



COVID-19: The Lessons We Should Have Learned from Existing Literature

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Abstract

The linkages between natural resources and human well-being lie at the heart of biophysical economics. Huge disruptions to human well-being which can occur as a result of the impact of particular natural resources or species are, or should be, an obvious focus of interest for the biophysical economist whose focus is on flows between the natural world and human society. The causes and consequences of such disruptions, such as emanate from pandemics and epidemics, are a clear example of this. There is a need for better understanding of these causes and consequences. As an example, twelve books on epidemics and pandemics are considered here as providing the core for what guidance they might, and should, have provided on the sources, spreaders, and responses to COVID-19. A substantial amount of guidance is given in these and other sources referenced, which if followed would have reduced spread and mortality, but in far too many countries preparedness and speed of responses were inadequate. An effective global network and funding are required, as long advocated, but still not implemented. The economic and resource costs of this failure are huge.

Keyword COVID-19 · Preparedness · Speed of responses · Ongoing awareness

Introduction

COVID-19, or SARS2-CoV2, is still with us. By 12 July 2020, over 560,000 deaths, and over 12.5 million cases, had been attributed to it—and rising. The debate continues as to how well prepared countries and people around the world were for it; the timeliness and soundness of responses; and how aware politicians, ‘scientists’, and the public were that “the Next Big One” pandemic was just around the corner?

The focus of biophysical economics has always been on the intimate connection between the human economy and the natural environment, the needs of human society derived from natural resources, and the dependence of the natural environment to some degree upon human interventions. When those flows are severely disrupted the consequences can be dire, and few more obvious examples exist than those which flow from pandemics and epidemics.

The principles lying behind biophysical economics have long been set out by the leading scholars in this field such

as Cutler Cleveland, Charles Hall, Robert Kaufmann, and their inspiration—Howard Odum. It was Howard Odum who referred to the “network nightmare” when stating that “the difficulties of managing nature and man can be stated in circuit terms” (Odum 1971, p. 274). Energy was being considered in its broadest ecological sense, mostly positive and essential for human existence, but also disruptive and even destructive. The focus of these luminaries in more recent years has been mainly on mainstream energy sources and their efficacy, especially oil, while recognising the importance of the Physiocrats of the 18th Century in the history of their subject area.

For this author there has long been a need to focus more on pandemics and epidemics because of the large-scale disruptions, illness, and deaths they can cause. Here we are, therefore, at the core of biophysical economics. But because of the nature and transmissibility of infections, we are also in the realm of resource quality. Without improvements in avoidance of, or responses to, epidemics and pandemics, severe challenges to sustainability are liable to increase for as long as the human population expands, becomes even more urbanised, and travels more widely and frequently.

In this ‘Perspective’ paper, twelve books on epidemics and pandemics familiar to this author were the basis for

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attempting to address the questions: how well prepared were people for a new coronavirus pandemic; how timely and sound have the responses been to date (July 2020); and should there have been much greater awareness that “the Next Big One” was coming? The more effective the answers to those questions, whether at the national economy level or the individual well-being level, the better the reflection in biophysical economics and resource quality terms, although this paper does not attempt to estimate the economic value of either.

Each of the twelve books are among the References listed at the end of this paper. The term “Next Big One”, for example, is a feature of (Quammen 2013, p. 503). But what was the starting point for this contribution? It began several decades ago, listening to my elders talking about the 1918/1919 ‘flu epidemic, then reading about the plague of Justinian, the Black Death, and other plagues. Then my own experience of the 1957/1958 Asian ‘flu epidemic and awareness of those since has been an ongoing interest. Participating in the development of scenarios from the early 1970s, when it was strange to discover that there was little interest in considering the possible impacts of future epidemics or even pandemics on the energy sector and wider economy. I found visiting Chinese “wet markets” in the 1990s provided both unpleasant sights and aroused concern for their potential implications for human health. More recently, reviewing IASA’s 1852-page “Global Energy Assessment”, it seemed necessary to point out that a complete failure to mention possible future epidemics or pandemics was a strange omission (Jefferson 2015).

Some Background

It has been widely recognised, in the UK at least, that responses to past epidemics and pandemics have proved inadequate. Lori Loeb, for example, having examined discussions in *The British Medical Journal* and *The Lancet* between 1889 and 1919 concluded that it: “reveals confusion and lack of consensus”, as well as contradictory advice on remedies (Loeb 2005). A similar tale is told by Tomkins (1992). Tomkins wrote: “medical professionals and public health administrators deprecated the virulence of the epidemic and counselled the public to ignore its ravages”.

This is not the whole story of UK responses to past ‘flu epidemics—at the local level of administration and among lay members of public health committees there was evidence of more pragmatic attitudes, but these had only minor beneficial effects. Observing the effects of the 1957/1958 Asian ‘flu epidemic, this author noted that the standard response was to be sent to a sick room to join others in similar condition. The idea of social distancing seemed to be unknown, despite the responses in the USA 40 years earlier (see

below). For those with access to annual ‘flu jabs matters have since improved. Some of us, who are not medical people, have taken to acquiring numerous books and published papers in this and (my wife frequently reminds me) other fields.

When it became apparent that a new coronavirus pandemic had begun to sweep across the world in January 2020, the various comments and actions of US President Trump caused me to recall how previous Presidents might have reacted. For example, if George W. Bush had still been US President, things might have evolved very differently. I recalled that on 1 November 2005, he had announced plans to counter an influenza epidemic in the USA. He had announced the previous September a new International Partnership on Avian and Pandemic Influenza at a UN meeting. Why had President Bush taken this initiative? He had read either the first or second edition (2004 or 2005) of (Barry 2004). What, I wondered, if other politicians and those influencing policy had read this and other key books in the field? Would those countries and governments which have been slow or relatively ineffectual in their responses to COVID-19 have acted differently if they had? Was it merely geographical proximity to China which resulted in some East Asian countries apparently responding more effectively?

There have been, of course, numerous causes of epidemics and pandemics through human history—bubonic plague, smallpox, yellow fever, typhus, cholera, and HIV/AIDS among them. But influenza and, more recently, severe acute respiratory syndrome (SARS), have come to the fore over the past 60 or so years. Interestingly, and perhaps surprisingly given its focus on the influenza pandemic of 1918/1919, Barry’s book also mentioned coronaviruses and SARS, although we have no direct evidence that these references were major motivators of President Bush’s concerns (Barry 2004, pp. 102, 105, 250–251). However, it seems more than likely because, at that time in the USA, both Democrats and Republicans were speaking with one voice. In *The New York Times* of June 6, 2005, Senator Barack Obama (Democrat) and Senator Richard Lugar (Republican) stated: “Avian ‘flu outbreak is the most important threat we are facing now” (Oldstone 2010, p. 326).

Avian ‘flu was seen as the greatest threat in 2005, but it is important to recall that coronaviruses have been the subject of research since the early 1930s, and images of the crown-like halo around these viruses were first produced by June Almeida in 1964 with electron microscopy.

Of the twelve books mainly focussed upon here, eight refer to coronaviruses [Barry (2004); Honingsbaum (2020); Horton (2020); Kucharski (2020); Oldstone (2010); Osterholm and Olshaker (2017); Quick and Fryer (2018) and Waltner-Toews (2020)]. The others [Garrett (1995), Hays (2005), Quammen (2013) and Snowden (2019)] mention SARS and other epidemics since 1957/1958 which were

caused by influenza and other respiratory infections which are of relevance. Only two of these books refer to “super-spreaders” [Honingsbaum (2020) and Snowden (2019)], although the same phenomenon is referred to as “super-shedders” in Waltner-Toews (2020). It should be emphasised that (Honingsbaum 2020) has as its Chapter 7 the heading: SARS: “SUPER SPREADER” (pp. 167–196) in both its original 2019 edition and 2020 update, and there really should not be any excuse for the widespread surprise that “super-spreaders” caused from January to March 2020.

There have clearly been cases where individuals have had a remarkably high capacity to be asymptomatic spreaders, a trail which goes back to at least the early 20th Century with typhoid carriers Mary Mallon (Typhoid Mary) of New York City and Mr. N. the Milker of Folkestone, England.

Although the term asymptomatic has come into widespread use since the onset of the COVID-19 pandemic, the existence of a considerable delay between becoming infected and being infectious is not unusual. The term pre-symptomatic infectiousness would seem more accurate in such cases [see, for example: Anderson et al. (2020)].

There was also an early highlighting of the concept of “herd immunity”, the idea that if a sufficient number of people catch a virus then its transmission potential is reduced. This concept is linked to the focus during the first three or 4 months of the COVID-19 pandemic on the R-number (Reproduction number) and the importance of it not exceeding 1 if the pandemic is to have a good chance of coming under control. This is specifically mentioned in only [Kucharski (2020) and Quammen (2013)]. This is surprising as many scientific papers have been published on this precise topic over the past 15 years. (One of the best is arguably Stein 2011). However, whether—as is still claimed in some quarters—there is precisely a 20/80 rule (20% of a population contributing at least 80% to the transmission potential of a pathogen) has been strongly disputed. In July 2020, after examining people who had been struck down by COVID-19 in Munich and in London, researchers believe immunity maximises 3 weeks after infection is detected and only lasts for a few months.

Sources of Pathogens

In the context of the range of respiratory diseases considered here, not just COVID-19, the focus is on zoonotic diseases—which are caused by pathogens spreading between mammals or birds to humans. These diseases include most forms of influenza, avian ‘flu and swine ‘flu, Ebola, Marburg syndrome, MERS (Middle East Respiratory Syndrome), Zika, SARS coronavirus, and COVID-19. Most of these diseases, apart from the latest and last in this list, feature in all but one (Garrett 1995) of the twelve books focussed upon here. However, there are about seventy known zoonotic diseases,

and these include bubonic plague, leprosy, Lyme disease, rabies, and tuberculosis. The book by McNeill (1997) is a useful guide to the wider range of zoonotic diseases. HIV/AIDS once featured in this list (and is covered in several of the books listed here) for being originally zoonotic, though now generally regarded as passed only between humans. J. N. Hays provides an excellent history of epidemics and pandemics from the “Plague of Athens”, 430–427 BC, to modern times.

The threats caused by the species in which these pathogens originate—poultry, pigs, rodents, fleas, mosquitoes, Asian palm civets, pangolins, bats—are among those generally considered as likely to intensify as human population growth, urbanisation, increased travel (especially by air), inadequate personal hygiene, factory farming (poultry and pig rearing in particular), and destruction of the natural environment (especially deforestation) take place.

Large concentrations of factory-farmed poultry and pigs create one source of threat to human health. Rodents, fleas, and mosquitoes another set, which should be responsive to counter measures from repellents to improved human hygiene and cleansing. The third set encompasses some species which can be carriers of zoonotic pathogens, many of which are now considered to have their original source in bats.

China’s ‘wet’ markets have come under frequent attack as a likely source of widespread epidemics or pandemics. They are not pleasant places to visit. The Chinese authorities have again made recent efforts to discourage ‘wet’ markets, and even granted pangolins the highest level of protection (pangolins are an Asian and sub-Saharan species that were initially blamed as a likely source of COVID-19, although this now seems very unlikely).

Early work on coronaviruses, in the 1930s, was largely provoked by pathogens found in places of intensive poultry rearing in the USA, although there was an outbreak of ‘Russian ‘flu’—H1N1—in 1933 which mysteriously reappeared in 1977. Except for Ebola, Marburg, MERS, and Zika the respiratory diseases focussed upon since 1957 have originated in China in all but one case (the 1968 outbreak of Hong Kong ‘flu). As with COVID-19, the Chinese authorities were adversely criticised for not providing full information about SARS after it first broke out in Guangdong in November 2002. China eventually apologised to the World Health Organisation for not doing more to contain the disease in its early stages. China’s Health Minister, Jiang Zemin, was fired on 19 April 2003, for having claimed that China was “a perfectly safe place”, and Beijing’s Mayor Meng Xuenong was also fired for making misleading claims (Quick and Fryer 2018, p. 200).

Unfortunately, in the past there has been a reluctance to publicise sources and impacts in some countries, notably China. The case of six miners who picked up what appeared

to be severe pneumonia while clearing bat droppings from a disused copper mine near Tongguan, in Yunnan Province, is such an instance. Three of the miners died. There appeared to be a news blackout about this event until papers were published in 2016 and 2017 on the large number of SARS-related coronaviruses detected in horseshoe bats since 2005 in different areas of China, although two unpublished academic theses earlier gave clues. The victims were checked for antibodies, but no link to known viruses was found.

In 2012, a team from Wuhan led by Dr. Zheng-Li Shi had been called in to investigate bat faeces in the disused copper mine, took samples from 276 bats, and returned to the Wuhan Institute of Virology. It was discovered some horseshoe bats (*Rhinolophus affinis*) exhibited a “new” strain, RaBt-CoV/4991. Papers co-authored by Dr. Shi and her colleagues issued in 2016 and 2017 did not mention why the research had been carried out, the miners or the three deaths. The 2016 paper, published in *Virologica Sinica* (Vol. 31.1.31–40), did mention that the research had been carried out in an abandoned mineshaft in Mojiang County, Yunnan Province. The 2017 paper (published in *PLOS Pathogens*, 13.11:e1006698) referred to surveillance of mainly horseshoe bats over a period of nearly 5 years “from a single habitat in proximity to Kunming city, Yunnan province”. The paper’s lead author was Ben Hu, and there were sixteen co-authors. Dr. Shi was listed as having contributed: “Supervision”.

It has been claimed fears that the COVID-19 virus could have escaped from the Wuhan Institute of Virology as early as October 2019. Between 2003 and 2004, in the wake of the 2002–2003 SARS epidemic, laboratory-acquired SARS-CoV infection occurred in Singapore; Guangzhou and Beijing, China; and in Taiwan. Whether or not the COVID-19 virus had escaped from the Wuhan Institute of Virology, in Dr. Shi’s mind and that of others there was a risk of local contamination (recognising such things had happened in other laboratories, including in the USA), and this she made clear at a conference in Shanghai on 30 December 2019. The Chinese authorities immediately sought to silence her. In the USA, particularly, it has been claimed that the virus did indeed escape from the Wuhan Institute of Virology, but no firm evidence has emerged. The attitude and behaviour of some Chinese authorities had once again caused international concern, and encouraged many elsewhere around the world to believe there was an official wish to suppress the facts.

But whereas the initial response of some Chinese authorities was to try and batten down on news of a new outbreak of coronavirus infection, a group of Chinese scientists quickly published a paper: “A pneumonia outbreak associated with a new coronavirus of probable bat origin”, in the journal *Nature*. The paper’s lead author, Peng Zhou, and several other of the twenty-nine co-authors, had direct

links to the Wuhan Institute of Virology—including Dr. Shi. They reported a clear sequence identity between the latest outbreak of disease, dated to 12 December 2019, and the horseshoe bat coronavirus detected in Yunnan Province. This paper had been received by *Nature* on 20 January 2020; accepted on 29 January 2020; and published online on 3 February (and in hard paper version on 12 March). By 23 January 2020, the Chinese authorities had recognised the likely severity of the emerging COVID-19 pandemic and took effective action.

Although “the verdict on the virtues of China’s response remains to be written”, as has been noted in (Horton 2020, p. 19), Richard Horton—Editor-in-Chief of the British medical journal *The Lancet*—has also written: “I also believe that we must say this—Chinese scientists and health workers deserve our gratitude. I know from my own knowledge of these dedicated individuals that they worked tirelessly to understand the nature of this pandemic. They made it their duty to inform WHO when they were sure there was reason to signal global alarm. And, in my dealings with Chinese scientists and policymakers, I have observed nothing less than an extraordinary commitment to collaborate openly and unconditionally to defeat this disease” (Horton 2020, p. 22).

As this paper turns to the widespread failure to recognise the challenges of the spread of, and needed responses to, COVID-19, it seems worth mentioning that there had been several papers published earlier on the risks of SARS/coronavirus-like virus in Chinese bats, for example, Susanna et al. (2005). Cheng et al. (2007) was another which noted the role of horseshoe bats, and also the history of laboratory acquisition up to 17 April 2004. It was therefore somewhat surprising to see the title of a paper published on 8 June 2020: Zhou et al. (2020). By that date such a bat-source coronavirus had surely lost some of its novelty! The likely source and potential threats had also not gone unrecognised in some of the twelve books that form the foundation for this paper [Honingsbaum (2020), pp. 269; Oldstone (2010), pp. 230 and 357; Osterholm and Olshaker (2017), p. 167; and especially Quammen (2013), pp. 194 and 201].

Spreaders—How the Pathogens are Spread

The COVID-19 virus would appear to spread mainly via droplets from those infected, whether they show symptoms or not. These droplets may be large, coming from mouth or nose (sneezing) of the infected, and do not travel far. Or they can be small—aerosols—entering via mouth, nose, or eyes. Whereas in earlier ‘flu epidemics the impact of large droplets had been emphasised, for COVID-19 aerosols have rather belatedly been recognised as the likely widest spreader ever since evidence emerged of infection occurring in individuals at least 4.5 m away from spreaders, and when 33 singers out of 61 in a choir meeting near Seattle,

Washington, USA, contracted COVID-19 after a two-and-a-half hour practice session on either of both of March 3 and March 10, 2020, despite using hand sanitiser on entry and avoiding physical contact (two of them died). Curiously, it was not until 5 June 2020 that the WHO recommended the wearing of face masks where social distancing was not possible, and not until 7 July that it stated it would issue new guidelines to take account of aerosol transmission, especially where ventilation is poor and contact not wide (*Nature*, 8 July 2020). The early emphasis on sanitised hand washing was downgraded somewhat, though not eliminated, as was an early focus on how long the virus could exist on various surfaces and materials.

Most of the books listed here give an idea of how far, and how rapidly, contagion can spread. In the case of SARS from Guangdong to Hong Kong, to Taiwan, and to Toronto and Vancouver. Ebola passed rapidly across several West African countries. Zika was first recognised in Uganda, and then passed to Nigeria, Malaysia, across the Pacific and on to Brazil, before heading North across the Caribbean to Florida. West Nile fever also originated in Uganda before spreading widely, arriving in New York City in 1999, for example. From New York's two international airports in Queens Borough, West Nile fever is considered to have had a drastic effect on populations of bird species in the USA (including a 45% loss in the crow population) [Oldstone (2010), pp. 245–247].

The influenza epidemics of the past 60 years have been modest in their effects compared to that of 1918/1919, when about 50 million people are believed to have died from the 'flu, but they nevertheless caused considerable numbers of deaths. The 1957/58 Asian 'flu epidemic (H2N2) may have caused over three million deaths. The 1968 Hong Kong 'flu epidemic (H3N2) a similar number. The 2009 swine 'flu epidemic (H1N1) perhaps 500,000 deaths, a number COVID-19 is finally expected to exceed greatly.

A widely publicised case was that of UK national Steve Walsh, who had attended a conference in Singapore, caught COVID-19 but was asymptomatic for over a week, during which he enjoyed skiing with friends in the French Alps, before returning to England where he was diagnosed with COVID-19 despite showing no symptoms. He was estimated to have infected eleven people. There are presumably many other such cases of "super spreaders". Another UK national, Daren Bland, was skiing in Austria in mid-January with friends from Denmark and Minnesota, USA. They all attended a very crowded bar in their resort, and all picked up COVID-19. It is possible that another UK national had also picked up COVID-19 in Obergurgl, Austria, as early as 6 January. On 31 January 2020, the BBC reported that a Chinese student attending university in York, and his mother, had fallen ill by 29 January and were transported to hospital

in Newcastle-upon-Tyne, where they were diagnosed with COVID-19.

Such cases will no doubt prove useful when the time comes for an assessment of the timing and effectiveness of responses to the pandemic. More challenging for the Chinese authorities in particular are the reports that in October 2019, a number of European athletes fell ill while attending a sports event in Wuhan, and satellite evidence picked up by the Harvard Medical Centre that the number of vehicles visiting hospitals in Wuhan greatly increased above their normal volume between August and December 2019. *The South Chinese Morning Post* reported evidence of a new disease having appeared in its edition of 17 November 2020. Coronavirus traces were found in wastewater in Italy (Milan and Turin) on 18 December 2019, and in Spain (Barcelona) on 15 January 2020.

This evidence seems reminiscent of China's handling of the SARS epidemic from 2002, when its government initially denied the disease existed but was pushed into reversing this line by whistle blower Dr. Jiang Yanyong (Oldstone 2010, p. 227). In December 2019, Wuhan-based Dr. Li Wenliang also blew the whistle—this time on COVID-19 in what had been intended as a private warning to medical colleagues sent out on 31 December 2019. Dr. Li was also instructed to remain silent. He died on 7 February 2020, after contracting COVID-19. Eight other medical staff in Wuhan were also accused of spreading "false information" about COVID-19. On 17 April 2020, it was claimed in media reports that three Chinese journalists who had provided early reports on COVID-19 had not been permitted to report since. Over in Hong Kong Li-Meng Yan, a scientist at the Hong Kong School of Public Health, fled to the USA in order to expose the truth about a Beijing cover-up over the initial outbreak of COVID-19 because otherwise she believed her life would be endangered. On 31 December 2019, she had been informed by contacts in mainland China that human-to-human transmission was occurring. She reported this information to her manager, Leo Poon, who apparently ignored it. On 9 January the Hong Kong laboratory contacted the WHO with the information that the virus "does not transmit readily among people" (*The Times* of London, 13 July 2020).

Why did China's Public Security Bureau interview Dr. Li Wenliang and others, accusing them of making false accusations on 31 December 2019? Why was Dr. Li accused of "illegal rumour mongering", "disturbing public order", summoned to Zhongnan Police Station and "made to sign a statement declaring that his Weibo messages were incorrect and promising not to repeat the offence" when the Chinese authorities were already aware of the existence of "unexplained pneumonias" in the area? The local office of China's Centre for Disease Control, in Wuhan, had already dispatched a team to the local 'wet' market where they had identified 27 cases of "unexplained pneumonias", and on

30 December the Wuhan Municipal Health Committee had acknowledged that seven patients were in a critical condition (Honingsbaum 2020, p. 263).

Dr. Li's death aroused fury in various parts of China's social media and caused Professor Xu Zhangrun of Tsinghua University to draw a parallel with the attempted cover-up by the Chinese authorities of the SARS outbreak in 2002: "They stood blithely by as the crucial window of opportunity that was available to deal with the outbreak snapped shut in their faces" (Honingsbaum 2020, p. 265).

Full and unfettered investigation will be required to uncover the facts relating to the involvement or otherwise of Chinese authorities in relaying the facts concerning the outbreak of the COVID-19 pandemic. A fairly comprehensive 84-page report from China's National Health Commission was presented by its Director, Ma Xiaowei, as making clear: "The fact is that there's no delay or cover-up whatsoever by the Chinese government. Rather, it reported virus data and related information as soon as possible to the international community, making an important contribution to the cause of the global effort against the virus" (*The Times* of London, 8 June 2020, page 15).

Responses to the COVID-19 Pandemic

One of the most controversial aspects of the COVID-19 pandemic has been the speed, or lack thereof, in official responses in terms of preparedness, health checks, tracing, isolation, social distancing, and extent to which businesses and social activities should be cut back or closed down for a period of time.

It will already be clear from the previous section that those governments which failed to take action to limit exposure to COVID-19 until after 1 March 2020 were intervening over 6 weeks after the first cases were reported in Europe and the USA. They were intervening nearly 6 weeks after China had introduced stringent controls. In the case of the UK, there was a delay of at least 8 weeks before the UK authorities took major action in response to the pandemic. Among other countries considered to have unduly delayed or ineffectually conducted needed measures are the USA, Brazil, Italy, Spain, and Sweden (this last country has nevertheless managed to achieve relatively low confirmed cases and resultant deaths). By contrast, South Korea, Taiwan, Singapore, Vietnam, Australia, and New Zealand are rated more highly although there have since been brief secondary rises in South Korea, Singapore, Australia, and New Zealand.

Probably a more challenging issue is whether a second general wave of COVID-19 could occur. This is a highly sensitive issue as the second wave of the 1918/1919 'flu pandemic proved much more deadly than the first, and was believed to support the hypothesis that a second strain of the

virus in Europe had linked with the first originating in the USA (Barry 2004, p. 176). There has already been discussion of whether a second strain of COVID-19 has merged with the original one. That debate is likely to continue for some time, not least because it is believed that COVID-19 is more infectious in colder weather (the virus appears to flourish at around four degrees Centigrade), and therefore may be lurking around waiting to strike again in winter 2020/2021 in the Northern hemisphere. Also, by June 2020, there had occurred numerous new spikes in COVID-19 infection, in countries from Australia to the UK, following the lifting of some of the restrictions on people getting together.

The concerns about new spikes and a second wave are exacerbated by recent evidence (media reports on 13 July 2020) that immunity after displaying COVID-19 symptoms peaks after about 3 weeks and may last only a few months. This is the finding of research conducted at the Schwabing Clinic in Munich, and by a team at King's College, London (having examined ninety patients and healthcare workers at Guy's and St. Thomas's hospitals in London).

What Should Have Been Learned from Past Publications

However, there have already been numerous warnings from those engaged in seeking to curb the pandemic not to engage in hindsight. The purpose here is therefore somewhat different: what can past epidemics and pandemics covered in the relevant books suggest are the most effective responses? Thus, there is no need to resort to hindsight, the relevant information was already widely available.

The first lesson is that as so little is known about a particular virus, official communications are often vague or contradictory, and the exchange of information between officials and frontline responders far from systematised and sometimes non-existent (Quammen 2013, p. 164). Another way of putting this is that "bureaucratic lethargy and government inertia are never-ending blockages" (Oldstone 2010, p. 325).

Not being able to act because one does not have all the answers is "nonsensical"—we have to go into battle with the knowledge and resources we have, beginning with basic observation (Osterholm and Olshaker 2017, p. 47). If, for example, epidemiologists consider the evidence abundant "any delay in responding is an irresponsible and indefensible position". Or "You have to make adequate decisions based on inadequate information" (Osterholm and Olshaker 2017, p. 48). It is recognised that an inability to reliably and quickly diagnose patients has been a contributing factor to the rapid spread of viruses—such as Ebola—in the past (Osterholm and Olshaker 2017, p. 304).

Again there are numerous published papers which indicate that delayed actions increase mortality (for example,

Thomas Hale et al.: “Global assessment of the relationship between government response measures and COVID-19”, 2020, <https://www.bsg.ox.ac.uk>; and Anthony Lander: “The UK Covid-19 lockdown weakened in April and May 2020: implications for the size of the epidemic and for outcomes had lockdown been earlier”, 2020, Creative Commons Attribution.)

The general guidelines for dealing with an influenza-type pandemic remain based upon the experience in 44 US cities during the 1918/1919 ‘flu pandemic, thus quite specifically in the USA. This would seem antiquated but has in principle served the purpose quite well (Oldstone 2010, p. 325). It is astonishing that almost 100 years later they were not almost immediately implemented around the world.

These guidelines include (listing them in the order they appear in [Oldstone (2010), p. 326]: “(1) closing all schools for up to 3 months; (2) cancelling athletic events; (3) closing churches, theatres, and areas of assembly; (4) working staggered hours to ensure less crowding in public transportation vehicles; (5) limiting contact with the sick by isolating and quarantining them in their homes or treatment centres, preventing public gatherings, encouraging use of face masks, and providing public education”.

Among the many recent papers considering responses in the USA to the 1918/1919 ‘flu pandemic are Bootsma and Ferguson (2007), Jester et al. (2019), Markel et al. (2007), Ott et al. (2007), Shanks (2015), and Stern et al. (2009).

Although the words “novel” and “unprecedented” keep on cropping up in discussion of COVID-19, therefore, they would appear to be misleading. A recent paper covering China, the USA, South Korea, Italy, France and Iran claimed: “Governments around the world are responding to COVID-19 with unprecedented policies designed to slow the growth rate of infections” (Hsiang 2020). Another paper, covering eleven European countries, claimed that: “In response (to the pandemic), many European countries have implemented unprecedented non-pharmaceutical interventions such as closure of schools and national lockdowns” (Flaxman 2020). Some may question usage of the word “unprecedented” here.

These two papers do appear to set out strong grounds, on the basis of their modelling, for concluding that these measures had greatly reduced infection and mortality up to early May 2020. The paper on the eleven European countries noted that the onset of interventions took place between 2 March 2020 (Italy) and 29 March. China introduced strict measures (including social distancing, staying in homes, travel restrictions, case isolation and quarantine) on 23 January. There can scarcely be any doubt that there was undue delay in introducing such measures in both Europe and the Americas.

Then from June 2020, public debate arose in many countries about the soundness of introducing lockdown and social

distancing measures to tackle COVID-19 spread, mainly on the grounds of their feared effects upon economies, jobs and incomes, education, and mental health. Others claimed that such measures were, and had been proven to be, ineffectual (which earlier such measures would have exposed as ill-founded). Few appeared to recall that: “It was only thanks to the low transmissibility of SARS and the fact that China and other Asian countries had been able to introduce ‘fairly draconian’ public health measures, such as home isolations and mass quarantines, that disaster had been averted”. Roy Anderson at a post-mortem meeting at The Royal Society in London predicted: “such measures would have met greater resistance in North America, where people tend to be more litigious, and to a lesser extent in western Europe” (Honingsbaum 2020, p. 195). The literature considered in this paper would seem to support the view that early action by Asian countries has helped them reduce the impact of COVID-19; earlier action by many other countries would have helped them; and the higher transmissibility of COVID-19 compared with SARS provides an even stronger case for “fairly draconian” measures.

United Failures?

The USA and the UK have come under strong adverse criticism for their mishandling of the COVID-19 pandemic. First a look at the USA under President Donald Trump.

It would add little to repeat the comments made by President Trump since COVID-19 arrived in the USA. There is a selection in (Horton 2020, p. 12). Also in (Horton 2020) there is the charge against President Trump that his decision to halt US funding of the World Health Organisation was incendiary and, the author claimed, “a crime against humanity”. The author points out that the WHO “exists to protect the health and wellbeing of the world’s peoples” and was “doing all it could to protect peoples in some of the most vulnerable countries in the world” (Horton 2020, p. 27). President Trump accused the WHO of “severely mismanaging and covering up the spread of the coronavirus”. On 6 July President Trump formally moved to withdraw the US from the WHO, partly on the grounds, it was claimed, of the WHO’s refusal to respond to reforms the US Administration had sought. The process could take a year, and the move was strongly criticised by many—including Joe Biden, standing in the Presidential election in November 2020.

What President Trump appears to have been unaware of is that Chinese officials in Beijing, following receipt of a report from Wuhan, immediately informed the WHO’s office in Beijing, and on 1 January 2020, the WHO set up an Incident Management Support Team to investigate the outbreak. By 3 January 44 new cases of COVID-19 had been reported. On 5 January the WHO issued a formal official notification of the outbreak, and a few days later

began the process of gathering support for a Public Health Emergency of International Concern (PHEIC).

A PHEIC requires general recognition that the disease constitutes an international public health risk and requires a co-ordinated international response in order to control it. Unfortunately, the first Emergency Committee meeting on 22/23 January found its members evenly split on whether to back a PHEIC and the WHO's Director-General felt unable to act without more support (Horton 2020, pp. 12/13). The Statement issued on 30 January after the second meeting of the Emergency Committee included in bold script: "The Director-General declared that the outbreak of 2019-nCoV constitutes a PHEIC" and issued advice to China, to all countries, and to the global community. All countries were asked to: "be prepared for containment, including active surveillance, early detection, isolation and case management, contact tracing and prevention of onward spread". Particular emphasis was then placed on preventing international spread, although at this point the WHO did not recommend any travel or trade restriction based on the information then available. A WHO team which visited China between 16 and 24 February was highly impressed by the containment measures which had been put in place (Horton 2020, p. 45).

The speed of WHO responses was quicker than that of most other countries, the USA and UK among them, both of which have experienced very high numbers of coronavirus cases and deaths. In the USA, the number of cases by mid-August 2020 was close to 5.5 million: the number of deaths approaching 170,000.

In the UK over 314,000 coronavirus cases had been identified and over 46,700 deaths reported by mid-August 2020. (Another official source, the UK Office for National Statistics put the figure for COVID-19 deaths in England and Wales alone at 51,505 between 22 March and 24 July 2020.) Yet the UK's Prime Minister, Boris Johnson, was clear as late as 3 March 2020 that the UK "remains extremely well-prepared" to meet a pandemic, continuing to shake hands, and only advised hand washing until he became a victim of COVID-19 on 27 March (Horton 2020, pp. 11 and 50).

Back in October 2016 Public Health England had carried out Exercise Cygnet, and produced a confidential report on behalf of the UK Department of Health, published as "Official—Sensitive" in July 2017. The 57-page Report was sub-titled "Tier One Command Post Exercise". It has been claimed that: "The result of Cygnus was a stark warning: UK preparedness was 'currently not sufficient to cope with the extreme demands of a severe epidemic'" (Horton 2020, pp. 25 and 55) *The Guardian* of 7 May 2020, referred to its "key learning" that "the UK's preparedness and response, in terms of its plans, policies and capability, is currently not sufficient to cope with the extreme demands of a severe pandemic that will have a nationwide impact across all sectors".

This was a correct quotation from page 6 of the Cygnus Report,

Not all readers of the full Report thought it reached such a dark conclusion. After all, "the response planning system is robust", the Report declared on page 28. On the following page, having repeated this claim, the Report "also identified a number of aspects of the response that could be strengthened particularly with respect to surge and triage management; and management of excess deaths and business continuity." Admittedly "further work would be required to consider surge arrangements for a reasonable worst case scenario" (page 30) and, worryingly, there had been "limited feedback about the provision of scientific advice" (page 23).

The Report provided the outline of an influenza pandemic scenario beginning in Thailand in June; the virus isolated in July at the CDC in Atlanta, Georgia; the WHO declared a PHEIC also in July; and on 12 September the UK's anti-viral stockpile was activated. A fortnight later the WHO declared a pandemic, and on the same day (26 September) the scenario had all ordering arrangements in place for respirators and Personal Protective Equipment. What struck many readers was not the inadequacy of preparedness but the claim of an overall robustness despite the length of time between the onset of the pandemic and the anticipated UK response.

There was one reference in the body of the Report to the availability of Personal Protective Equipment (PPE), on page 25, but this only referred to the need to provide for recently retired nurses and care workers. There was no specific reference to the need to protect all medical staff and care workers. The only other issue the careful reader of the Report would have picked up (on pages 14 and 25) was the possible need for a rapid discharge protocol for quick decisions on whether someone should stay in hospital or be discharged to residential or community care, or home.

The Government's advice, according to the Report, was for schools to remain open, so the Report's mention of studying the impact of school closures (on page 22) seemed scarcely relevant. As it turned out schools were quickly closed for all except the children of essential workers.

From early March 2020, the Report's throw away lines were shown to signal the prelude of one disaster after another. As explained in (Horton 2020, pp. 78–81) UK medical staff and care workers "were left unprotected because governments had failed to procure sufficient supplies of protective equipment as soon as PHEIC had been declared. It was a stunning act of administrative omission and certainly cost the lives of dozens of health workers in some of the most affected countries". There are 37 different quotes in (Horton 2020) from health workers claiming they did not feel protected, it was terrifying, shambolic, and they felt completely abandoned. Often the PPE that was available was of substandard quality or design. Then into July 2020, there were numerous reports of delayed contracts worth

millions of pounds sterling going out to companies for the supply of PPE which had never before had any experience of supplying medical equipment—but had some sort of business experience in purchasing goods from countries such as China. The UK government was accused of over-promising, and even of lying (Horton 2020, p. 78).

Worse was to come, especially in the UK. There was a fear that the pandemic would induce such a demand for intensive care units that National Health Service hospitals (and those in the private sector) would be unable to cope with the needed number of beds. [This concern found expression, *inter alia*, in: Davies (2020)].

This concern, which the Cygnus Report had made reference to, failed to materialise. Only a few beds in one of the temporary Nightingale hospitals specially built to cope with the expected influx of COVID-19 patients were ever occupied. Unfortunately, many potential patients with other maladies—heart, stroke, cancer—have found assessment and treatment delayed, some with fatal consequences. It has now been frequently suggested that many avoidable early deaths from cancer could have been avoided if access to hospital treatment had not been massively reduced.

But the Cygnus Review's view that rapid discharge from hospital, particularly for elderly patients, was to have its fatal consequences. On 3 July 2020, the UK's Office for National Statistics announced that between 2 March and 12 June 19,394 deaths of care home residents involved COVID-19. Of these, 14,519 occurred in care homes (residential homes specially intended to care for numbers of the, often infirm, elderly) and 4810 occurred in hospitals. Male mortality had been significantly higher than female mortality. This spike in care home mortality is widely considered to have been the result of discharging elderly patients from hospitals into care homes from mid-March 2020, without checking them for COVID-19 infection, due to the pressures to free-up hospital beds. Care home workers were in many cases unable to access PPE (a problem which was also experienced by many hospital and other health workers as noted above). Care home owners and supervisors were in some cases threatened with legal action if they did not comply with demands to accept patients from hospital. Depending upon whether one bases the figures on those directly attributed to COVID-19 or excess deaths, between 31 and 45% of total UK deaths attributed to COVID-19 by early July 2020 occurred in care homes.

Jeremy Hunt, Secretary of State for the UK's Department of Health for 6 years until 2019, in an interview published in *The Times* of London newspaper on 11 July 2020, stated that “reducing the number of avoidable deaths” was the “most passionate” thing he felt about that role. He now considers the scientific advice provided was wrong; and the UK “unfortunately followed a ‘flu policy, not SARS”. He also stated: “We did lock down too late”.

No historical precedent has been found in the literature considered here for the plight which so many UK care homes and their residents were subjected to. Scotland and then England have been disproportionately affected. The evidence to date suggests that in addition to patients being discharged from hospital into (often back to) care homes without being effectively tested for COVID-19 symptoms, not only permanent care home staff but also—more significantly it is believed in the sector—temporarily employed staff who were or became infected with COVID-19 have been the source. It is also the case that whereas COVID-19 has struck down the elderly disproportionately, this has not always been the case with zoonotic viruses.

In the case of COVID-19, there is concern that children under the age of five may suffer from a link to Kawasaki disease, named after a Japanese researcher in the 1960s, which has been traced back to a case in the 1870s. Kawasaki, although generally treatable, can result in heart disease. It is only mentioned in (Garrett 1995) of the twelve books covered here, but although its existence has mainly been noted in Japan it has spread geographically in recent years. It has been suggested that COVID-19 can be linked to inflammation of the heart in children, but not precisely to Kawasaki disease. Although young children are considered to be low spreaders of COVID-19, by July 2020 there was growing concern that children of secondary school age may have greater spreading capacity.

There is increasing evidence that many of those infected by COVID-19, of all ages, are continuing to suffer heart and lung conditions, fatigue, and loss of some functions such as hearing and touch.

A further potential complication is that the availability and reliability of tests for COVID-19 remains in doubt as of August 2020. As the literature points out, the development of rapid tests has not been keeping up with needs, and rapid point-of-care tests for various diseases have been shown to be less reliable than microscopy and lab-based tests (Quick and Fryer 2018, p. 184). Even tracking has proved problematic in some countries.

On 7 June 2020, John Edmunds—a Professor of epidemiology and member of the UK's Scientific Advisory Group for Emergencies (SAGE) expressed the view in a television programme: “I wish we had gone into lockdown earlier. That has cost a lot of lives”. Matt Hancock, UK Secretary of State for Health, responded that there had been a broad range in SAGE of scientific opinion and the UK government had sought to be guided by the balance of opinion.

The literature surveyed in this paper and the opinions expressed therein suggest scientists advocating early action, even when only partial evidence is available, should receive the greatest attention. Most observers, it was mentioned in (Horton 2020, p. 56), were astonished when the UK's Deputy Chief Medical Officer, Dr. Jenny Harries, called

the UK's state of preparedness an "international exemplar". In reality the UK's official response was "collusive" as selected scientists and politicians acted together to protect the government and promote the idea that an "international exemplar" was at work (Horton 2020, p. 58). Several other countries could lay claim to that description, mainly in Asia but, in Europe, only Germany seemed a likely candidate—a country that had started testing, contact tracing, and isolating infected patients early in February 2020.

The Need for an Effective Global Response Organisation

Much has been written in the past about the need for better and greater funding of preparedness for epidemics and pandemics (Garrett 1995), and reform of the World Health Organisation (Osterholm and Olshaker 2017, pp. 291, 310–314, 318; Quick and Fryer 2018, pp. 194–197). The world is currently well short of the "sophisticated and well-organized global network" which many epidemiologists consider is required (Oldstone 2010, p. 324). Even those broadly supportive of the WHO and its role in providing early global warning about COVID-19 have been critical of the organisation's failure to follow up by convening a summit of nations to initiate and lead a co-ordinated response. "It absented itself from its global leadership role, leaving countries to struggle to respond to COVID-19 alone" (Horton 2020, p. 103). Further criticism has arisen because the WHO has indicated that, during its planned mission to visit China to investigate the origins of COVID-19, it would only look at "the zoonotic source" of the outbreak and would not visit Wuhan's Institute of Virology. Richard Ebright of Rutgers University and Nikolai Petrovsky of Flinders University (Australia) are among those who have stated that to have any credibility an investigation must address the possibility that the virus could have entered humans as a result of a laboratory accident or even laboratory manipulation (*The Sunday Times* of London, 12 July 2020, page 16).

Two chapter headings in (Quick and Fryer 2018) seek to ring the alarm bells: "Invest Wisely, Save Lives"; and "Ring the Alarm, Rouse the Leaders". The Bill & Melinda Gates Foundation and the Wellcome Trust together with the support of some governments have funded the Coalition for Epidemic Preparedness Innovations (CEPI). The EcoHealth Alliance and the Global Virome Project are among other relevant initiatives (Honingsbaum 2020, pp. 271–273). It has been over-optimistically claimed that among the "ambitious networks and programmes" that have been created are the World Health Organisation, various Centres for Disease Control and Prevention (the US CDC has come under stringent criticism from *The New York Times*), and other international and national agencies (Quammen 2013, p. 513).

A more realistic and pessimistic note is sounded in Chapter 21: "Battle Plan for Survival" of (Osterholm and Olshaker 2017) It begins: "We have no illusions about what is likely to be accomplished on our Crisis Agenda in a world divided on so many different levels". A Manhattan-type project is required to tackle viruses and provide vaccines; CEPI needs support and substantial expansion; adopt a One Health approach to human and animal diseases throughout the world; and maximise preparedness for a bioterrorist attack.

It has been claimed that: "Nothing shines a light on the quality of a country's leadership more than a public-health crisis" (Quick and Fryer 2018, p. 200). US Presidents George W. Bush and Barack Obama would appear to have had a different stance on epidemics and pandemics than President Trump. Some reports on the responses to COVID-19 in the USA have suggested that there were "revealed failures across government", "a lost month", and "lack of leadership at multiple levels" (Michael D. Shear and five others, 28 March and 1 April 2020, *The New York Times*). *The New York Times* returned to the theme on 3 June 2020: "The technology was old, the data poor, the bureaucracy slow, the guidance confusing, the administration not in agreement. The coronavirus shook the world's premier health agency, creating a loss of confidence and hampering the U.S. response to the crisis" (a lengthy article by Eric Lipton and six others). The US Centre for Disease Control and Prevention came in for severe adverse criticism for making early testing errors, failing to provide timely counts of infections and deaths, and took insufficient account of "the perils of silent carriers spreading the infection".

There have been numerous calls to improve the scientific basis for readiness (Quammen 2013, p. 513), but this should encompass not only natural zoonotic spread of diseases to humans but also bioterrorism (mentioned in Garrett 1995; Oldstone 2010; Quammen 2013; Quick and Fryer 2018; Snowden (2019).

One potentially good feature of COVID-19 for the longer term is that scientists, academic institution, private companies, policy advisors, and governments "have openly shared information in ways that were unimaginable even 5 years ago" (Waltner-Toews 2020, p. 245). But even David Waltner-Toews warns us: "In the midst of the COVID-19 pandemic, the models were everywhere in evidence, guiding many national and international policies. What became quickly apparent was that there was not a single scientific model and hence not one global policy. There were many models and many policies" (Waltner-Toews 2020, p. 238).

Perhaps most importantly for epidemiologists and related scientific specialists looking at past, the current, and potential future pandemics are the lines that conclude Adam Kucharski's book (Kucharski 2020), and which reflect the experience and views of most of the others whose books are cited in this paper:

In outbreak analysis, the most significant moments aren't the ones where we're right. It's those moments when we realise we've been wrong. When something doesn't look quite right: a pattern catches our eye, an exception breaks what we thought was the rule. Whether we want an innovation to take off or an infection to decline, these are the moments we need to reach as early as possible. The moments that allow us to unravel chains of transmission, searching for weak links, missing links, and unusual links. The moments that let us look back, to work out how outbreaks really happened in the past. Then look forward, to change how they happen in the future (Kucharski 2020, p. 266).

For society at large around the world the lesson is, or seems, simpler:

What is abundantly clear, however, is this: thousands of lives have already been lost, not due to lack of knowledge—we have had plenty of warnings—but because of our collective failure, abetted by complacent politicians, to take those warnings sufficiently seriously and to prepare for the pandemic that virologists and other experts told us was coming our way. It is to be hoped that, after Covid-19, no one will be foolish enough to make the same mistake again (Honingsbaum 2020, p. 278).

If, as this author believes, the risks of future epidemics and pandemics and the negative consequences are so high, then those whose interests are focussed on biophysical economics and resource should be well placed to contribute their experience.

Conclusion

The interconnections between the natural environment and the human economy are central to biophysical economics, and resource quality is of high importance for human well-being. Knowledge, and preparation beforehand, of the risks of zoonotic diseases should be fundamental requirements for political, economic, and medical decision-makers in the 21st Century.

Consideration of some of the previously published and readily accessible literature on epidemics and pandemics made in this paper has indicated that, although COVID-19 has some distinctive features, there are numerous lessons that can be learned from experience—not least from epidemics over the past 60 years. Apart from some countries in East and South-East Asia, there was a disturbing lack of preparedness and too slow a response to COVID-19. This

has cost many lives, even though the belated measures have also saved many to date.

This paper has not engaged in hindsight. It has looked at readily available earlier experience, encapsulated in readily available published sources. If they had received proper attention thousands of lives could have been saved, and hundreds of thousands of illness avoided. For example, all the books surveyed here have shown the need for being prepared (which surely must include personal protective equipment for all who may be exposed to hazard); speedy responses—including social distancing, curtailment of travel, testing and tracking; cautious relaxation of restrictions; and greater efforts to achieve the establishment and funding of an effective global institution to monitor and respond to epidemic and pandemic threats.

The lessons and recommendations to be learned from the books and published papers referenced here, when combined with similar lessons learned recently, could collectively serve as an excellent springboard for a needed much more comprehensive global plan for addressing future pandemics, which potentially could prove worse than COVID-19.

This paper has not considered the broader economic and general resource consequences of past epidemics or the current pandemic in any detail. These are clearly huge, from losses of business transactions, employment, income, and educational opportunities, to mental health issues for some. How large the losses for national economies and how soon they will recover, with what sorts of adverse consequences along the way, remain to be discovered. Admittedly, some countries have taken bold steps to try and mollify these effects. The implications for resources—medical and natural, for example—are also unknown territory. What we eat, how we provide and prepare it, will all come under additional scrutiny. International political and trade relations will come under pressure, not least with China.

In a world where the human population is still increasing, urbanisation continuing to rise, and travel seemingly ever wider and frequent, sustainable development is under increasing stress. The assumption that technological advances can and will resolve emerging issues has long been questioned in some quarters. The increasing and (hopefully) largely uninterrupted flows between natural resources and human society form the foundation of biophysical economics, resource quality, and sustainability. For those engaged in biophysical economics and assessment of resource quality COVID-19 should be of intense interest.

The “Next Big One” (Quammen 2013) has come. By mid-August 2020, there had been 21 million confirmed cases of COVID-19 worldwide (almost certainly an underestimate) and over 750,000 deaths. Will we be better prepared for the “Next One After This”?

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