV-2 virus with immunological trials that assess the immune response of the host will be critical to providing patients with precise and timely diagnoses. These same techniques offer an alternative in determining molecular markers of prognostic value, which will be especially useful in providing differentiated treatment for patients under 60 with no preexisting comorbidities.[28]

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26 PAHO/WHO, *op. cit.*, 8.

27 J. A. Córdova-Villalobos, A. E. Macías, M. Hernández-Ávila *et. al., op. cit.* 108.

28 Priscilia Aguilar Ramírez, Yanina Enríquez Valencia, Carlos Quiroz Carrillo *et al.*, "Pruebas diagnósticas para el covid-19: importancia para el antes y el después" in *Horizonte Médico*, vol. 20, no. 2, April-June 2020, 100, at *https://doi.org/10.24265/horizmed.2020.v20n2.14* (date of reference: February 22, 2021).

- The WHO Director-General has suggested ramping up COVID-19 diagnostic testing on several occasions, as has Michael Ryan, Executive Director of the WHO Health Emergencies Programme, and the same topic has been discussed at different academic forums,[29] but Mexico has chosen a completely different strategy, possibly for economic reasons. And while there can be no denying the impact SARS-CoV-2 has had on the domestic economy, the cost of hospitalizing a sick person is much higher than a diagnostic test, which ranges from US$ 146 to US$ 210. The advantage of widespread testing is precisely that this strategy provides information that can help contain the disease, direct the focus to areas where the rate of infection is higher and generate valuable pre- and post-testing clinical data, as well as information on who tested positive. Likewise, diagnostic testing helps address the problem of asymptomatic patients who can potentially pass the virus on without realizing they have it.[30]

Another serious problem has been the procurement of personal protection equipment (PPE) for those treating COVID-19 patients. Health workers have asked that these deficiencies—which range from delivery delays, poor quality supplies and lack of training in their use—be corrected. The problem was particularly severe at the beginning of the pandemic, when there were shortages of supplies of all kinds. There was a move to manufacture some essential supplies domestically and an "air bridge" was established with China for the purchase of materials, but distribution has been complicated by logistical problems encountered along the way. The efficacy of the PPE supplies that did arrive was compromised by lack of training in their proper use. To address supply shortages and the lack of protocols to protect health workers, the WHO published

[29] Nicholas P. Jewell, Neil Pearce, Jing Qin and Peter Song, "COVID-19 Pandemic: Epidemiological and Statistical Considerations and Findings" in ASA Statistics in Epidemiology Section, May 1, 2020, at *https://community.amstat.org/sie/siewebinars/webinarcovid19* (date of reference: February 22, 2021). Of special interest is Neil Pearce's presentation.

[30] "Precios de pruebas para coronavirus en México" in El Hospital, May 2020, at *https://www.elhospital.com/temas/Precios-de-pruebas-para-coronavirus-en-Mexico+134313* (date of reference: February 22, 2021).

a series of guidelines as far back as April 2020.[31] According to a report published by Amnesty International and The Lancet in September 2020, Mexico had the highest COVID-19 mortality rate in the world among its health workers.[32] This unfortunate statistic was compounded by attacks on health workers by members of the public during the pandemic.[33]

Lessons learned from the SARS-CoV-2 pandemic

The AH1N1 influenza pandemic of 2009 and the current SARS-CoV-2 pandemic are natural phenomena are going to keep rearing their heads on a regular basis if we continue to deforest and modify natural habitats and ecosystems at the rate we are currently doing, causing the extinction of countless species and the migration of many others in search of better conditions. And if we continue to put politics before science, the consequences for human beings will be increasingly disastrous. Although we have been anticipating a serious respiratory disease of pandemic proportions since the last decade of the twentieth century, there is consensus that it is not this pandemic,[34] reason why we need to fully heed the lessons of the AH1N1 influenza and SARS-CoV-2 pandemics to ensure we are better prepared for what lies ahead.

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31 WHO, *Uso racional del equipo de protección personal frente a la covid-19 y aspectos que considerar en situaciones de escasez graves*, Geneva, WHO, April 6, 2020 at *https://apps.who.int/iris/bitstream/handle/10665/331810/WHO-2019-nCoV-IPC_PPE_use-2020.3-spa.pdf* (date of reference: February 22, 2021).

32 "México, el país con más personal médico muerto por coronavirus", in *Forbes México*, September 3, 2020 at *https://www.forbes.com.mx/noticias-mexico-pais-con-mas-personal-medico-muerto-por-coronavirus/* (date of reference: February 22, 2021). See also David Agren, "Understanding Mexican Health Worker COVID-19 Deaths" in *The Lancet*, vol. 396, no. 10254, September 19, 2020, 807.

33 Carmen García Bermejo, "Más de 200 médicos y enfermeras fueron atacados por el estigma asociado al virus en México", in Salud con Lupa, July 12, 2020 at *https://saludconlupa.com/noticias/mas-de-200-medicos-y-enfermeras-fueron-atacados-por-el-estigma-asociado-al-virus-en-mexico/* (date of reference: February 22, 2021).

34 Victoria Gill, "Coronavirus 'Ésta no es la última pandemia': la advertencia de los científicos ante 'la tormenta perfecta' para nuevas enfermedades" in BBC News, June 9, 2020 at *https://www.bbc.com/mundo/noticias-52986518* (date of reference: February 22, 2021).

This inevitably brings us to the subject of vaccination, which, despite being recognized as the preventive measure par excellence in the history of medicine, is currently being combined with treatments due to high global demand and a shortage of vaccines. Mexico was once among the world's largest vaccine manufacturers, producing enough doses to meet domestic demand and exporting to 15 countries. Today, 90% of the vaccines administered in the country are imported by the private sector, with Birmex, the domestic manufacturer, producing only reagents for diphtheria, tetanus and poliomyelitis. When the 2009 pandemic hit, Birmex looked set to reemerge with influenza vaccines. Unfortunately, Mexico still remains highly dependent on foreign-produced vaccines, especially COVID-19 vaccines.[35]

Regarding vaccination, estimates indicate that national coverage of vaccination programs ranges from 60.1% to 82.1%,[36] while the United Nations International Children's Emergency Fund (UNICEF) calculates that only 34.3% of children receive all their shots. In the case of sectors of the population that do not have access to social security, the coverage is between 22.3% and 56.3%, while data from the Health Ministry's Electronic Vaccination Card Program reveals that only 21.9% of children aged one have received all their vaccinations. In the case of the pentavalent vaccine, of the 37 353 children who received the initial dose, 8550 did not receive the third and 16 800 the fourth. According to the National Institute of Pediatrics (INP), in 48.8% of cases of whooping cough in children under 12 months, the child had not received all his or her shots; the INP also shows that the number of cases of whopping cough increased from 371 in 2010 to 1017 in 2015.[37] A similar trend can be seen with measles, a disease that, until recently, was deemed

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35 Carmen Morán Breña, "México fue una potencia en vacunas: ahora espera la de la covid-19 mirando al exterior" *El País*, June 10, 2020 at *https://elpais.com/sociedad/2020-06-10/mexico-fue-una-potencia-en-vacunas-ahora-espera-la-de-la-covid-19-mirando-al-exterior.html* (date of reference: February 22, 2021).

36 "La vacunación en México. Cifras inciertas, aprobaciones apresuradas", in Mauricio Hernández Ávila (ed.), *Salud deteriorada. Opacidad y negligencia en el sistema público de salud*, Mexico, Mexicanos contra la Corrupción y la Impunidad, 2018, 137-188, at *https://saluddeteriorada.contralacorrupcion.mx/wp-content/uploads/pdf/SD-Completo.pdf* (date of reference: February 22, 2021).

37 *Ibid*., 140.

almost extinct in Mexico, but that has reemerged due to failure to vaccinate, which can partly be attributed to anti-vaccination movements.[38]

As regards vaccination reports, the figures are truly alarming. ISSSTE reports vaccination coverage of 161.74% and state figures are at the very least implausible, ranging from 94.2% in Guanajuato to 483.33% in Chiapas. It could be argued that a large number of vaccines go to waste at the ISSSTE, although procurement mechanisms have revealed conflicts of interest and the trafficking of influences.[39]

These figures confirm that Mexico has a serious problem attributable not just to a shortage of trained personnel to implement vaccination campaigns, but a shortage of vaccines, due to a combination of insufficient investment and the refusal of certain sectors of society to be vaccinated or vaccinate their children.

In 2004, a working group from the Faculty of Chemistry at the UNAM made some useful recommendations to the Health Ministry as to how to better prepare for a possible pandemic. These included: the building and operation of diagnostic laboratories with a biosafety level III at the very minimum (preferably level IV); the training of staff for these laboratories; the establishment of a safe, but efficient system for the collection, transportation, handling and analysis of samples; regional centers for the storage of PPE for the handling of potentially infectious/contagious samples, with sufficient reserves to equip a large number of health workers until such time as possible microbiological threats are identified; frequent emergency drills; and a master plan of training, refresher and advancement courses for all health workers covering topics such as biosecurity, etiology, pathology and the laboratory diagnosis of diseases of microbial origin; and the correct use of PPE, according to the specific tasks required of each group of workers.[40]

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38 Sylvia Claudine Ramírez-Sánchez, "El antiguo enemigo resurge: el sarampión está de vuelta", in *Revista de Enfermería del Instituto Mexicano del Seguro Social*, vol. 28, no. 2, April-June 2020, 71-74 at *http://revistaenfermeria.imss.gob.mx/editorial/index.php/revista_enfermeria/article/view/1179/1057* (date of reference: February 22, 2021).

39 M. Hernández Ávila (ed.), *op. cit.*, 141.

40 I myself participated in this working group along with Eduardo Marambio Dennet and Raúl Garza Velasco. At the time, we collaborated with the United States-Mexico Border Health Commission.

Conclusion

The 2009 pandemic provided us with important information that spawned dozens of recommendations and articles in scientific journals. Many of those who were involved in handling the AH1N1 pandemic are currently responsible for managing the SARS-CoV-2 emergency, but no epidemiological surveillance strategy was established in the inter-pandemic period, nor were improvements made to the country's medical and hospital infrastructure, and our capacity to develop and manufacture vaccines did not improve either. The SARS-CoV-2 pandemic has taught us new lessons, the most important of which is the need to prepare better for future health crises that will presumably be more challenging than the one we currently have on our hands.

The actions that should have been taken in the wake of the 2009 pandemic and that still apply in the case of COVID-19 include:

- Shoring up the sentinel surveillance system by increasing the number of USMI. Even though the 2009 pandemic demonstrated that the system is deficient and prone to erroneous interpretations, we now have fewer USMI than we did in 2009.
- Ramping up the number of diagnostic tests conducted, not just under the sentinel system, but on a larger portion of the population. Back in 2009, Mexico did not have the laboratory infrastructure it has today, so there is no excuse for not following WHO testing guidelines.
- Following up more closely on the contacts of those who test positive and suspected cases, because it is preferable to be overly cautious than negligent when pain and death can be prevented.
- Making the wearing of masks mandatory, over and above political stances that either dismiss or do not recommend their use for personal reasons. In 2009, masks were widely used and fewer protests were made. The official policy needs to be consistent.
- Stocking emergency supplies of PPE for each type of task. This does not mean storing equipment for years until it is needed, but ensuring supplies are regularly replenished before their expiration date. In 2009, we had no such emergency reserve and neither did we in 2020.

- Implementing continuous training programs in the use and handling of PPE, with clear, coherent guidelines and accessible academic language. In 2009, there were only a handful of such programs and in 2020 they were developed on the go, which complicated their implementation and made it impossible to reach workers in all the different health fields.
- Implementing emergency drills for the treatment of patients with severe acute respiratory disease, the reconversion of hospital facilities and the relocation of patients to ensure they are not left without the care they need and deserve.
- Designing timely, objective and credible information campaigns. We need to stop telling people, "If you feel unwell, stay at home", only to blame them for not seeking help in time. In 2009, people were asked to stay home and they did, perhaps begrudgingly, but the firm hand with which this measure was implemented reduced time in lockdown, as opposed to what we are seeing today.
- Informing the public as to social distancing and hand hygiene protocols, and the proper use of disinfectants and masks, among other basic, but vitally important preventive measures. In 2009, fewer people used social media than they do today. We need to capitalize on this and take advantage of all the media channels at our disposal, without vilifying those who take a different stand to the official line. The government, the media and civil organizations need to make sure they are all on the same page, while campaigns should focus on educating the public in health matters by incorporating study plans into curriculums on all academic levels, as this will help counteract the misinformation that currently prevails.

It is my hope that, once the pandemic comes to an end, these recommendations will be implemented and that we will be better prepared for the next one when it comes along, which it inevitably will. It will not be easy, but it is not impossible. It is, however, more than necessary.