

# Introduction



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## 1 Introduction

At a number of points in the twentieth century, bold proclamations were made to the effect that the era of infectious diseases was coming to a close, and that humanity would soon no longer be afflicted by the microbes and viruses which had plagued humanity hitherto. The most notable of these comments came in 1962, when the noted virologist Sir McFarland Burnett stated that “[b]y the end of the Second World War it was possible to say that almost all of the major practical problems of dealing with infectious disease had been solved”.<sup>1</sup> A few years later, in 1970, the Surgeon-General of the United States of America, William H. Stewart, claimed that it was “time to close the book on infectious diseases, declare the war against pestilence won, and shift national resources to such chronic problems as cancer and heart disease”.<sup>2</sup>

Looking back, these comments may seem naïve; however, they were not as wild as they may appear—and it is tempting to bask in some of their optimism even now. Smallpox—the last natural case of which was reported in 1977, and which was declared eradicated in 1980<sup>3</sup>—provides the paradigmatic example of humanity being able to eliminate at least one of the thousand natural shocks that flesh is heir to. The eradication of polio has been promised for some time now, and though that

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<sup>1</sup>Brachman (2003).

<sup>2</sup>Spellberg and Taylor-Blake (2013).

<sup>3</sup>World Health Organisation, ‘Smallpox’ <https://www.who.int/csr/disease/smallpox/en/> last accessed: 22nd December 2018.

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aim does keep slipping through our fingers, it is still tantalisingly close. Not all infectious diseases will be eliminated in the foreseeable future, but programmes of vaccination intended to reduce their prevalence have made an important difference for the better, and continue to do so; innovations such as antibiotic drugs historically gave reason to think that the mortality and morbidity rates associated with other diseases could be slashed. Finally, improved surveillance and reportage provided the means to make better public health interventions. A host of infectious diseases that had caused widespread misery throughout human history had, in the hundred years preceding Burnett's and Stewart's comments, either been eradicated, or largely brought under control.<sup>4</sup> Why not take that as a sign for the future?

However, events in the closing couple of decades of the twentieth century and the first decade or so of the 21st have eroded such hope. The years since Burnett's and Stewart's comments saw the emergence and spread of new diseases such as HIV/Aids, hepatitis C, Sudden Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS) and a number of haemorrhagic fevers; they saw too the resurgence of diseases once considered confined to the history books or controllable, such as cholera and malaria. Indeed, as we write this Introduction, the second largest ever outbreak of Ebola virus disease continues to impact the Democratic Republic of the Congo and a pandemic of COVID-19 coronavirus shows very little sign of ending.<sup>5</sup> Moreover, we are also faced with very real prospect of many antibiotics ceasing to be effective, rendering even routine surgery a potentially life-threatening prospect.<sup>6</sup>

It therefore seems an appropriate time to reflect on the state of our responsiveness to the threat of infectious diseases in the early twenty-first century, and determine what, if any, lessons we can learn from the recent past. What are the problems that remain that need to be addressed by policymakers? To this end, this collection draws together scholars from across the globe, and across disciplines to create a multi-disciplinary perspective on what, if any, lessons we can learn from such infectious diseases in the new millennium.

## 2 Themes

It is a commonplace to point out that humanity is the only species that has the slightest regard for national borders. Microbes do not stop to get their passports stamped. However, the scope of moral concern is not defined by jurisdictional boundaries either: if the suffering of a compatriot wholly unknown to us has any moral claim to our attention at all, then surely so does the suffering of a foreigner. Even if we think that compatriots should for some reason count for more than foreigners, it does not follow that foreigners count for nothing; they still have a moral gravity that can,

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<sup>4</sup>Brachman, (n 1).

<sup>5</sup>World Health Organisation (2018).

<sup>6</sup>World Health Organisation (2014).

does, and should influence our behaviour. Is this kind of cosmopolitanism anything more than a fashion, though—and a dying one at that? One might think that there are signs that this is the case. Donald Trump’s inaugural address as President of the United States told listeners that

a nation exists to serve its citizens. [...] From this day forward, a new vision will govern our land. From this moment on, it’s going to be America First.<sup>7</sup>

Admittedly, to say that a nation exists to serve its citizens does not mean that it may not serve others: Trump might have meant that a nation exists *primarily* to serve its citizens, or—which is not the same thing—to serve its citizens *primarily*. Likewise, “America first” is compatible with “and others close behind”. But these imputations are departures from what he said; and it is fair to infer from his words—and his behaviour since—a certain looking inwards, perhaps bordering on isolationism. Neither is this attitude unique to the 45th President: we write this at a time when populist movements throughout the developed world are making hay from parochialism of one sort or another.

But even the most hyperbolically or childishly isolationist policy platform has a reason to care about disease in other lands. As noted, pathogens do not recognise borders, and are not halted when the people or the winds, animals, and rivers carrying them cross from one state to another. An outbreak of disease in a country may incentivise the movement of people, which will spread its reach further. It may cause economic damage—which will itself incentivise migration, and which has knock-on effects for other countries anyway. Closing borders in this sort of situation may be counterproductive: the incentive to move will remain, but if all migrants are rendered illegal by the stroke of a pen, the incentive to seek treatment that might help prevent an outbreak in the host country will be nullified. A policy of national self-interest means, then, that states have an indirect interest in what happens in their neighbours, like it or not. To treat illness as anything other than a transnational problem is therefore not only morally questionable, but—if they stop to think about it for a moment—too short-sighted even for today’s populists. Parochialism can be *too* parochial.

But if diseases are not neatly confined to states, what does this mean in reality?

One of the prevailing themes of this collection is the fact that the detection, response, and control of infectious diseases has moved clearly beyond the state-based paradigm, and now encompasses a range of non-state actors. While in some respects this is nothing new—the Pan American Health Organisation and the International Health Office of the League of Nations were both created in the early 1900s, and the World Health Organisation was created in 1948,—responses to infectious disease outbreaks in the twenty-first century have been characterised by the presence of an ever more diverse range of actors, carrying out an ever more diverse range of tasks in place of the state. Included in this is the increasing role of the United Nations and through the securitisation of global health agenda, which has resulted in two Security Council Resolutions concerned with infectious diseases. The first, Resolution 1308 in 2000, recognised the potential of the Aids epidemic, if unchecked, to pose a risk to

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<sup>7</sup>Trump (2017).

stability and security, and largely focused on the potential of HIV/Aids to affect the health of UN peacekeeping personnel.<sup>8</sup> Resolution 2177, passed in 2014 in regards to the West African Ebola outbreak,<sup>9</sup> was the first Resolution to acknowledge a health issue as an ongoing threat to peace and security, and was also the impetus for the creation of the United Nations' first ever health-related mission: the United Nations' Mission for Ebola Emergency Response (UNMEER).

The increased role of the United Nations in matters of public health has not been entirely without its problems. UN forces became an unwitting vector for infectious disease in Haiti in 2010, introducing the cholera bacterium to the country and thereby causing a serious outbreak of the disease. This was something that the UN attempted to cover up for nearly six years.<sup>10</sup> This episode is considered in detail in this anthology by Adam Rainis Houston, who argues that the containment of cholera is at the heart of a longstanding legal principle, which the UN violated. While there may be things that we can learn from cholera as we respond to threats such as Ebola, what remedy might be available to the people of Haiti in the meantime is not obvious: Houston's conclusion is that Haiti's first encounter with cholera "has resulted in much legal debate but little justice". This episode is not the only one considered in the anthology to consider Haiti in the context of public health: Mason Maier, Evans and Phelan's paper notes the harm done to that country by policies intended to curb the spread of HIV.

Of course, the UN is not the only non-state actor to respond to public health emergencies, as is shown by the role of organisations such as Médecins Sans Frontières<sup>11</sup> and the Red Cross<sup>12</sup> in responding to—inter alia—the West African Ebola outbreak in 2014. But the involvement of a multitude of actors, with heterogeneous structure, liabilities, and legal standing on the international stage is not without its added complexities. Notably, not all agencies are civilian: as Kamradt-Scott notes, military involvement in public-health related interventions brings a raft of problems of its own. Civilian agencies have reason to be wary of military involvement, not the least of the reasons for which is that such involvement may erode trust and, at best, make aid agencies look partial. Military organisations, too, have reasons to be wary of getting too involved in aid work: their primary responsibility is to their national governments. And yet there are times when civil and military bodies must work together. Moreover, military bodies come with their own medical teams, which are—Kamradt-Scott notes—presumably beholden to some standard of medical ethics; and the Hippocratic ideal of doing no harm is a relevant consideration. The doctrine of doing no harm can be taken to mean simply that healthcare professionals

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<sup>8</sup>UNSC (2000, 2011).

<sup>9</sup>UNSC Res 2177 (18th September 2014) UN Doc/S/Res/2177.

<sup>10</sup>Katz (2016).

<sup>11</sup>Hofman and Au (2017).

<sup>12</sup>See: The International Red Cross and Red Crescent Movement Response to the West African Ebola Outbreak 2014 by Christy Shucksmith-Wesley p. 70.

ought not to harm when they can avoid it.<sup>13</sup> But it is—at least sometimes—interpreted as a contributory consideration in the idea that it is the job of the medical professional to *allow* no harm, or to be *beneficent*, not just non-maleficent.<sup>14</sup> This being so, it is plausibly part of the job of the military medic actively to pursue health, too. But how might one reconcile military loyalties with a perceived moral obligation to intervene? And what about things that militaries can do that other agencies cannot?

For example, were militaries to reconnoitre mobile phone text-messaging to identify potential infectious disease outbreaks in a health crisis, would this be ethically sound given that it is a breach of individuals' privacy?

There being a public health emergency might make a difference to how we should answer this question; it might make a difference to how we answer other questions. It might not. As things stand, there is little guidance, let alone explicit rules, to govern how military agencies should act during a health crisis.

This does not mean, of course, that things are always much more straightforward when the military is not involved. Christy Shucksmith-Wesley's chapter considers some of the complications surrounding the Red Cross' work, with particular reference to its interactions with bodies such as the WHO. Using the 2014 Ebola outbreak as her reference, she compares the ability of the Red Cross and other organisations to respond to emerging crises. Once again, we are led to the conclusion that there is more that needs to be done when it comes to regulating and organising NGO roles. "New ground," she argues, "needs to be broken in the future coordination of humanitarian responses to infectious disease." Spotting a problem, and diagnosing it correctly, will not yield a solution—one possibility is that there should be one overarching coordinating body, though Shucksmith-Wesley would herself not necessarily be in favour—but it is a vital first step in working out what to do next.

The 2014 Ebola outbreak, with a particular emphasis on the WHO's role and response, also motivates Eccleston-Turner and McArdle's chapter. Their exploration of the criteria for declaring—and the obligation to declare—a Public Health Emergency of International Concern echoes, in important ways, the themes raised in the opening paper of this anthology, concerning the obligation to act to limit cholera's spread. Though the paper is ostensibly a piece of legal analysis, it is nevertheless true that it points us towards important themes from political philosophy and international relations: what is the nature—indeed, the ontology—of a transnational body? In what sense can an organisation have duties and responsibilities? How can those duties and responsibilities be enforced? And, in the final analysis, what would justice look like if and when those duties and responsibilities are not properly discharged? After all, those who are most vulnerable to illnesses such as Ebola are overwhelmingly people who live in the greatest economic and political precarity already, in countries whose

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<sup>13</sup>We take it as a given that never harming is an implausible demand, since surgery inevitably does harm in the pursuit of a longer-term good: the injunction must be interpreted as "do no harm without good reason".

<sup>14</sup>See Beauchamp and Childress (2013) *passim*.

governments are least able (and sometimes least willing) to press the case on behalf of their citizenry.

“There are numerous practical limitations to finding and giving effect to any determination of responsibility in relation to an international organisation like the WHO,” Eccleston-Turner and McArdle write, continuing:

Not only is there a question about a lack of judicial fora before which cases on breach of international law by international organisations could be brought, but there is also the question of practical consequences arising from actions before such courts, if one with appropriate jurisdiction could be identified. A determination of responsibility gives rise to an obligation to make reparation. The extent to which this is possible in the present case, both in terms of enforcement, and of where any money would be drawn from in order to make such reparation, is highly questionable.

Clearly, it would be fallacious to suggest that since responsibility implies obligation, and obligation may be unenforceable, there is *modus tollens* no responsibility. Not the least of the reasons for this is that unenforceability of an obligation doesn't stop there being an obligation at all. All the same: if responsibilities cannot be enforced, then one might think that there is *to all intents and purposes* nothing much to be said about them: that they are purely notional. This also seems as though it must be incorrect, though, both as a matter of jurisprudence and as a matter of ethics. Working out how one might resolve this problem looks to be a major task, though no less important for that.

In short, all these papers indicate that there is a lack of formal structures in place to hold international actors to account for the power they exercise on the global stage.

A second major theme of this volume is innovation in global health, and the manner in which that innovation occurs. As has been noted elsewhere, “[i]nnovation is essential to address the complex problems in global health today – widening inequity, changing patterns of disease burden, the impacts of conflict, migration, natural disasters, and climate change.”<sup>15</sup> This collection considers two interlinked elements of the innovation process.

The first element, addressed in the chapters by Minssen and Nordberg,<sup>16</sup> and by Gopinathan, Peacocke, Gouglas, Ottersen and Røttingen,<sup>17</sup> concerns how innovation might be properly incentivised and rewarded in such a way as to generate the greatest possible good in the most just way possible. At present, we currently lack an effective vaccine or treatment for a number of infectious diseases, not least of all, COVID-19. Neglected tropical diseases affect more than 1.4 billion people in low-income countries, and a growing number of microbial organisms are becoming resistant to available drugs. This problem is compounded by another: poor access in developing countries to those products that do exist. These problems of access are a factor in low immunisation rates, and a correspondingly high prevalence of vaccine-preventable diseases, resulting avoidable morbidity and mortality. Getting intellectual property rights right is central to addressing these challenges, as intellectual property rights

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<sup>15</sup>Mannell et al. (2018).

<sup>16</sup>p. 130.

<sup>17</sup>p. 164.

have the potential to incentivise innovation in a market, but also to inhibit access to the resulting products. Two chapters here address these interlocking issues in detail, highlighting why traditional market-based forces do not offer an adequate solution to either of these problems.

Minssen and Nordberg confront the relationship between the IP system and the need for pharmaceutical innovation in the context of antimicrobial resistance to currently available drugs, claiming that the former hinders (or, at best, does not foster) our ability to respond to that need. This is a pressing issue, given that there are almost three quarters of a million deaths worldwide every year that are attributable to antimicrobial resistance, and warnings that this will only get worse in future unless there is a significant breakthrough. But new antibiotics do not promise significant rewards for their developers

due to limits on sales imposed by national conservation plans, the existence of a strong generic market functioning as substitute products, the fact that health regulations and reimbursement procedures encourage the use of the less expensive drug, and the short duration of treatment.

It is tempting to add to this list an observation that the people most vulnerable to infectious disease are often the world's poorest; but if surgical disinfection procedures are rendered ineffective by antimicrobial resistance, it will be the world's wealthy who suffer as well. This is not, then, just a problem that will impact on people somewhere vaguely "out there". For Minssen and Nordberg, what is really needed is a combination of push and pull factors that will stimulate development in a way that the legal framework we have currently does not.

Meanwhile, Gopinathan et al. focus more directly on a strategy for providing vaccines for emerging diseases: the Coalition for Epidemic Preparedness Innovations (CEPI). This initiative, which includes governmental and non-governmental bodies, was announced in 2017, with the aim of stimulating vaccine development. One particularly striking aspect of their paper is that they examine CEPI—and, by extension, other strategies to encourage the development of medical interventions—in terms of claims about justice, and intergenerational justice in particular. There is a parallel, they suggest, between the way that a phenomenon such as anthropogenic climate change can be seen, and the way that our success or lack of success in facilitating medical innovations can be seen. If ACC can plausibly be presented as an intergenerational injustice, then so (*pari passu*) can collective failures in respect of disease prevention and treatment. More,

[i]nvoking the concept [of intergenerational equity] for epidemic preparedness and protection against infectious diseases would make the case that present generation has benefited from vaccines developed by the previous generation, and accordingly, the present generation should do the same for future generations. Moreover, since vaccine development takes a long time, and the present generation has experienced the consequences of outbreaks and acquired knowledge about the value of vaccines in preventing such outbreaks, the present generation should be compelled to invest today for the sake of preventing human suffering in the future.

It is not a given that being the beneficiary of some good from Alice means that one is under an obligation to provide a comparable good to Bob (and the idea that one

could be compelled to do so). Nevertheless, we might think all the same that there is a sense in which decency means that we owe it to Bob to provide him with some good, and that Bob may have a legitimate criticism of our character if we take the benefits from Alice without passing anything on. And if that is true for Bob, it may also be true for future generations. After all, if we think that there is a good moral reason to—say—try to minimise (or even reverse) our carbon emissions for the sake of merely possible future people, the same kind of consideration is not obviously inapplicable when we're talking about new vaccines or antibiotics. The point is this: if we think that future generations are of any moral importance at all—and most of us, to some degree, do think that—then we would seem to have to acknowledge that it is not implausible to recognise at the very least *a moral reason* to support measures that incentivise steps to maximise their wellbeing. (How we compare the moral pull of people in distant lands and people in distant places, given the claim above that people in distant places do exert *some* pull, would be a matter for further consideration.)

The second element relates to the commercialisation of scientific research. In this context, the chapters by Nicholas Evans and Michelle Rourke consider how 'pure' scientific research builds towards innovations in infectious diseases.

Rourke's aim is directed squarely at the concept of viral sovereignty, "the concept that virus samples isolated from within the territorial boundaries of a Nation State are the sovereign property of that State", which she treats as generating problems that are yet to be resolved. She traces the evolution of the concept through the legal and policy responses to H5N1 influenza, MERS, Ebola, Zika and H7N9 influenza. Countries, she argues, "own their viruses in the very same sense that they own the birds in their skies". It does not follow from that they own the data about those viruses, although there are good moral and practical reasons to think that data-sharing should be encouraged. Importantly, though, she warns against romanticism concerning data-sharing, noting that the benefits of such protocols generally accrue to the wealthy rather than the poor. Once again, though, this may not be desirable given certain intuitions about global justice, and given that the world's poorest are often the most vulnerable to illness, and might be most vulnerable to the power of a few politically and economically powerful actors to take control of the benefits that are there to be had from data. Likewise, while insisting on sample-sharing has a certain intuitive appeal, she asserts that that "completely ignores the demands of LMICs for equitable benefit-sharing". There is a sense in which unfettered research may be contrary to justice.

Another potential problem with unfettered research is that of "dual use dilemma"—the possibility that entirely legitimate research may be coopted for entirely nefarious ends. Allow that there is a good reason to manipulate the genes in a virus to make it more transmissible, as a way of understanding how likely that might be in the wild. Allow, too, that there is good reason to publish research. In so doing, though, one puts into the public domain insight that may be used in a deliberately harmful way. How ought regulators and ethicists to deal with this sort of situation? How should we balance goods—including the good of scientific freedom—with potential harms?



Evans notes in his paper that even framing the question in these terms smuggles in all manner of assumptions. Not the least of these is that risks and benefits can be balanced on the same fulcrum:

We typically and perhaps justifiably tend to think of risks and benefits as straightforwardly comparable or commensurate. But this need not be the case. [I]t isn't clear that the kinds of benefits we typically describe for dual-use infectious disease research – saving lives – are morally equivalent to the typical risks we assign to dual-use research in terms of lives lost.

And it's not only that harms and benefits may be different in kind: there may be different kinds of harm, and different kinds of benefit. Trying to balance the pros and cons may be not so much simple as simplistic. Evans suggests that we should adopt what he calls a "position of pluralism" when it comes to the ethics of dual-use research, but using policy, through funding decisions, to bias research towards that which provides the clearest benefit for the lowest foreseen dual-use potential, commensurate with scientific freedom.

In the final chapter of this collection, we return to a focus on the state, but through a particular lens—that of human rights. The chapter by Mason Meier, Evans and Phelan "examines the evolving link between infectious disease control and human rights, analysing rights-based approaches to preventing, detecting, and responding to infectious disease outbreaks". They take as their starting point the observation that "public health efforts to prevent, detect, and respond to infectious disease outbreaks continue to employ mechanisms that infringe individual rights", such rights covering bodily integrity, freedom of movement, and privacy. At the same time, measures such as vaccination, quarantine, and monitoring are quite plausibly important measures if we are to take seriously another ostensible right: the so-called "right to health" (or, perhaps more accurately in this context, the right not to be deprived of one's health). These sets of rights-claims appear to be in tension; the question, then, is whether and how they can be reconciled. Likewise, individual rights may be in tension with states' rights (and obligations) to protect their citizens.

One of the problems here, of course, is defining what we mean by rights in the first place. Are rights generated by legal *fiat*, or are they things that one has irrespective of the legal dispensation, and that any decent legal system ought to recognise and strive to realise? If some rights belong to one category and others to the other, how can we compare them? For the purposes of their paper, rights are taken to be expressed in law, but there is a hint that they are not exclusively the products of law. "Assuring the realisation of human rights in public health," the authors write, will require that we assess

whether infection control policies, programmes, and practices pose the least threat of infringing on human rights while posing the greatest opportunity to realise health-related human rights.

If human rights are posits of lawmakers and nothing else besides, a statement like this would not make sense. There would be no need to worry about a policy infringing on a human right, because endorsing that policy would mean that one no longer had that right, and that there was therefore nothing to infringe. So there must be (we may

infer) something more fundamental—something bankable by the individual against the state. This represents an approach to infectious diseases born out of a growing interest in human rights in healthcare, and the putative right to health. It returns our focus to the person, the individual, who is caught up in the devastating impact infectious diseases can have on lives.

### 3 Lucky All the Time: Addressing the Challenges of Infectious Disease

Notwithstanding the more optimistic ideas mentioned at the beginning of this introduction, and whatever optimism we may try to salvage from them, it is abundantly clear that the era of infectious diseases has not come to a close. The most that we can hope to say with any degree of good faith is that the list of diseases that may kill us in the twenty-first century is not *quite* the same as the list of diseases that killed us in the twentieth. Smallpox is no longer a worry, and polio—with luck and a following wind—is at least on its way to extinction, and is even now not a worry for most. Even HIV might be conquered: if providing antiretroviral drugs can reduce viral load to undetectable levels, making transmission near impossible, the reservoir of the virus in the human population will gradually fade away as those who are infected die of other causes. UNAids published its 90-90-90 target in 2014, which aimed to ensure that by 2020, 90% of HIV cases would be diagnosed, of which 90% would be on treatment, of which 90% would be virally suppressed. “Modelling suggests that achieving these targets by 2020 will enable the world to end the AIDS epidemic by 2030.”<sup>18</sup> As we write this in early 2019, this target may seem a touch optimistic—in 2017, treatment was being accessed by just short of 60% of people living with HIV.<sup>19</sup> Still, the general point stands that the virus is not as invulnerable to human action as we may have feared a generation ago.

But SARS, MERS, and COVID-19 have shown us that new pathogens are waiting in the wings, and flu has shown us that old enemies will keep on returning. In the grand scheme of things, the damage that these illnesses have done has been relatively small so far; but in the age of mass global travel, it is surely not implausible to think that a truly devastating global pandemic with truly mass mortality may be just a few sneezes away. A widely-reported statement issued by the IRA in 1984 reminded the British government that bomb-setters only have to be lucky once; the security services have to be lucky all the time. Something similar might be said in this context. Indeed, infectious diseases remain one of the top five causes of years of life lost around the globe.<sup>20</sup>

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<sup>18</sup>UNAids, 90-90-90: An Ambitious Treatment Target to Help End the AIDS Epidemic (available via <http://www.unaids.org/en/resources/documents/2017/90-90-90>).

<sup>19</sup>Figures via <http://www.unaids.org/en/resources/fact-sheet>, as of 10.1.19.

<sup>20</sup>GBD 2016 Causes of Death Collaborators (2017).

That said, while infectious diseases have changed in the twenty-first century, so has infectious disease control and response. In many ways, the world is much better prepared for the next major infectious disease outbreak: medical interventions continue to improve; surveillance and response is more accurate and quicker than it has ever been. Even so, and partly because we don't know exactly where it'll come from, we remain unprepared for the next pandemic. New medical interventions are of no use if they are inaccessible to those who need them; and fine ideas about new interventions are of no use if the right incentives and rewards for development and propagation are not in place. Scientific willingness will always founder on the reef of political and policy complacency, underfunding, and over-cautiousness among international health agencies.

We cannot pretend that this small volume goes very far to solving the problems that face us. Indeed, we cannot be sure that the authors here have even spotted every problem that has to be solved. Nevertheless, what they have done has been to spot *some* of them, and to outline why they are problems, and what kinds of factors would have to be taken into account in any plausible solution. Whether it be from Ebola or influenza, the global public will face another major threat of massive morbidity and mortality sooner or later. Knowing what the obstacles are to an effective defence and response is the first step in overcoming them.

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