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SUCCESS STORIES FROM SOME COUNTRIES IN COPING WITH COVID, AND PREPAREDNESS FOR FUTURE HEALTH THREATS: PRESENTATION OF FREE ONLINE EDUCATIONAL RESOURCES[i,ii]

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Abstract:
This article presents documents downloadable for free on the success stories from countries such as Taiwan and Vietnam, which in 2020 limited the number of victims respectively to 7 and 35, while most other countries reported disproportionately larger losses. The economic growth in these two countries also remained positive. *Taiwan contained Covid thanks to timely actions taken from December 2019, including border control and quarantine of passengers arriving from Wuhan*. Public education campaigns, citizen engagement with government policies, and the civic technology of this country helped to contain the disease without a lockdown. According to several documents, the intense global circulation of the virus contributed to the development of several variants, which implied a decline in both vaccine effectiveness and acquired immunity in recovered people. The article presents studies aimed at reducing the transmission of the disease, considered the best way to prevent both life losses and the development of new variants; they also include public health surveillance and international cooperation. According to the "One Health" approach, the health of humans, animals, plants and ecosystems is interdependent. An estimated 60-75% of human infectious diseases originate from animals. Several studies provide examples of the factors that facilitate the transmission of zoonotic diseases; understanding them is essential to preventing future outbreaks. Wildlife trade, with stressful transportation and close vicinity of cages where different species are kept, facilitates transmission and creation of new viruses. A document discusses the association of the MERS outbreak with changes in camel husbandry. Disease outbreaks have been associated with land use change, forest destruction, urbanisation of deforested areas, and facilitating contact between humans and dangerous

[i] CASOS DE ÉXITO DE ALGUNOS PAÍSES EN LA GESTIÓN DE LA COVID-19 Y PREPARACIÓN PARA FUTURAS AMENAZAS SANITARIAS: PRESENTACIÓN DE RECURSOS EDUCATIVOS GRATUITOS EN LÍNEA
[ii] STORIE DI SUCCESSI DI ALCUNI PAESI NEL FRONTEGGIARE IL COVID E PREPARAZIONE PER FUTURE MINACCE SANITARIE: PRESENTAZIONE DI RISORSE EDUCATIVE ONLINE GRATUITE
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viruses. Forest fragmentation may have consequences on biodiversity, resulting in increased risks for human health. Some studies deal with relations between conflicts and disease outbreaks. Some documents deal with the links between our lifestyle and immune system.

Keywords: online educational resources, Covid containment, Taiwan, timely response, one health approach, deforestation, health surveillance

Resumen:
Este artículo presenta documentos descargables de forma gratuita sobre las historias de éxito de países como Taiwán y Vietnam, que en 2020 limitaron el número de víctimas a 7 y 35 respectivamente, mientras que la mayoría de los demás países registraron pérdidas desproporcionadamente mayores. El crecimiento económico de estos dos países también se mantuvo positivo. Taiwán contuvo la COVID gracias a las medidas oportunas adoptadas a partir de diciembre de 2019, entre ellas el control de fronteras y la cuarentena de los pasajeros procedentes de Wuhan. Las campañas de educación pública, la participación ciudadana en las políticas gubernamentales y la tecnología cívica de este país contribuyeron a contener la enfermedad sin necesidad de imponer un confinamiento. Según varios documentos, la intensa circulación mundial del virus contribuyó al desarrollo de varias variantes, lo que implicó una disminución tanto de la eficacia de las vacunas como de la inmunidad adquirida en las personas recuperadas. El artículo presenta estudios destinados a reducir la transmisión de la enfermedad, considerada la mejor manera de prevenir tanto las pérdidas de vidas como el desarrollo de nuevas variantes; también incluyen la vigilancia de la salud pública y la cooperación internacional. Según el enfoque «One Health», la salud de los seres humanos, los animales, las plantas y los ecosistemas son interdependiente. Se estima que entre el 60 % y el 75 % de las enfermedades infecciosas humanas tienen su origen en los animales. Varios estudios proporcionan ejemplos de los factores que facilitan la transmisión de enfermedades zoonóticas; comprenderlos es esencial para prevenir futuros brotes. El comercio de animales silvestres, con el estrés que supone el transporte y la proximidad de jaulas en las que se mantienen diferentes especies, facilita la transmisión y la creación de nuevos virus. Un documento analiza la relación entre el brote de MERS y los cambios en la cría de camellos. Los brotes de enfermedades se han asociado con el cambio en el uso del suelo, la destrucción de bosques y la urbanización de zonas deforestadas, lo que facilita el contacto entre los seres humanos y virus peligrosos. La fragmentación de los bosques puede tener consecuencias para la biodiversidad, lo que aumenta los riesgos para la salud humana. Algunos estudios tratan de la relación entre los conflictos y los brotes de enfermedades. Algunos documentos tratan de los vínculos entre nuestro estilo de vida y el sistema inmunitario.

Palabras clave: recursos educativos en línea, contención de la COVID-19, Taiwán, respuesta oportuna, enfoque de una sola salud, deforestación, vigilancia sanitaria

Riassunto:
Questo articolo presenta documenti online scaricabili gratuitamente, sui successi di paesi come Taiwan e Vietnam che nel 2020 hanno limitato le vittime, rispettivamente a 7 e 35, mentre altrove le perdite sono state sproporzionatamente maggiori. La crescita economica in questi due paesi è rimasta positiva. *Taiwan affrontò il Covid con azioni tempestive, ad es. controlli di frontiera e quarantena dei passeggeri in arrivo da Wuhan già dal dicembre 2019*. Campagne educative, adesione dei cittadini alle iniziative governative e "tecnologia civica" hanno contribuito a contenere la malattia senza bisogno di lockdown. Secondo vari documenti, l'intensa circolazione globale del virus ha contribuito allo sviluppo di diverse varianti, riducendo sia l'efficacia dei vaccini che l'immunità acquisita con la guarigione. L'articolo presenta studi volti a limitare la trasmissione della malattia, considerato il modo migliore per prevenire perdite di vite umane e sviluppo di varianti; questi includono sorveglianza sulla salute pubblica e cooperazione internazionale. Secondo l'approccio "One Health", la salute umana, animale, vegetale ed ambientale sono interdipendenti ed il 60-75% delle malattie infettive umane ha origine dagli animali. Vari studi danno esempi sui fattori che ne facilitano la trasmissione; la loro comprensione è fondamentale per prevenire future epidemie. Il commercio di animali selvatici, con trasporti stressanti e stretta vicinanza delle gabbie in cui sono tenute specie diverse, facilita trasmissione e creazione di nuovi virus. Un documento descrive come l'epidemia di MERS è stata associata a cambiamenti nell'allevamento dei cammelli. L'insorgenza di epidemie è stata associata a cambiamenti nell'uso del territorio, includendo la distruzione delle foreste; l'urbanizzazione di aree precedentemente deforestate facilita poi il contatto tra esseri umani e virus pericolosi. Alcuni documenti studiano l'effetto della frammentazione delle foreste sulla biodiversità ed i maggiori rischi per la salute umana. Altri studi trattano la relazione tra conflitti ed epidemie. Alcuni documenti sono dedicati alle relazioni tra stile di vita e sistema immunitario.

Parole chiave: risorse educative online, contenimento del Covid, Taiwan, risposta tempestiva, approccio sanitario unico, deforestazione, sorveglianza sanitaria

1. Aims of the teaching unit

The article aims to promote a conscious use of the possibilities offered by the internet by personally researching authoritative documents that may help to reach the information directly. For instance, the students may learn the importance of timely actions in containing a pandemic and the benefits of international health surveillance.

2. Materials and methods

The educational and informative documents presented hereafter are downloadable for free from the internet. They consist of text, videos, graphs, and images that can be used by teachers with the method they feel is most appropriate.

3. Introduction

During the Covid pandemic, huge mortality differences between countries were observed. During 2020, the total number of deaths was limited to 7 in Taiwan and 35 in Vietnam, thanks to the low virus circulation. This enormously differed relative to many other countries (1> select a country). From a table in this document, information and graphs by country can be accessed. In 2020, Taiwan and Vietnam exhibited GDP growth of, +3.4% and +2.9% respectively, while many other countries experienced negative growth (2).

A document may help in selecting additional reliable literature for a deeper study on the subject (75).

4. Variants: the decline in both vaccine effectiveness and acquired immunity in recovered people

The longer a virus circulates within a population, the more it can change (25). This explains why, for example, we need a new flu vaccine every year (25 / 71 video).

Dr. Fauci A., former Director of the National Institute of Allergy and Infectious Diseases, says, "*You can be almost certain that as long as there's a lot of virus circulating in the community, there will be the evolution of mutants because that's what viruses do*" (26 video).
While in 2020, Taiwan experienced more than 200 days without a single Covid case (30), the number of patients quickly increased worldwide (24). Figure 1 (24) shows when and where some Covid variants have been discovered.

In patients who have recovered from Covid, the immune response can protect against reinfection, but this protection lasts only a matter of months (23). In fact, as the virus evolves, new variants start circulating in the community that can circumvent the formerly acquired immunity, which exposes people to the risk of reinfection. A person can get infected multiple times.

According to "Why does COVID-19 continue to spread despite mass vaccination?", *when an effective vaccine against a certain variant is developed, a new variant appears* (24). As a consequence, the current vaccines do not provide full protection and, even repeated booster shots do not guarantee zero risk of reinfection.

"The Science Behind Why New Covid Variants Are Spreading Faster" shows how a variant acquires an increased ability to infect human cells, thus becoming more transmissible (26 video).

Covid vaccines have been on the market for a short time; consequently, long-term observational data are lacking. This implies that the long-term effects of such vaccines are unknown, as are the consequences after repeated booster shots. According to the study, *countries should ensure a synchronised response on the basis of a global perspective aimed at stopping the transmission of the virus as quickly as possible* (24).

Concluding: A reduction in the number of infections in the community is the best way to prevent the development of new variants (25).

5. The transmission of Covid

A common route of infection is thought to be the droplets that infected people emit. The emissions are intensified when speaking loudly, singing or exercising (20 / 21 figures 1 and 2). The graphs also show the efficacy of face masks in reducing the emissions (21). *These infectious particles can accumulate and persist in the air for hours, even after who has emitted them has left the room*. Closed environments with inadequate external air exchange, prolonged exposure times, improperly worn masks and crowded environments increase the risk. Again, according to the document, choir singing was suspended in many countries during the Covid pandemic after reports of disease transmission. Notoriously, physical distancing is important in the prevention (20).

According to Hitoshi O., virologist and public health expert at Tohoku University, *in the notoriously crowded Japanese commuter trains no Covid clusters have been traced; here, the people wear the masks and do not talk* (22).

"Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020" provides text and images that show how the air flow created by an air conditioner likely caused virus transmission from an asymptomatic customer to people sitting at other tables (35). To prevent the spread of the virus in restaurants, the authors of the study recommend accurate temperature-monitoring surveillance, increased distance between tables and improved ventilation.

"Coronavirus disease (COVID-19): Ventilation and air conditioning" is a World Health Organisation document that provides information on the subject (46).

This respiratory disease can also be transmitted through contaminated surfaces. For this reason, handwashing and keeping clean the surfaces are also of the utmost importance (20). A document also discusses the importance of hand hygiene. *Washing hands should be a daily routine, especially before and after meals* (34).

We can observe that for influenza, similar transmission patterns were observed for Covid (71).

"How Viruses Spread Indoors and What to Do About It" may widen knowledge on the subject (74).

6. Different professions imply different risk levels

The first graph in "These are the occupations with the highest COVID-19 risk" shows which occupations carry the highest infection risk. This depends on how much, how close and how often a job requires the worker to be in contact with others (40).

A document studies the risk ratios observed in several professional categories (41). Relative to non-essential workers, in health and transport workers, the risk ratios observed were, respectively, 7.43 and 2.20. While a part of the population transitioned to remote work, *the essential workers that provide crucial or basic public services continued working, and often without personal protective equipment*. High infection, morbidity and

mortality rates were observed, e.g. among transport, food, sales, retail, and in particular health workers.

According to "COVID-19 Dentistry-Related Aspects: A Literature Overview" dentists, dental hygienists and dental assistants face a very high risk of contagion resulting from close contact with the patient's oral cavity, and with aerosols created by dental instrumentation (42). Patients are also exposed to risk.

According to "Shopping for Groceries", an infographic of the World Health Organisation, *if online shopping is not possible*, the document provides tips for a safe shopping (47).

7. Covid transmission in the school and mitigation

A 2020 Chinese document mentions some organisational examples for a safe school resumption (43). They include, e.g. implementing sunshine sports every day, such as the practice of Qigong, typical of the Chinese culture.

According to an Italian study, in classrooms equipped with mechanical ventilation systems, the risk of infection was reduced by 74-80% relative to classrooms with only natural ventilation (44).

Notoriously, a teacher may speak aloud for a long time and may emit large amounts of aerosol in the classroom. "Ventilation methods to prevent the spread of airborne pathogens from teachers to students" is a Korean study that analysed several ventilation methods for the classroom (45). In case 5 (figure 2), *a local ventilation system installed on the teacher's desk removes immediately the airborne pathogens emitted by the teacher, thus protecting students from a dangerous exposure*. The system is combined with natural ventilation in the room. In principle, this is similar to the exhaust fan that removes noxious gases from kitchens or chemical hoods.

8. The Taiwan model in facing Covid

When Covid appeared in China, Taiwan was predicted to be one of the most affected countries, given the geographic proximity and close relations (3). Different from expectations, the graph entitled "Total Coronavirus Deaths in Taiwan" shows the very low mortality observed in this country, with 7 victims in 2020 (1> Taiwan).

According to a governmental document, the strategies used included *timely border control and quarantine of passengers arriving from Wuhan starting from December 31, 2019* (4). After experiencing the 2003 SARS outbreak, the Taiwanese people gained competency and *understood the importance of actively cooperating with governmental policies and measures for getting the best results* (4).

They also learned the importance of increasing the diagnostic capacity and stockpiling personal protective equipment (5).

The civic technology culture of this country was helpful in tracking 55,000 people under home quarantine (27). For instance, the elderly were taught how to use their TV for video conferencing (4).

To prevent some individuals from becoming a gap in epidemic prevention, mobile phone technologies were adopted to monitor people in home isolation and home quarantine (4), with fines that discouraged people from violating the quarantine (27). *At the same time however, isolated or quarantined people were provided with meal delivery, physical and psychosocial support, medical assistance, and garbage collection service* (5).

The document (27) discusses the privacy implications of the digital fence system. The government said this tracking system would be discontinued as soon as the pandemic was over.

According to "How Taiwan used simple tech to help contain Covid-19", *the tracing system was based on QR codes found on transports and business*, such as café and shops, that in case of a community outbreak, the customers scan every time they enter (30). This helps health authorities to retrace the movements of people; clearly, *this is possible thanks to being in a country with a very low rate of cases*. These data are deleted after 28 days and kept out of the hands of prosecutors.

Strict travel restrictions kept the virus out of Taiwan, with the few arriving visitors spending 14 days in a quarantine hotel, or at home, and then 7 days of the so-called "self-health management" (30).

Domestic tourism was encouraged through subsidies with the aim of offsetting the loss of foreign tourists (31 / 3).

The strategy based on find, test, isolate and support helped Taiwan to contain the spread of the disease. In April 2022, during the surge of the Omicron variant, the strategy shifted from containment to mitigation (5). *The success of this country in containing the Covid pandemic in 2020 was attributed to timely actions. Disease surveillance, including actively monitoring even rumors, proved essential in avoiding delays in response*.

According to "Achieving COVID-19 zero without lockdown, January 2020 to March 2022: The Taiwan model explained", as suggested by the title, the strategies adopted did not include any lockdown (6). Here, modelling studies based on the epidemic curve obtained from China showed that the R0 of this new coronavirus was much higher than that of the SARS coronavirus. It became clear that testing and contact tracing alone would not have been enough to contain the Covid; conversely, supplementing this strategy with mask-wearing, the R0 could be reduced below 1. This strategy, combined with stringent border control measures aimed at preventing an overwhelming arrival of imported Covid cases, effectively contained the spread of the disease. Text and graphs in Figure 1 (6) provide more explanations. The government mobilised the manufacturers to produce quality masks for the population and distributed them evenly. *Social distancing also proved very useful*.

Figures 2 and 3 (6) explain the *importance of a strict border quarantine*, considering the large number of local cases that the imported cases generate.

In March 2022, in the light of conflicts and economic crises, the containment ended. At this time, however, most of the population was already vaccinated, and effective antiviral therapy was available (6).

Table 2 discusses the strengths and weaknesses of Taiwan's efforts in fighting Covid (7).

9. Vietnam is another success story

This country took actions such as closures, the requirement of mask use, and limiting international travels *even before the first cases were confirmed, while other countries made such decisions only when the numbers were much higher* (8).

"Emerging COVID-19 Success Story: Vietnam's Commitment to Containment" focuses on the Vietnamese situation from the start of the pandemic, up to the end of 2020, with 35 victims reported. In this highly centralised country, many decisions were made at the local level, which contributed to a *timely response, with many key decisions made in a few days, differently from other countries*. Information and participation of the citizens played an essential role in the success (8 / 1> Vietnam).

Thanks to a low case number, the country opted for the testing strategy to reduce transmission. *Even when just one case was found, the government reacted quickly with extensive contact tracing and commune-level lockdowns,* as shown in a table (8). The time lapse between contact and start of symptoms is about 5 days but, since the patients become infective 2 days before the symptoms, quick action is of the utmost importance.

While for SARS, a strategy aimed at just isolating symptomatic people was enough since the asymptomatic were not infectious, for Covid the management of patients and contacts is less simple, as described in the documents (8 / 33).

In March 2020, systematic multi-tiered testing and quarantine requirements were introduced. The cases (F0) underwent mandatory quarantine in assigned hospitals until they tested negative at least twice. Differently, the direct (F1) and indirect contacts (F2) were requested to undergo quarantine for not less than 14 days in structures such as hotels or military camps, with a negative test required before the exit. Other indirect contacts (F3 and F4), were requested to self-quarantine for 14 days (33 / 32).

According to "The First 100 Days of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Control in Vietnam", the control of Covid was based on early mass communication, accurate contact tracing, quarantine, and restrictions on international travels. *Without such measures, the virus might have been silently transmitted, thus undermining other control efforts* (33).

A special permission was required to enter Vietnam from abroad; the international flights were diverted away from the airports used for domestic travel, and incoming travellers underwent a 14-day mandatory quarantine (32).

Many initiatives proved useful, such as free rice distribution, aimed at supporting people who suddenly lost the job (9). The images show free mask dispensers in Hanoi (10).

10. Different experiences from Korea and Sweden

10.1 Korea

"Emerging COVID-19 Success Story: South Korea Learned the Lessons of MERS" discusses how this country responded to the Covid pandemic after the weak response to a MERS outbreak. The number of victims in 2020 was limited to about 900, without long-term restrictions such as lockdown and business closures (12 / 1> Korea).

10.2 Sweden

In 2020, this country suffered about 9,900 Covid victims (1> Sweden).

According to "How Sweden approached the COVID-19 pandemic: Summary and commentary on the National Commission Inquiry", the pandemic was largely faced relying on voluntary behavioural changes and personal responsibility (37). Kindergartens, primary and secondary schools remained open during the pandemic, which is a unique policy. *Extensive restrictions were implemented at a later time*.

According to the National Commission Inquiry, strict and proactive measures should have been applied earlier. The virus probably entered Sweden during late February 2020 through travellers from the Alps. They should have been tested and quarantined to limit the transmission and, in the Spring 2020, entry to the country should have been banned. The National Board of Health and Welfare did not recommend extensive testing in residential care facilities until May 2020 (37).

"Coronavirus: Swedish King Carl XVI Gustaf says coronavirus approach 'has failed'" is a BBC article whose title summarises the content, with Prime Minister Stefan Lofven agreeing with the king's remarks (38).

According to "The Swedish COVID-19 approach: a scientific dialogue on mitigation policies", *learning from mistakes is essential for developing effective strategies aimed at a future pandemic preparedness* (36).

11. The importance of breaking the transmission chain as soon as possible

In "The Math of Ending the Pandemic: Exponential Growth and Decay", the first diagram shows a potential coronavirus chain of transmission, where each dot represents an infected person. The person at the top of the diagram transmits the virus to two others that, in turn, transmit it to four persons, and so on (39). *Every Covid case prevented results in an interruption in the transmission chain, which prevents many more cases later*. This may help to understand the utmost importance of early action in facing a pandemic.

The benefits of early actions aimed at stopping the entry of the pandemic are observable when looking at "Total cases" and "Total deaths" graphs of the countries considered in this article (1).

12. Experiences from other countries

An image from the Bangkok Post shows a phone booth transformed into a makeshift Covid box for testing, designed to avoid the risk of infection among healthcare personnel (11).

"Community engagement for successful COVID-19 pandemic response: 10 lessons from Ebola outbreak responses in Africa" deals with the often overlooked importance of involving the communities in both planning and implementing the interventions. This may have importance in reducing possible reluctance, vandalism and violence against healthcare personnel. In fact, *an epidemic may reawaken old resentments and conflicts within a population, thus negatively affecting the achievement of a public health intervention* (13). According to this African study, lessons learnt by countries hit by Ebola outbreaks can be used in facing Covid.

According to "Modifying School Spaces During Mealtimes to Reduce Spread of COVID-19", *hygiene practices, such as use of foot presses instead of hands*, ensuring optimal ventilation with open doors and windows as much as possible to bring in outdoor air, and *staggering lunchtimes*, can importantly contribute to safer school spaces (34).

Staggering shifts to limit the number of staff simultaneously present in the restaurant or bar may contribute to reducing the spread of Covid (48).

"COVID-19 and the holidays: How to reduce your risk Tips to help keep you and your family safe" is a UNICEF document (29). According to the paper, people who choose to travel can try to avoid peak times, avoid large gatherings, and consider that the risk depends largely on where they go.

According to "Best Tips for Staying Safe in a Hotel During COVID-19 Times", room service could be a safer alternative than going to a restaurant in view of limiting contact with others (49).

13. Importance of public health surveillance and international cooperation in the containment of infectious diseases

According to "S A R S How a global epidemic was stopped", international experts and researchers cooperated and, in a matter of weeks, identified the coronavirus causative agent of the disease. At the World Health Organisation, Dr. Urbani C. first alerted about the new disease (14).

The strategy based on testing, tracing and isolation, although old and labour intensive, proved effective in slowing and containing the spread of SARS. The World Health Organisation could share information with member states and, inter alia, restricted travels to high-risk areas in order to protect global health from SARS (14).

Again, according to the document, SARS was the first emerging disease in the globalisation era; subsequently, avian influenza posed another threat to humans. *Nowadays, the need is felt to be more prepared for the next health threats* (14).

A 2024 World Health Organisation document describes the Rwandan situation where Marburg virus disease cases were reported in 7 out of 30 districts of the country (17). The outbreak, started in September 2024, posing a formidable public health challenge (17), and was declared officially over in December 2024 (19).

According to "Rwanda's Swift Response to the Marburg Virus Disease Outbreak: Exemplary Coordinated Partnerships in Action", the collaborative efforts of the government of Rwanda, supported by several international organisations, resulted in a timely deployment of expert teams, and procurement and distribution of critical supplies. Rapid capacity building of key health personnel, was also achieved within a few days of the outbreak confirmation. *This enabled immediate laboratory testing, protection of healthcare personnel, and adequate patient care* (18).

According to "Dodging a Bullet: WHO, SARS, and the Successful Management of Infectious Disease", *countries should be encouraged to quickly inform the international community when experiencing an outbreak of infectious disease* (16). This may avoid the high social and economic costs that delayed information may imply. Not all countries do this, perhaps for fear of losing credibility in the eyes of other countries.

According to "Surveillance in emergencies" (15), a *disease surveillance system is essential to detect disease outbreaks before they spread, thus becoming difficult to control and costing lives*. This is particularly true when emergencies occur, such as disasters or conflicts and severe malnutrition, which increase the risk of transmission of infectious diseases and other health conditions.

14. The importance of prevention and the "One Health" approach

According to "WHO to identify pathogens that could cause future outbreaks and pandemics", the list of priority pathogens includes Ebola and Marburg virus diseases, Nipah virus disease, MERS, and the Disease X. This latter indicates an unknown pathogen with the potential of causing a serious international epidemic (53). The World Health Organisation is launching a global scientific process to keep updated the list of priority pathogens, aimed at guiding investments, research and development, particularly for vaccines, tests and treatments.

According to the "One Health" approach, the health of humans, animals, plants and ecosystems is interdependent. Zoonotic spillover events can be prevented or reduced, however (65). Some examples hereafter may help to understand more.

15. Zoonotic spillover: how it occurs and the favouring conditions

According to "Zoonotic spillover: Understanding basic aspects for better prevention", *60-75% of human infectious diseases originate from non-human animals* (65).

Text and images in Figure 2 summarise how a pathogen can be transmitted between species. The transmission may occur: directly from the source host to the recipient host, or through the environment, or through an intermediate host. An example

of direct transmission is the HIV transmission to humans from other primates, that is thought to have occurred through handling their meat, probably slaughtered for human consumption (65).

Conversely, when, for example, swine species pollute the environment through infected feces and cause infection to humans, the transmission occurs through the environment (65).

Differently, in Brazil, we can observe an example of transmission through an intermediate host. When previously deforested areas of this country are urbanised, certain mosquito species coexist with some endemic arboviruses such as Dengue, Zika and Chikungunya. *In this case, mosquitoes can act as intermediate hosts in spreading the arboviruses* (65).

In Figure 3 (65), text and images show how new viral strains may emerge when an intermediate host is infected by two or more viruses. In such cases, recombination or reassortment may occur between the viral species, thus generating a new viral strain. Genetic reassortment may occur, for instance, in swine species simultaneously hosting influenza viruses from birds and humans.

The chances of pathogen transmission from a source to recipient hosts are greater when the genetic similarity is high, thanks to similarities in body physiology and cellular receptors. Yet, even between phylogenetically distant species, the transmission may occur, provided the necessary conditions for infection and adaptation of the pathogen in the new host are met (65).

Despite the fact that several animal species may host pathogens, it is the way we interact with them and our activities that cause diseases. None of such animal species should be eliminated for fear of human health risks; each species plays an important role in the ecosystem and must be respected (65).

15.1 Trade of exotic animals as a contributor to increased health risks

Consuming the flesh of exotic animals has the potential to contribute to increased health risks. Unhygienic markets where different kinds of animals are kept together for sale, without barriers between them and humans, may create the conditions for the emergence of new viruses (14 / 50).

According to "Illicit Wildlife Trade, Wet Markets, and COVID-19: Preventing Future Pandemics" (50), although the origin of Covid is still unclear, the virus is thought to originate from bats, much like SARS and MERS. Under the severely stressful conditions of the transportation of animals, and subsequent storage in a wildlife market, the virus could be transmitted, e.g. from bats to pangolins or other exotic creatures (50 / 65).

According to a study reviewed in this document, animals kept in stressful conditions may shed more viruses, while being more susceptible to infections (50). The close vicinity of cages where different animals are kept, often stacked one on top of another, and the presence of their by-products, result in the perfect conditions for the creation of new viruses. In addition, such exotic animals, which often originate from

remote geographic areas, are likely to carry diseases that the human body has never come in contact with.

For instance, in wild pangolins 22 different microbes have been detected; conversely, in trafficked pangolins at least 84 microbial species have been detected (52). *Many of them are human and animal pathogens, which suggests the possibility that this animal could be a reservoir of emerging infectious diseases.*

"Assessment of transport stress on cattle travelling a long distance (≈648 km), from Jessore (Indian border) to Chittagong, Bangladesh" deals with the adverse health effects of the harsh conditions of animal transport, deprived of food and water (68). Figure 2 shows different types of injuries on several parts of the body of the animals, consequent to travelling standing and at a high density, on roads often damaged with potholes, and without a roof covering. Notoriously, the skin barrier constitutes an important first line of defence against pathogens.

Tables 5 and 6 (68) compare the mean changes in the values of, respectively, haematological and biochemical parameters consequent to the transportation. Considering the immune response, stressed animals exhibited an increased number of total white blood cells, neutrophils, eosinophils and mononuclear cells.

Increased nasal discharge observed in the animals (68) may result from the invasion of microorganisms into the upper respiratory tract, consequent to immune suppression. An increased frequency of diarrhoea observed in these animals could be consequent to intestinal invasion of pathogens in immunocompromised animals. Clearly, such health conditions contribute to poor environmental hygiene.

Transportation without rules may expose the animals to cruelty, thus decreasing immunity and increasing susceptibility to infectious diseases. In some cases, animals can die as a consequence of transportation (68).

A previously cited document (50), and "Wet Markets: A Food Safety and Public Health Concern" (51) discuss possible solutions to the sanitary problems often associated with wet markets.

Despite the ban, pangolins remain the most trafficked mammals in the world. According to a document of the United Nations Office on Drugs and Crime, for both preserving biodiversity and preventing a future public health emergency, the illegal wildlife trade must stop (66 / 52).

"One Health in the Wildlife Trade" is an educational book that deals with the multifaceted impacts of wildlife trade on human and animal health. Text and images describe the proactive steps that can be taken to contribute to a safer and more sustainable planet (67).

15.2 MERS: changes in camel farming and a human respiratory syndrome

"Drivers of MERS-CoV Emergence in Qatar" describes how this disease emerged from the Middle East (64). Oil and gas exploitation modified the lifestyle of people, who, as they have become wealthier, have moved from a nomadic to a sedentary urban lifestyle, with most camels now used for racing instead of the Bedouin traditional activities. In

Qatar, the camel population increased from 6,000 to 90,000 individuals in a few decades. The shift from open grazing to closed housing systems, with the workers who raise them living in the same premises. Here, the poor hygiene may have favoured the jumping of this respiratory disease from camels to humans.

The weaning of calves is modified relative to the traditional system; subsequently, the young camels start heavy training and again undergo drastic food changes. Racing activities, grazing, reproduction and commerce of camels imply intensive mobility and transportation, which constitute stressful conditions for the animals. At the same time, cross-border movement of camels and mixing of animals and humans of different origins may have increased the chances of spreading this coronavirus (64).

At the same time, with a sedentary lifestyle now prevailing, there has been a sharp increase in obesity and other comorbidities that render the population vulnerable to virus transmission and to its deadly complications (64).

According to "Risk factors for MERS coronavirus infection in dromedary camels in Burkina Faso, Ethiopia, and Morocco, 2015", MERS-CoV antibodies have been observed in camels in many African countries (28). But while the outbreaks occurring worldwide originated from the Arabian Peninsula, surprisingly, African autochthonous MERS-CoV infections have only been observed in Kenyan camel handlers. The reasons for this difference are not yet well understood; the study discusses some hypotheses on this regard.

15.3 Forests destruction and Nipah virus disease

As a consequence of huge forest fires in Indonesia, fruit bats migrated to Malaysia, thus reaching agricultural areas with fruit orchards and pig farms (54 / 56). These pteropodid fruit bats, later identified as a natural reservoir of Nipah virus, are believed to have infected the orchard fruits with saliva and excretions. Here, pigs eating such fruits became sick and, in turn, transmitted the disease to the workers of the farms. Even some workers of a Singaporean abattoir, which at the time imported live pigs from Malaysia, were infected by the virus. *Among the measures adopted to eradicate the disease, one million pigs were culled*.

A few years later, Nipah virus disease outbreaks occurred in Bangladesh and then in India. In these countries, the transmission chain was associated with ingestion of date palm sap contaminated by saliva, urine and excreta of the bats. Here, the transmission chain did not include pigs, while human-to-human transmission was observed. Years later in Mindanao, an outbreak was associated with slaughtering and/or consumption of undercooked meat of infected horses (54).

Studies have found a genetic diversity between the Nipah virus strain observed in Malaysia and the one from Bangladesh; in the latter, more respiratory symptoms, greater transmissibility and more fatalities were observed (54).

According to a World Health Organisation document, besides causing severe diseases and death in humans, Nipah virus can infect a wide range of animals, which makes it a public health concern (55).

While fruit bats apparently do not get sick, near annual outbreaks occur in Bangladesh, and periodically the disease has been identified in eastern India (55 / 69). Antibodies against the Nipah virus have also been observed in African fruit bats of the family *Pteropodidae* (55 / 54 figure 2).

According to "Review Lessons from the Nipah virus outbreak in Malaysia", *free sharing of information and cooperation among scientists, wildlife specialists and medical doctors, both locally and internationally, played an important role in the control of the disease*. Thanks to such favourable conditions, the outbreak that raged for 6 months, was controlled in just 2 months after the virus was discovered (56).

15.4 Land use change and disease outbreaks

"Outbreaks of Vector-Borne and Zoonotic Diseases Are Associated With Changes in Forest Cover and Oil Palm Expansion at Global Scale" has found links between deforestation in tropical countries and outbreaks of zoonotic and vector-borne diseases. Deforestation may increase contacts between humans and vectors or reservoirs of pathogens (57). The study has also found a link between afforestation, especially when aimed at creating commercial plantations, and new risks of infectious diseases. The document discusses the limits of the study, which is compounded by several confounding factors.

15.5 Forest fragmentation and Lyme disease risk

Lyme disease is caused by a bacterium, *B. Burgdorferi*, transmitted to humans by the bite of a tick (58). According to "Effect of Forest Fragmentation on Lyme Disease Risk", in the remnant forest patches resulting from the fragmentation of a previously continuous forest, a reduction in species diversity is observed. At the same time, here certain species may reach unusually high densities, probably as a result of decreased abundance of predators and competitors. This may apply to the white-footed mouse.

Ticks feeding on the blood of white-footed mice are much more likely to be infected with the microorganism that causes Lyme disease, relative to ticks feeding on the blood of other animals. Consequently, where white-footed mice are prevalent, we find a high density of infected ticks (58 figure 1C and text). For this reason, according to the authors of the study, avoiding forest fragmentation may reduce the risk of Lyme disease to humans.

Two documents may help to understand why the marten, a small predator that feeds on rodents, avoids living in forest fragments (61 / 62). Martens prefer over-mature forests with hollow trees offering nesting sites, and without large openings and clearings. When forests are reduced to narrow strips, martens suffer the lack of forest interior since they feel deprived of protection from predators, even the thermal benefits are lost, especially during resting time. Figure 6C (62) represents a landscape that maximises the forest interior.

15.6 Ebola outbreaks and deforestation

"Recent loss of closed forests is associated with Ebola virus disease outbreaks" used remote sensing techniques to investigate the link between deforestation and Ebola outbreaks in Africa (59). *The study, has found a significant association between Ebola outbreaks and forest losses occurred during the previous 2 years*. This is particularly true for closed forests, and is consequent to more frequent contacts between infected animals living in the forest and humans. According to the study, to reduce the probability of future outbreaks, the loss of forests should be avoided.

16. Consequences of conflicts and disease outbreaks

A World Health Organisation document describes how the aftermath of conflicts impeded a rapid containment of Ebola in West Africa (60).

In "Civil conflict and sleeping sickness in Africa in general and Uganda in particular", graphs and text describe the negative influence of conflicts on the progress of this human disease transmitted by the tsetse fly (63 figure 2). In this country, the forcible displacement of people and animals into marginal or swampy areas increased the likelihood of being bitten by flies. In addition, when such forcibly displaced people returned home after the conflict, they encountered an increased risk consequent to the regrowth of bushy tsetse habitat in the previously abandoned agricultural fields.

According to an FAO document, sleeping sickness can be eradicated through integrated land use and development operations. But, abandoning lands previously cleared for agriculture results in bush re-encroachment and re-infestation by tsetse flies (62).

17. Healthy lifestyle and immune system

According to "Healthy Habits: Enhancing Immunity", our immune system, besides protecting against common illnesses like flu and cold, plays a crucial role in fighting serious conditions such as cancer. *A healthy lifestyle enhances the functioning of our immune system* (70). This CDC document provides information on the benefits of a healthy diet, physical activity, sleeping enough, quitting smoking, weight management, and limiting alcohol.

In fact, for instance, obesity can reduce vaccine efficacy against numerous diseases; whereas, smoking may reduce the success of our body at fighting a disease (70).

According to a document of the Harvard Medical School, aging implies a reduction in immune function, which may imply an increased vulnerability to infection and cancer. In people over age 65, even the influenza vaccine is less effective relative to healthy children (72). The document also discusses *micronutrient malnutrition*, which is common even in wealthy countries, and occurs when some minerals and vitamins are lacking in the diet, thus increasing susceptibility to infectious diseases.

Interestingly, it is not the exposure to moderately low temperatures that increases our susceptibility to flu and cold. *The emergence of these latter is instead associated with increased time spent indoors in close proximity with others during winter, facilitating the transmission of respiratory viruses* (72).

The document provides tips aimed at a healthy lifestyle, while recognising however, that the complexity of the immune response is far from being completely understood (72).

According to "Sports and Immunity, from the recreational to the elite athlete", moderate intensity exercise enhances the immune system. In contrast, overtraining, mental stress or insufficient recovery may cause immunodepression, with negative impacts on general health, with upper respiratory tract infections most frequently observed in overtrained athletes (73).

The benefits of physical activity to immune health become more evident as people age. This is even more true after age 60, when immune-senescence accelerates (73).

Conflict of Interest Statement
The author declares no conflicts of interest.

About the Author
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