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Emerging and reemerging diseases

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Abstract

Emerging and reemerging diseases are the result of the interaction of multiple factors, such as social determinants of health, climate change, and conditions that prevail and are identifiable in some populations. As a consequence, there may be situations that by their nature are defined as a health emergency, impacting directly on the health of a population, either because they are not known or due to their rapid spread, resulting in a health security problem. Examples of these diseases are described in this article, starting with their origin, their impact on the population, and the response necessary in order to contain or prevent damage of a greater magnitude. The presence of these agents and their consequent damage to the population should lead efforts towards comprehensive prevention and appropriate containment strategies to ensure the protection of public health. Endeavors should be directed not only to a specific agent, but rather to factors that determine their reemergence, such as Ebola, or their permanence, such as the binomial infection of tuberculosis-AIDS. In order to correctly implement strategies, training and availability of supplies play a crucial role in facing the challenges that lie ahead. (Gac Med Mex. 2015;151:626-31)

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Pathogenic microorganisms can be persistent and dangerous enemies. Although their individual emergence is impossible to be predicted in time and place, we can be sure that new microbial diseases will appear.

Institute of Medicine (USA)
Emerging Infections: Microbial threats to health, 1992

Emergent diseases are defined as those related to new agents, as well as those with already known causative agents that recently have acquired an epidemic nature, which can turn into a threat and occur in regions where previously they were inexistent[1].

We speak about reemerging diseases when we refer to those previously known, controlled or efficaciously treated, the frequency and/or mortality of which are increasing. There are a large number of infectious diseases that can be included within the above definitions, which have acquired importance in both global and local public health due to the impact they cause on the health of a population. Some examples of them appear in figure 1.

The emergence or reemergence of infectious diseases responds to a complex process where several factors

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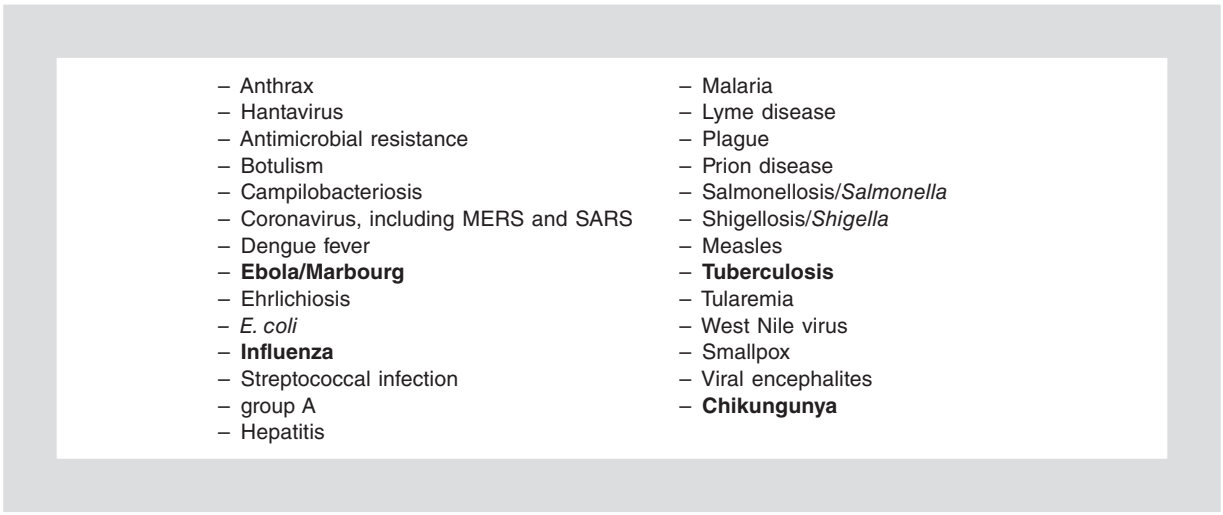

Figure 1. Infectious Diseases.

interact; social determinats of health, climate change and conditions that prevail and are identified in a population[2]. Many of the "new diseases" are not caused by new or newly identified pathogenic agents, but existing conditions in a population favor for them to develop again and to be able to turn into an emergency situation and with an impact on public health.

Some of the agents involved in these processes are the prions, viruses, bacteria, fungi, protozoos and helminths; however, we cannot leave the emergence of non-transmittale diseases aside, which are responsible of damages to the population as well. The concept of microorganisms as causative agents of diseases is now inadequate and incomplete, since they are known to be the result of a multifactorial interaction that includes human activities as a powerful driver that determines the presence of new entities and/or their prevalence.

Commonly mentioned factors include the environment, which, influenced by climate change, has modified the way natural phenomena occur, increasing their frequency and intensity (e.g., tropical cyclones). Deforestation, drought and flows are the result of modification and intervention by the human being in ecosystems, which influences on epidemiological patterns of disease in mankind.

Associated with the above, modification and adaptation of agents to new environments makes them resistant and influences on the natural course of disease, a factor that has to be taken into account always when speaking about the resistance agents against antimicrobials. Similarly, there are associations between causative infectious agents and lifestyles; some examples: 1959 is estimated to be the probable beginning of human circulation of HIV in central Africa countries[3]; however, it was not until 1981 when the first reports of HIV/AIDS occurred in the United States of America (USA). The same way, there is the acute respiratory distress syndrome outbreak in 1993 in "Four Corners", USA, which had a lethality rate of 30 to 40% and in which Hantaviruses were identified as new etiologic agents of this syndrome after thorough investigation[4]. And in the same year, an epidemic outbreak of dehydrating diarrheic disease in adult residents of Calcutta and Madras in India, where the etiologic agent was a choleric toxin-producing non-O1 vibrio named *Vibrio cholerae* O139[5]. By 1997 made its appearance an avian influenza strain (AH5N1) with the capacity to infect humans, be transmitted among them and cause high lethality, as well as the AH7N9 of the same etiologic agent, with the first cases in humans identified in China in 2013, causing a severe acute respiratory syndrome with a lethality rate of 30%. With regard to this condition, no person-to-person sustained transmission has occurred, but it is kept under surveillance due to its high pandemic potential.

Currently, special surveillance and interest are maintained on the binomial TB and HIV/AIDS, TB bacillus multi-drug resistance to antimicrobials, cholera, regarded as reeemergent, as well as the rise in the incidence of malaria and the reintroduction of dengue. In the face of a panorama as the described one, we must be prepared for the unexpected, as well as in the face of the rise of some diseases that were kept under control or practically eradicated.

Table 1. Possible scenarios in the face of a pandemic of influenza in Mexico. Results with 25% of infected subjects

Scenarios	Expected deaths	Number of hospitalizations	Consultations provided
Minimum	21,522	80,727	11,798,789
Most probable	54,104	250,829	14,941,629
Maximum	117,461	352,513	20,710,591

Some examples of emergent and reemergent infectious diseases in Mexico

Influenza

One of the best examples of emergent diseases is those that are caused by the different strains of the influenza virus. First, it is important to define the concept of pandemic; it results from the appearance of a new influenza virus that is transmitted between human beings and that represents and an epidemic of human influenza of large magnitude that affects two or more continents simultaneously. Generally, during a pandemic there is an important number of cases and deaths over a short period; this phenomenon has occurred several times every century. The question is: why do influenza viruses continue to cause pandemics? The answer lies in genetic changes of the influenza viruses, which due to transcription mechanisms suffer modifications of their main viral antigens; these changes are known as "antigenic drift" and "antigenic shift"[7]. Antigenic drift refers to changes or mutations that result in new strains, whereas antigenic shift comprises important changes in the genetic composition of the virus but without a new strain necessarily being originated; in both processes, infectivity and pathogenicity of the virus can be increased. The most relevant points when a pandemic is discussed include its impact on society, which ranges from school and work absenteeism to healthcare services overload, which invariably leads to a state of social restlessness, wlth all this triggering a problem of health security, a situation that, in turn, requires a global answer from society.

This all said, next we will present a mathematical model that me and other collaborators published in 2008[8] on possible scenarios of an influenza pandemic in Mexico. An impact mathematical model was constructed, where 8-week pandemic activity was estimated with 25% of the population infected, 17% of the population at high risk for complications and with a behavior similar to that of the pandemic of 1918. The results were the following:

Table 1 shows the different scenarios: minimum, most probable and maximum with number of expected deaths, number of hospitalizations, as well as the number of provided consultations. Hence, with 25% of infected persons, the impact on healthcare services would translate into 912% in excess of the hospital capacity, 1,220% of the intensive care units capacity and 269% of ventilators capacity, all this in only 5 weeks. This would represent a mean income loss of $289.13 per day, with most probable estimated direct economic impact of $59,515 million pesos and 205,840,125 working days lost, including days lost either by sick leave of absence or because of having to take care of a sick relative.

To answer to a situation similar to the described one, a National Plan of Preparedness and Response was created in Mexico, which includes lines of action and components where planning and coordination, monitoring and assessment of the situation, communication, dissemination reduction and continuity are clearly established.

Chikungunya

Chikungunya virus fever is an emergent disease transmitted by the mosquito *Aedes aegypti,* same vector that transmits dengue. It is characterized by fever, joint pain and headache, with a mean incubation period of 3 to 7 days after the mosquito's bite[9]. Since January 2014, the Panamerican Health Organization (PAHO) informed via its web the number of cases of the disease that were occurring in the region of the Americas, with the Caribbean countries being the most affected. By August 2014, Central American countries adjacent to ours had already recorded cases and, therefore, it was foreseeable for our country to start having imported and, subsequently, autochthonous cases.

According to PAHO's weekly publications, as of August 1, 5,271 autochthonous and imported cases and 32 deaths had been recorded in the region of the Americas, with a lethality rate of 0.6%, and it should be mentioned that, at that moment, imported cases had already occurred in our country.

It is important to remember that since the mosquito *(Aedes aegypty),* which is responsible for the transmission of this disease, transmits the dengue virus, the differential diagnosis should include this and other pathologies with similar symptoms, such as leptospirosis, malaria, meningitis, post-infectious arthritis, and some exanthematic viral diseases such as rubella, measles and parvovirus, among others.

The presence of the vector in the continent and the great mobility of people from one country to another represent a high risk for the spread of the Chikungunya virus and, for this reason, the WHO issued recommendations to strengthen epidemiological surveillance, including[10]:

- Strengthen the capability to detect and confirm cases.
- Timely diagnose and give adequate treatment to the patients.
- Implement a communication strategy with the population.
- Set up epidemilogical surveillance of this disease based on that already in place for dengue.

To answer to these recommendations, different actions for the control of the vector, strenghtening of epidemiological surveillance and diagnosis of the disease have been implemented in Mexico, including: strengthening of the epidemiological surveillance system for Chikungunya through the development of specific guidelines[11], implementation of polymerase chain reaction (PCR) testing in the Institute of Epidemilogical Diagnosis and Reference (InDRE – *Instituto de Diagnóstico y Referencia Epidemiológicos)* to identify the virus; a national meeting of health services directors was carried out in order to inform on the panorama in the country in the face of the imminent introduction of the disease in our territory; preventive warnings were published on travelling to the Caribbean and an epidemiological warning was issued to all units of the health sector in order to spread information both among the general population and healthcare personnel; epidemiological surveilance reinforcement on the disease was carried out in operatives due to the 2014 footbal World Cup and the Central American and Caribbean games celebrated in Veracruz on October 2014; in addition, the national meeting on the Chikungunya virus was carried out in Jalisco last July 28, 2015. According to the above, we have not lowered our guard to the introduction of the Chikungunya virus disease in the country, as well as with regard to its control, since with globalization and the presence of outbreaks in countries adjacent to ours, it is unavoidable for autochthonous cases to start occurring and, most likely, they won't be few.

EVD

The Ebola virus disease (EVD) is characterized for causing fever and hemorrhages in the human being. In some cases it is mortal: in fact, the lethality rate has been estimated to be able to reach up to 90%; it occurs mainly in remote villages of Central and Western Africa, near the tropical jungle.

The transmission of the virus that causes this disease occurs when a person has direct close contact with organs, blood, secretions or other bodily fluids of infected wild animals or people. The natural host of the virus is known to be the fruit-eating bat of the *Pteropodidae* family. To this moment there is no specific treatment or vaccine to treat infected persons or animals.

The virus was first detected in 1976 when two simultaneous outbreaks occurred: one in Nzara (Sudan) and another in Yambuku (Democratic Republic of the Congo) and received the name of Ebola because the village where the second outbreak was produced is located close to the river that bears this name.

The Ebola virus belongs to the family of the filovirus viruses and comprises five different ebolavirus species: Bundibugyo, Zaire, Sudan, Reston and Taï Forest; the three first species have been associated with the outbreaks that have occurred in Africa[12].

After a person is infected with this virus, between 2 and 21 days can elapse before the onset of symptoms, which include sudden onset of fever, intense weakness, muscle, head and throat pain, in addition to vomiting, diarrhea, skin eruptions, kidney or liver failure and, in some cases, internal and external hemorrhages occur. To diagnose this disease, it is necessary to rule out other conditions such as malaria, cholera, hepatitis and other hemorrhagic fevers. Confirmation of a suspected case of EVD is made by means of a specialized laboratory test.

A preson can infect another through direct contact with bodily fluids and/or secretions; contagion is also possible indirectly as it could happen by having contact with objects contaminated with bodily fluids (needles or linens) and the virus has been documented to be able to survive up to 61 days in semen.

Until August 6, 2014, in the EVD outbreak occuring in Guinea, Liberia, Sierra Leone and Nigeria, a total of 1,440 cases and 826 deaths have been recorded; the country with the largest number of cases and deaths is Sierra Leone with 574 and 252, respectively[13].

In the first hours of Monday 4th of August, a patient with high fever and gastrointestinal symptoms attended

the emergency department of the Mount Sinai Hospital in the city of New York; this person had recently travelled to Western Africa, which made him the first probable case in USA. Strict isolation was indicated for the patient, who underwent tests to confirm the presence of the disease.

The next day, Tuesday August 5th, investigation was started of other possible case of EVD in the city of Columbis, Ohio, USA. It was a 46-year-old woman who came back to that country after a trip to Western Africa.

It is important to note that the WHO carried out a critical analysis of the elicited response to the outbreak in order to support the elaboration process of the national operational plans in the affected countries[14]. As a result of the assessment carried out in Liberia, the following shortcomings and problems were identified: deficient identification and follow-up of contacts of a case with EVD, persistent denial and resistance of the community in the face of the outbreak, lack of reliable information and inadequate prevention and control practices in the centers, as well as poor coordination and leadership, lack of economoc resources and need for technical training of human resources to be able to carry out an adequate contention and management in the face of the presenting emergency.

In Mexico, several actions were implemented to face a possible case of EVD, including: issuing a preventive warning with regard to travelling to zones affected by this virus[15], the National Committee for Safety in Health held the Extraordinary Session on Emergent Diseases in order to inform on the current situation and the risk posed by the presence of cases in national territory; in addition, a single information channel, in charge of the Ministry of Health, was established in order to adequately and responsibly inform on the situation in a timely manner and to prevent information leaks, as well as the spread of false information; press bulletins were issued and videoconferences were held with different state authorities in order to inform on immediate response and communicate key points on its organization; a formal request was submitted to the PAHO asking for preventive recommendations that should be followed to prevent the introduction of this disease in the country. It is important to note that the risk of the presence of the Ebola virus in our country is extremely low, although its occurrence is not ruled out.

TB and HIV

There are certain factors that favor the reemergence of diseases, including poverty, unhealthiness, poor sanitary infrastructure, lack of financial resources and antimicrobial resistance.

An association has been observed to exist between the presence of tuberculosis (TB) and the human immunodeficiency virus (HIV) because the latter weakens the immune system, which increases the probability of TB infection; a person with HIV is estimated to have 50 times more probability of having TB sometime in his/her life[16]. Currently, the presence of AIDS is known to be able to exacerbate the clinical manifestations of TB, which complcates its microbiological diagnosis; in fact, it is increasingly common for patients with TB to exhibit a negative bacilloscopy test result.

The simultaneous presence of HIV and TB triggers an unfavorable clinical evolution, with higher degree of immune deterioration and, in addition, the combination is considered to be lethal compared with cases with only one of both diseases. TB is associated in up to 30% of deaths in persons who have AIDS.

The recorded cases of tuberculosis-HIV/AIDS by age group and gender in Mexico in 2013 are presented in figure 2[17]; during that year, a total of 1,193 cases ocurred, out of which 200 were females and 993 were males.

At the reemergence of the TB/HIV-AIDS binomial, it is important to point out that response actions have been implemented in Mexico, such as strengthening the collaboration between TB/HIV-AIDS programs, preventive treatment with isoniazid for people with HIV-AIDS, in addition to the inclusion of process and result indicators in the assessment of both programs. An important point that deserves to be specially mentioned is the strengthening of HIV detection in individuals with TB, as well as the decrease in the prevalence of coinfection with both agents.

Conclusions

The presence of emergent and reemergent diseases has become more accelerated as a consequence of different factors that have allowed rapid dissemination of etiologic agents. In order to be able to respond in an appropriate manner, the geographical distribution of the affected country or region, commercial trade and tourism have to be taken into account and, most importantly, the solution must be focused on preventing the spread and economic or commecial damage; the key is successful implementation of comprehensive and innovative systems.

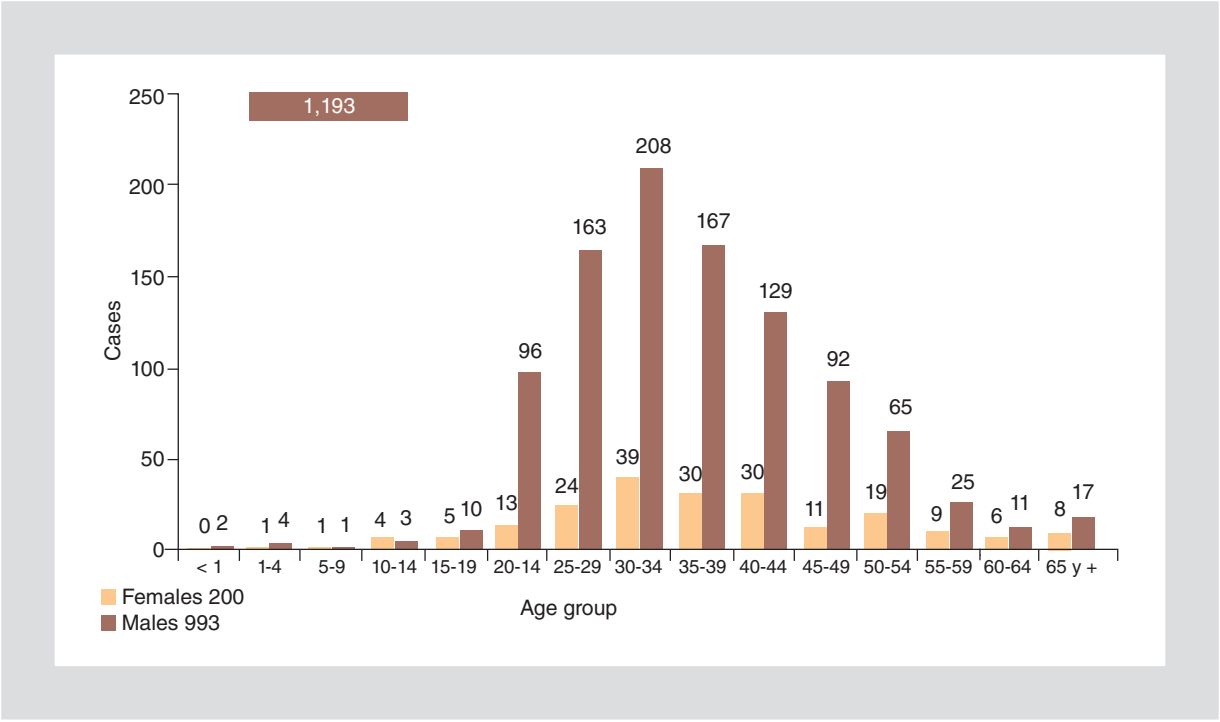

Figure 2. *Tuberculosis-HIV/AIDS records by age and gender, Mexico 2013.*

In consequence, and in the face of the unexpected in emergence or reemergence, there is no doubt that the following should be considered:

- Population flow modifies the environment in different forms and favors their presence.
- Programs should be reinforced and epidemiological surveillance actions should be intensified.
- Specific interventions to control these conditions should be designed.

Finally, we must not forget the need to prioritize the training of field personnel that during epidemics or pandemics, such as the current EVD pandemic occurring in some countries of Western Africa, play a fundamental role in the response to them. It is our responsibility to provide with the necessary supplies in terms of personal protection gear, as well as infection-control essential strategies through training seminars, in order to ensure health and safety of the personnel.

Wit, knowledge and organization can alter, but not cancel, the vulnerability of humankind to the invasion of parasitary forms of life. Infectious diseases have preceded man, will last as long as mankind itself and will continue to be as up to the present time one of the fundamental determinants of human history.

WH Mc. Neil *in Plagues and Peoples, 1976*

References

1. National Institutes of Health U.S. Understanding emerging and re-emerging infectious disease; Biological Sciences Curriculum Study, 2007.
2. Kuri-Morales P. La transición en salud y su impacto en la demanda de servicios, Gac Med Mex . 2011;174(6):451-4.
3. Manual de Procedimientos Estandarizados para la Vigilancia Epidemiológica del VIH-SIDA (septiembre 2012). Dirección General de Epidemiología. Subsecretaría de Prevención y Promoción de la Salud. Secretaría de Salud.
4. El Síndrome del Hantavirus Pulmonar. Indiana State Department of Health: http://www.state.in.us/isdh/23696.htm.
5. Bhattacharya SK, Bhattacharya MK, Dutta D, et al. Vibrio cholerae O139 in Calcutta. Arch Dis Child. 1994;71(2):161-2.
6. Chowell G, Simonsen L, Towers S, et al. Transmission potential of influenza A/H7N9, February to May 2013. BMC Med. 2013;11:214-27.
7. How the flu virus can change: "Drift" and "Shift". www.cdc.gov/flu/about/virus/change.htm.
8. Kuri-Morales P. La pandemia de influenza: posibles escenarios en México. Gac Med Mex. 2008;144(4):285-90.
9. Organización Panamericana de la Salud. Preparación y respuesta ante la eventual introducción del virus Chikungunya en las Américas. Washington D.C.; 2011.
10. Alerta Epidemiológica: Fiebre por Chikungunya y Dengue en las Américas. 29 de Agosto 2014. Organización Panamericana de la Salud/ Organización Mundial de la Salud.
11. Lineamientos para la Vigilancia Epidemiológica y Diagnóstico por Laboratorio de Fiebre Chikungunya. Julio 2014. Dirección General de Epidemiología. Subsecretaría de Prevención y Promoción de la Salud. Secretaría de Salud.
12. Ebola virus disease. Fact Sheet No. 103. World Health Organization. http://www.who.int/mediacentre/factsheets/fs103/en/.
13. Centers for Disease Control and Prevention. Ebola Hemorrhagic Fever Outbreak in Guinea, Liberia and Sierra Leone 2014.
14. High Level Meeting on Building Resilient Systems for Health in Ebola. World Health Organization; 2014.
15. Aviso Preventivo de viaje a los Países Africanos de Guinea, Liberia, Sierra Leona y Nigeria ante los brotes de enfermedad por Virus del Ébola. 1° de Agosto del 2014.
16. Talking Points TB/HIV. June 2007. World Health Organization. http://www.who.int/tb/challenges/hiv/talking_points/en/.
17. Plataforma Única de Información/SUIVE/DGE/SS. Cierre 2013.