

POSSIBILITIES FOR REAL-TIME MONITORING OF COVID-19 PANDEMICS

Ioan VOINA, PhD. Eng, „1 Decembrie 1918” University of Alba Iulia, Romania, nutu_rc@yahoo.com

Luciana OPREA, Asoc.Prof. PhD. Eng, „1 Decembrie 1918” University of Alba Iulia, Romania, lucii_oprea@yahoo.com

Tudor BORŞAN, Asoc.Prof. PhD. Eng, „1 Decembrie 1918” University of Alba Iulia, Romania, borsant@yahoo.com

Abstract: *Pandemics have been a real challenge for all humanity since time immemorial, leading to the finding of scientific and medical solutions for long-term monitoring, the development of solutions for pharmaceuticals and equipment specialized in their treatment and healing, but also in the storage of information in the form of spatial data sets necessary for the analysis and study of the phenomenon of their transmission on the entire globe.*

The contemporary world is currently facing the pandemic caused by the SARS-CoV-2 virus, which is, from our point of view, probably one of the greatest disasters caused by human intelligence from World War II to the present day.

This paper aims to reproduce and, why not, to propose at the international level the realization of a unique global real-time monitoring system of pandemics through geodetic sciences, using in this sense the technology based on GNSS systems for real-time monitoring of individuals invested with a certain type of virus, using technical equipment that includes systems that allow the use of GNSS technology who, through the interconnection between them and a digital database created in the GIS environment based on metadata, individuals invested and suspects can be monitored by existing specialized institutions at international, national and local levels, which can transmit useful information to each other in the fight against the pandemic created by COVID-19.

Keywords: *COVID-19, GNSS, GIS, metadates*

1. Introduction

The pandemic is known in the medical literature as an extended-scale epidemic that extends beyond international borders and affects a large number of people.

The humanity has faced a series of pandemics in the last millennium that have caused significant human deaths worldwide, with an estimated 1,200,000,000 people dead throughout history. Among the most famous pandemics can be mentioned [1]:

- the Justinian plague that took place between 541-542 affecting Asia, Africa and Europe with the death of 100,000,000 people;
- the bubonic plague that took place between 1347-1350 and was also called "The Black Death of the Fourteenth Century", affecting continents such as Asia, Africa and Europe with the death of about 50,000,000 people [4] ;
- the smallpox pandemic that took place between 1870 and 1874, which started in France and spread rapidly to Germany, Belgium, Switzerland and Italy, then to Asia and America, killing about 500,000 people;

- the plague pandemic that took place between 1894 and 1903, which broke out in Canton and Hong Kong, spreading rapidly around the world, carrying rats on steamships.

In the twentieth century there were a series of pandemics that affected humanity in various ways, both in terms of population health and economic development. In this sense they can be mentioned [2]:

- the pandemic registered between 1918-1919 caused by the H1N1 virus of avian origin, being the most severe pandemic of the last century, although it is not known exactly where it broke out, it spread very quickly globally between 1918-1919, the number of deaths amounting to over 50 million;
- the pandemic caused by the influenza A (H2N2) virus that occurred in February 1957 on the Asian continent in the city of Singapore under the name of "Asian flu" and making an estimated 1,100,000 deaths worldwide;
- pandemic caused by influenza A (H3N2) virus recorded in September 1968 in the USA which has led to an estimated 1,000,000 deaths worldwide and continues to circulate around the world as a seasonal flu virus;
- the HIV / AIDS virus that was discovered at the beginning of 1979, being reported internationally about 379,000,000 cases infested by 2018, being considered the disease of the 21st century, this causing a wide range of deaths in the world, especially in countries on the African continent.

The 21st century has not been spared the problems of the world health system either, so a number of major medical events have been identified as follows [3]:

- severe acute respiratory syndrome was the first serious communicable disease in the 21st century, being identified in China at the end of 2002, and spreading globally in 2003;
- the H1N1 flu virus, which in 2009 was declared a pandemic; the Ebola virus, which in 2014 caused the most severe epidemic on the black continent, being spread mainly in areas where medical infrastructure and water are deficient.

The last and most current pandemic facing humanity today is the emergence of the SARS-CoV-2 virus, which is an RNA virus in the family of „Corona” viruses known since 1960 in humans and animals. -19 started in Wuhan City, Hubei Province, in central China, in December 2019, and is now spreading around the world.



Fig.1 Presentation of the virus SARS-CoV-2 [3]

This virus is called the "new crown" because over time there have been known infections in 2002 (SARS-CoV) and in 2012 (MERS-CoV), this type of virus has the symbol SARS-CoV-2 and causes the occurrence of the disease called COVID-19. SARS-CoV-2 is a virus that belongs to the group of coronaviruses, an extensive group of viruses that infect both animals and humans.

The problem of finding solutions in terms of preventing the spread of the SARS-CoV-2 virus, as well as other types of viruses is a challenge for the entire scientific and medical sector.

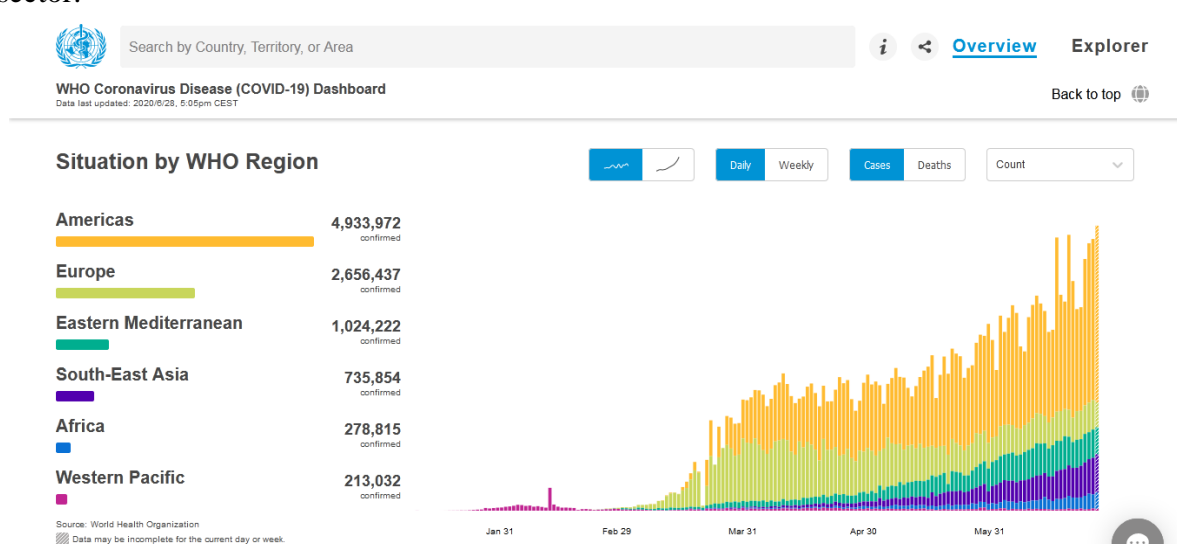


Fig. 2 Distribution of COVID-19 on 28.06.2020 [6]

Thus, in this article, we aim to present some possibilities for real-time monitoring of the COVID-19 pandemic using the geodetic technology of GNSS equipment and the realization of a digital concept created in the GIS environment based on metadata, which to provide us with information on infected individuals and asymptomatic carriers of the virus as well as their real-time monitoring by existing specialized institutions at international, national and local levels. The information obtained will be able to be transmitted in real time in order to issue: communiqués, procedures and even treatment schemes successfully applicable to individuals carrying pandemiological viruses in order to stop the spread and widespread treatment of pandemics.

2. Materials and Methods

In order to make the proposal we chose to use the possibilities offered by GNSS systems and those offered by the GIS environment, these allowing us the opportunity to provide useful metadata for interconnection between states and even between continents, facilitating the optimization of the information process.

The satellite-based positioning and navigation system is nothing more than a global positioning system, meaning a system through which the position of points on any part of the Earth can be determined from mobile positions along the orbits of satellites [7].

In order to establish a concrete position, the receiver must receive real-time signals simultaneously from at least 4 satellites, the figure below showing the principle of data acquisition and determining the position of a point or an individual on the earth's surface.

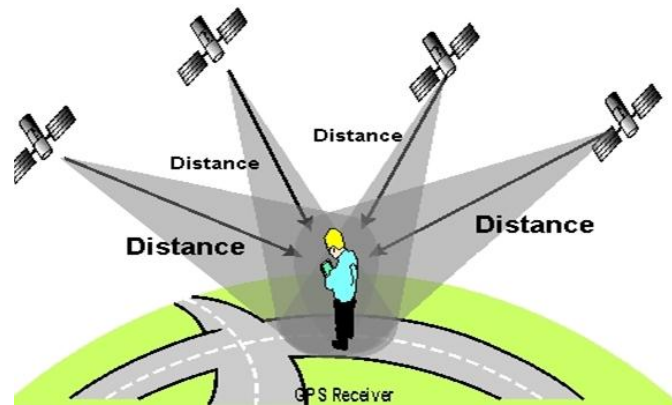


Fig. 3 The principle of acquiring GNSS data

A geodetic reference system must be geocentric, unique for the whole globe and fixed with respect to the movement of the Earth, which is why, since 1984 and until now, a series of international geodetic reference systems have been developed to meet these conditions such as: WGS84, GLONASS, GALILEO, BEIDOU and IRNS which are connected to each other allow a particularly accurate determination of the position of a point on the earth's surface [8].

Geographic information system is a set of people, equipment, programs, methods and rules and methodologies, aimed at collecting, validating, storing, analyzing and viewing geographic data. Geographic Information Systems is a revolutionary, interdisciplinary science, based on knowledge from several disciplines, such as geography, cartography, remote sensing, photogrammetry, topography, statistics and operational research, applied informatics, computer aided design, computer graphics, systems management databases and artificial intelligence, all these areas forming the GIS [9].

The fields of applicability of GIS are multiple and diverse, from administration, construction, cadastre, topography to medicine, history and even the military field, being developed over time a series of integrated and specialized modules for each field. , with independent research sections that can provide a wide range of information that can be implemented either on smart media or on online platforms visible to specialized institutions or stakeholders in the form of metadata.

Given that the subject of this paper is to present the possibilities of real-time monitoring of pandemics, the World Health Organization has integrated with ESRI on its official website an updated situation of the global COVID-19 pandemic.

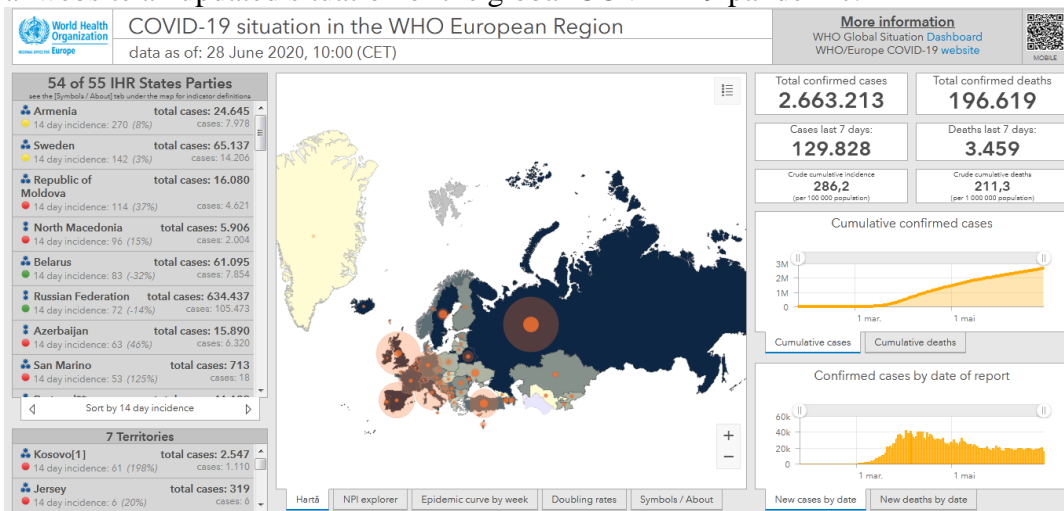


Fig. 4 World Health Organization status of the COVID-19 pandemic in Europe [10]

Thus, we can observe, compared to the existing monitoring problem at international level due to the SARS-CoV-2 virus, a major concern among specialists, institutions and bodies in various fields of activity, including geodesy, a field that we represent in in this article. Thus, we have schematically chosen our methodological concept regarding the monitoring of medical social events.

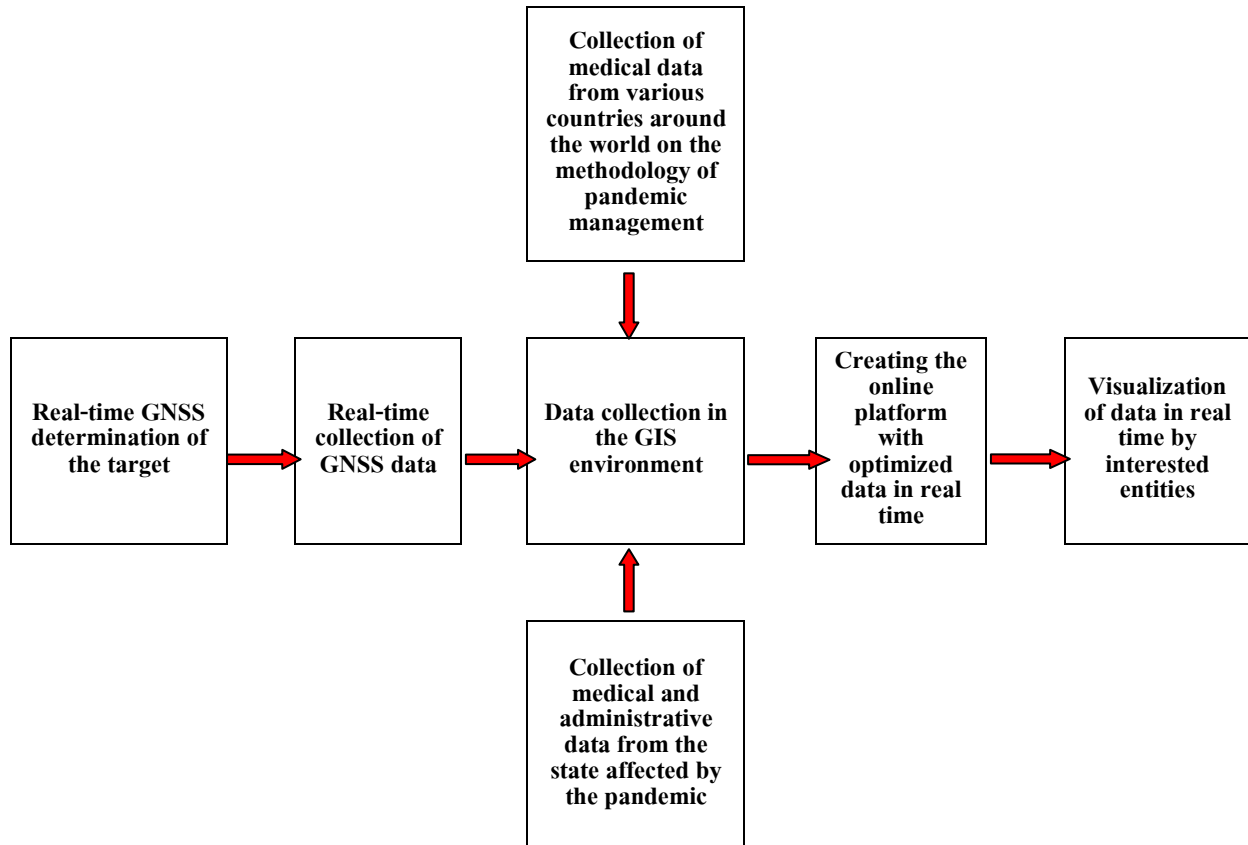


Fig. 5 The structure of creating a real-time monitoring system with GIS interconnection to an online virtual environment

The development of such a methodology can lead, from our point of view, to the development of future ideas in order to create a system of continuous real-time monitoring of an individual invested with pandemiological viruses such as SARS-CoV-2 virus and finding solutions. to prevent and combat the spread of pandemics globally.

3. Results and Discussion

Analyzing the possibilities of achieving the presented methodology, we can say that at present the realization of such a system is only a notion of time, in the sense that the means and methods currently available allow easy realization of what we propose, so that determining the real-time position of an infected or suspected individual to be infected with a particular type of virus.

In this regard, we aim to mount real-time GNSS data collection equipment, such as a clock or bracelet that has the ability to collect that data in real time using the RTK method of collecting GNSS data to monitor the position. in time and space of the patient and which can enable the provision of patient medical data based on magnetic sensors.

Thus, an intelligent equipment for monitoring a suspicious person will be able to be structured so as to allow obtaining vital medical information for each medical situation.

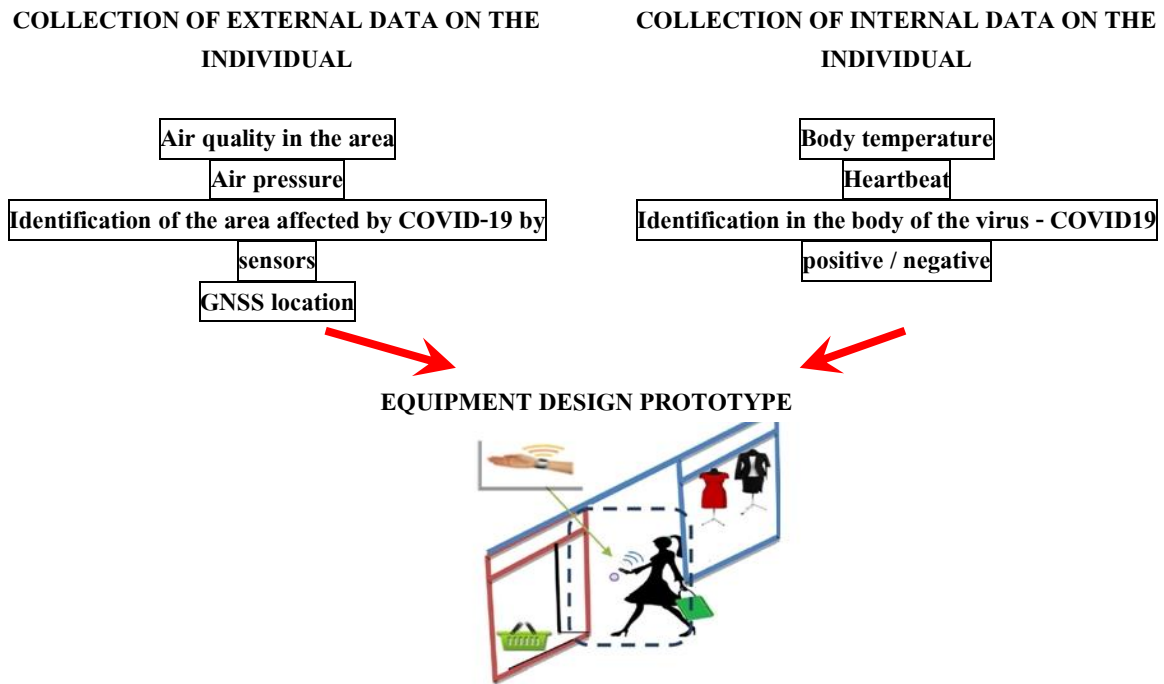


Fig. 6 Equipment model with GNSS patient monitoring capability

Once the GNSS data on patient positioning are collected and the administrative and medical data are collected from the international specialized structures, a database is created in the GIS environment capable of allowing the management and optimization of information, which can be transmitted in real time to users. from the virtual environment in the form of metadata, further being presented two existing models regarding the creation in the GIS environment of a platform regarding the monitoring of the COVID-19 pandemic in Romania.

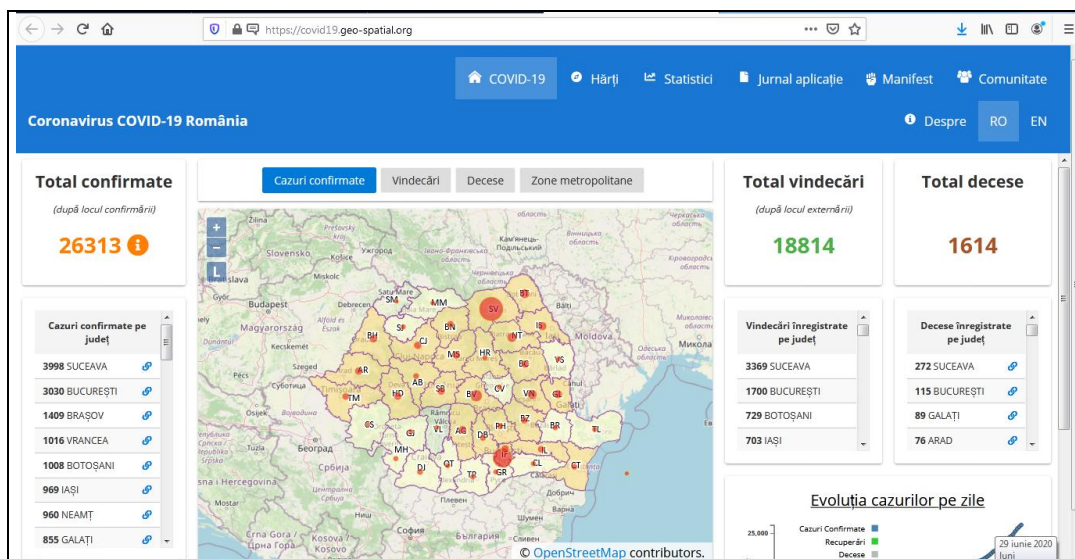


Fig. 7 Presentation of a GIS environment created to monitor the COVID-19 pandemic in Romania [11]

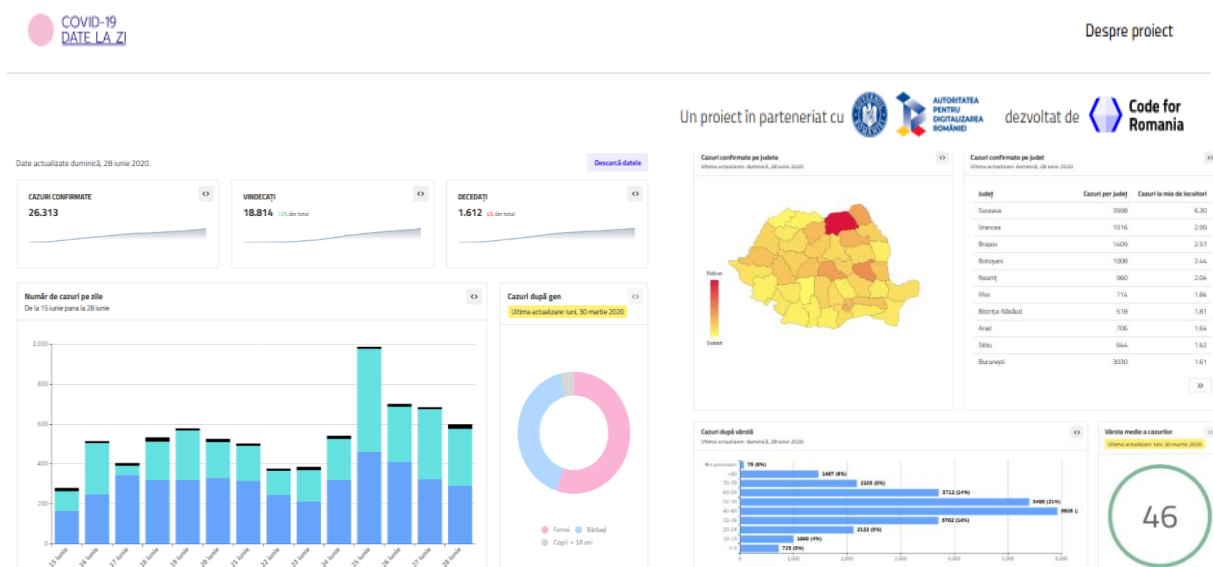


Fig. 8 Presentation of the evolution of cases caused by the COVID-19 pandemic in Romania [12]

4. Conclusion

The need to implement such solutions globally is a priority for the conservation and preservation of the human race, pandemic control strategies can be optimized with the help of types of systems such as those presented in the content of this article.

These systems have a number of facilities including:

- monitoring the development of the pandemic and the planning of the global virus control strategy;
- creating real-time statistics on the evolution of the pandemic;
- analysis and archiving of the obtained metadata;
- monitoring the patient's health and position in real time;
- the applicability of a widely visible treatment scheme developed to combat the pandemic;
- the connection between the existing database and the online virtual environment.

Depending on the requirements of contemporary development and changes in the evolution of the human race with the emergence of new viruses, the impact on health, the economy and the administrative management of pandemic situations is a major one for each affected state.

Given the fact that recent years tend towards an upward scientific evolution and everything around us is gaining momentum in various fields of activity, including medical but also geodetic, we must not neglect the multidisciplinary and interdisciplinary nature of addressing these phenomena, so so that it can be identified quickly. The identification of the phenomena produced by different factors that influence the development of pandemics at global level, in this case and not only, will make possible the early realization of certain forecasts and analyzes so that the most effective measures can be taken to avoid disasters on human health and the loss of human lives.

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