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Introduction

Science funding policy and the COVID-19 pandemic

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Science funding policy is constantly evolving as a result of geopolitical, technological, cultural, social, and economic shifts. The last major upheaval of science funding policy happened in response to a catastrophic series of events: World War II. The newest worldwide catastrophe, the COVID-19 pandemic, has prompted similar reflections on fundamental questions about the roles of the sciences in society and the relationships between governments, private industry, public bodies, and the broader public. Contained in this special section of the *International Journal of Risk & Safety in Medicine* is a series of reflections and insights from four interdisciplinary scholars, most of which urge drastic and urgent changes that should be made.

In particular, the COVID-19 pandemic has pushed us to think seriously about several topics. One concerns the importance of basic research in the medical and social sciences. Questions about the state of preparedness we had before the pandemic in terms of medical knowledge related to the transmission of aerosols, numerous issues with developing, distributing, and holding onto vaccines, and post-symptomatic diagnostics are being asked and conflicting answers are being given. Moreover, questions about the strengths and weaknesses of pandemic related policies such as lockdowns, travel bans, or particular means of communicating science are being raised faster than social scientists have been able to answer. Are we as prepared as we could have been? What have we learned for future pandemics or similar outbreaks? These are the questions we are forced to ask.

In one sense, these issues are not new. In Vannevar Bush's legendary document, *Science: The Endless Frontier* [1], advancements in the medical sciences during and before WWII were one of the chief reasons he sought to establish what would become the National Science Foundation. Bush thought that a crucial way to lay the groundwork for advances pertinent to public health was to fund far and wide amongst the

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"entire front of the sciences". Interestingly enough, though, the social sciences are conspicuously absent from Bush's doctrine as their 'scientific' status was considered questionable at the time. This was the beginning of a long, arduous journey for the social sciences, which often struggled (at least in the United States) to secure reliable sources of support [2]. The political responses to the pandemic re-raise just how important the social sciences are to responsible policy-making; public policy should not be justified by explanations of social phenomena that just "seem right". While Bush's view and legacy are highly contested, it certainly provides us with an interpretative perspective to think about how science funding policy before the pandemic facilitated or hindered our ability to respond effectively to the coronavirus.

Things have changed since Bush's time. Globalization has accelerated at a spectacular rate over the past 75 years leading to new questions relating to international governance and global responsibilities. Science funding policy can no longer be solely occupied with national needs and goals – there are also considerations of international obligations, especially to the Global South, and cooperation among nations that do not always trust each other. As Jacob Stegenga points out in his contribution to this special section, viruses know no borders, and this presents new challenges and opportunities about the goals of science funding policy. From a different angle, as Manuela Fernández-Pinto observes in her contribution, medical knowledge is becoming increasingly privatized. Multi-billion-dollar pharmaceutical corporations are a reality of science funding policy that must be managed. What can we realistically expect from these companies? What relationships (if any) should governments seek to arrange with them? On the one hand, every major vaccine was developed by a private firm, and this seems like a cause for celebration. On the other hand, there are serious worries about the global distribution of vaccines, the ways in which they were produced, transparency about the clinical trials, and the exploitation of the Global South (especially in the sub-Indian continent). Again, having our backs against the wall pressures us to think carefully about steps forward. Some concrete steps, such as the removal of tax credits for pharmaceutical companies, are suggested by Sergio Sismondo in his piece in this special section.

Another dimension of science funding policy raised by the pandemic concerns the flexibility of funding bodies and research institutions to rearrange themselves in light of new pressing concerns. This was highlighted by the public dispute between Mauro Ferrari and the European Research Council (ERC) (as mentioned in Stegenga's paper). The main issue at stake in this conflict was whether the ERC should transform itself to fund 'frontline' research – science that tackled immediately pressing societal issues related to the pandemic. This transformation, of course, doesn't merely require administrative reorientations at the ERC but expects a great deal of flexibility on behalf of scientists themselves who must take the intellectual and material resources at their disposal and bring them to bear on new topics. The situation is made more complex by the fact, as espoused by Ferrari's critics, that the ERC is bound up in various legal contracts that restrict what institutional changes can be made. This re-raises old questions about the value of so-called 'basic science' in a new light. On the one hand, some worry that massive influxes of funding for particular projects will crowd-out the most valuable research. It will entice or even pressure scientists with little to no relevant expertise to overpromise what their perspective can offer. On the other hand, urgent issues are usually much more tractable, though multifaceted and complex, than typical scientific research which is (when done honestly) shrouded in uncertainty.

Another, more political dimension of science funding policy raised by the pandemic concerns the role of the public in determining what questions are salient, how they should be answered, and how risks and uncertainty should be managed. The days of hoping for a society run purely by 'experts' have passed, and we know how much including the public can offer socially responsible scientific research. As is often the case, many voices have been lost or simply unheard when offering critical perspectives on scientific or societal issues that deserve to have their concerns considered and addressed. This is not

only of monumental importance for the quality of the research and policy proposals themselves, but also have severe implications for public trust. Vaccine hesitancy and public mistrust are common, and this is largely due to marginalization and overly quick dismissals of citizen concerns [3]. The opportunities for including citizens more seriously in science funding policy is not a new idea, but it takes on a new significance in a global event that has touched just about everyone on the planet.

The complexity of science funding policy is seemingly unending, and the fluidity of its practice has the potential to make the most pertinent questions of today become barren and obsolete tomorrow. This should not intimidate us into submission—that we are forced to simply go with the flow and do the best we can in a given situation. The outpouring of scholarship on what lessons we should take from this pandemic, for science funding policy and many other topics of concern, continues to grow and inform policy-makers. We hope to contribute to these developments with this collection of papers.

In a bit more detail, Jacob Stegenga uses the example of the COVID-19 pandemic to stress that medical research should be reorganized in order to achieve higher efficiency. Stegenga argues that an appropriate response to a highly infectious respiratory virus is developing rapid science. Moreover, such a virus does not stay within the borders of one country. As a way of enabling science to rapidly respond to global pandemics in the future, Stegenga suggests the founding of an international institute for pandemic science that would be publicly funded. Such a specialized body could direct all its efforts to responding quickly to a pandemic without the potentially harmful commercial influence.

Manuela Fernández Pinto criticizes the response of the pharmaceutical industry to the COVID-19 pandemic. In her opinion, the interest of private capital in vaccine development neglects the social and epistemic factors. More specifically, Fernández Pinto argues that the countries in which the COVID-19 vaccines were available early on profited from that fact, while other parts of the world were left behind. One of the big problems, according to her, was the phenomenon of vaccine hoarding by richer countries that only count for a small proportion of the world's population. All this, Fernández Pinto concludes, was possible because of the financial interest of private companies to distribute their products to the highest bidders.

Sergio Sismondo takes a broader perspective on privately funded pharmaceutical companies and stresses the negative influence of marketing on drug development. According to Sismondo's empirical research, private companies sometimes hire academics, doctors, and ghostwriters to advertise, publish, and develop drugs. Moreover, Sismondo argues that tax incentives can direct private research in ways that do not serve public health. They are rather motivated by increasing the profit. One of the effective and illustrative examples that Sismondo brings up is the approval of Biogen's drug Aducanumab. This drug received approval from the U.S. Food and Drug Administration for its use against Alzheimer's disease in 2021. Even though its efficiency is questionable, the potential financial profit for the company is remarkably high.

In his contribution, Rade Injac discusses the development of vaccines that should be produced and distributed in a short time to the whole population. According to Injac, the demand of supplying several billions of people with a preventive medication is a significant and unique challenge for the pharma industry. Injac goes further by arguing that political factors play an important role in vaccine distribution. His important point is that, in order to have an effective response to global health threats, the international support to the WHO has to be stronger and its recommendations need to be binding for every country.

These papers emerged from an event hosted online in December 2020, sponsored by Forum Advise (https://forumadvise.wordpress.com/) together with the Weizsäcker Center at the University of Tübingen and the Centre for Philosophy of Science at the University of Geneva. (The talks

themselves can be watched online at: https://www.youtube.com/watch?v=9qDE8z3GHzY&list=PLsY-pzz3J1IRy1rwrpb7C3C0WSzoDHR7U). A number of important points surfaced during the roundtable which followed, and some of those will be summarized here. Several participants expressed harsh criticisms of the actions of large multinational pharmaceutical companies. Our representative of that world, Injac, agreed that many of these were fair. For pharmaceutical firms, marketing really is everything. However, Injac insisted that once a medicine loses its copyright, outside researchers can analyze the mechanism and produce generic versions. Most of the discussion centered on so-called "innovative companies" and the ethics of their work, but Injac urged us also to think about these generic companies. Fernández Pinto agreed that it would be interesting to talk about such companies. We would like to point out that in many cases, the same companies (e.g., Pfizer) produce both the name brand and the generic versions of a drug.

With respect to Fernández Pinto's discussion of lobbying, Injac asserted that some of the companies that lobby the most aren't the ones involved in producing a coronavirus vaccine. However, this isn't to say that the reasons those companies are lobbying are altruistic ones for the sake of humans in general.

With respect to the price of the vaccine, especially in countries in the Global South, Injac pointed out that the price of a drug is the result of a process of negotiation. While drug companies can push for certain prices, they aren't always successful, and so the responsibility isn't entirely on those drug companies if the price of a drug is too high: after all, a government should have fought harder to bargain for a better deal. One might worry here, however, that there are other power relationships in place that prevent governments from bargaining to their full potential. Further, we might worry whether "not bargaining well enough" is really enough to justify loss of human life.

Injac agreed with Ivor Ralph Edwards that very few medicines are removed from the market due to adverse effects. He explains this, not as a lack of care on the side of the pharmaceutical industries, but due to several other factors: (1) It can be hard to say what caused an adverse side effect, because everyone is different and because people often take several medications at the same time; (2) companies only investigate an adverse reaction if there is significant media and legal pressure, which is the responsibility of society to produce, given that (3) adverse effects must be reported within 24 hours of their occurrence, and most people fail to do this. In reply to the first point, Edwards pointed out that currently, we require a clinical trial to prove that an adverse effect exists. That is the notion of causality in play, for the industry. However, this is a poor choice for determining medical causation. If you have several countries that report that they have a problem with a drug, this should be taken seriously. And you can evince a causal connection within a single person, e.g., by re-exposure, without the need for a clinical trial. If someone has an adverse reaction that stops when they stop taking the medicine, and it starts again when the drug is taken again, we can be confident that the effect was caused by the medicine. In response to the second point, Heather Douglas pointed out several clear examples where adverse effects were reported, the mechanisms of the adverse reaction were clear, and yet these were still not investigated. So yes, we have a responsibility to report reactions and put pressure on the companies to investigate adverse effects, but even when we do, drug companies tend to avoid investigating or retracting drugs.

An issue that was highlighted several times in the discussion concerned the relationship between government and university scientists. Moneef Zou'bi pointed out that the information sent to politicians and decision-makers from scientists is often conflicting. This is equally true for the information sent to the media, which is interpreted in different or conflicting ways, and then circulated to the public. It is tempting to blame politicians who don't follow the advice of scientists, but we must admit that when clear answers were needed (e.g., about mask mandates, lockdowns, etc.), the scientific community was not ready. We heard stories about people hanging masks in a tree outside a supermarket in Brazil, taking one to enter,

and leaving it on exit for the next customer. In the UK, footpaths in parks are widening because people believe they should be two metres apart from everyone, despite the fact that it is extremely improbable that someone could catch the virus from a passerby outdoors. In the US, one school claimed that moving pupils around every quarter of an hour would mitigate the spread of the virus. It is unlikely that we will be able to force scientists to deliver a clear, univocal message, either to politicians or to the public. And it is certainly not clear that if we could, we should. In the end, as always, decision makers will choose the advice that matches their needs and goals, and non-politicians will do the same. Still, is there no way we could have done better?

A related issue raised by Zou'bi is that the bulk of scientific research in the Global South is carried out at universities. These have been in a state of turmoil for a long time, but this has been exasperated during the pandemic. Faculty and students can't do their research together, and this compounds the difficulties at all levels. For Fernández Pinto, these difficulties are heightened by the contract research organisations (CROs) that take advantage of this gap: recruiting patients, doctors and nurses to increase profit instead of help the public. Injac disagreed, claiming that the CROs come to the Global South because countries in the Global South want them to provide specific proof that a drug will work on the members of its population. Fernández Pinto pointed out that there are many less benevolent reasons CROs come to the Global South. For example, since 1923, the NIH and FDA have required vaccine trials to be conducted on a diverse sample of participants. One of the main marketing strategies of CROs in Latin America is to point out how diverse populations are there, to tempt people from the US to run a trial there, for profit.

Fernández Pinto had several important clarificatory questions. One, for Matthew Wallace, concerned his view that governments in the Global South dictate research development priorities. She wondered whether we should be asking more from them, as Wallace seemed to suggest, given that in many cases international treaties and companies have already tied their hands. Wallace replied that he wasn't suggesting that governments in the Global South should dictate research priorities more effectively, but rather that we should work to *enable* those governments to do more, by changing funding structures. One way to do this, he emphasized, was to provide external funding from international sources, to give them the power to speak up and play a more equal role in projects organized by big intentional organizations like the WHO.

Fernández Pinto asked Stegenga about his idea to reform science funding via his analogy to the Manhattan project and the Human Genome project. Aren't these quite different, after all, from modern pharmaceutical science? Those large scientific projects were centrally organized and controlled, run through universities, and publicly funded, while corporate pandemic science is a paradigmatic example of privatized, commercialized science. Stegenga replied that his view was meant to be sufficiently general, like Philip Kitcher's idea of well-ordered science, such that it would apply to both kinds of science. All science needs guidance, in terms of which research ought to be done, and if we get that guidance from stakeholders instead of shareholders, those questions would be very different than they are now. For example, there are 150 ongoing trials for hydroxychloroquine. Presumably, if there was more careful oversight about research priorities, then we might learn more about social distancing, lockdowns, and other mitigation strategies instead of that one drug.

There were other worries about Stegenga's proposal about how to reorganize science funding. For instance, Wallace expressed concern about how well it squared with pluralism about research objectives. If there was a top-down global research strategy, how would we ensure that research avenues going in pluralistic directions due to local concerns weren't cut off? And how could it manage the marketing power of big pharma, and the major disparities and power imbalances that we already see in global research funding?

Jamie Shaw pointed out that we mostly know how to ensure that research done on and for a particular community can be tailored to the needs of that community. But how can we do this when the community is the entire world? Injac argued that one important gap between academic research (which can be very general) and political action (which is usually quite specific), is industry. Edwards agreed: scientists must make it clear which parts of their findings are relevant to others, e.g., to industry and politicians, and in addition, must specify how those findings can be used.

There were many other questions that could only be raised, but not answered. These are the hard questions that we need to keep asking, and keep trying to answer, even if we only ever receive partial, temporary, local answers. For example, how much top-down regulation of science funding practices is required to ensure the best outcomes for science? What is the ideal relationship between public and private initiatives? What role should charity and crowd-sourced funding play in science and medicine? How can we ensure that the positive changes brought about by the pandemic are kept, and the flaws that have been exposed are expunged? How, if at all, can the increasingly powerful pharmaceutical industry be held responsible for the global harms it causes, given how deep it has dug itself into national and international law?

We think it is important to discuss these issues, as it has recently been shown that academic discussion, even in philosophy, has influenced funding strategies, including those of the NSF [4]. Along these lines, Vlasta Sikimić closed by urging that those of us who study science must pay closer attention to the data, which is now more accessible than ever, concerning how funding decisions are made, who gets what funding, how the funding is used, and what it leads to.

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