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Navigating complex trade-offs in public health interventions

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Abstract
Public health, just as any policy-related field, faces the evergreen problem of turning knowledge into action. Among other problems, there is a clash between the inherent complexity of public health problems and the inevitable push, by decision-makers and the public, to simplify them. The Covid-19 pandemic has shown the insufficiencies of our current epistemological, methodological and normative apparatus to handle such crises in a timely manner. Despite this, several authors have been arguing for the importance of engaging global crises such as Covid-19 in ways that do not oversimplify key dimensions of the issues involved. In this paper, we contribute to this emerging scholarship. Building on existing work in the field of environmental problem-solving, we propose an integrative approach to navigating complex trade-offs in public health interventions. Briefly put, we propose that decision making should be informed by an analysis of any given problem from four distinct, but interrelated, lenses: (i) values and valuation, (ii) process and governance, (iii) power and inequalities and (iv) scientific evidence, methods and concepts. This normative framework, we argue, can help with spelling out the complexity of public health problems and with spelling out the rationale behind public health decision making to non-specialists and the general public. We illustrate our approach using the controversy over wearing face masks in the Covid-19 pandemic.

KEYWORDS
evidence, health policy, medical ethics, public health

1 | QUESTIONING ‘EVIDENCE-BASED’ AND ‘SCIENCE-DRIVEN’ APPROACHES IN PUBLIC HEALTH

The relations between science and policy, or between knowledge and action, have never been simple, linear, or straightforward in any obvious way, and are rightly defined as ‘complex’ or ‘wicked’.1–4 The Covid-19 pandemic, to be sure, has been a catalyst for the urgent need to engage this complexity and find new ways to generate knowledge and turn it into policy interventions.5–7 We share critical views of evidence-based or science-driven approaches in policy making,8–10 and seek to contribute to the literature that is delineating better ways of generating knowledge, designing interventions and acting under high uncertainty. In particular, we offer a framework to make explicit the rationale behind the voices of public health researchers that have pleaded, in the past 2–3 years, for science-informed decisions. Often, these voices have been part of a larger and long-term attempt to broaden the scope of what is considered scientifically admissible beyond the gold standards of EBM,11–15 and to promote decision making that takes into account cultural.
moral and political values beyond the ‘diktats’ of a scientific rationality.

Our approach spells out, rather than flattens or reduces, the complex relationships between normative and epistemological dimensions of public health issues, while also taking into account the socio-political-cultural context of public health decision making. We support public health rationality with insights from environmental ethics, introducing the concept of ‘navigating complex trade-offs’.[16–18] Navigating complex trade-offs entails attending to diverse value sets that may be difficult to compare, to decision procedures and governance arrangements at disparate scales that may be difficult to reconcile, and to increasingly divided people and groups who possess different levels and types of power. As we argue here, this also entails dealing with different modes of evidence that may not easily coalesce into a unified perspective.

Briefly put, our approach consists in the application of multiple lenses through which to analyse the multiple dimensions of a set of interconnected issues: ‘values and valuation’, ‘process and governance’, ‘power and inequality’ and ‘scientific evidence, methods, and concepts’. In this way, normative considerations proper can be discussed in the same framework as considerations about scientific evidence. It is worth noting, however, that considerations about scientific evidence are never merely descriptive; instead, they always carry a normative component, and for this reason we dub our framework ‘normative’, as a whole. We illustrate our approach through application to the controversies about face masks in response to Covid-19 and its many variants. The goal is not to provide a definitive answer to specific questions (e.g., whether masks are effective; or whether they should be made compulsory), but to illustrate how we can spell out the complexity behind public health interventions. Our framework, we submit, avoids simplification and the polarisation that often results; instead, it fosters dialogue and pragmatic decision-making by exploiting and engaging the very complexity of those interventions.

2 | KNOWLEDGE, ACTION AND VALUES

Our specific concerns about the relations between knowledge and action, or the epistemological and normative components of public health, is that these discussions often run on parallel and non-intersecting tracks. There is abundant literature to show how science (the health sciences and public health are no exception in this respect) is value-laden. This literature broadly reconstructs how methods and concepts are not value-free, despite strenuous attempts in (philosophy of) science to establish value-neutrality. This literature is fundamental, and should be supplemented with an even more powerful idea, namely that science (the health sciences and public health are but a case in point) is also value-promoting.[19] The idea of ‘value promotion’ is to emphasize that being conscious of the non-neutrality of science and policy may not be enough. Instead, we should be explicit and transparent about the values that motivate and guide research as well as policy design, and we should accordingly tune our concepts, methods and empirical investigations to these values; this is a continuous exercise in articulating the working of values throughout the whole process, from evidence generation and assessment to policy design and implementation.

We build here on existing work in public health, and that puts upfront the need to discuss values as part and parcel of the process of knowledge generation and policy design.[20,21] What our approach offers is a framework to consider simultaneously questions about evidence and scientific method, about values, and about the procedural and political dynamics that shape the contexts in which research is pursued and interventions are unleashed.

Our particular contention and contribution in this paper is that, while ethics does occupy a large part of the debate in public health, the way this is done is not conducive to considering, in the same framework, epistemological and ethical questions. Indeed, the flourishing and important field of public health ethics has brought much-needed attention to specific ethical concerns in public health.[22–30] On the one hand, some authors have emphasized that the main generation of evidence is not just epidemiology but population health science, which is simultaneously broader than epidemiology (since it may include studies from the social sciences and/or the life sciences) and also has a more specific focus, namely the health of populations. On the other hand, in public health ethics, we are specifically concerned with normative questions that arise at group level (rather than individual action).[31,32] Although important differences between bioethics and public health ethics have been identified,[30] the field remains largely problem-based, trying to offer solutions to specific problems, and often leaving the discussion of supporting ethical theories in the background. In public health ethics, specifically, the discussion focuses on questions having to do with equity and justice, and also of paternalism and autonomy or self-determination, as they arise in specific settings. There is no doubt that these worries and issues are real, important and urgent. At the same time, we take issue with the methodology of public health ethics (and of analytic ethics more generally), and notably with the way in which problems are framed and simplified. To be sure, ethical problems always require simplification, but it’s important to be aware of how the simplification process functions to leave out or obscure important problem dimensions.[16] Let us explain our reservations about this methodology.

We consider the formulation of public health problems and associated analytical approaches in terms of ethical dilemmas is a paradigmatic example of (problematic) simplification that is at the core of the methodology of public health ethics. The process of simplification is simultaneously a reductive and a creative act. As a reductive act, simplification entails deciding which of many possible variables in a given problem scenario to focus on. Such decisions can and should be informed by scientific theory and previous empirical findings. They may also be informed by moral priorities, political expediency and social or cultural biases. But deciding what to leave out of a given analysis is only half the problem of simplification: that which is left in must be made comprehensible and even elegant (think Occam’s Razor). This is the creative part of simplification, and entails
the application of an appropriate theoretical lens, cultural model, metaphor, or rhetorical strategy to boil a problem down to one or two key considerations that can then be taken up by decision-makers and other key stakeholders.

When ethical values are at stake, the process of simplification generally occurs through the application of a specific ethical framework to an ethically fraught scenario. With a rights-based framework, important ethical considerations can be boiled down to problems of rights; with a utilitarian framework, ethical considerations become a problem of maximising ‘utility’ or welfare for the greatest number; and so on. The application of these frameworks, in turn, allows for an ethical problem or conflict to be simplified in terms of a tension between rights, in the former case, or a trade-off between gains and losses (to utility, to welfare or perhaps to our pocketbooks), in the latter.

In academic work in ethics, the process of simplification often involves the identification of a small and finite set of options, along with the imposition of a forced choice between those options. These choices then are often framed in terms of tensions between two overarching values—values such as freedom, or privacy, and so forth. A key rhetorical frame in public health is thus the ethical dilemma. For example, the question of whether or not to mandate Covid vaccines often gets framed, and especially in the public discourse, as a dilemma between individual freedom and health as a public good. Similarly, questions surrounding the sharing of health data are posed in terms of a dilemma between privacy and knowledge. In public health economics and other policy-oriented fields, problems are often framed in terms of maximising gains and minimising losses33 in a way that foreshadows—but does not fully engage with—the complexity of the problems we face today.

These are common simplifications that obscure important problem dimensions. There are others, to be sure, and the dimensions that get obscured or over-simplified vary along with the means of simplification. In Section 3, we present an alternative strategy for framing problems that have important ethical dimensions—one that can help, for any given case, to reveal, rather than obscure, the multiple problem dimensions at stake.

3 | LEARNING FROM ENVIRONMENTAL ETHICS HOW TO NAVIGATE COMPLEX TRADE-OFFS

We now lay out the main features of a different approach to framing challenges with intersecting ethical, epistemological and social questions, one in which the complexity that results from the intermingling of epistemological and normative questions is treated as a resource to be utilized rather than a problem to be obscured. For a number of reasons, the field of environmental ethics offers a good place to look for frameworks that can allow stakeholders, scientists and decision-makers to embrace, and not be paralysed by, the plurality of relevant dynamics that must be grappled with across some of our most pressing public health issues. In fact, public health interventions too are the outcome of description and evaluation of complex scenarios, in which actors and stakeholders negotiate on a number of trade-offs.

First, ‘environment’ and ‘health’ belong to a shared territory. Both, in fact, have to do with individual and group behaviour; in both of them, the relationships between human behaviour, technology, and the natural/social environment are constitutive; also, environment and health both see a kind of ‘diffused’ causation at work in a network, across individuals and groups and/or across factors of different nature (social, biological, psychological,...) rather than simple, linear and neat cause-to-effect relations. But there is more. In both cases, we deal with multiple values and perspectives at stake, and with multiple stakeholders at any given time. And the level of scientific uncertainty—together with the amount of scientific evidence produced—is quite significant. For all these reasons, we can hold a parallel between problems as they arise in environmental science, and in the sciences of health.

In environmental ethics and decision-making, the concept of trade-offs has become an increasingly popular way to think critically about decision contexts in which a plurality of dynamics are at play.3,17.18.34–37 At a most basic level, a trade-off is a decision scenario in which any decision will simultaneously lead to gains in some dimensions and losses in others. In a way, the idea of trade-offs takes the notion of dilemmas and opens up the possibility that more than two sets of values or objectives are at stake. In previous work, Hirsch and co-authors have argued for the importance of talking about and dealing with ‘complex trade-offs’34,16,38,39 which entail not only gains and losses across diverse (often incommensurable) categories, but also a set of additional characteristics, including:

- Epistemological uncertainty—and often ignorance—regarding the likelihoods that different gains and losses will be realized;
- The existence of multiple spatial and temporal scales at which values—and trade-offs among them—play out;
- The existence of diverse social perspectives on the normative significance of the different values involved, and/or on the material relationships between the various dynamics at play;
- The embeddedness of both the material dynamics of a given problem, and the social perspectives on those dynamics, within a socio-political context characterised by many sorts of inequality, and in particular inequalities in different actors’ abilities to frame the problem, and therefore to make the gains and losses that are important to them a meaningful part of the conversation.

Building on these basic characteristics of scenarios involving complex trade-offs, Hirsch and collaborators proposed three analytical lenses that are designed to be ‘looked through’ first in parallel, and then iteratively, when working to productively complexify a particular issue.34 These lenses are:

1. Values and Valuation—what counts as a gain or loss?
2. Process and Governance—who participates, how are decisions made?
3. Power and Inequalities—who has the power to simplify, how is it exercised?
We argue that a complex trade-off scenario can be productively illuminated by developing an expanded view of what might count as a gain or loss, in parallel asking who gets a say in what counts, and in parallel again asking what forms of power are present in the system that shapes how problems are formulated. Once these questions have been asked independently of each other, insights from each lens can be combined to develop an expanded view of the complex trade-offs involved. This process of parallel and iterative analysis allows the insights yielded by each lens to be considered for their own specificities and for their interrelations. In fact, while it is certainly true that we can conceptually separate values, governance and power, the three will be more often than not intertwined.

We expand the previous set of ‘complex trade-offs’ with a fourth one.

4. Scientific evidence, methods and concepts—what grounds decisions?

This fourth lens helps us address the question we set out at the beginning of the paper, notably about the relation between knowledge and action. In fact, considering questions about scientific evidence, methods and concepts requires understanding the practices of the health sciences (broadly construed), and how scientific knowledge about health and disease gets translated into the policy world. On the ‘science’ side, we rarely (if ever) start with a clean knowledge base. Scientific knowledge of health and disease is produced across time, and across countries, cultures, institutions, and individuals. It is partly bottom up and partly driven by research funding schemes. And it involves a continuous process of correction and of self-correction. Even when we have (rarely) cases of neat scientific consensus, it may take a while until scientific knowledge is translated into action. This may be for various reasons, some having to do with methods, some others having to do with power or vested interests, and it is for this reason that this fourth lens can shed light on the relations between knowledge and action, to the extent that it is considered together with other three. It is also important to bear in mind that scientific evidence, methods and concepts are never value-free, and instead always encapsulate or promote values, one way or another.

Our argument is that this framework offers conceptual tools to analyse in detail, spell out, and understand the various aspects at work (i.e., the complexity) in the hard territory of policy making. We also submit that, contrary to first appearances, the lenses may help structure the complexity of the epistemological and ethical (and other) dimensions of policy interventions. In the next section, we illustrate how the trade-offs lenses (values and valuation, process and governance, power and inequality), augmented with a fourth lens focusing on scientific methods, evidence and concepts may help in practice.

4 | NAVIGATING COMPLEX TRADE-OFFS IN PRACTICE: DO FACE MASKS PROTECT FROM COVID-19?

Since its beginning in late 2019/early 2020, the Covid-19 pandemic has mobilized scientific communities, policy-makers and citizens/patients in multiple ways: the virus was studied and quickly sequenced thanks to unprecedented world-wide collaborations; measures to ensure physical distancing and aeration have been implemented in various ways and with different degrees of success; and vaccines have been administered at unprecedented speed (although not uniformly).

The issues arising at the intersection of ethics and epistemology in relation to the pandemic are vast: they include the justification for general or partial lockdowns, questions around appropriate strategies for distributing vaccines, about travel across borders and its regulation, or about whether and in what contexts vaccines and facemasks should be required or voluntary. The normative and epistemological principles behind any of these issues are worthy of scrutiny, and there is already abundant literature on each of them. The problem of face masks is an excellent case in point,\textsuperscript{40–42} and we use it to illustrate how the narrative and analytical framework of complex trade-offs presented in Section 3 can be of help in navigating the various dimensions of the issues involved.

Since the very beginning of the pandemic, measures of hygiene, notably hand washing and physical distancing, have been widely recommended. The use of face masks, however, has not been immediately, unanimously or consistently mandated either at a global, or at local level, despite numerous public health scholars advocating mask-wearing as both a strategy for protecting oneself and others from exposure, thus reducing infections at a large scale.\textsuperscript{41,43–48} Nevertheless, the ongoing (and dynamic) need to reduce exposure leads individuals to face questions regarding whether or not to wear a face mask, and leads governments, local authorities, and institutions at various levels to continuously face questions regarding whether or not to mandate them. This has become a touch-point for personal and political conflicts.

Our goal is not to judge the governmental decisions taken in any given country or to criticize public health scholarship on this issue. Instead, we offer the framework of complex trade-offs presented in Section 3 as a way to make explicit the rationale behind recommendations given by a number of public health scholars, the sophistication of which nevertheless has been obscured in the public discourse.

The public discourse, unlike public health scholarship, by and large oversimplified and polarized mask-wearing.\textsuperscript{49–51} On the one hand, epistemological dimensions of the issues involved have been distorted, oversimplifying the interpretation of evidence of effectiveness. Effectiveness has been communicated to the public as an ‘all or nothing affair’, and thus face masks should be obligatory only if full evidence is available or if full protection is ensured. What we intend to focus on here is not the strenuous attempts of some public health scholars to explain the nuances of the problem in the open (see, e.g.,
TABLE 1 Key questions and complex trade-offs to address questions about mask wearing

<table>
<thead>
<tr>
<th>Key questions</th>
<th>Values and valuation</th>
<th>Process and governance</th>
<th>Power and inequality</th>
<th>Scientific evidence, methods and concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>What publicly held values are affected by government mask mandates (e.g. public health, basic human rights)?</td>
<td>How are people included in decisions when the different values at stake are in conflict or tension?</td>
<td>Do dominant problem frames exclude certain voices from public conversations and decision processes about mask mandates?</td>
<td>What is the evidence that a mask will be an effective means to reduce exposure?</td>
<td></td>
</tr>
<tr>
<td>What are the acceptable thresholds at which those values can be considered to be upheld?</td>
<td>Should a government or other institution suggest or impose wearing masks, and under what circumstances?</td>
<td>How can the issues be reframed to include the range of relevant perspectives?</td>
<td>If evidence is limited regarding the impacts of mask use, can we legitimately infer not to mandate their use?</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>What is the evidence that will promote identified values, and to what degree?</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Complex trade-offs</th>
<th>Individual comfort, sovereignty, tolerance for risk, collective responsibility, solidarity</th>
<th>Different stakeholders in the process, different views on role of the government in individual health decisions</th>
<th>Structural inequalities between different parts of the populations (intersectoral vulnerability)</th>
<th>Different parameters to assess scientific evidence, varying quality of available scientific evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Values and valuation</td>
<td></td>
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</tr>
<tr>
<td>A number of normative issues are at stake both in people’s individual decisions regarding whether or not to wear masks, and in the decisions of governments, businesses, and public administrators regarding whether and when to mandate mask use. Some of the normative issues that are at stake include individuals’ values for their own health and the health of their families; the value of sovereignty and the freedom to make one’s own decisions about risk; issues of collective responsibility; and the commitments held by many to act in solidarity with those most at risk.</td>
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4.2 | Process and governance                                                                                       |                                                                                           |                                                                                  |                                                                                  |
| Because the importance and prioritisation of each of these values (and others) differs across people and social contexts, and because some of these values are likely to stand in tension with others in the case of mask-wearing, it is essential to attend to the larger procedural and governance issues involved. In particular, at whatever scale a decision is made, it is worth considering how the people affected by that decision can be included in the decision process. While there are
certainly circumstances in which mandates from above are warranted, it is equally important to reflect on what sorts of circumstances warrant such mandates.

4.3 | Power and inequality

To the extent that the social context of such decisions is characterised by social divisions and various forms of inequality, ensuring participation in decisions about masks and appropriate deliberation regarding the circumstances in which mandates are warranted requires additional efforts to include those whose voices may be excluded from public conversations and decision processes, and to reframe the issues involved in ways that support such inclusion. There may also be tensions in terms of what public institutions or private organisations can do in terms of making masks mandatory, for example, in education, in a shop, and so on. A large part of the difficulty also comes from the fact that it is not obvious who has the power to simplify the problem, and how this power is exercised.

4.4 | Scientific evidence, methods and concepts

The role of evidence needs to take centre stage in consideration of the complex trade-offs involved. At one level, this includes evidence for and against the hypothesis that masks are effective in reducing exposure, as well as evidence regarding the degree to which mask-wearing is likely to promote or take away from the other values involved. If such evidence is inconclusive, as it inevitably will be, then we must also ask the question of what types and degrees of evidence warrant the imposition of government mandates. The mandate of wearing a face mask as an essential protective measure, in fact, rests on the assumption that the virus does not simply propagate via droplets, but is airborne. To minimize exposure to an airborne virus, we need ventilation and face masks. It should be noted that other airborne viruses are known and well-studied, and for these ventilation and face masks have been used as effective protective measures. Importantly, the need or utility of wearing a mask may differ depending on whether we are in the acute phase of the pandemic or whether (supposedly) we are approaching an endemic state. Also, wearing a mask may be necessary for some people directly (for instance those who are immunocompromised), and to protect such vulnerable people. Very young children may be also affected, as masks impede lip reading and may considerably slow down the process of learning to speak. The assessment of risk may be very different depending on the specific circumstances in which one lives (e.g., having an elderly person in the house) and such difficulties may not be immediately recognized/able by others. Last, but not least, in the haste of having ‘solid’ evidence to ground decisions, the inherent difficulties to any scientific problem and domain become more visible than ever: the generation, evaluation, and assessment of scientific evidence is anything but a linear and simple process, in which ‘the truth’ will emerge by ‘simply’ using the best methods of modern (and Western) science. Additionally, scientific assessments made in the context of pressing, values-based issues are never purely objective, but always relative to some frame of reference, for instance a threshold for safety, and so any scientific claim about evidence embeds, and is embedded in, value judgments.

To sum up, there isn’t one answer to the question of whether or not to wear a mask. Public health scholars have strenuously tried to explain this, but this message has failed to reach the general public. We suggest that explicitly adopting our framework would force us to specify a great deal in terms of what type of mask, and where, and when, and mostly why. The exercise of analysing complex trade-offs, as anticipated, is additive and creative. For each of the trade-offs, in fact, we identified more sub-questions, and none of them led to a simple, binary dilemma. In our view, a policy decision should be the outcome of the collective pondering of the various complex trade-offs involved, not only by experts, but in public settings that allow for the input and engagement of diverse perspectives. Circumstances can be very different and the only way to produce sensible policies is to complexify rather than simplify. This is how we can make appropriate decisions in different contexts.

5 | CONCLUSION

In this paper, we sought to contribute to recent movements that call for novel ways of turning knowledge into action, and that hopefully will make us better prepared for future health crises. We presented a normative framework that can support public health in making explicit the rationale behind the design of policy interventions. This framework is borrowed from the field of environmental ethics, and originally identified three lenses: value and valuation, process and governance, power and inequalities. We also contributed to further developing the framework by proposing a fourth lens, explicitly geared towards considerations about scientific evidence, methods, and concepts.

While we hope that his framework will be of help in public health contexts, we also wish to note that, in our understanding, the potential use of this expanded framework is not confined to public health, or to environmental science/policy. In fact, there is a striking similarity of problems in environmental science and policy, in epidemiology and public health, and in emerging, digital technologies including issues around AI. These areas share a number of features. They deal simultaneously with individual and group behaviour—behaviour which, whether individual or group, has to be considered in the context of a relevant environment, and of the technologies that are in play. There are never simple and linear, causal relations involved, but causality is always a matter of emergence from complex networks of relations. There are always multiple values and perspectives at stake, and there is an irreducible scientific uncertainty in the knowledge base that is produced. Similarities do not just concern the high uncertainty that these fields deal with, but also the fact that results produced in these areas are likely to be used to
ground decisions for the population at large, affecting social structures in important ways, and also altering delicate equilibria between us, the environment and the technologies.

Because complexity is inherent to the connection between knowledge and action, we did not try to reduce or flatten it. Instead, we hope that the proposed augmented framework for navigating complex trade-offs can help with improving intersectoral communication for example, between the scientific community and policy makers, between politicians and the public, and between the scientific community and the public. Complexity, we think, needs not to be wiped away, but needs to be articulated as a key part of the process of choosing which route we take at any given junction in the intricacies of the decision-making process. It is only through more clarity and explanation that we can achieve better communication, and eventually trust.

In the end, we plead for more synergy between epistemology, ethics, and interdisciplinary analysis of the social and political dimensions of complex problems. The Covid-19 pandemic has not only put to the fore in a very urgent and dramatic way how all these questions are entangled, it also highlights how science alone cannot provide the answers or the magic recipes, and how the policy process may not lead to effective interventions if it rests on oversimplified representations of complex, interconnected dynamics. The way to go, we submit, is to complexity, rather than simplify.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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