

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

## Why a Bioethical Approach is Needed in Addressing Health Risks Stemming from Pandemics Due to Zoonoses Linked to Human Impact on Biodiversity?

### This is the author's manuscript

*Original Citation:*

*Availability:*

This version is available <http://hdl.handle.net/2318/1792452> since 2023-01-31T14:00:19Z

*Publisher:*

Intech Open

*Published version:*

DOI:10.5772/intechopen.98359

*Terms of use:*

Open Access

Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

# Why a Bioethical Approach is Needed in Addressing Health Risks Stemming from Pandemics Due to Zoonoses Linked to Human Impact on Biodiversity?

*Tullia Penna*

## Abstract

This chapter aims to demonstrate why a precautionary and bioethical approach is needed to avert forthcoming pandemics due to zoonosis. Precautionary principle should be intended as a conceptual tool for assessing whether human action, and its arising environmental alterations, exceed the absorption capacity of Nature. Likewise, original meaning of *bioethics*, namely the questioning of unsustainable progress and human survival, should be resumed to reflect on human footprint on biodiversity. This reflection seems to be even more pressing if we consider how national policies are struggling to face the pandemic's socio-economic consequences. Focusing on how to prevent zoonosis' events, by pondering on the concept of 'biological wisdom' coined by Van Rensselaer Potter, might be more effective than suggesting complex reforms of healthcare systems. Furthermore, a bioethical approach, by its very definition, consists of a multidisciplinary approach, increasingly worthwhile in present-day societies characterized by strong complexity. Indeed, the SARS-CoV-2 pandemic has demonstrated how dense is the network of nature, human beings and socio-economic structures. It seems appropriate to think origins of SARS-CoV-2 pandemic as a warning for the future, by questioning methods and extension of human impact on biodiversity.

**Keywords:** SARS-CoV-2 Origin, COVID-19, Bioethics, Wildlife Preservation, Precautionary Principle, Anthropocene, Public Health

## 1. Introduction

On February 11, 2020, World Health Organization (WHO) named COVID-19 a new severe acute respiratory syndrome, provoked by a new coronavirus isolated a month earlier. WHO declared this disease an international health emergency and the virus, SARS-CoV-2, has entered to take part of our daily lives. Life as we know it has changed rapidly, and the evolving pandemic scenario has made us realize how deep globalization is. Every country around the world willing to curb the spread of COVID-19 has placed precautionary principle at the core of public

health policies. At EU level, precautionary principle is defined as principle enabling “decision-makers to adopt precautionary measures when scientific evidence about an environmental or human health hazard is uncertain and stakes are high” [1]. In the case of SARS-CoV-2, reflecting on human health means reflecting on environmental conditions as well, given the strong interconnection between human beings and their surrounding environment. Indeed, even if the whole causal sequence between ecological changes and emerging zoonosis is not thoroughly clear, there is strong evidence of their bonding. Especially, when we consider that the epoch we are living in could be termed ‘Anthropocene’, since the devastating impact of human activity on our planet. This much is clear: addressing pandemic tightly as a national healthcare issue would prove to be unsuccessful, likewise conceiving it as a merely human health matter. Indeed, multidimensional connection between human health and environment is nowadays very clear and we have a pressing need to choose an ethical and legal approach that takes due account of this link.

## **2. Zoonosis as an environmental and human health crisis**

SARS-CoV-2 belongs to the family of coronaviruses, whose preferred hosts in nature are various animal species [2], and which were identified in human beings for the first time in 1966 [3, 4]. In the event of transmission of disease or infection from vertebrate animals to humans, we refer to “zoonosis”. Nowadays we know over 200 types of zoonoses, whose conspicuous portion consists of existing diseases in humans (rabies, AIDS, etc.) [5]. The possibility of infection and disease transmission from other vertebrates to human being testifies to the belonging of humans to the animal kingdom, as a memorandum of the interdependence amongst animal species.

When it comes to zoonosis, infectious disease is due to a pathogen (such as a bacterium, virus, parasite or prion) affecting a reservoir animal, which actually can remain undamaged by this infective agent. Pathogens hosted by reservoir animals may need an intermediate to gain access to humans, and this intermediate serves as an amplifier of the infectious strength [6]. That is, sometimes the last victim in a zoonotic infection chain requires higher dose of pathogens or prolonged contact to get infected [7]. A differentiated infection threshold ensures significant protection to humans against viruses, but more considerable degree of protection is ensured by high biodiversity and an unhindered ecosystem. In such a context, possibility of contact and transmission decrease sharply. Pathogens are definitely unconscious, therefore their transfer responds to an evolutionary mechanism: they move from one host to another since this solution, randomly found, turned out to be successful from both reproductive and survival standpoint. Amongst pathogens, viruses are undoubtedly the most troubling due to their evolutionary rapidity, flexibility, and resulting mortality rate. Moreover, “viruses have no locomotion yet many of them have traveled around the world” [8].

Describing zoonotic mechanism requires also to stress the difference between spillover and emerging infectious diseases. Spillover indicates the point at which a pathogen moves from one animal species to another; while an emerging infectious disease is the one which has been increasing after introduced in a specific population. These notions are clearly linked, especially if we consider that, under ordinary conditions, infectious diseases are natural events, which bond individuals and species in their ecosystems. Cross-species transmission is not rare, but rarely it is the result of chance. In fact, last decades have been heavily characterized by an increasing disruptive human activity perpetrated on the environment: Transforming natural habitats, altering ecosystems, reducing biodiversity and damaging patterns of interactions between different species [9–12]. Climate change, deforestation,

overfishing, natural resources extraction, intensive farming, wildlife poaching and trade are all key drivers of increased rates of zoonotic emerging diseases. Human communities find themselves living near wildlife ever more frequently, and wildlife turns out to be often potential host of pathogens responsible for transmitting infection [10]. So, it is hardly surprising that zoonosis has been indicated as a word of the future, expected to become quite common in this century [13]. Environmental devastation provides a suitable growth medium for interspecies viral transmission, a perfect trampoline for “host jump”. Three core elements have to be considered. The first is the difference between past and present human activity: nowadays Earth hosts 7 billion people, equipped with the most up to date technologies. This set far exceeds the absorption capacity of Nature. The second core element regards the notion of “virosphere”, that is the remarkable viral diversity existing on our planet - a group of living organisms of exceptional size [14]. The third core element consists of the overlapping of the first two: Where wildlife and natural habitats are destroyed, there is an impressive amount of unknown pathogens prompt to assure their own survival by affecting new kind of hosts. Consequently, when we consider zoonoses, we can safely affirm that we face both an ecological and a health crisis.

Within this framework, SARS-CoV-2 is no exception. Current pandemic is the third of zoonotic origin in the twenty-first century, after severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-Cov) [15]. Even if the animal species at the origin of COVID-19 outbreak has yet to be determined, knowledge gained on SARS-CoV and MERS-CoV has enables scientists to identify bats as likely reservoirs of SARS-CoV-2 [2, 11, 16]. Evidences suggest that pangolins might have served as amplifiers, in a sequence of spillover from bats to pangolins and finally to humans [11, 17].

### 3. Contemporary legal shape of the precautionary principle

Emerged in German law during the 1970s, precautionary principle, in its legal declination, has since been uphold in a number of international environmental treaties and by the European Union (EU) in the Maastricht Treaty. Then, this principle has been included in the Treaty on the Functioning of the European Union (TFEU), under article 191 § 2, which provides for preservation, protection and improvement of the quality of the environment, as well as protection of human health, prudent and rational utilization of natural resources, and the promotion of measures addressing regional or worldwide environmental problems, and in particular countering climate change. Indeed, the Court of Justice of the European Union (CJEU) has classified precautionary principle as *general principle* of the EU (case *Artegodan v Commission*, T-74/00). In general, at EU level, precautionary principle is defined as principle enabling “decision-makers to adopt precautionary measures when scientific evidence about an environmental or human health hazard is uncertain and stakes are high” [1].

Notwithstanding, there is no universal, or European, consensus on the kind and the extension of measures that can be adopted according to precautionary principle. In fact, domestic institutions enjoy a wide discretion when defying precautionary policies, although these measures have always to be declined according to the degree of scientific uncertainty, severity of potential hazards, and costs linked to action or inaction. In this regard, a minimalist interpretation of precautionary principle does not support action to be taken as long as scientific evidence of the existence of specific hazard is provided. Instead, a maximalist interpretation advocates adoption of measures until a scientific evidence of the absence of any hazard is provided [1].



Considering pandemic spread in western contemporary societies brings to mind the notion of “risk society” immediately, that is societies facing unprecedented hazards for persons, communities, and surrounding environment [18]. Therefore, it is absolutely plain that every democratic government has a specific managing and regulatory duty towards its citizens when it comes to risk. This duty relates both to the degree of scientific uncertainty of a given phenomenon, and to the risk appetite that a given society tends to prove [19]. In this setting, precautionary principle plays a key role, whose legal nature is subject to jurisprudential and academic debate focused on the combination of risk and emergency. The first COVID-19 outbreaks in Europe, especially in Italy, have been a shining example of this combination: formerly infection containment measures have been adopted at a local level, then national governments took emergency measures.

To support the hypothesis that health emergency due to COVID-19 represents a textbook case of application of precaution, we should take into account the meaning to be attributed to scientific uncertainty. Far from suggesting that scientific uncertainty means mere ignorance, it regards “different forms of lack of information in science: the complexity of knowledge, the lack of data, the unpredictability of results, and the stochastic character of predictions” [20]. In other words, the field of action of precaution consists of complex scenarios (the case with the COVID-19 entails economic, social, health and environmental interconnection), shady risk factors (infection transmission through aerosol), and unforeseeable circumstances (acquired immunity against SARS-CoV-2).

Given complexity of scenarios and scientific uncertainty, precautionary principle may take different forms. As ethical principle, precaution is rooted in Hans Jonas’ philosophical statements [21]. Precautionary principle is not a moral principle, suitable for distinguishing between good and evil, but an ethical one, that is a guiding criterion for human activity according to awareness of the uncertainty of risks and responsibility in managing hazards. At the foundation of awareness and responsibility, Hans Jonas placed the psychological element, rather than the cognitive one. That means that when facing hazards without a structure of scientific knowledge, a prudential mechanism (genus of the precautionary one) proves to be a suitable response to psychological dimension of fear, which tends to prevail over the cognitive dimension of ignorance. In legal terms, precautionary principle acknowledges a positive role to ignorance, that is it emphasizes the epistemological status of ignorance in contemporary science, by disengaging law from the submission to science and by opting for actions aimed at general safety [20]. Relationship between science and law, and between science and institutions, yields a form of science neither pure nor applied. This relationship gives rise to a policy-related science [22] required to frame problems in the light of feasible solutions identifiable through public policies. It follows that, in the case of COVID-19, precautionary principle may be declined according to different intensities under a cost–benefit analysis pertaining the adoption of more-or-less sharp containment measures. In this regard, the European Commission (EC) requires Member states to verify that measures based on precaution are proportional to chosen level of protection, consistent with eventual actions already taken, and revisable in the event that brand-new scientific evidences are acquired [1].

#### **4. A precautionary approach based on the principle of responsibility**

Recovery of a precautionary approach, in its ethical declination proposed by Hans Jonas, could be suggested as a theoretical and operational proposal aimed not

only at managing current pandemic emergency, but also future health or environmental crises. During the 1970s, precautionary principle was enshrined in German law on environmental pollution and, particularly, degradation of air quality caused by deforestation. That law was enlivened by responsibility principle, as a cornerstone of human activity when it affected the environment. We suggest that the profile of ethical responsibility of human activity towards environment should be recovered, as proposed by Hans Jonas [21]. Consequently, it should be highlighted how human activity, and its arising environmental alterations, exceeds the related absorption capacity of Nature [23]. This is particularly true if we consider how human knowledge is, by its very definition, limited to a given time in history and, in the present, characterized by a high degree of complexity and global interconnection. Nowadays we live in risk societies wherein we have to be aware that our action on environment yields unknown and unprecedented hazards. In this context, it is often a principle of reaction, rather than precaution, which leads public health and environmental policies. That means Governments and their regulatory agencies, before they can act, find themselves in a position to have to wait until evidence of harm is established beyond all reasonable doubt [24]. Therefore, we believe that precautionary principle has to be declined both as responsibility principle and foresight, aiming at emphasizing a proactive and anticipating approach, suitable to result in actions of planning [25]. Because, if on one side human knowledge is, by its very definition, limited, on the other increasingly sophisticated technologies for assessing risks and data-processing do exist. Suffice it to refer to research project “Exscalate4CoV”, dedicated to virtual screening, through supercomputing services and urgent computing, of a wide variety of molecules in order to verify their capacity to contrast SARS-CoV-2 and better the course of the disease.

Recovery of principle of precaution, with distinctive focus on human responsibility towards the environment, seems particularly profitable in the case of COVID-19. Formerly, for the zoonotic nature of the pandemic [26, 27]. Spillover phenomenon, that is a host jump from an animal species to human beings, has its deep roots in the human disruption of natural habitats, through deforestation, overfishing, natural resources extraction, intensive farming, wildlife poaching and trade. Therefore, principle of responsibility, whose archetype - according to Hans Jonas - is responsibility of human beings for human beings, and ultimately for every living, should serve as guiding criterion when it comes to foresee natural hazards and to regulate related risks. This is particularly true in so far as COVID-19 pandemic management could have taught us that, both at a domestic and international level, a governance of risks may be more effective than a governance of damages.

## 5. Bioethics in addressing zoonotic diseases

From an ethical perspective, precautionary principle and responsibility principle, which encompass not only human beings but also science, technology, and nature, may have as counterpart bioethics as a discipline. Originally, *bioethics* was a term coined and conceptualized by Van Rensselaer Potter in the 1970s, referring to the proposal to set up a new discipline able to combine ethical values with biological facts. In this sense, Potter portrayed *wisdom* as “the knowledge of how to use knowledge for the social good” and, more specifically, as a guide for action for the last decades of the twentieth century [28], when some scientists and scholars already perceived human activity’s impact on nature as deadly disruptive. Indeed, until the 1970s Nature’s limitlessness was taken for granted, along with its capacity to regenerate from human exploitation. Therefore, no specific questioning had been

led about human responsibility for consequences of the destruction of ecosystems, natural habitats and natural resources. Beginning to sense that exploitation of nature could have resulted in human extinction, Potter suggested that an *instinct* for survival was not enough. It was more about setting a system of priorities in order to re-think how humankind related to nature, and drawing up a new “science of survival” [29]. This science had to be nourished with multidisciplinary planning: biology and ethics should have conversed progressively to create a new discipline called *bioethics*. Potter warned scholars on risks stemming from dangerous knowledge, that is knowledge acquired faster than the wisdom to manage it. Given that knowledge in itself cannot be intrinsically good or bad, dangerousness should be traced in the use made of knowledge. Particularly if knowledge is understood as technology. Potter did not suggest a radical criticism of technology, instead he highlighted the potential misuse of it, regarded as meager questioning about the consequences of its application. In this respect, a more rigorous intervention of politics was demanded, since human activity was perceived as potentially devastating to nature and hence to humankind. Indeed, amongst the priority problems of his time, Potter already identified pollution and material progress by all means.

Fifty years later, ecological instability has sharply increased and ecosystems’ crisis has been drastic exacerbated. As indisputable proof of it, in the twenty-first century we faced two zoonotic epidemic due to a coronavirus, and we are currently facing the third. In this matter, the agreement on a common ethical value system and the notion of obligation to future generations assume great importance. A common ethical value system which designs responsibility principle as key factor in the relationship of human beings with nature, and precautionary principle as element capable of safeguarding when it comes to environmental hazards due to human activity. As Potter marked fifty years ago, “If the nations of the world are to find a “bridge to the future”, they will have to realize that they must unite to preserve the fragile web of nonhuman life that sustains human society. From this moment on we are fighting a desperate war for survival, and we cannot indulge in fratricidal forays to uphold value systems that may no longer be relevant” [30].

## 6. COVID-19 as paradigmatic disease of the Anthropocene

To support this thesis, in recent years it has been suggested that Earth is in an epoch called Anthropocene [31, 32]. The main character of Anthropocene is a major geological and environmental force, more relevant than natural forces, which is also the most powerful species: The *Homo sapiens* [31, 33]. Human beings exhibit indeed three peculiar broad-scale ecological (macroecological) patterns: “humans spreading geographically disperse pathogens and parasites [and] visiting or settling in new areas encounter new organisms, including new pathogens, and new alternative hosts for existing pathogens and parasites; [then] increased human population density and frequency of contact substantially influence the ecology of disease” [34]. Moreover, given this deep interconnection between humans and surrounding habitats, COVID-19 outbreak will potentially have several consequences on the functioning of human population and extensive effects for human-affected ecosystems (e.g., incremented poaching, bans to wildlife trade, increased medical waste, and bad medical refuse disposal) [33, 35].

On the point of Anthropocene, and in particular of anthropogenic climate change (ACG), bioethics scholars have advocated a return to the origins of bioethics, in order to reflect about human interaction with the environment through the lens of hard sciences and humanities as well [36]. Truly, in recent years bioethics has been focusing strictly on human beings, by caring mostly about human health and clinical



medical practice. Consequently, some bioethicists suggest employing public health ethics as a bridge between environmental ethics and bioethics (in its contemporary meaning) [37–43]. According to some, recovering original bioethics would mean disrupting discipline itself insofar as it would endanger its humanist character. In other words, many environmental scholars already embody Potter's perspective, mostly unconsciously, but in so doing they threaten the humanist element of the discipline [36]. This suggestion comes from a traditional understanding of humanism, as a philosophical stance placing humans at the very center of the universe, by emphasizing their experience of living and hence interpreting every phenomenon in this perspective. "Humanism involves the privileging of the human" [36]. But nowadays this angle is not consistent with precautionary principle, responsibility principle, and, even more fundamental, with a clear understanding of the environmental realm wherein we live. Given human action as a major geological force [31, 33, 44–45], whose effects will be potentially persistent for millennia, a perspective prioritizing human amongst non-human lives may be considered outdated or even dangerous. In this setting, Timothy J. LeCain notes, by addressing Dipesh Chakrabarty's work on the history of climate [45], that considering human beings as a geological force, a natural force, entails a metaphysical thesis. Thesis which consists of dissolving the traditional distinction between humans and nature, and hence suggesting an ontological flattening. LeCain's analysis is thus characterized as the "Great Ontological Collapse" [46]. In philosophical terms, it would be an authentic revolution.

Nonetheless, we may consider that addressing climate change, deforestation, natural resources exploitation, and other disruptive human activities, does not require this immediate and radical revolution. We may suggest that adopting a bioethical approach, in Potter's perspective, is feasible without thoroughly eradicating humanism as philosophical statement. Indeed, humanism may be declined differently, that is taking into account, as imperative human exigence and experience, the urgency of compressing human activity towards environment. Increasing of public environmental awareness, and consequent implementation of new international laws, would benefit both nature and human health. In other words, a new humanism might encompass the protection of the whole biotic community, since this means protecting human beings ultimately [11]. What is certain is that COVID-19 pandemic claims a new questioning about how humankind conceive its role towards the environment and, even earlier, a deep awareness of the powerful connection between humans and their surrounding habitats. We cannot pursue our action on the Earth without acquiring a "planetary health lens" [10, 47]. There can be little doubt that COVID-19 is a paradigmatic example of an Anthropocene disease, and therefore we should adopt the angle of Planetary Health, that is to say, reacting to the current pandemic being aware that we need a valid response to the crisis both for humans and the environment [9]. SARS-CoV-2 epidemic, global environmental degradation, and climate change have their roots in the very same ground, wherein we should seed a bioethical approach to face future challenges.

## 7. Conclusions

On the whole, COVID-19 pandemic provides a wake-up call for humankind. As a zoonotic disease, it represents a textbook case for scholars engaged in environmental, public health policies, ethical, medical, and legal studies. We therefore suggest that a multidisciplinary appraisal is needed. Zoonosis in itself is not a rare event, nevertheless it cannot be regarded as a random one. Indeed, zoonoses are due to many factors, such as climate change, deforestation, overfishing, natural resources extraction, intensive farming, wildlife poaching and trade. In this century,



increased rates of zoonotic emerging diseases shed light on the relationship between human action and surrounding environment, and they highlight how dangerous is to conceive, even unconsciously, environment as a non-viable stage design wherein human act, concerned only by their mutual relations. Environment consists instead of a huge variety of non-human lives, increasingly affected by our exploitation of resources and transformation of habitats. Human beings and surrounding environment are inherently bound.

Nowadays, Earth is in an epoch called Anthropocene, whose main feature is a major geological force: humans. In such a context, many living beings are challenged in their habitats and fight a war, more or less consciously, for reproduction and survival. In the case of pathogens, and in particular viruses as SARS-CoV-2, we refer to unconscious living beings, which, once their habitats are disrupted, seek new organisms wherein survive, reproduce, and eventually flourish. Unfortunately, humans cannot make an analogous “host jump”, as zoonosis, for their survival. For this very reason, it is unlikely that facing COVID-19 pandemic with a strictly human health perspective shall prove to be a successful strategy. Instead, it might reveal palliative care: undoubtedly relieving in short-term period, but pointless in the long one. Maybe a consistent question is not *if*, but *when* another zoonosis will occur, in the case of human action pursuing its journey of exploitation and disruption.

In this context, we would suggest that precautionary and bioethical approach would be as feasible, as effective. This means recovering and implementing precautionary principle, responsibility principle, and bioethical focus in their original meaning, as proposed by Hans Jonas and Van Rensselaer Potter. In general, that means understanding how deep is human interconnection with nature, and how relevant is human responsibility towards both other human beings and surrounding environment, conceived as a whole of living beings. In particular, at EU level precautionary principle is defined as principle enabling “decision-makers to adopt precautionary measures when scientific evidence about an environmental or human health hazard is uncertain and stakes are high” [1]. Elements depicted in this definition play a key role in contemporary society, which may be indicated as *risk societies*. Indeed, degree of technological progress and need for natural resources exceed more and more often the absorption capacity of Nature. This excess entails unavoidably increased natural hazards, particularly in the shape of ecological instability and human health crises.

If we agree that we are a major geological force, the need to implement responsibility principle ensues. Responsibility towards the whole biosphere as awareness of Nature’s limitedness capacity to regenerate. Precaution as guide for action when the consequences of human activity occur. Then, prevention as perspective, instead of reaction. COVID-19 pandemic taught us how disruptive the sense of emergency can be. At the same time, we might have learnt from pandemic management, both domestic and international, that a governance of risks may be more effective than a governance of damages.

In this context, a bioethical approach appears potentially useful. We refer to the traditional understanding of bioethics, as a discipline that encompasses both biological facts (hard sciences in general) and ethical values (humanities). Contemporary bioethics scholars, in fact, focuses almost entirely on human health and clinical medical practice. Meanwhile many Anthropocene ethicists apply Van Rensselaer Potter’s view, being unaware of doing so, or at least without saying it. In any case, there are many scholars who advocate a bioethical approach when it comes to natural hazards as environmental responses to human activity. Biomedical ethics, in this setting, is unquestionably needed to face effects of natural hazards such as zoonoses. But it should not be regarded as sufficient, specifically in a precaution and prevention perspective. Finally, the most urgent goal may be considered the

increasing of public environmental awareness, in order to adopt and implement new international binding laws within the shortest possible time. Laws led by precautionary principle as response to natural hazards, such as zoonoses, but enlivened by a deep-rooted principle of responsibility, and nourished by scientific knowledge and ethical values. If the pandemic vanishes, we should strictly question our relationship with the environment, otherwise the precarious stability perhaps regained would result in a future - quite certain - natural catastrophe. In the end, protecting wildlife, natural habitats, and their patterns and mechanisms will also mean protecting us as living beings deeply bound with them.

**Conflict of interest**

The authors declare no conflict of interest.

**Why a Bioethical Approach is Needed in Addressing Health Risks Stemming from Pandemics Due to Zoonoses Linked to Human Impact on Biodiversity?**

WRITTEN BY

**Tullia Penna**

Submitted: December 11th, 2020 , Reviewed: May 11th, 2021 , Published: June 9th, 2021

DOI: 10.5772/intechopen.98359

**Author details**

**Tullia Penna**

Department of Law, University of Turin, Turin, Italy

\*Address all correspondence to: [tullia.penna@unito.it](mailto:tullia.penna@unito.it)

**IntechOpen**

© 2021 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

## References

- [1] Bourguignon D, EPRS - European Parliamentary Research Service European Parliamentary Research Service. The precautionary principle. 2015. Available from: [https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS\\_IDA\(2015\)573876](https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_IDA(2015)573876).
- [2] Reina J. The SARS-CoV-2, a new pandemic zoonosis that threatens the world. *Vacunas*. 2020;21:17-22. DOI: <https://doi.org/10.1016/j.vacun.2020.03.001>.
- [3] Guarner J. Three emerging coronaviruses in two decades. *Am J Clin Pathol*. 2020;153:420-421. DOI: <http://dx.doi.org/10.1093/ajcp/aqaa029>.
- [4] Liu SL, Saif L. Emerging viruses without borders: the Wuhan coronavirus. *Viruses*. 2020;12:130. DOI: <http://dx.doi.org/10.3390/v12020130>.
- [5] Wolfe ND, Dunavan C, Diamond J. Origins of major human infectious diseases. *Nature*. 2007;447:279-283. DOI: <https://doi.org/10.3201/eid1112.040789>.
- [6] Jing-An C, Fangyuan C, Shengjie F. Effect of Intermediate Hosts on Emerging Zoonoses. *Vector Borne Zoonotic Dis*. 2017;17(8):599-609. DOI: 10.1089/vbz.2016.2059.
- [7] Quammen D. *Spillover*. 2nd ed. Milan: Adelphi; 2014. 39p.
- [8] Morse S, editor. *Emerging Viruses*. New York: Oxford University Press; 1993. IX p.
- [9] O'Callaghan-Gordo C, Antó JM. COVID-19: The disease of the anthropocene. *Environmental Research*. 2020; 187:1-2. DOI: <https://doi.org/10.1016/j.envres.2020.109683>
- [10] Jowell A, Barry M. COVID-19: A Matter of Planetary, not Only National Health. 2020;103(1): 31-32. DOI: 10.4269/ajtmh.20-0419.
- [11] Turcios-Casco MA, Cazzolla Gatti R. Do not blame bats and pangolins! Global consequences for wildlife conservation after the SARS-CoV-2 pandemic. *Biodiversity and Conservation*. 2020; 29:3829-3833. DOI: <https://doi.org/10.1007/s10531-020-02053-y>.
- [12] Myers SS, Gaffikin L, Golden C D, Ostfeld R S, Redford H, Ricketts T K H, Turner W R, Osofsky SA, Human health impacts of ecosystem alteration. *Proc. Natl. Acad. Sci. Unit. States Am*. 2013;110: 18753-18760. DOI: <https://doi.org/10.1073/pnas.1218656110>.
- [13] Quammen D. *Spillover*. 2nd ed. Milan: Adelphi; 2014. 21p.
- [14] Goodman JR. Welcome to the virosphere. *New Scientist*. 2020; 245(3264):40-43. [https://doi.org/10.1016/S0262-4079\(20\)30077-4](https://doi.org/10.1016/S0262-4079(20)30077-4).
- [15] Perlman S. Another decade, another coronavirus. *N Engl J Med*. 2020; 382:760-762. DOI: <http://dx.doi.org/10.1056/NEJMe2001126>.
- [16] Guo YR, Cao QD, Hong ZH, Tan YY, Chen SD, Jin HJ, Tan KS, Wang DY, Yan Y. The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak: an update on the status. *Mil Med Res*. 2020; 7:1-10. DOI: <https://doi.org/10.1186/s40779-020-00240-0>.
- [17] Cazzolla Gatti R. The pangolin's revenge: SARS-CoV-2 did not emerge from a lab but from wildlife exploitation. *GAIA*. 2020; 29:79-82. DOI: 10.14512/gaia.29.2.3.
- [18] Beck U. *Pioneer in Cosmopolitan Sociology and Risk Society*. New York: Springer; 2014.

- [19] Graziadei M. La regolazione del rischio e il principio di precauzione: Stati Uniti ed Europa a confronto. *Sistemi Intelligenti*. 2017; 2: 499-512.
- [20] Tallacchini M. Before and beyond the precautionary principle: Epistemology of uncertainty in science and law. *Toxicology and Applied Pharmacology*. 2005; 207(2): 645-651.
- [21] Jonas H. Il principio di responsabilità. Un'etica per la civiltà tecnologica. Torino: Einaudi; 1990.
- [22] Funtowicz S, Shepherd I, Wilkinson D, Ravetz J. Science and Governance in the European Union. A Contribution to the Debate. *Science and Public Policy*. 2000; 27(5): 327-336.
- [23] Bartolommei S. Il principio di precauzione nel diritto internazionale. Lecce: Argo; 2006, 11p.
- [24] Kriebel D, Tickner J. Reenergizing public health through precaution. *American Journal of Public Health*. 2001; 91(9): 1351-1355.
- [25] Comba P, Pasetto R. Il principio di precauzione: evidenze scientifiche e processi decisionali. *Epidemiol. Prev*. 2004; 28/1: 41-45.
- [26] Cui J, Li F, Shi ZL. Origin and evolution of pathogenic coronaviruses. *Nat. Rev. Microbiol*. 2019; 17(3): 181-192. DOI: <https://doi.org/10.1038/s41579-018-0118-9>.
- [27] Sokolow SH, Nova N, Pepin KM, Peel AJ, Pulliam JRC, Manloves K, Cross PC, Becker DJ, Plowright RK, McCallum H, De Leo GA. Ecological interventions to prevent and manage zoonotic pathogen spillover. *Phil. Trans. R. Soc*. 2019; 374: 1-10. DOI: <https://dx.doi.org/10.6084/m9>.
- [28] Potter VR. *Bioethics. Bridge to the Future*. Englewood Cliffs: Prentice-Hall; 1971. 183p.
- [29] Potter VR. *Bioethics. Bridge to the Future*. Englewood Cliffs: Prentice-Hall; 1971. 5p.
- [30] Potter VR. *Bioethics. Bridge to the Future*. Englewood Cliffs: Prentice-Hall; 1971. 193p.
- [31] Corlett RT. The Anthropocene concept in ecology and conservation. *Trends Ecol Evol*. 2015; 30:36-41. DOI: <https://doi.org/10.1016/j.tree.2014.10.007>.
- [32] Malhi Y. The concept of the Anthropocene. *Ann Rev Envir Res*. 2017; 42:77-104. DOI: <https://doi.org/10.1146/annurev-environ-102016-060854>.
- [33] Skórka P, Grzywacz B, Morón D, Lenda M. The macroecology of the COVID-19 pandemic in the Anthropocene. *PLoS ONE*. 2020; 15(7):1-17. DOI: <https://doi.org/10.1371/journal.pone.0236856>.
- [34] Skórka P, Grzywacz B, Morón D, Lenda M. The macroecology of the COVID-19 pandemic in the Anthropocene. *PLoS ONE*. 2020; 15(7):2p. DOI: <https://doi.org/10.1371/journal.pone.0236856>.
- [35] Buckley R. Conservation implications of COVID-19: Effects via tourism and extractive industries. *Biol Conserv*. 2020; 247:108640 DOI: <https://doi.org/10.1016/j.biocon.2020.108640> PMID: 32501298.
- [36] Cummins PJ. The Anthropocene: A challenge to humanism in bioethics?. *Éthics, Medicine and Public Health*. 2018; &: 105-114. DOI: [10.1016/j.jemep.2018.07.001](https://doi.org/10.1016/j.jemep.2018.07.001).
- [37] Lee L. A bridge back to the future: public healthethics, bioethics, and environmental ethics. *Am J Bioethics*. 2017;17:5—12. DOI: [10.1080/15265161.2017.1353164](https://doi.org/10.1080/15265161.2017.1353164).



[38] Ehrlich PR. Bioethics: are our priorities right? *BioScience*. 2003; 53:1207—1216. [https://doi.org/10.1641/0006-3568\(2003\)053\[1207,BAOPR\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2003)053[1207,BAOPR]2.0.CO;2)

[39] Dwyer D. How to connect bioethics and environmental ethics: health, sustainability, and justice. *Bioethics*. 2009; 23:497—502. DOI: 10.1111/j.1467-8519.2009.01759.x

[40] Gruen L, Ruddock W. Biomedical and environmental ethics alliance: common causes and grounds. *J BioethInq*. 2009; 6:457—466.

[41] Macpherson CC. Climate change is a bioethics problem. *Bioethics*. 2013; 27:305—308. DOI: <https://doi.org/10.1111/bioe.12029>

[42] Richie C. What would an environmentally sustainable reproductive technology industry look like? *J Med Ethics*. 2015; 41:383—387.

[43] Richie C. Medical technologies, health care, and environmental conservation. *Medicina e Morale*. 2016; 65:759—72. DOI: 10.4081/mem.2016.465

[44] Crutzen PJ, Stoermer EF. The “Anthropocene”. *Global Change NewsLetter*. 2000; 41:17—18.

[45] Chakrabarty D. The climate of history: four theses. *Crit Inq*. 2009; 35:197—222. DOI: <https://doi.org/10.1086/596640>

[46] LeCain TJ. Heralding a new humanism: the radical implications of Chakrabarty’s “Four Theses”. In: Emmet R, Lekan T, editors. *Whose anthropocene? Revisiting Dipesh Chakrabarty’s “Four Theses”*. Munich: Rachel Carson Center for Environment and Society. 2016. 15—20p.

[47] Whitmee S, Haines A, Beyrer C, Boltz F, Capon AG, de Souza Dias BF, Ezeh A, Frumkin H, Gong P, Head P, Horton R, Mace GM, Marten R, Myers SS, Nishtar S, Osofsky SA, Pattanavak SK, Pongsiri MJ, Romagnelli C, Soucat A, Vega J, Yach D. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *Lancet*. 2015; 386: 1973

<b>PUBLISHED</b>	<b>DOI</b>
December 1st, 2021	10.5772/intechopen.92909
<b>ISBN</b>	<b>PRINT ISBN</b>
978-1-83968-756-3	978-1-83968-755-6
<b>EBOOK (PDF) ISBN</b>	<b>COPYRIGHT YEAR</b>
978-1-83968-757-0	2021
<b>NUMBER OF PAGES</b>	
322	