

Epidemiology and the Covid-19 pandemic: opportunities to review trajectories and plan for the future

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Epidemiología y pandemia de Covid-19: oportunidades para revisar trayectorias y planear el futuro (resumen: p. 16)

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The Covid-19 pandemic has caused substantial changes in various spheres of academic life. Epidemiology can use the experiences accumulated in this period as an opportunity to plan for its future. Facing a pandemic requires the production of explanatory theories about the pandemic process and its unequal manifestation in the population. In this sense, Epidemiology needs to strengthen its scientific foundations and recognize the values and limits of its approaches. Thus, it is essential to strengthen the links with other disciplines. A new teaching model can be produced from pandemic experiences, including transversal contents, such as preparation for responses to natural and technological disasters, like epidemics and pandemics, and scientific communication. The teaching of Epidemiology needs to be contextualized with the bases of Collective Health, reinforcing its commitment to the translation and application of knowledge in order to improve people's health and lives.

Keywords: Epidemiology. Pandemic. Covid-19. Teaching. Disaster epidemiology.



Introduction

The Dictionary of Epidemiology, edited by the International Epidemiologic Association, proposes the following definition for Epidemiology: “The study of the occurrence and distribution of health-related events, states, and processes in specified populations, including the study of the determinants that influence such processes, and the application of this knowledge to control health problems”¹. It is a useful definition in lexicographic and operational terms, as it is provided by a dictionary committed to recognizing the plurality of practices and perspectives in Epidemiology¹. However, and consequently, such diversity encompasses varied meanings of Epidemiology, and reflects, to some extent, theories, methods, values, and social commitments existing in different historical and geographical contexts².

More than relevant and necessary definitions, it is important to delimit epidemiological theories that provide subsidies to think about and seek explanations in the sphere of its specific domain of interest, namely the population distribution of diseases, disabilities, deaths, health and their determinants and restraints, in space and time^{3,4}. Epidemiological theories of health events distribution need to address not only the mechanisms causing the events per se (for example, diseases), but also the reasons that lead to spatial-temporal heterogeneities in the distribution of these events and their determinants⁴.

If it were only a scientific enterprise, perhaps this theoretical delimitation would be sufficient for epidemiology to accomplish its mission. However, the objectives of Epidemiology go much further to include generation of knowledge that can be translated and applied to bring about changes that improve populations’ health and quality of life, and reduce social inequalities in health^{4,5}. Such commitment is inherent in Epidemiology, as different authors and organizations recognize, but it is not necessarily a consensus among epidemiologists. Some understand that Epidemiology should harbor the freedom of searching for decontextualized knowledge (for example, knowledge that focuses on the understanding of illness mechanisms in individuals), as it might bring more immediate health benefits when compared to social changes, which are complex and hard to achieve⁶. In general terms, this view, broadly dominant during many years, corresponds to the so-called Modern Epidemiology, also referred to by its critics as “risk factor epidemiology”, whose analytical focus went down from population to the individual and emphasized methods and techniques to the detriment of theory^{7,8}.

The authors who adopt this point of view recognize that epidemiological research is included in the context of Public Health, and must be motivated by its potential for producing and maximizing benefits to the population’s health^{9,10}. However, they also understand that the epidemiologist should carry out their scientific activity with rigor and objectivity, without passion, leaving the roles of advocacy and implementation to policy makers^{9,10}. Undoubtedly, although decisions about incorporation and implementation of health actions, technologies, programs, and policies must be guided by the best scientific evidence available, they cannot and must not be grounded on epidemiological evidence only, nor should epidemiologists alone be responsible for this task. However, viewing Epidemiology as an activity whose nature is eminently scientific implies a specific, naive,

disinterested and idyllic conception of Science devoid of moral values and political interests¹¹. Epidemiology, just like Science, is a human enterprise that cannot argue for neutrality, mainly in a context of growing influence of industries and corporations in epidemiological research¹²⁻¹⁵.

The implications of divergent views on the domain and objectives of Epidemiology for its theoretical, conceptual, and practical configuration, and for its relations to Collective Health itself and other fields of knowledge, have been broadly discussed in many countries and also in the Brazilian context^{2,4,7,8,16-18}. Thus, I do not aim to revisit this debate from a theoretical-conceptual point of view. My objective is to use my personal experience of the greatest health crisis of our generation, the Covid-19 pandemic, to present reflections on some of the challenges faced by Epidemiology (and by epidemiologists) in this context, and to identify themes and questions that deserve to be debated thoroughly, so that they can be developed in the next years.

Epidemiology in the spotlight

The Covid-19 pandemic is one of the most impactful events in the recent history of Public Health. It has been called “mass disabling event” or “mass deterioration event”^{19,20}. Such designations emphasize not only direct short-, medium- and long-term effects on those who developed the disease and their implications to health policy and planning, but also highly disruptive indirect effects on population health. For example, the Covid-19 pandemic has affected the offer of preventive programs, like vaccination and cancer screening, as well as the delivery of continuous care for chronic conditions²¹⁻²³.

The Covid-19 pandemic caught the Brazilian population in a situation of profound social, economic, and program vulnerability²⁴. Thus, a perfect storm was formed, grounded on the dismantling of social policies, on the chronic underfunding of the Brazilian National Health System (SUS), and on the catastrophic management of the pandemic^{25,26}. Pandemics are phenomena with biological, ecological, social, and historical dimensions. As such, they unveil and deepen social inequalities, causing the greatest burden of illness and death from Covid-19 to fall on the most vulnerable^{27,28}. This dramatic picture can be better expressed as a syndemic, in which the Covid-19 pandemic interacts with different sources of health, social, and environmental vulnerabilities, and intensifies the adverse effects of all factors on the population’s health^{26,29}.

The health crisis immediately threw Epidemiology into the heart of the storm. Although the key principles to face health crises necessarily demand interdisciplinary and intersectoral perspectives³⁰⁻³⁴, in the constitutive sphere of Collective Health, Epidemiology was the area that was most promptly and intensely required to manifest itself³⁵, a pattern already detected in other epidemic situations³¹. The prominence of Epidemiology can have different explanations: greater institutionalization of epidemiological practices in health services; familiarity with biomedical concepts³¹; training in epidemics investigation³¹; specific knowledge of building forecast scenarios for the spread of Covid-19³³; greater importance given to the scientific capital of Epidemiology due to its numerical predominance; and, consequently, occupation in the decision-making spheres of prestige assessment³⁶.

The unprecedented and broad engagement of the entire community of epidemiologists in the response to the pandemic has brought many issues to light. One of them was the reemergence of theoretical and political tensions between Epidemiology and the other structuring sub-areas of Collective Health: Social and Human Sciences in Health, and Health Policies, Planning, and Management³⁷. It is evident that Epidemiology has had a greater weight in consultations with specialists related to decision-making about public policies related to the Covid-19 pandemic when compared to the Social Sciences - which have been historically sidelined³⁸. Right in the outset of the pandemic, the Brazilian Collective Health Association (Abrasco) perceived this discomfort in its community and tried to act on several fronts. First, it denounced the exclusion of themes related to the Social and Human Sciences from Notices for the public funding of research in the context of the Covid-19 pandemic³⁹. Second, it promoted debates on the theme in the sphere of “Ágora Abrasco”, a program of activities that aimed to monitor, discuss, and propose responses to the pandemic⁴⁰.

As I highlighted above, because of its domain of activity, objectives, concepts and methods, and mainly due to the influence of “risk factor epidemiology” on its scientific practice, Epidemiology has used, more frequently, theories on the mechanisms that cause health events to the detriment of theories on the distribution of health problems in populations to interpret the outcomes of its studies⁴. The subtlety of the differences has huge implications. Theories on causal mechanisms of diseases and other health events are important to generate knowledge that can be eventually translated, but do not meet the need of understanding how and why these events are distributed unevenly in different populations over time and space⁴. A simplistic way of interpreting the integration difficulties between Epidemiology and the Social and Human Sciences would be to attribute to Epidemiology an intrinsic link to the biomedical explanation model of health phenomena, which does not do justice to the historical connections between Epidemiology and the Social Sciences⁴¹.

Epidemiology does not identify itself inherently and preferentially with the biomedical explanation model of health phenomena, nor does it have difficulties in exercising interdisciplinarity or focusing on complex theoretical issues. Modern Epidemiology may be insufficient for the dimension of the mission of the Epidemiology that we want and need in Collective Health, but it allowed theoretical, conceptual, and methodological advances that were essential to the maturation and consolidation of the area. Furthermore, it required interactions not only with biomedical disciplines, but also with fields as different as philosophy, artificial intelligence, and computer sciences^{42,43}. Establishing that Modern Epidemiology is the sole paradigm of Epidemiology is a mistaken and little constructive idea, as it ignores the vigor of different movements within the area that seek to recover the roots of critical Latin American Epidemiology and aim to stimulate a greater integration with the Social and Human Sciences^{2,4,44}. In fact, the pandemic has revealed a plural Epidemiology, which harbors approaches that have more disciplinary emphases and participates in a varied range of efforts to form and produce interdisciplinary knowledge and practices^{45,46}. In Brazil, in the current pandemic context, I highlight the initiatives of *Rede CoVida*⁴⁷ and *Observatório Covid-19 BR*⁴⁸, among others.



Balancing the role of the different axes of Collective Health in health emergency situations is a practical need, but it must also be a fundamental principle and a requirement to the very field of Collective Health. This is no simple task. Tensions between (sub)areas are part of the very constitution of the field, but it is in this process that Collective Health can be strengthened, and the benefits to population health, maximized.

A committed, engaged, and challenged Epidemiology

The strength of the Brazilian Epidemiology had already been noted in other occasions; for example, in the response to the Zika epidemic^{49,50}. However, in no other situation was the total and intensive engagement of the entire community so evident, regardless of its specific areas of activity. Thus, the Brazilian Epidemiology's response to the pandemic is a tribute to its origins and social commitment, and shows that it is essential to the field of Collective Health.

To the generations of epidemiologists that graduated in recent decades, this may have been the first concrete experience of the simultaneously scientific and applied nature of Epidemiology. In the midst of personal and professional uncertainties, of fear and mourning, never before have so many epidemiologists committed so strongly to one mission⁵¹. With this in mind, the journal "Epidemiology" payed homage to the area: it published a special issue with the report of twenty epidemiologists on their experiences of what being an epidemiologist in 2020 meant for them⁵¹. The experiences of these epidemiologists, their daily difficulties to adapt to remote education and domestic chores, and their efforts to gain knowledge on specific concepts of infectious disease Epidemiology are assets that must not be lost and can play an important role in shaping the future of the area⁵¹.

This process of immersion in and exposure of the epidemiologist's work reflects a recognition of the area and, at the same time, has brought many challenges, frustrations and uncertainties - which are always potential sources of learning. Regarding the epidemiologist's work, the Covid-19 pandemic triggered new discussions and debates about the mission and ethics of Epidemiology research and practice. The debate about whether the existence of a neutral and disinterested epidemiology-science is possible has been renewed, which, in a way, revives the old questionings about "risk factor epidemiology"^{52,53}. Declarations from groups for and against different pandemic control strategies have also agitated the academic Epidemiology circles, taking the debate to the ethical and social field⁵⁴. Various factors, like the increased publication speed of Covid-19 papers, the high frequency of scientific paper retractions, even in journals considered exemplary in editorial terms, and the broad use of platforms for the dissemination of preprints, have enhanced the concern about the growth of practices incompatible with ethics in scientific publication^{55,56}.



In the applied sphere, central canons of Science and of Epidemiology itself started to be disputed, like the need to ponder to what extent the pandemic context authorizes relativization of the type and degree of evidence usually required to make a Public Health recommendation, which somehow made the principle of precaution conflict with the principle of not causing damage to health nor to other spheres of social life, like education^{57,58}. Using incomplete information to support decision-making can be uncomfortable for epidemiologists, but the urgency of the situation demands using the best evidence available at a certain moment, synthesized from different sources⁵⁹. It is important to understand that the epidemiologist's work does not end when decisions are made - they must evaluate how events evolve by means of recommendations in order to update knowledge to shift direction, if necessary⁵⁹.

One example of this clash was the closure of schools right at the outset of the pandemic, with unprecedented duration and amplitude. In the absence of solid knowledge on the role of children in the transmission of SARS-CoV-2, the implementation of this measure was largely based on the analogy with influenza pandemics, when it was demonstrated that school closure can reduce the size of the epidemic⁶⁰. However, such measure brings high social and economic costs, especially to vulnerable populations, intensifying educational disparities and increasing school dropout, not to mention its deleterious impact on child nutrition, on parents' and children's Mental Health, and on exposure to violence⁶¹. In this topic, it is worth highlighting the joint participation of researchers from Epidemiology, Social and Human Sciences in Health, and Postgraduate Programs in Collective Health, under the leadership of Abrasco, of the National Association for Postgraduate Programs and Research in Education (ANPED), and of other Education organizations, in the consolidation of the manifesto "Occupying schools, protecting people, valuing education", signed by dozens of civil society entities⁶².

Specialists also had to deal with questionings about the role of Epidemiology and, more generically, of scientific knowledge, in decisions about public policies. To their displeasure and frustration, epidemiologists discovered, tardily, that the maxim "follow the science" has limits, and that Science must research, discover, assess, inform, and advise, but the decision must be made by managers after hearing other actors and sectors of society⁶³. Science alone does not change the world. Science, politics and social militancy walk together in the life of all people, and this includes us, epidemiologists.

Another great challenge, perhaps unprecedented in terms of scope and frequency, has been the presence of epidemiologists in the media. Scientific communication, the "ugly duckling", so to speak, of academic activity, has proven to be essential and, clearly, beyond the capacities of most of us. The obstacles encountered are not just difficulties in explaining complex concepts - for these, the use of creative metaphors may be more viable. Other obstacles are related to a more effective communication about risk, especially about the uncertainties inherent in scientific work^{35,38,63}. For example, to the epidemiologist, talking about uncertainty overcomes the issue of randomness; it is also necessary to approach how biases can influence the credibility of research outcomes⁶⁴.



Communication about the principle of precaution was also difficult. It is necessary to perceive that certain control and mitigation measures require a great effort of people, and recommendations regarding their utilization in the context of a prolonged pandemic contribute to the so-called pandemic fatigue^{65,66}. If the recommendations are not negotiated in a systematic way and, perhaps, made more flexible - even though this implies some additional risk -, society becomes frustrated, as it does not perceive the benefits of its efforts in daily life. Pandemic fatigue reduces the search for information related to Covid-19 and decreases adherence to control measures⁶⁵.

Another example of communication failure that must be debated in the area was the lack of consensus on the main ways Covid-19 is transmitted, which eventually led to the prioritization of little effective actions that may have contributed to pandemic fatigue (for example, the cleaning of materials, surfaces, and food items) to the detriment of the use of masks⁶⁴. In addition, in the case of mask use, recommendations varied from use of cloth masks to the need of more effective filtering masks like FFP2 and N95, which may have contributed to confuse the population⁶⁴. It is certain that part of the inconsistency was due to the perception that there was a shortage of high-quality masks for the health services environment, but another important factor was the delay in recognizing that SARS-CoV-2 is transmitted not only by droplets, but also by aerosols⁶⁷.

Finally, Epidemiology rarely succeeded in influencing the media and the political agenda, and the list of themes to be discussed was usually set in the opposite direction. In some situations, the political agenda cornered the epidemiological research agenda, as it seems to be the case of the use of chloroquine for treatment of Covid-19⁶⁴. Despite the extensive interaction between Epidemiology and the media, the quality of the presentation of epidemiological data in these vehicles stills needs to improve⁶⁸.

How to communicate risks and uncertainties in a transparent way, how to make control measures more flexible in situations of pandemic fatigue, and how to tackle fake news and influence agendas in the relationship with the media and civil society are incipient issues that need to be further debated and incorporated into Epidemiology education, both in the undergraduate and graduate levels.



Are we all epidemiologists?

Epidemiology has been placed in the center of attention by the media and in the public policy decision arena in the fight against the Covid-19 pandemic³⁵. In the media in general, but also in social conversations, epidemiological terms are being used on a daily basis. It is as if, all of a sudden, all people have become epidemiologists⁶⁹.

Apparently, this would be a positive sign of the popularization of the field, but it might, on the contrary, de-characterize Epidemiology if, suddenly, everyone starts giving opinions, interpretations and recommendations as if they were epidemiologists. I believe the most appropriate term to define this situation is *ultracrepidarian*, that is, a person who expresses opinions on matters outside the scope of their knowledge. The term “armchair epidemiologist” has also been employed in this sense⁷⁰. Undoubtedly, epidemiologists are not the only ones who can use and explain technical concepts and terms typically used in the area. However, it is necessary to recognize and value Epidemiology as a defined area of knowledge, included in the field of Collective Health, operating in a particular domain, with its own objectives, concepts and methods, and requiring specific theoretical and practical education⁷¹. This is fundamental for managers and the public in general to recognize its relevance and the necessary differentiation as a professional of the biomedical areas, which implies opportunities for qualified work.

One possible positive aspect of that public exposure may have been the dissemination of an academic and professional niche that can amplify people’s interest in gaining admission into the area. We have not yet reached the stage where a child tells their parents that they want to be an epidemiologist when they grow up; therefore, it is necessary to seize this opportunity to disseminate what it means to be an epidemiologist, what Epidemiology researches, and the role it plays in the health services and in society. Given the intrinsic and inherent relation between the Brazilian Epidemiology and Collective Health, this is a promising occasion to the entire field.

Therefore, it is necessary to take advantage of the pandemic legacy to rethink Epidemiology education in the undergraduate and graduate levels. The basic components of Epidemiology education usually involve development of critical thinking, acquisition of information for subsequent application to the academic or professional spheres, and consolidation of a professional identity⁷². Information acquisition implies the relation between student and content, commonly mediated by tutors. It can be maximized by means of digital technologies, which enhance flexibility, responsibility, cooperation, inclusion, democratization, orientation to the problem of interest, and interaction between postgraduate programs, students and teachers^{64,73}. In contrast, more traditional pedagogical approaches with synchronous, tutorial and practical interpersonal interaction are essential to encourage dialog and belongingness, and to develop sense of community and critical thinking^{64,73}. Digital technologies can contribute to increase representativeness and identification with the field; moreover, they can collaborate to remove geographical and social barriers⁷³. Studies have shown that hybrid strategies, like flipped classrooms, help improve the quality and effectiveness of teaching and foster the development of autonomy, problem-solving skills, teamwork, and communication^{64,74}.

In the Brazilian context, it is necessary to make specific policies to ensure digital inclusion in distance education. Caution and the establishment of criteria are also necessary, so that the dissemination of distance education platforms does not “authorize” the indiscriminate expansion of poor quality courses.

Two other pandemic legacies can be good to the future of Epidemiology. The first refers to the renewed interest in descriptive Epidemiology. Descriptive investigations are a constitutive part of epidemiological activity, particularly in its interface with the health services⁷⁵. The term “descriptive epidemiology” took on a pejorative connotation that indicates a less scientific or sophisticated approach⁷⁶. However, descriptive studies are fundamental to the understanding of health problems, and pose challenges just as complex as or more complex than those faced in other types of epidemiological studies^{75,76}. During the pandemic, we were systematically introduced, almost on a daily basis, to simple moving averages or complex nowcasting models⁷⁷ to describe the trends and geographical distribution of hospitalizations and deaths from Covid-19. We searched for lethality information according to the most affected age groups and investigated whether such distribution changed over time, which would indicate a change in the epidemic severity profile. We talked about investigation of cases and contact tracing, typical health surveillance measures that were underused in the fight against the pandemic in Brazil, but which are essential to the interruption of transmission networks⁷⁸.

The second legacy was the rediscovery of infectious disease Epidemiology. The microbiological revolution that started in the 19th century and the social, scientific and technological advances, particularly in the area of Health, substantially modified the population’s morbidity and mortality profile in the first half of the 20th century, mainly in Global North countries⁷⁹. The participation of infectious diseases in the burden of morbidity and mortality gradually decreased, while the opposite happened with chronic-degenerative diseases, accidents, and violence cases⁸⁰. This panorama led to what has been recognized as the healthcare optimism of the 20th century: an inexorable march towards the eradication or elimination of infectious diseases as Public Health problems⁸⁰. This process led to a decrease in interest in the area of infectious disease Epidemiology, which resulted in a drastic reduction in the number of professionals and research studies⁸⁰. Unfortunately, the idea that infectious diseases would be simply crossed off history and replaced by other types of health problems was proved to be wrong. In fact, from the 1970s onwards, many unknown infectious diseases and others believed to have been eliminated have been largely affecting populations, and the advent of AIDS may be one of the most significant milestones of this shift in direction.

During the Covid-19 pandemic, basic concepts of infectious disease epidemiology were disseminated without the necessary rigor, which led to a series of misunderstandings and mistaken opinions about the pandemic process. Most epidemiologists involved in the effort of fighting against the pandemic were not adequately familiarized with concepts like herd or collective immunity, basic and effective reproduction number, serial interval, secondary attack rate, transmissibility and its implications. The question now is



not “if” a new pandemic caused by an unknown microorganism is going to happen, but “when” it will happen⁸¹. Therefore, it is important to include such basic concepts in the epidemiologist’s education. Considering the scenarios of climate change and growth of natural and technological disasters⁸², including epidemics and pandemics, such themes must be approached in undergraduate and graduate Collective Health programs.

Conclusions

The Covid-19 pandemic can be considered a large natural experiment⁵⁹ with potential for causing substantial changes in different spheres of life, including the academic one. Epidemiology can use the experiences accumulated in this period as an opportunity to plan its future. The pandemic years have shown that knowledge of Public Health tools and access to data are not enough to control a pandemic³⁵: it is necessary to produce explanatory theories about the pandemic process. Such theories must consider temporal and spatial heterogeneities of biological and social phenomena that allow an unequal manifestation of the pandemic in the population. To achieve this, Epidemiology needs, at the same time, to strengthen its scientific foundations, recognize the values and limits of its approaches, and understand that tools and techniques are not what ground transformative knowledge. In this path, it is essential to start from effective experiences of interdisciplinary action to overcome chronic obstacles that hinder the strengthening of links with other disciplines. A new teaching model can be produced from the experiences accumulated during the pandemic. This new model must encompass transversal contents, like preparation for responses to natural and technological disasters, including epidemics and pandemics, and scientific communication. Epidemiology teaching needs to be contextualized in the bases of Collective Health, and its commitment to translating and applying knowledge to improving people’s health and life must be reinforced.



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Conflict of interest

The author has no conflicts of interest to declare.

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A pandemia de Covid-19 provocou modificações substanciais em diversas esferas da vida acadêmica. A Epidemiologia pode utilizar as experiências acumuladas nesse período como oportunidade para planejar seu futuro. O enfrentamento de uma pandemia exige a produção de teorias explicativas sobre o processo pandêmico e sua expressão desigual na população. Nesse sentido, a Epidemiologia necessita fortalecer seus fundamentos científicos e reconhecer os valores e limites de suas abordagens. Nesse caminho, é essencial o fortalecimento dos elos com outras disciplinas. Um novo modelo de ensino pode ser produzido por meio das experiências ao longo da pandemia, integrando conteúdos transversais, como a preparação para a resposta a desastres naturais e de origem tecnológica, incluindo epidemias e pandemias e a comunicação científica. O ensino da Epidemiologia precisa ser contextualizado com as bases da Saúde Coletiva, reforçando seu compromisso com a tradução e a aplicação do conhecimento para a melhoria da saúde e da vida das pessoas.

Palavras-chave: Epidemiologia. Pandemia. Covid-19. Ensino. Epidemiologia em desastres.

La pandemia de Covid-19 causó modificaciones substanciales en diversas esferas de la vida académica. La epidemiología puede utilizar las experiencias acumuladas en este período como oportunidad para planear su futuro. El enfrentamiento de una pandemia exige la producción de teorías explicativas sobre el proceso pandémico y su expresión desigual en la población. En ese sentido, la epidemiología necesita fortalecer sus fundamentos científicos y reconocer los valores y límites de sus abordajes. En este camino es esencial el fortalecimiento de los eslabones con otras asignaturas. Es posible producir un nuevo modelo de enseñanza a partir de las experiencias en el transcurso de la pandemia, integrando contenidos transversales, tales como la preparación para la respuesta a desastres naturales y de origen tecnológico, incluyendo epidemias y pandemias y la comunicación científica. La enseñanza de la epidemiología tiene que contextualizarse con las bases de la salud colectiva, reforzando su compromiso con la traducción y aplicación del conocimiento para la mejora de la salud y de la vida de las personas.

Palabras clave: Epidemiología. Pandemia. Covid-19. Enseñanza. Epidemiología en desastres.