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EPIDEMIOLOGY

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Coronavirus in Ecuador: an opinion from the Academia

Coronavirus en Ecuador: una opinión desde la Academia

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Abstract

This is the third time that a zoonotic coronavirus has infected various human populations. This new virus, classified as SARS-CoV-2 (*severe acute respiratory syndrome coronavirus 2*), is the causative agent of the new pandemic outbreak called COVID-19 (*coronavirus disease 2019*). The international research carried out around this new outbreak was so effective that shortly thereafter the genome of the virus, its biology and its main epidemiological aspects were determined. To date, 1962 positive cases of SARS-CoV-2 have been reported in Ecuador, situation that has caused great concern among Ecuadorian academics and society. Thus, in this opinion article, the main research carried out internationally on the SARS-CoV-2 will be detailed, the importance of the Academia in healthcare decision-making will be discussed and the role of fundamental research to hold a possible outbreak in Ecuador will be mentioned.
Keywords: coronavirus, SARS-CoV-2, COVID-19, Ecuador.

Resumen

Esta es la tercera vez que un coronavirus zoonótico ha podido infectar diversas poblaciones humanas. Este nuevo virus, clasificado como SARS-CoV-2 (*severe acute respiratory syndrome coronavirus 2*), es el agente causal de la epidemia denominada COVID-19 (*coronavirus disease 2019*). La investigación internacional realizada en torno a este nuevo brote fue tan eficaz que en poco tiempo ya se conocía el genoma del virus, su biología y sus principales aspectos epidemiológicos. En Ecuador se han reportado hasta la fecha 1962 casos positivos de SARS-CoV-2, situación que generó una gran preocupación por parte de la sociedad y la Academia ecuatoriana. Por lo tanto, en este artículo de opinión se detallarán las principales investigaciones realizadas sobre el SARS-CoV-2 a nivel internacional, se discutirá sobre la importancia de la Academia en la toma de decisiones sanitarias y se pondrá en perspectiva el papel de la investigación fundamental para la contención de un posible brote en Ecuador.
Palabras clave: coronavirus, SARS-CoV-2, COVID-19, Ecuador.

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1 Introducción

"Another Decade, another Coronavirus" is the heading of the editorial published by Stanley Perlman in the prestigious journal "The New England Journal of Medicine". Indeed, this is the third time that a zoonotic coronavirus has infected various human populations. Like SARS-CoV (*severe acute respiratory syndrome coronavirus*) in 2002-2003 and MERS-CoV (*Middle East respiratory syndrome coronavirus*) in 2012, this new virus, called SARS-CoV-2 (*severe acute respiratory syndrome coronavirus 2*) was also transmitted from animals to humans (Perlman, 2020).

Coronaviruses can cause viral upper respiratory tract infections (URTIs) in a wide variety of domestic and wild animals, as well as in humans. These viruses were not considered highly pathogenic to humans until the SARS-CoV outbreak occurred in Guangdong Province, China. Coronaviruses circulating before this outbreak only caused mild infections in immunocompromised people. Ten years after SARS-CoV, another highly pathogenic zoonotic coronavirus (MERS-CoV) emerged in Middle Eastern countries. The latter was transmitted directly from camels to humans, while SARS-CoV was transmitted from civets sold in markets; both viruses are believed to have originated in bats (Perlman, 2020).

There are currently more than 200 serologically different viral types that cause URTIs. The symptoms of URTIs depend on the nature of the virus, but it is mostly affected by the age, physiological state and immune response of the host. Thus, depending on these factors, URTIs can go unnoticed (asymptomatic) until death. The main agents that cause URTIs in humans are rhinoviruses ($30-50\,\%$ of cases), followed by coronaviruses ($10-15\,\%$), influenza viruses ($5-10\,\%$) and other lower-incidence viruses such as adenovirus, human respiratory syncytial virus, among others (Eccles, 2005).

The great viral diversity makes it difficult to detect URTIs and develop diagnostic methods at the time of a new outbreak. For example, the SARS-CoV outbreak appeared in November 2002 but it was not until April 2003 that the virus genome was identified thanks to an international collaboration of 13 laboratories from 10 countries (Cui et al., 2019). Once the genome of the virus has been determined, the real-time RT-PCR (real time *reverse transcription polymerase chain reaction*) is used to amplify a specific region of the virus and identify it at the molecular level.

The molecular identification of the virus and the study of its biology and epidemiology is of great importance to stop an outbreak as well as for drug development and public health policies aimed at preventing the spread of this type of virus. Hence, this opinion article will detail the main research carried out on SARS-CoV-2 at the international level, discuss the importance of the Academia in health decision-making and put into perspective the role of main research to the containment of a possible outbreak in Ecuador.

2 SARS-CoV-2: identification, epidemiology and treatment

SARS-CoV-2 is the causative agent of the new outbreak called COVID-19 (*coronavirus disease 2019*) originated in Wuhan, China. The first cases were reported at the end of December 2019 by Chinese authorities to the World Health Organization (WHO). Research to determine the causative agent of COVID-19 was so thorough that, by January 7, 2020, scientists at the Shanghai Clinical Center for Public Health, associated with Fudan University, identified the pathogen responsible for COVID-19 and it was genomically characterized (Liu et al., 2020).

The genetic sequence of SARS-CoV-2, shared with the public through the GISAID initiative (*Global Initiative on Sharing All Influenza Data*), enabled the rapid development of diagnostic tests using the real time RT-PCR technique worldwide. Thus, by 17 January 2020, scientists from Charité University in Berlin shared the detection protocol with WHO and made positive controls available worldwide through the *Global European Virus Archive* (EVAg). Subsequently, scientists from Hong Kong, Japan, China, Thailand and the United States, associated with universities and public institutes, shared their screening protocols to WHO from January 23 to January 28, 2020 (Corman et al., 2020b). Currently, 133 partial or complete sequences of the virus are now available at the GenBank (https://www.ncbi.nlm.nih.gov/genbank/).

At the clinical-epidemiological level, the largest study published to date conducted by the China CDC (*Chinese Center for Disease Control and Prevention*), analyzed 72 314 patient records: 44 672 (61,8 %) confirmed cases, 16 186 (22,4 %) suspected cases, 10 567 (14,6 %) clinically diagnosed cases and 889 asymptomatic cases (1,2 %). Among confirmed cases, 1 023 died resulting in a mortality rate of 2,3 %. Although the mortality rate is low, it increases to 8 % in individuals aged 70-79 years and to 14 % in patients over 80 years old; these patients also had pre-existing conditions, such as hypertension, cardiovascular disease and diabetes. In addition, this study found that 80,9 % of infections are classified as mild, 13,8 % as severe, and only 4,7 % as critical. With respect to previous outbreaks, SARS-CoV infected 8 096 individuals in 29 countries, killing 774 people (mortality rate: 9,6 %), while MERS-CoV infected 2 494 people in 27 countries, causing 858 victims (mortality rate: 34,4 %) (Huang et al., 2020; Liu et al., 2020).

Currently, several institutes and research centers along with biotech companies are developing possible vaccines against SARS-CoV-2. Research in this field also advanced in leaps and bounds. In this way, just weeks after the publication of the SARS-CoV-2 genome, scientists associated with the National Institute of Allergy and Infectious Diseases (USA) and the University of Texas managed to solve the glycoprotein S structure of this virus. This protein is involved in the entry of the virus into the host cells and its structure is key to the development of vaccines, therapeutic antibodies and diagnostic methods (Wrapp et al., 2020).

Another strategy to fight the virus is to use developed antivirals to treat other infections. In this regard, Jinyintan Hospital in Wuhan is conducting a randomized controlled trial to treat patients diagnosed with COVID-19. This trial aims to test the effectiveness of a combination of lopinavir and ritonavir, medicines already used to treat HIV (Huang et al., 2020). These compounds inhibit protease, an enzyme used by both HIV and coronaviruses for the processing of new viral particles. Previously, in 2004, a study showed that such combination may have a positive clinical effect in patients infected with a strain similar to SARS-CoV-2. However, the study did not randomize patients to receive the combination or a placebo, which is a priority for a controlled trial. In addition, two other trials are ongoing to test the efficacy of remdesivir in 760 people with COVID-19 in China. This compound showed great efficacy against several coronaviruses *in vitro* and *in vivo*, including SARS-CoV and MERS-CoV (Cohen, 2020). Currently, China has more than 80 clinical trials running or pending on possible treatments for COVID-19 (Maxmen, 2020).

3 Situation in Ecuador

1962 positive cases of SARS-CoV-2 and 62 deaths have been reported to date in Ecuador (30-march-2020). During the first days of the epidemic, Ecuador's Ministry of Public Health (MSP) announced on January 26, 2020 the presence of a suspected case of COVID-19. It was a 49-year-old Chinese citizen with the symptomatology associated with this disease: high temperature ($39°C$), cough with greenish phlegm, chest pain and signs of severe renal and respiratory failure (Figure 1) (MSP, Ministerio de Salud Pública del Ecuador, 2020).

To diagnose the case, the MSP sent the samples for their analysis to the *Centers for Disease Control and Prevention* (CDC) located in Atlanta, USA. According to official reports issued on January 29 and February 1, 2020, Ecuador had not yet received the results of the CDC; however, it was not until February 4 that the MSP ruled out the presence of SARS-CoV-2 based on the results presented by the CDC. Finally, the Chinese citizen died on 7 February presenting symptoms of hepatitis B and pneumonia (Figure 1) (MSP, Ministerio de Salud Pública del Ecuador, 2020). While waiting for the results by the CDC, the MSP also announced that the *National Institute of Public Health Research* (INSPI) has the necessary reagents for the identification of future suspected cases (Figure 1). This institute has the National Influenza and Other Respiratory Viruses Reference Center, a WHO-accredited organization for testing possible cases of SARS-CoV-2 (MSP, Ministerio de Salud Pública del Ecuador, 2020).

Weeks later, on February 29, 2020, the MSP reported the first case of COVID-19 (Figure 1). She was an Ecuadorian citizen residing in Spain who entered the country on February 14 from José Joaquín de Olmedo Airport. Subsequently, out of the

177 citizens who were in the epidemiological area with respect to the first case, 1962 have tested positive for SARS-CoV-2 (MSP, Ministerio de Salud Pública del Ecuador, 2020). Worthy of note, diagnosis of the first case ocurred 5 days after admission to the hospital and 13 days after arrival to Ecuador (MSP, Ministerio de Salud Pública del Ecuador, 2020).

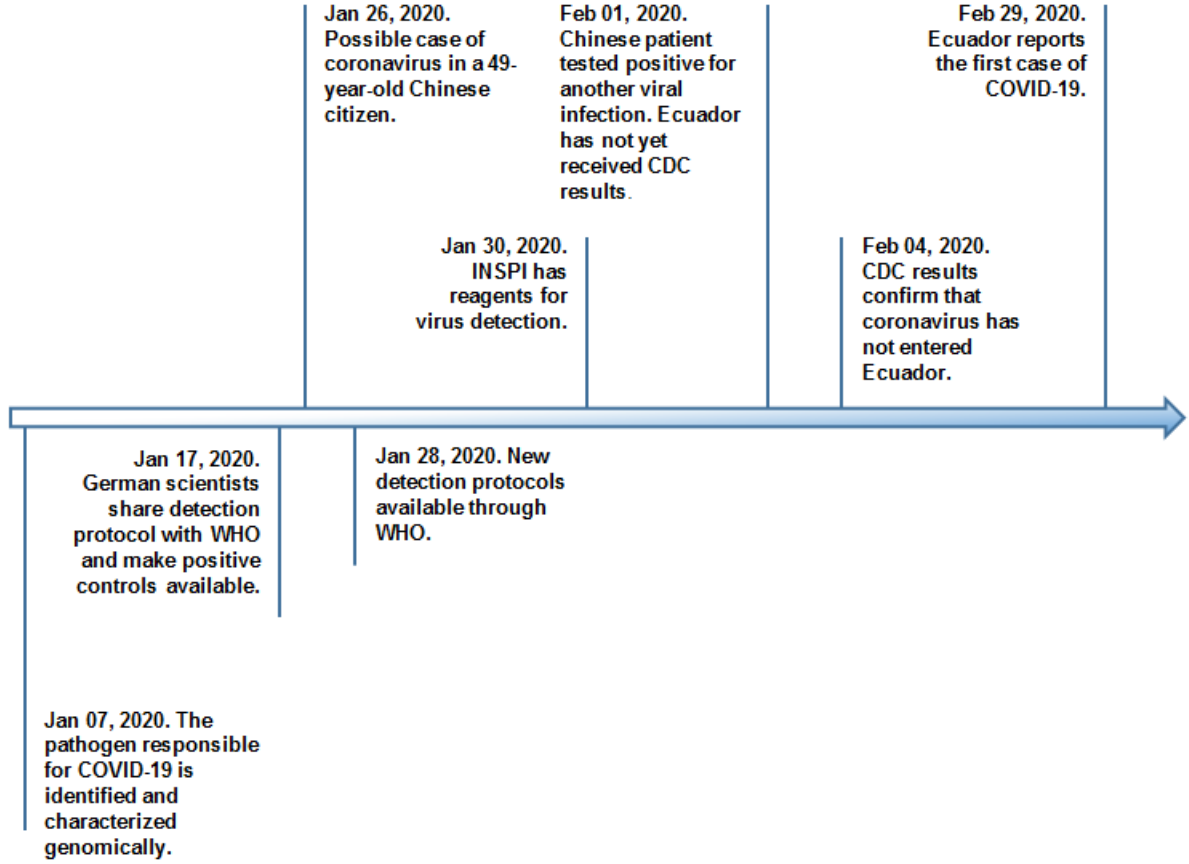

Figure 1. Main events occurring in Ecuador and internationally on the detection of SARS-CoV-2 in the early days of the epidemic.

4 Perspectives for Ecuador

International research on this new outbreak was so effective that in just months the causal agent of COVID-19 was discovered, its biology— highlighting its genome and the structure of glycoprotein S^{-} and its epidemiology. The research progressed to such an extent that there are 80 pending or running clinical trials on possible treatments for this disease. In addition, several institutes and research centers, in collaboration with the industry, are developing potential vaccines. This has been achieved in large terms by close collaboration between university research groups, public research centers and biotech companies.

In Ecuador, it is essential that the Academia, through its accredited institutions, e.g. *Academia Ecuatoriana de Ciencias* (AEC) or consolidated research groups, work closely with the State to generate fundamental and applied research in issues of national importance. In this way, Ecuador could generate a more effective response for an epidemic outbreak containment. This is supported by WHO recommendations for the formation of *Emergency Operations Centers* (EOCs) for health decision-making. EOCs, made up by several entities including the Academy, manage the response to a wide variety

of dangerous situations, such as natural disasters, chemical spills, outbreaks, etc (Balajee et al., 2017).

Unlike other countries, Ecuador has not published any scientific reports on the positive cases of SARS-CoV-2 circulating in the country. To generate an effective health response, it is essential that the MSP publish clinical cases of COVID-19 in specialized journals. Clinical case reports present the lowest evidence within the scale of scientific research and are considered as the first source of information at the medical level (Pineda-Leguízamo et al., 2018). Thus, based on these reports, primary care physicians will be able to better assess future suspected cases in Ecuador. In addition, the genetic identification of SARS-CoV-2 types present in Ecuador will help to implement containment protocols more effectively, because the virus evolved into two types: L and S, called based on their genetic variants. The L type is more aggressive and it transmits faster than S (Tang et al., 2020). In Ecuador, it is still unknown which strain infected patients diagnosed with COVID-19. At the international level, this type of research has been carried out thanks to close collaboration between the Academia and the State.

On the other hand, Ecuador is home to a surprising number of endemic species that inhabit a wide variety of ecosystems. With regard to bats, the main reservoir of coronaviruses, the Museum of Zoology of the Pontifical Catholic University of Ecuador (Pontificia Universidad Católica del Ecuador) has recorded 176 species of bats in the country (Brito et al., 2019). A study published in 2013, led by Christian Drosten, who published the German protocol for SARS-CoV-2 detection (Corman et al., 2020a), found a great diversity of coronavirus in neotropical bats sampled in Costa Rica, Panama, Ecuador and Brazil. However, out of 1 868 collected samples, only 62 (26 species represented) were obtained in Ecuador and no samples tested positive for coronavirus (Corman et al., 2013). This highlights the need to study the diversity of coronavirus in Ecuador to determine geographical areas that may be at high risk of zoonotic outbreaks. Indeed, the most effective way to prevent these outbreaks is to identify these areas and maintain the barriers between natural reservoirs and civilization.

To conduct this type of research, Ecuador needs a diversification of research groups that develop specific lines of study, such as coronaviruses or other zoonotic viruses. However, according to World Bank data (https://www.bancomundial.org/), Ecuador spends only 0,44% of *gross domestic product* (GDP) in research. Other Latin American countries, such as Argentina and Brazil, allocate 0,53% and 1,2%, respectively. The difference is significant with more developed countries: China, 2,11% and The United States 2,7%. With adequate funding and focused on the country's research priorities, Ecuador will not only be able to cope with any zoonotic outbreak but also participate in international research.

References

Balajee, S., Pasi, O. G., Etoundi, A. M., Rzeszotarski, P., Do, T. T., Hennessee, I., and Mounts, A. W. (2017). Sustainable model for public health emergency operations centers for global settings. *Emerging Infectious Diseases*, 23(13):Online: https://bit.ly/2WRMOlI.

Brito, J., Camacho, M. A., Romero, V., and Vallejo, A. F. (2019). Mamíferos del ecuador. versión 2019.0. Museo de Zoología, Pontificia Universidad Católica del Ecuador (February 25, 2020). Online:https://bit.ly/2y5WrmA.

Cohen, J. (2020). Can an anti-hiv combination or other existing drugs outwit the new coronavirus? Science. Online: https://doi.org/10.1126/science.abb0659.

Corman, V., Bleicker, T., Brünink, S., Koopmans, M., Zambon, M., Peiris, M., and Drosten, C. (2020a). Diagnostic detection of 2019-ncov by real-time rt-pcr. resreport 2, Charité Virology, Berlin, Germany.

Corman, V., Landt, O., Kaiser, M., Molenkamp, R., Meijer, A., Chu, D., Bleicker, T., Brünink, S., Schneider, J., Schmidt, M. L., Mulders, D., Haagmans, B. L., Van der Veer, B., Van den Brink, S., Wijsman, L., Goderski, G., Romette, J. L., Ellis, J., Zambon, M., Peiris, M., and Drosten, C. (2020b). Detection of 2019 novel coronavirus (2019-ncov) by real-time rt-pcr. *Euro surveillance : bulletin Europeen sur les maladies transmissibles = European communicable disease bulletin*, 25(3):2000045. Online:https://bit.ly/39gJH9z.

Corman, V., Rasche, A., Diallo, T., Cottontail, V., Stoecker, A., Dominguez Souza, B., Corrêa, J., Carneiro, A., Franke, C., Nagy, M., Metz, M., Knörnschild, M., Kalko, E., Ghanem, S., Sibaja-Morales, K., Salsamendi, E., Spínola, R., Herrler, G., Voigt, C., and Drexler, J. (2013). Highly diversified coronaviruses in neotropical bats. *Journal of General Virology*, 94:1984–1994. Online:https://bit.ly/2wE42sg.

Cui, J., Li, F., and Shi, Z. L. (2019). Origin and evolution of pathogenic coronaviruses. *Nature Reviews Microbiology. Nature Publishing Group*, 17(3):181–192. Online:https://bit.ly/3aniJOW.

Eccles, R. (2005). Understanding the symptoms of the common cold and influenza. *Lancet Infectious Diseases*, 5(11):718–25. Online: https://bit.ly/2Uiilf8.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., and Cao, B. (2020). Clinical features of patients infected with 2019 novel coronavirus in wuhan, china. *The Lancet*, 395(10223):497–506. Online: https://bit.ly/2y8T0eV.

Liu, Z., Bing, X., and Za Zhi, X. (2020). The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (covid-19) in china. *Lancet*, 41(2):145–151. Online:https://doi.org/10.3760/cma.j.issn.0254--6450.2020.02.003.

Maxmen, A. (2020). More than 80 clinical trials launch to test coronavirus treatments. *Nature*, 578(7795):347–348. Online:https://bit.ly/3braEsM.

MSP, Ministerio de Salud Pública del Ecuador (2020). Comunicados oficales del ministerio de salud pública del ecuador.

Perlman, S. (2020). Editorial: Another decade, another coronavirus. *New England Journal of Medicine*, pages 1–2: Online:https://doi.org/10.1056/nejme2001126.

Pineda-Leguízamo, R., Miranda-Novales, G., and Villasis-Keever, M. (2018). La importancia de los reportes de casos clínicos en la investigación. *Revista Alergia México*, 65(1):92. Online:https://doi.org/10.29262/ram.v65i1.348.

Tang, X., Wu, C., Li, X., Song, Y., Yao, X., Wu, X., Duan, Y., Zhang, H., Wang, Y., Qian, Z., Cui, J., and Lu, J. (2020). On the origin and continuing evolution of SARS-CoV-2. *National Science Review*.

Wrapp, D., Wang, N., Corbett, K. S., Goldsmith, J. A., Hsieh, C.-L., Abiona, O., and McLellan, J. S. (2020). Cryo-em structure of the 2019-ncov spike in the prefusion conformation. *Science*, 367(6483):1260–1263. Online:https://bit.ly/2Ju8f4N.