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Ale, Ben J.M.; Slater, David H.; Hartford, Des N.D.

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ORIGINAL ARTICLE

The ethical dilemmas of risky decisions

Ben J.M. Ale¹  | David H. Slater² | Des N.D. Hartford³¹ Technical University Delft, Delft, The Netherlands² Carey Dene, Carey, Herefordshire, UK³ British Colombia, White Rock, Canada

Correspondence

Ben J. M. Ale, Technical University Delft, Mekelweg 5, 2628 CD Delft, The Netherlands.
Email: ben.ale@xs4all.nl

Abstract

Even in a pandemic there seem to be inherent conflicts of interest between the individual and societal consequences of remedial actions and strategies. Actions taken in the sole interests of patients, as required by the Hippocratic oath, can have broadly inconvenient economic implications for the State. (“Average” benefits for a population can impose individual inconveniences for the vulnerable.). Understandably these decisions are not normally made explicitly and transparently by governments. This leads to seemingly illogical and inhumane strategies which are not understood and hence mistrusted and often ignored by the public. Vaccination sentiments on social media are often an unwanted symptom of this dilemma. This article outlines and discusses a number of examples of such situations with a focus on ethical aspects. It concludes that each case must be considered individually as to the issues that need to be weighed in these difficult decisions; and that there are no clear and universally acceptable ethical solutions. What can be learned from the COVID-19 crisis is that short term utilitarianism has consequences that in the eyes of the population are unacceptable. This lesson seems equally valid for cost benefit evaluations regarding other risks, such as from hazardous industries, flood defenses, and air transport. Decisionmakers and politicians can learn that persuasion only goes so far. In the end the people appear to prioritize in terms of deontology.

KEYWORDS

Cost benefit analysis, COVID-19, deontology, risk, utilitarianism

1 | INTRODUCTION

In a previous article (Ale et al., 2021), we discussed how decisions on vaccination against COVID-19 have the potential to re-frame the whole debate about individual and societal risk, risk balancing, benefit-cost analysis, individual rights, societal responsibilities of individuals, and responsibilities of governments, within the overall context that there are limits to what can be achieved in particular instances, and in totality across society.

Because the word risk is used with many meanings, interpretations, and connotations, in the remainder of this article the use of the word risk is avoided as much as possible and replaced by its definition as is appropriate in the context where this word would otherwise be used. When the word risk is used, it is used where further specification is not necessary for the line of reasoning and in the general meaning: risk is a combination of probability and consequences (Ale, 2009).

1.1 | Primum non nocere

The basic maxim in health care is “do no harm.” This means among other things:

- do not intervene with a treatment that is worse than the illness,
- if you do not know what you are doing: don’t.

Unfortunately, in most cases it is not that simple. Almost all health interventions have potential negative side effects, as can be seen from the, often extensive, packaging leaflets of medicines. Or with another classical citation from the *Tristia* by Ovidius: “nil prodest quod non laedere possit idem” (Naso, 8 BC), or nothing is useful, which is not also able to injure (Fielding, 2014). The vector-based vaccines developed against COVID-19 have a small probability, about 1 in 7 million (CDC, 2021), of causing vaccine induced prothrombotic immune thrombocytopenia (VIPIT, also known as VIIT), but this is an “average” risk for an average person. We are all

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individuals with a range of susceptibilities and the 1 in seven million individuals, has a 100% chance of being affected. Identifying and excluding these susceptibilities is often much more difficult and takes time and relevant exposure data; which is often not readily available at the time of decision.

However, managing, or reducing these risks, comes with the potential to cause damage as well. Lockdowns to prevent the spread of the disease have considerable economic, societal, emotional, and psychological costs (Chorus et al., 2020; Gupta Strategists, 2020). Zoning around chemical industry installations keeps the population away from hazardous installations, but at the same time, it makes the development of sometimes premium real estate impossible. Putting high voltage lines underground protects people against electromagnetic radiation, but is considerably more expensive than the classic lines on masts.

It is often claimed that risk aversion hinders progress in medicine (Eichler et al., 2013) and elsewhere (Jongejan, 2008). Although there is evidence that safety and precaution are beneficial in the long run (Gollier et al., 2000); and the maxim of Trevor Kletz: If you think safety is expensive, try an accident (Barzier et al. 2021), still seems to hold true also for pandemic diseases (Ale et al., 2020). It cannot be denied that reducing, or mitigating risk, comes with costs and that therefore adhering strictly to the principle of “do no harm,” is not possible.

2 | DECISION MAKING PRINCIPLES

In making decisions which lead, or may lead, to differing benefits for individuals, the decisionmaker can base their reasoning on a range of arguments. These include the following:

- equal benefit for all,
- no harm to anybody,
- maximum benefit for a group, or a society, or
- equivalence of costs and benefits.

The last, often termed the zero-sum game, can be seen as the minimalistic application of the As Low As Reasonably Practicable (ALARP) principle, according to which, society should only stop spending money on saving the lives of those who want their lives saved, when the costs are disproportionately larger than the benefits (Ale et al., 2015; NN, 1949; UKSC, 2011a, 2011b). In the zero-sum game, the costs and benefits can also be expressed in various metrics, such as

- money,
- level of nuisance,
- health, lives, and
- life-years.

The arguments on which the decisions are made, are rooted in ethical principles.

Deontological ethics is any ethical theory based on the action itself (the duty, obligation, or rule for this action).

Deontology includes the ethical theories of Kant (1788) but is not limited to this theory. Consequence ethics is any ethical theory based on the consequence of the action. Utilitarianism is an example of this but is not limited to this theory. We will discuss the observation that decisions are often defended using one of these principles, regardless of whether it is difficult, or even possible, for any decisionmaker to adhere rigorously to any one of these principles. We will also discuss how often it is just too difficult to frame a decision problem, so that it can be dealt with unambiguously by invoking such a principle. In Section 4 we will give a more extended discussion of these principles in as far as this is relevant for this decision-making context and without attempting to summarize centuries of discussion and evolution of ethics.

2.1 | Vaccination

The ethics of vaccination (Giubilini, 2021) exemplify very well the interdependence of individual responsibilities collective responsibilities, and institutional responsibilities. Since the vaccination against COVID-19 is currently a major consideration, we use this to illustrate three decision-making problems.

- The first is the decision of an individual to take the vaccine,
- the second is the equitable distribution of vaccines over the population, and
- the third is the problem of the distribution of vaccines over the rest of the world.

2.1.1 | Taking the vaccine

Although at first sight it seems obvious that an individual should take the vaccine when it protects them from the serious or deadly consequences of a disease, there are a number of factors that make this much less obvious.

The first one is whether there is a reasonable chance of being exposed to the infection. Many infectious diseases, such as yellow fever, malaria, or diphtheria are only present in certain parts of the world. Therefore, if one is not living in the affected areas and one is not going there, there is no reason to take a merely prophylactic, precautionary vaccination. This is especially the case, when the vaccination itself has side effects, such as a mild illness, and even more if there are potentially more serious, even lethal side effects. Obviously, the probability of being exposed and infected, increases if the fraction of the population that is infectious, surrounding an individual, increases; and the advantage of taking the vaccination increases. However, if the general level of vaccination in a population increases, the probability of coming into contact with an infectious individual decreases, an effect also called “herd immunity.” Herd immunity keeps the herd and thus most of its members safe.

However, to maintain herd immunity the majority of the members of the herd need to be vaccinated. Such is the

case with diseases like diphtheria, whooping cough, tetanus, poliomyelitis, and measles. In many developed countries, there is a nationwide program to vaccinate children against these diseases. However, taking the vaccine is not mandatory. Therefore, to maintain the level of vaccination required for herd immunity, a continued program of encouragement needs to be maintained; especially now that through social media, the potential negative side effects of vaccines, whether true, real, perceived, or false, are getting increasingly more attention. There are previous examples of the consequences of dismissing such encouragement from the measles, mumps, and rubella (MMR) vaccination programs (RIVM, 2017).

It has now been reported that serum viral vector type vaccines against COVID-19 could have a potentially lethal side effect. As of May 7 2021, the probability of a reaction of concern is thought to be low to extremely low, when represented in terms of generally accepted metrics of the safety sciences. This is of the order of 1 in 26,000 to 2 in a million depending on the location (Pai et al, 2021), which significantly contributes to explaining why these side effects were not found during the trials. Because they appeared during the massive vaccination campaigns in various countries, this was a shock and caused the nascent resistance to vaccination in—parts of—the population, to escalate. This resistance was enhanced by organized dissemination of conspiracy theories through social media (Channel 4, 2021). With no other means available to increase the level of vaccination than persuasion, nudge tactics like free drinks and even million-dollar prizes are being used to encourage people to get vaccinated.

It should be noted that this societal problem is not restricted to people getting the disease, getting ill, and dying. If too many people are ill at the same time, the capacity to treat patients and prevent death from many other causes, can be overwhelmed, but also the capacity to treat the regular stream of patients will be affected. Almost all countries were forced to take costly “lockdown” type measures to prevent overwhelming their health services, but the restriction of civil liberties and the staggering economic costs are a powerful incentive for governments to try and convince people that they should take the vaccine, even if arguably the probability of death associated with the side effect may actually be larger than the probability of death from the disease in a community that has achieved “herd-immunity.”

2.1.2 | Who gets the vaccine first?

Since COVID-19 affects the elderly more than the young; and it is the elderly who fill up most of the intensive care unit (ICU) capacity of the health services, it seems an obvious choice to prioritize the elderly. However, the care workers in care homes can transport the virus from the outside world to inside the care homes: and moreover, if they fell ill, there would be nobody left to deliver the necessary care. Obviously then, the care workers need to be vaccinated first. There may of course, also be elderly who live at home, sometimes cared for by specialized care takers, but more often by fam-

ily, friends, and neighbors. This is problematic and requires alternative measures such as isolation.

The measures taken to prevent the spread of the virus have to be supervised by the police and other forces, who therefore come into close contact with, as yet, unvaccinated people, who may—even unknowingly—be bearers of the virus. So equally arguably, should they not be vaccinated with priority? A similar situation exists for the nurses and doctors in hospitals. But cleaning and catering in hospitals is also vital for the continued operation of the health service, so maybe they should be vaccinated with priority also. Then there are the ambulance drivers who collect the ill, the general practitioners, the teachers, people with illnesses that make them more susceptible for serious symptoms. This reasoning results in an ever-increasing number of groups that claim a need to be prioritized, so that in the end everybody claims priority.

In several, but not all countries, the most often chosen prioritization was the inhabitants of care homes (the elderly and their care staff), followed by the general public according to decreasing age. In parallel, vaccines were given to the nursing staff in hospitals, where in some hospitals, management was vaccinated as well as people with illnesses and GPs. This did not really affect the rate of vaccination in the main program, because for these groups different types of vaccines were deemed appropriate. In other countries, such as is seemingly the case for the United Kingdom, the care homes and care workers were not prioritized to this extent.

In deciding the vaccination prioritization order, the deontological approach seems to have been the overriding principle, although again there were voices that questioned the choice of the elderly first and above people in services with a higher economic output, which would have been the utilitarian approach (Helsloot, 2012)

2.1.3 | Export of vaccines

It would logically be deemed important for the response to a global pandemic, that the vaccines should be equitably distributed all over the world (WHO, 2021), to prevent reintroduction of the disease, and especially its variants of concern (i.e., more infectious or more deadly or in general more dangerous). But in areas where the virus has been controlled, countries have generally prioritized their own populations. The situation is complicated in that the expertise and manufacturing facilities are mainly owned by private companies and available in only a limited number of countries. Supply chains are thus subject to export bans where countries can attempt to commandeer these supplies for their own needs first. Understandably India has been forced to do this to address its catastrophic pandemic consequences. Consequently, as yet only a limited number of vaccines have been sent to COVAX (NU, 2021), the WHO organization that distributes vaccines over the world. The European Union (EU) has considered banning exports, but in the end decided not to. Many countries without the manufacturing facilities, are thus, not only unable to commandeer supplies, but have to

compete on the open market for the remaining supplies. Up to April 2021, the United Kingdom did not export any vaccines (Morris, 2021) and had to delay its vaccination program as the Indian supplies were diverted to India's internal needs. The EU supplied the United Kingdom (almost 11 M doses) and smaller amounts to, among other, Canada, Japan, Mexico, and Saudi Arabia (McCarthy, 2021). The United States had a similar "America first" approach but has since started to export vaccines after many of its citizens were vaccinated (McCarthy, 2021a).

There is also the problem of vaccine wastage in countries that do not have the logistical capacity to distribute sufficient quantities of vaccine within the timeframe that the vaccine remains viable (Sahay, 2021). This situation is not unique to the COVID-19 situation and the WHO has had guidance in place since 2005 (WHO, 2005).

From these examples it can again be seen that in as far as utilitarian arguments play a role, they only seem to be applied locally. The general approach is more pragmatic, to tackle the problems as they present themselves and thus deal with domestic issues first, which is more in line with the deontological principle.

2.2 | Hypothetical example

As a hypothetical, but realistic example, consider a working woman in the Netherlands of between 30 and 40 years old, with one or two children and an elderly parent. If she feels a moral responsibility for the welfare of the world at large, she would want to contribute to the build-up of herd immunity in the population, by getting vaccinated against the virus. She can be vaccinated with a vector type vaccine. She would, however, want to make an informed decision, and therefore would consult the information supplied by reputable institutions; such as the Netherlands National Institute for Health and Environment (RIVM), The WHO, and the John Hopkins University, in their efforts to inform and educate decision-makers, politicians, members of parliament, and the general public on issues of importance regarding the COVID-19 pandemic (D'Souza & Dowdy, 2021; HHS, 2021; WHO, 2020a, 2020b). This information does not have the depth of original peer reviewed scientific papers (Bärnighausen et al., 2014; Milman et al., 2021; Robertson, 2021), but the latter generally are too specialized and too concentrated on details, to be of use for lay people wanting to make an informed decision on the subject. The information issued by authorities, chief medical scientists, and others involved in managing the COVID-19 pandemic, through the media, concerning the state of affairs and the actions they desire or demand the public to take, are of similar depth.

Up to the summer of 2020—that is, when vaccines became available—RIVM published the number of deaths categorized by age and gender, in great detail. Later, the deaths below the age of 50 were combined into a single category, because of the low number with respect to the total. In the published data (RIVM, 2020), therefore, the woman would

find that at the time when 6% of the Dutch population of 17 million people were infected, only three women below the age of 40 had died of COVID-19. Therefore, based on, this information, her probability of death given infection (also often called the infection fatality rate), would be 3×10^{-6} . In the United Kingdom the death rate under the nonvaccinated below the age of 40 at a vaccination rate of 79% is at 4.5×10^{-6} . (UKHSA, 2021). With a ratio of 1.3 to 1 for female lethality against male lethality (Nguyen et al., 2021), the lethality for women in the United Kingdom amounts to 5.4×10^{-6} . The deathrate in this age group in the United States is considerably higher at 5.1×10^{-5} . (Statista, 2021).

If she were to assume that eventually everybody would be infected, that would also be her probability of dying from the pandemic

For those countries that are explicit about the acceptability of a probability of death from manmade and of natural causes, this probability of death is considered completely acceptable and far below the often used limit for the probability of death of natural causes of 10^{-5} /year (HSE, 1988, 2001; IENM, 2013; Jongejan, 2008). The woman would therefore deem her individual probability of death from COVID-19, although non-zero, by this precedent acceptable, when compared to other natural causes of even, for instance, with her probability of death in a traffic accident.

When vaccinations became available, the woman would have to decide on whether or not to be vaccinated. When she was made aware of the potential lethal side effects of some of the vector type vaccines, she could also consider that, should she be the unfortunate victim of a side effect and become seriously ill long term, or die, there would be nobody to take care of her children and mother.

If she were to look up the numbers in the sources readily available to her, she would look for the probability of her becoming the lethal victim of such side effects and for women of her age she would find data between 1×10^{-6} (AD, 2021; CDC, 2021; Marks, 2021) and 4×10^{-5} (Zulli et al, 2021) Shimabukuro (2021) reports 8.5×10^{-6} for the United States, but does not specify whether this is a death rate or a case rate.

This would justify the conclusion that the probability of her death from COVID 19 without vaccination is of the same order of magnitude if not much smaller than her probability of death from a vector-type vaccine. In the United States, the conclusion could be different due to the much higher death rate.

From the information issued by reputable institutions as mentioned above and by information supplied repeatedly by the public authorities in charge of managing the pandemic, it is advised that the rate of spread of a virus is reduced when the immunity in the population is increased, and that the probability of an individual being infected in a population that is predominantly immune, (also called herd immunity) is significantly reduced (De Gier et al, 2021; Eyre et al, 2021; Hsu et al, 2021). She would also learn that in the long run the population would become immune; either by being infected, or by being vaccinated. This, she could conclude, would make her probability of dying from COVID-19 in a population that

is predominantly immune, much smaller than dying from the (vector type) vaccine. Moreover, it would not be unnatural for the woman to be more cognizant of the welfare of her own direct family, than for society as a whole and that herd immunity given that this would eventually be attained anyway, without her personal vaccination. Given then, that according to the information available to her, that after a successful vaccination program in the wider population, her probability of death from COVID-19 would appear to be relatively small when compared to probability of death of the side effect, it would be a rational decision for her to not take the unnecessary probability of death with a vaccine.

As observed previously, this is the same as the underlying reasoning behind the recent decisions by the UK's Joint Committee on Vaccination and Immunization (JCVI, 2021).

One could argue that it would have been even more prudent if she would have considered that, if every woman under 40 would make the same evaluation, the extent of vaccine induced immunity would be considerably reduced. However, that does not take away the reality in this case, just as in every other case where "free rider" behavior is an option, such behavior is not irrational, as for instance is illustrated by the tax avoidance behavior of international corporations.

2.3 | Perspective

This situation illustrates the issue of risk being a matter of perspective (Ale et al., 2021; Aven, 2009), and acceptably safe being a matter of the perspective of the person making the determination. This realization has widespread implications across society as often decisions to accept a certain level of risk are made deep within organizations, often without proper appreciation of the nature, magnitude, or significance of the risk. This situation arises frequently across the spectrum of engineering endeavors, where design choices that can have risk implications right across society are made by individuals, or groups. The Boeing 737Max (Gates & Baker, 2019) auto override being just one example of a great many such cases.

Such a situation with vaccines, where the risk to the many can be lowered by an increase of the risk to the few, is not uncommon and occurs in many instances. If one designates risk as being a cost, then any situation in which a decision or an activity benefits one party, while passing the costs on to another, poses a similar ethical dilemma. There is a similar, but arguably more difficult ethical issue, when many in society benefit from the imposition of an albeit small risk to a few. The latter is a common issue in many decisions making processes involving hazardous activities, such as chemical industries (Ale, 2005), hydropower dams (Ale et al., 2021a), and airfields (Ale & Piers, 1999).

The COVID-19 pandemic seems to be a prime example of these decision-making problems. In the remainder of the article, we will discuss the general characteristics of these decision problems in more detail.

3 | UNEVEN DISTRIBUTION

Although the benefits of electricity and many other common goods are usually equally distributed over the population, in many cases neither the benefits nor the costs are as equally distributed.

In COVID 19, the elderly have a considerably higher probability of dying from the disease (Lam, 2020), although new variants seem to hit the young harder than the original (Loveless, 2021; Marshall et al., 2021), and the effects of "long Covid" are still uncertain. However, lockdowns and other measures to reduce contacts between people are especially hitting the young (Sumption, 2020). This uneven distribution of benefits and costs is a common challenge in decisions about risk and its reduction.

The risks, in terms of probability of death and injury of many hazardous industries, fall on the workers and those living in the immediate surroundings, while the benefits of the products are available to the wider population. Cheap clothing in the west is made in hazardous factories in Bangladesh (CCC, 2021). The risks in terms of probability of death, injury, and material damage of hydro-electric dams fall on the people downstream, while the clean energy is available for all and the favorable effects on the climate, serve the world (Conway & Gawronsky, 2013).

Although one might expect that risks are managed with the most appropriate means given the nature of the risk and other circumstances, this is not completely true in practice. Decisions in the public domain are made by politicians and other elected officials. Elected officials have a political and ethical background on the basis of which, they are elected, to which they therefore have to adhere and this reduces their options and their decision space. There are several ethical principles on the basis of which, these decisions can be based, of which two are often considered mutually incompatible: utilitarianism and deontology (Ersdal & Aven, 2008). These two conflicting considerations can be clearly detected in the way decisionmakers consider risk problems, especially those involving the probability of death.

Without aspiring to be complete, a short characterization of these two principles is given below.

3.1 | Deontology

The deontological principle is based on the considerations of Immanuel Kant in his *Critique of Practical Reason* in which he formulates the only categorical imperative in morality as "Act only according to that maxim by which you can at the same time will that it should become a universal law" (Kant, 1788). Kant gave two alternative formulations: "Act that you use humanity, whether in your own person or in the person of any other, always at the same time as an end, never merely as a means" and "we should so act that we may think of ourselves as legislating universal laws through our maxims. We may think of ourselves as such autonomous legislators only

insofar as we follow our own laws” (Ersdal & Aven, 2008). These formulations are often interpreted as meaning the same as “treat others as we wish others to treat us” (Matthew, 7:12), but Kant himself objected, noting that a prisoner duly convicted of a crime could appeal, pointing out that the judge would not want anyone else to send himself to prison, so he should not do so to him (WIKI, 2021). This objection is a little weak, because it is not to be expected that a universal law that exempts all judges from being sent to prison would be acceptable, as even judges can violate the law and therefore it would be justified to send them to prison, the operative term in this case being “duly convicted.” A more substantial argument can be that people who defy death would not object to putting others in mortal danger or even kill them. However, such an action would have the implicit assumption that others also defy death and therefore the act would be in violation of the categorical imperative.

The precautionary principle can be called deontological, if formulated as a deontological type of principle like; one should not do anything, or expose anyone to risk, if one has not enough knowledge to make an informed decision to do otherwise. In the case of COVID-19, where, at least in the beginning, neither the consequences of getting the disease were sufficiently known, other than that there was a substantial probability of death, nor the mechanisms and the rate of spread, lockdowns provided a sensible precautionary measure (Aven & Boudier, 2020).

In the general case, precaution is criticized because it does not take account of the—opportunity—costs of precautionary actions (Jongejan, 2008). In the case of COVID-19 this criticism is merely based on utilitarian arguments, which will be discussed later in this article. However, there is an additional element, which is that precaution also can be exercised on a first come first served basis. On the basis of the information currently available to the authors, the situation seems to have developed in that first, came the COVID-19 patients that were admitted to ICU as, and when, they arrived, thereafter there was no longer enough space to treat patients with other life-threatening conditions. Second came the lockdowns to prevent the spread of the disease, whereafter came the realization of the consequential economic costs. Or, alternatively, first came the economically driven cuts in the budgets for health service with the associated reduction in the ICU capacity. Then came the realization that the capacity could be overwhelmed in a pandemic; and for the time being a realization that there was not a satisfactory answer to the question as to whether the savings made before the pandemic, actually made any difference to the costs of the pandemic, let alone outweighed the cost. Although Germany has about five times as many ICU beds per unit of population than the Netherlands (OECD, 2021, Bauer et al., 2020), they still had to resort to lockdowns to prevent their health service being overwhelmed. In any case, the problem addressed by precaution sometimes seems to be the first problem that presents itself and subsequent problems are then seen as collateral to addressing the first. In the case of COVID-19, the postponement of critical care for non-COVID-19 patients is presented as collat-

eral damage of the choice to prioritize the care for COVID-19 patients. The alternative could have been to continue treating the regular patients; in which case the death of COVID-19 patients would have been collateral to the continued regular care. The imminent overwhelming of the healthcare system was thus a collateral outcome of solving the budget problems of governments, which in part were caused by a problem that was seen as more immediate: the need to reduce taxation on business, including multinational corporations, in the interest of promoting economic activity. In all these cases subsequent problems were deemed collateral to the solution of the first, an issue often pointed out by utilitarians (Steffansson, 2019) and others (Aven, 2019).

3.2 | Utilitarianism

Utilitarianism, in normative ethics, is a tradition stemming from the late 18th- and 19th-century English philosophers and economists Jeremy Bentham and John Stuart Mill according to which, an action (or type of action) is right if it tends to promote happiness or pleasure. Utilitarianism is often seen as Hedonistic, because of the position taken by Bentham and Mill (Duigan, 2021). Decisions made on the principle of utilitarianism should bring the “maximum amount of happiness” (Wiki, 2021a). Originally there was an addition: “to the largest number of people.” The principle allows accounting of costs and benefits falling to all of the people involved. Large increases in happiness for some therefore, can compensate for smaller decreases in happiness for others. It also allows for very large increases of happiness to a few to compensate for many small decreases in happiness for the many, as long as the sum total is positive. This argument justifies the rich getting richer at the expense of the poor (Ale et al., 2018, 2019; Baujard, 2013). On the other hand, the principle supports the idea that a decrease in the happiness for some can be compensated by the increase of happiness for the rest.

The principle creates a further question which is who should be taken into the account. Should one for instance investigate whether it brings more utility to put high voltage cables underground, or provide healthier school meals; or even wider, should one spend one’s money on keeping the population of the “west” healthy, or would the money better be spent on foreign aid, thereby increasing the happiness of a few billion people at the expense of a small decrease of life expectancy in the “west,” where the associated decrease in happiness would probably hardly be noticed.

The ultimate expression of utilitarianism in this context, is fixing the maximum amount to be spent on medicines or other measures aimed at extending human lives. This cap on the value of a statistical life (VOSL) is assumed to prevent too much happiness to be given to a single person, or group of persons at the expense of the happiness of society as a whole, also referred to as “the taxpayer.” Although there is no reasonable scientific, or even historical basis for a universal value for a human life, or the extension of it, several

countries and institutions use values in the order of a few million (of their currency units) for a life as guidelines for their policies (Ale et al., 2018, 2019). Recently, NOVARTIS reversed the argument by stating that their medicine ZOLGENSMA against SMA prolongs the life of children by some 20–25 years by a single dose and therefore this dose is worth 2 million euros, regardless of the production costs (De Visser, 2021).

3.3 | Moral incentive

Although utilitarianism and deontology are often described as opposite and mutually exclusive ends of the ethical spectrum, recent research suggests that these inclinations are in fact independent and that increased moral identity increases both inclinations, be it not to the same extent. Deontological inclinations depend more on emotional responsivity and utilitarian inclinations depend more on cognitive deliberation. Although emotions are generally seen to be a disturbing factor in debates about decisions on risk, as they are taken to be irrational and immune to factual information, the usual support for this idea to be found in the psychological literature is due to a flawed understanding of emotions. Emotions can be a source of practical rationality. Emotions such as fear, sympathy, and compassion help to grasp morally salient features of risks, such as fairness, justice, equity, and autonomy, that are not part of the utilitarian way of thinking (Roeser et al., 2012). Which way a decision goes therefore, depends on the circumstances, the decisionmaker and the decision-making process; and cannot be called unethical *à priori* (Conway & Gabronsky, 2013).

4 | APPLICATION TO COVID-19

The original and almost universal reaction to the outbreak of COVID-19 was to protect the population against the infection and attempt to protect the health-care system such that it could cope with the rush of patients needing immediate treatment. This reaction can be classified as deontological. Protect the people who need protection just as you would want yourself to be protected. There was some vocal opposition though. The consequences of an infection with COVID-19 depend to a significant degree on age (Chorus et al., 2020), and certainly at the beginning and before mutations, or “variants of concern,” came along, patients that needed intensive care were predominantly people with previous health conditions, or obesity. Therefore, the typically utilitarian question arose early in the course of the pandemic, as to whether the costs of saving the lives of patients with a relatively short remaining life expectancy were actually worth it, given the economic and other collateral damage (Sumption, 2020). It was even stated that “death is part of life” (Fokkelman, 2021) and that the elderly should accept that their life would be shortened by this or another illness without appeal to scarce

resources of society and without making themselves a burden to society (Bessems, 2021).

A similar question arose when certain types of vaccines proved to have potentially lethal side effects. This question was first answered in a utilitarian manner: the risks, in terms of probability of death and injury from the vaccine, were declared to be obviously smaller than that of catching COVID-19, although as illustrated earlier in the article that may be the case for the population as a whole but not necessarily for everybody. But when it became clear that the side effects for instance, largely affected only healthy young women, who otherwise would have little to fear from the disease, also the official stance became deontological and precautionary: why take the risks of these vaccines if there are other vaccines which do not pose these risks (Ale et al., 2021). Countries where vaccines were produced, prioritized vaccination of their own population over world-wide distribution. As such the maximization of happiness only considered their own national society. In general, “happiness” or utility in dealing with the COVID-19 pandemic was merely defined as survival, without much consideration of, for instance, the economic happiness of the hospitality industry.

4.1 | Application to other risks

In decisions about risks, that have nothing, or only possibly remotely, to do with life or death, similar mechanisms can be found. An increase in “happiness” for shareholders does not necessarily pair with an increase in “happiness” for the employees. A hedge fund that buys a department store, sells off the assets, such as the buildings in which the stores operate, and then lets it go bankrupt, meaning that the employees lose their jobs, is an example. This makes the shareholders in the hedge fund happier, and possibly the owners of the store, but presumably not the employees; and it is doubtful that here, the total amount of happiness is increased and for as many people as possible.

The risk of being infected with COVID-19 is small when most of the population is vaccinated and therefore there is little need for an unvaccinated individual, in an otherwise vaccinated community, to take a vaccine. Similarly, the probability of a flood behind a sea defense is small, as long as the people keep paying for the maintenance of the sea defense. Therefore, there is no need for an individual to contribute, when all the others in the community do. To prevent such free-rider behavior, taxes are levied by states, forcing everybody to contribute. The big difference is that the universal declaration of human rights (“Everyone has the right to life, liberty, and security of person”) makes making vaccination mandatory subject to extremely stringent conditions (AE, 2021): that is, (1) there should be a basis for mandatory vaccination in law, that (2) each case should be motivated separately by showing that the mandatory vaccination has a legitimate purpose (3) it is protecting individual AND public health, and (4) the vaccination not only protects the vaccinated individual but also

the individuals that cannot be vaccinated because of medical reasons through herd-immunity (NBHR, 2021).

Contrary to vaccination, in flood protection, the maximization of “happiness” is organized by the state, not leaving an individual citizen the chance to increase their individual “happiness”—that is, freedom from being flooded—by not having to pay for it.

The latter example illustrates that whenever the utility for individuals does not coincide with the utility of the collective, choices have to be made. If the choice is made that the interests of the collective prevail over the interests of the individual and that maximizing the total “happiness” outweighs the decrease of “happiness” perceived by the individual, some mechanism has to be found to overcome the rational reluctance of the individual, be it coaxing, coercion, demand, or using the force of law.

4.2 | Application to industrial risks

Reactions to the imposition of industrial risk in terms of probability of death and injury developed along different lines. In the early stages of the industrial revolution, accidents were considered as part of the game. However, when the number of occupational accidents increased, policies to reduce the number of accidents were developed (Swuste et al., 2010). At first, it followed the deontological approach, As Low As Possible (ALAP). But soon other aspects were considered, changing the philosophy into a more utilitarian one: ALARP (Ale et al., 2015).

The Tolerability of Risk Framework (HSE, 1988, 2001) embodies three types of decision criteria; an equity-based criterion which reflects deontological principles, a utility-based criterion (costs and benefits), and a technology-based criterion (best available technology and best available practices). The intent is to capitalize on the advantages of these different decision philosophies while avoiding their disadvantages. Reducing Risk, Protecting People (HSE, 2001) notes that there are also many risks in terms of probability of death and injury that people are prepared to take by operating a trade-off between the benefits of taking the risks and the precautions we all have to take to mitigate their undesirable effects. However, this rationale is not always applicable as set out herein.

With the rise of the neoconservative market driven thinking, attempts were made first to investigate whether there was a financial pattern in decisions on risk (Tengs et al., 1995), followed by attempts to put a value on human lives (Viscusi et al, 2003), which could be used in evaluating a cost benefit analysis. Although, as mentioned before, the findings of these attempts were largely inconclusive (Ale et al., 2019), the application of a cap on medical intervention was too appealing to ignore in policies to control the ever-increasing costs of health care and of medicines. Although as far as is known, no country ever explicitly decided on a cap on the cost of saving a statistical life, institutes such as NICE (The National Institute for Health and Care Excellence) in the United Kingdom

(NICE, 2013), the Heath-Care Institute (Zorginstituut) in the Netherlands (Zorginstituut, 2021), the Environmental Protection Agency in the United States (EPA, 2020), and Commissariat Général à la stratégie et à la prospective in France (Quionte, 2013; Téhard Detournay et al., 2020), have produced guidelines on maximum amounts to be spent. There are, however, ample examples to prove that even these institutes and those in Government who they are responsible to, do not adhere to these limits when confronted with real illnesses and real people.

As an example, take kidney dialysis. There are some 6500 patients in the Netherlands who have such problems with their kidneys, that they need either dialysis, or a kidney transplant. The life expectancy of a patient who is dialyzed is 25 years from the onset of the treatment. A patient with a transplant has a “normal” life expectancy. However, a transplanted kidney only lasts 15 years (Bemaleman, et al, 2018). This means that after 15 years a new transplant is necessary. Nevertheless, transplantation is cheaper than dialysis. Unfortunately, there are not enough donor kidneys available. This means that the majority of the patients are dependent on dialysis. This treatment costs 100,000 euro per year (Vektis, 2019). This is above the amount advised by the Zorginstituut. There is however nobody, not even the Zorginstituut, who suggests the end of this treatment. Therefore, although the Zorginstituut promotes a utilitarian approach, when “push comes to shove,” deontology prevails. And even if the costs do not fall to the budget of a national health service, in many cases treatments deemed too expensive, are paid for by crowdfunding and thus paid for by members of society after all (Justgiving, 2021).

Nevertheless, these utilitarian values are used outside the health care system, mostly to argue that certain measures—including lockdowns—are disproportionately expensive (Helsloot, et al, 2020), and the money could be better be spent elsewhere.

4.3 | Specifically to hazardous installations

Many industrial installations pose a certain probability of death and injuries to the workers that operate them and the community/environment around them. Chemical installations bring the probability of fires, explosions and exposure to chemicals, and the consequences thereof. Steam engine boilers can explode. During the transportation of hazardous materials accidents and incidents have the potential to injure or kill many people. Hydro-electric and other water resource dams may fail and cause flooding. Flood protection dykes for the purpose of protecting life, livelihoods, and economic activity, sometimes at a national level, fail occasionally. More common activities such as exposure to traffic hazards, also bring a daily stream of injured and killed. All these activities are undertaken because they bring a good for society and for the owners of the facilities. Modern society cannot survive without electricity, or transport, or manufactured materials and products.

Therefore, a decision to allow the building of a particular installation at a certain place implies a decision to allow a good for society to be produced at the expense of a small probability of death, injury or material damage to a limited number of people. In some cases, the people who carry this small probability of death, injury or material damage are readily identifiable, other cases less so and in other cases those that have a probability of death, injury or material damage are not directly identifiable, but are part of a large population group. These different contexts further complicate the ethical dilemma. Even with products that spread through the environment such as pesticides, herbicides, persistent chemicals, and microplastics a small and often unknown increase in the small probability of death, injury or material damage to the world population as a whole is implicitly accepted.

The discussion on the balance between benefits and costs, usually arises explicitly, when mitigating measures are contemplated to reduce the probability of death, injury or material damage, whether from existing facilities, or newly to construct ones (Ale et al., 2021a).

Asbestos has been, from ancient times, considered as a useful construction material because of its fire safety and heat insulation properties. However, from the 1930s the probability of death and injury from inhalation of the fibers started to be publicly discussed. The increase of the scale of use, for instance in the brake-linings of motor vehicles, increased the probability of death and injury and the discussion of what to do about it. From the 1990s, the use of asbestos was increasingly banned. This recognized that the fibers from deteriorating asbestos roofs disperse into the environment and thus poses a probability of death and injury to society as a whole. It resulted in programs to eliminate asbestos and sanitize buildings and roofs. However, it is a costly operation and discussions about whether the costs of asbestos removal are proportional to the probability of death and injury avoided, have been debated ever since. Two arguments raised in this discussion are relevant for the current context.

- The first one is about relativity. The question raised is whether the money spent on asbestos removal can be better spent elsewhere, so that more life-years are saved. A potential area that is mentioned is to improve the health of children by supplying healthier food and drinks at school (Van Dijk, 2012).
- The other one is absolute. The question raised is whether the money spent on saving a life-year is worth the money given the VOSL or the value of preventing a fatality (VPF) which is based on willingness to pay (WTP) principles (Helsloot et al., 2010).

Similarly, one can argue that not enjoying the economic benefits of industrial activities leads to loss of health and shorter life expectancy (Nosrati, et al 2018; Preston (1975)). Although the relationship is contested (Chetty et al, 2016) it is argued that spending money on reducing the probability of death and injury decreases the income of the population and therefore costs life-years. This consideration has subse-

quently been used to justify exposing people to the probability of death and injury near a nuclear power station (HSE, 1988), near a chemical installation (TK, 1988) or downstream of a dam; to expose people to the noise from an airfield (WHO, 2018), or to increase the maximum speed on highways: in the US idiom: “There ain’t no such thing as a free lunch” (Heinlein, 1997).

These arguments are common in any cost benefit discussion. They are also used in the discussions about the various lock-down measures taken to curb exposure to the COVID-19 virus and thus its consequences.

5 | DISCUSSION

In Section 2 we listed four principles on which decisionmakers can base their reasoning. Their occurrence in the case of decisions in the COVID-19 pandemic and the implications for decisions in other areas can be evaluated as follows

5.1 | Equal benefit for all

This principle can rarely be maintained in practice. In the case of COVID-19, the potential damage was distributed unequally, because the elderly were more at risk than the young. Because the young participate more in the economic process, the benefits of measures such as lockdowns and social distancing benefit the elderly more than the young. For industrial hazardous activities, the higher risks are localized to the workers and the nearby population, while the profits are distributed to the shareholders in the company. Any measure to reduce the potential for physical, or emotional harm, will thus benefit workers and nearby populations and result in financial loss (harm) to the shareholders. One might even argue that safety measures make products more expensive and therefore impose a type of harm on all members of society. Therefore, as long as the a priori benefits, or damages, are unequally distributed, the benefits of interventions will be unevenly distributed, making this principle, although morally justified, not really applicable in real situations.

5.2 | No harm for anybody

The principle of “do no harm” is morally justified, but can only be upheld when only action, or inaction involving a single person, such as between a GP and a patient, is concerned. And even then it often is necessary to do a smaller harm—such as an operation—to avoid a larger one. On a wider scale, collateral damage seems unavoidable, when resources are limited. A GP can only see one patient at the time. There is only a limited supply of ICU beds, which means that treatment of COVID-19 patients necessarily leads to delay of treatment for others.

For vaccination, the situation is different in the sense that potential side effects of a vaccine usually lead to a low

probability of damage, in order to remove a much larger probability of being harmed by the illness against which the vaccination is directed. Nevertheless, no harm to anybody at all is difficult if to maintain.

The noise burden for people near an airport, or near wind farms and the associated damage to health (Van Kamp et al, 2020), is considered acceptable collateral damage for the benefit of society as a whole, so they can fly abroad for their holidays and enjoy renewable energy.

It seems that where health and life is concerned, doing direct harm is to be avoided and only acceptable when there is absolutely no other option. But it seems that probable harm is accepted to attain benefit from economic benefits, even if the harm includes death.

5.3 | Maximum benefit for a group or a society

Groups seem to try and maximize the benefit for their own group, even if this may harm other groups. In the COVID-19 case countries generally vaccinated their own people first, before they exported the vaccine to other countries. This even included vaccinating the less vulnerable young in their own country before the more vulnerable old elsewhere (Maddox, 2021; McKee, 2021).

Similarly, corporations try to maximize their profit. If pursuing profit involves reducing the profit of other corporations and putting the workforce and the nearby population at risk, this is a matter for the companies own morality (Goff & Noblet, 2018; Klein, 2008), but this often needs additional constraints such as laws, regulations, and policies of national and international governments (Swuste, et al., 2010; Dewatripont & Tirole, 2020).

Protecting one's nearest and dearest does not seem to be immoral. However, the boundary between self-preservation and selfishness is difficult to draw. In the neoliberal philosophy, selfishness is praised as the driving force for progress (Rand, 1964). It apparently needs continuing effort to constrain gain at the expense of others, by excessive selfishness, at a personal, group, company, or society level, and curtail "greed and capitalism" (Kuenssberg, 2021).

5.4 | Equivalence of costs and benefits

Of the four principles—equal benefit for all, no harm to anybody, maximum benefit for a group or a society, and equivalence of costs and benefit, cost benefit analysis (CBA), and balancing costs and benefits need the most accurate and precise evaluation of these costs and benefits. It can only really be done when all the costs and benefits are evaluated on a common metric and uncertainty can be virtually eliminated. The most used of the common metrics, is money (Ale, Hartford & Slater, 2015), and the balancing mechanism is then a deterministic benefit-cost analysis.

It seems obvious, that if the measures that cost less than the benefits are desirable to take, it may, at first glance, look illogical to consider measures to prevent, or reduce the probability or extent of harm of which the costs are higher than the benefits; in terms of a valuation of the reductions realized. However, when health and life issues are at stake, the principle of So Far As Is Reasonably Practicable (SFAIRP), also called ALARP or, As Low As Reasonably Achievable (ALARA), has been used by many countries in the world; notably also in Canada, the Netherlands and the United Kingdom.

The precedent has been enshrined in the United Kingdom case law since the case of *Edwards v. National Coal Board in 1949* (NN, 1949). In the case, the court stated that:

"Reasonably practicable" is a narrower term than "physically possible" and seems to me to imply that a computation must be made by the owner in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other; and if it be shown that there is a gross disproportion between them, the risk being insignificant in relation to the sacrifice – the [person on whom the duty is laid] discharges the onus on them [of proving that compliance was not reasonably practicable]. The ruling implied that the risk must be insignificant in relation to the sacrifice (in terms of money, time or trouble) required to avert it: risks must be averted unless there is a gross disproportion between the costs and benefits of doing so.

This is confirmed in the verdict on the appeal in the case of Baker against the Quantum Clothing Group (The Supreme Court, 2011a):

"In considering what is practicable, account must be taken of the state of knowledge at the time. A defendant cannot be held liable for failing to use a method which, at the material time, had not been invented: *Adsett v K and L Steelfounders and Engineers Ltd* [1953] 2 All ER 320; nor for failing to take measures against a danger which was not known to exist: *Richards v Highway Ironfounders (West Bromwich) Ltd* [1955] 3 All ER 205."

In the same verdict, the demand of gross disproportionality was confirmed (The Supreme Court, 2011b):

"I agree with Smith LJ in her conclusion (at para 84 of her judgment) that for the defence to succeed, the employer must establish a gross disproportion between the risk and the measures necessary to eliminate it. In the words of Asquith LJ in *Edwards v National Coal Board* [1949] 1 KB 704, 712, "the risk [must be] insignificant in relation to the sacrifice." In the present case, the provision of ear defenders at relatively modest cost was entirely practicable. For that reason, and since I have concluded that the employers ought to have been aware of the risk of noise induced hearing loss to the respondent, I do not consider that the defence of reasonable practicability was available to them."

This means that measures to prevent injury and death and/or, the probability thereof, have to be taken, even if the costs exceed the benefits; the latter being the value of the averted damage or harm. Only if the costs are disproportionately larger than the benefits there can be a case made to not

take—further—preventive action. The minimum amount by which the costs can exceed the benefits is “zero” pounds (or euros or dollars, etc.). And in many cases the duty holder—that is company, institution or authority that is responsible for taking preventive action—tries to minimize its costs and not let them exceed the benefits: balancing costs and benefits.

Material damage and the costs of avoiding it are readily evaluated in monetary terms. However, less material damages, such as the consequences of delayed operations, the delayed education for children, reduced future income due to lower future wages (Gupta Strategists, 2020) are much more difficult to evaluate. When health and life are at stake, the evaluation is even more elusive (Ale et al., 2019), a problem that is exacerbated by uncertainty.

In the case of COVID-19 these damages, which are collateral to the measures taken to curb the pandemic, are expected to occur in the future and are all highly uncertain. For the Netherlands the reduction of the GDP over 2020 was predicted to be 8.5% (Nu, 2021a), and turned out to be 3.8% (Waijers, 2021), which invalidates all predictions by Gupta Strategists (2020). Also, in other areas the costs turned out to be much lower than predicted (Holden, 2020). In these and other evaluations of the collateral damage (Helsloot et al., 2020), the uncertainty is rarely taken into account, which in this instance led to an overestimate of the present value of potential future damage.

The direct balancing of the costs of measures such as lockdowns against the value of lives saved (Conover, 2020) is also problematic. This is because there is no scientific basis for the VOSL or a quality adjusted life year (QALY), or any other metric by which human life values can be converted to money. A cost benefit analysis thus remains uncertain and littered with subjective and political choices.

The CBA in the case of COVID-19 then is not any different from CBAs for other hazardous activities, which involve balancing the costs of safety measures against the reduction of risk based on a risk analysis. Since risk is probabilistic, it is uncertain whether the consequences will arise at all and if they do arise, it will be in the future; although that future can be tomorrow. This is in contrast and contrary to, many of the future damage consequences predicted in the case of the COVID-19 pandemic, which are projected to arise over the next decades.

In practice, however, cost benefit analyses do not appear to have played any significant role in the choices made about policies to curb the pandemic. Spending money to “flatten the curve” and at the same time keep business, the economy and society afloat, was almost universally considered a good idea. In the aftermath, it might be concluded that the money spent per life saved was more than would otherwise have been considered acceptable *a priori*, for example, by advisers in the Governments and health services. On the other hand, if indeed a human life can be considered a “marketable entity” with a price attached to it, that price is set by the market and not dictated by advisory bodies. In this context, the market, that is, society, has apparently considered the price paid for lockdowns to be economically and morally acceptable.

5.5 | Utilitarian or deontological

From the above discussion, a few observations may be drawn.

The risk management problems in the case of COVID-19 and in the case of hazardous installations and hazardous activities differ only in the scale of the consequences. COVID-19 poses a world-wide problem addressed mainly by national governments, while hazardous installations pose local problems also addressed by national governments or sometimes by regional governments. They are similar in that measures have to be taken to reduce the—potential—adverse consequences, which affect the population and cost money.

In both cases, the section of society that bears the potential consequences and the section of society that bears the costs, are not the same.

Institutions such as the Zorginstituut in the Netherlands and NICE in the United Kingdom try to set a maximum value on the costs per statistical life saved. This utilitarian approach is followed by institutes such as Rijkswaterstaat (Deltares, 2011) in the Netherlands, in attempts to defend accepting the residual risks on the basis that the costs of further risk reduction are excessive.

However, when statistical lives become real people, the utilitarian principle seems no longer to be applicable. The National Health Service in the United Kingdom approved the drug Zolgensma for the treatment of spinal muscular atrophy at £1.8 M for a single treatment (Weston, 2021), the Zorginstituut did the same. Rijkswaterstaat in the end did not use the cost per life saved argument in their decisions about the improvement of sea-defenses (Schultz van Haegen, 2013). In the COVID-19 crisis governments decided to protect the lives of the people and protect the health services without much utilitarian evaluations and despite criticism from economists (Stil, 2021). Apparently when the threat to life comes near and imminent, or personal, people and society revert to deontology (Philippen, 2020).

It also seems that deontological arguments weigh more heavily than utilitarian considerations. At a number of places, new institutes aimed at preventing and combatting future pandemics have now been founded (ANP, 2021; InstPand, 2021; RF, 2021). Past budget reductions on providing hospital capacity can be reversed (Kleine, 2020), even if, before the pandemic, they were considered too expensive and bearing too much opportunity cost; (Jongejan et al., 2011), money which could be better spent elsewhere. These were however, made, despite warnings that a pandemic would be catastrophic and had a high probability (Gensheimer et al, 1999; OECD, 2003; RIVM, 2016).

6 | CONCLUSION

From the above, it seems that whether people choose the deontological, or utilitarian stance, depends on their remoteness from the risk, be it in physical distance, or in time. Institutions, which are detached from a threat, be it a threat

to health, or a threat posed by industrial installations, or infrastructure, tend to reason from a utilitarian point of view. They set acceptability criteria and base advice and decisions on cost benefit comparisons, in which even human lives can theoretically be bought and sold at a price. It seems, however, that dealing with threats that are only supposed to materialize in the future, can be postponed until they materialize (Ale et al., 2021).

When people are confronted with the reality of the consequences, they tend to choose a more deontological stance, giving preference to saving health and lives and even their businesses, regardless of the cost and without a cost benefit evaluation. This goes as far as giving financial support to companies which, under normal conditions, would not have survived anyway (UKGOV, 2021). Governments which, in the beginning of the COVID-19 crisis, took a utilitarian view and aimed for a cost-effective path to herd immunity, regardless of the loss of life, found out that such a strict utilitarian approach might be rational in their view, but not in the real-life world of their population (Habermas, 1985). Neither principle is immoral, nor is the utilitarian approach the only rational approach, despite what some institutions claim (Helsloot & Schmidt, 2012).

What can be learned from the COVID-19 crisis, is that short term utilitarianism has consequences, that in the eyes of the population may be unacceptable. This lesson seems equally valid for cost benefit evaluations regarding other risks, such as from hazardous industries, flood defenses, and air transport. Decisionmakers and politicians can learn that persuasion can only go so far (Susskind, 2010). In the end the people can reasonably be expected to prioritize a deontological approach concerning matters that have the potential to affect them directly and individually.

ORCID

Ben J.M. Ale  <https://orcid.org/0000-0002-9634-3002>

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