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Original article

Value choices in European COVID-19 vaccination schedules: how vaccination prioritisation differs from other forms of priority-setting

Abstract: With the limited initial availability of COVID-19 vaccines in the first months of 2021, decision makers had to determine the order in which different groups were prioritised. Our aim was to find out what normative approaches to the allocation of scarce preventive resources were embedded in the national COVID-19 vaccination schedules. We systematically reviewed and compared COVID-19 vaccination prioritisation regulations in 29 countries: 27 members of the European Union, the United Kingdom, and Israel. We differentiated between two main types of priority categories: groups that have increased an infection fatality rate (IFR) compared to the average for the general population and groups chosen because their members experience increased risk of being infected (ROI). Our main findings show a clear trend: all researched schedules prioritised criteria referring to individual IFR (in particular being over 65 years old and coexisting health conditions) over the ROI criteria (e.g. occupation and housing conditions). This is surprising since, in the context of treatment, it is rather common and justifiable to adopt very different allocation principles (e.g., introducing a saving more life-years approach or prioritising younger patients). We discuss how utilitarian, prioritarian, and egalitarian principles can be applied to interpret these normative differences between the allocation of curative and preventive interventions.

Keywords: COVID-19, health care ethics, prevention, prioritarianism, vaccination, vulnerability

Word count: 12587

BACKGROUND

The efficient and fair allocation of scarce medical interventions encompasses a wide range of particular issues, including diagnostic tests, the availability of healthcare personnel, organ distribution, access to various therapies or vaccines. In the early stage of the COVID-19 pandemic, many professional associations, healthcare institutions and governmental bodies published or updated prioritisation guidelines regarding the allocation of scarce medical resources, e.g., beds or artificial ventilation in intensive care units[1]. Later, in the second half of 2020, many governments published detailed prioritisation schedules for the distribution of COVID-19 vaccines, which were scarce goods at the turn of 2020 and 2021. Unlike guidelines on medical treatment, official schedules on the distribution of medical prevention in the case of COVID-19 have not yet been analysed or compared in scholarly journals. The only comparative analysis which we are aware of is that of Schmidt, Weintraub et al., who analysed the COVID-19 vaccine allocation schedules in the United States to check whether jurisdictions (i.e., states) adopted proposals to reduce inequity using disadvantage indices and related place-based measures[2]. Thus, our main aim is to provide the first systematic international comparison of the official prioritisation schedules for vaccinations in 29 countries and to analyse values and principles implicitly embedded in these documents. Although some suggest that prioritisation during pandemic raises structurally similar dilemmas in the cases of diagnosis, treatment, and prevention[3], we will highlight and analyse the specific nature of allocation schemes in the case of prevention.

The main challenges regarding the interpretation of any prioritisation guidelines or schedules stem from their valued-loadedness and the plurality of different principles implicitly

embedded in them. The specific content of such schedules (e.g., the order of groups prioritised) may be interpreted as representing different and conflicting types of ethical principles[4]. Four categories of such principles are commonly treated as generally relevant in healthcare contexts[5]. The first requires treating people equally, e.g., by providing them with equal opportunities in the form of a lottery or the "first-come, first-served" rule. Second, prioritarianism recommends favouring the worst-off, which are understood as either the sickest or the youngest. Third, utilitarian principles require the maximisation of total benefits, that is, either saving the most lives or those with the best prognosis or those who have the most life years ahead of them. Fourth, rewarding social usefulness by either promoting other important values (a future-oriented aspect) or rewarding those who have implemented some important values (a past-oriented aspect). A guideline or schedule motivated by these last principles might prioritise front-line health care workers or research participants in vaccine trials. Of course, these four general principles do not exhaust all relevant values, and in such situations, there may exist a genuine plurality of intuitively plausible principles that give conflicting recommendations[6]. There are also scholarly debates on the importance or weight of particular principles in a given context.

In the particular context of prioritising access to pandemic vaccines, the most commonly articulated goals are preventing illness and saving lives from the virus. However, these two general aims are framed differently in the scholarly literature: as saving lives; benefitting the greatest number of individual people; minimising years of life lost (YLL); maximising quality of life years saved; maximising quality-adjusted life-years (QALY); saving the worst off (i.e., those with the poorest prospects); saving those most likely to recover; saving younger lives; saving those most likely to contribute to a flourishing society (either economically or socially); saving

those who can most usefully contribute to minimising the impact of the pandemic (for an overview of the literature on prioritising access to pandemic influenza vaccines, see[7]).

In the context of the recent pandemic, it has been claimed that the most important among the principles mentioned above is the utilitarian one which requires the maximisation of total benefits: 'saving more lives and more years of life is a consensus value across expert reports'[8]. However, with respect to the limited time and information in the COVID-19 pandemic, the authors admit that it is justifiable to concentrate solely on saving more lives (with a reasonable life expectancy) and treating saving more years of life as a subordinate principle used when the likelihood of survival of different individual patients is similar. They specify that in the case of COVID-19 vaccination distribution, this rule would justify giving older people priority for vaccines immediately after health care workers and first responders. In the case of patients above some threshold of risk (i.e., those over 60 years of age and with coexisting conditions), they propose using random selection instead of any fine-grained categorization of this large group. However, another article about 'global vaccine allocation' by the same main author was published in the journal *Science* a few months later (11 September 2020). This proposed using Standard Expected Years of Life Lost (SEYLL) averted per dose of vaccine as the metric for premature death. SEYLL calculates life years lost compared to a standardized reference life table and is an explication of what we termed minimizing years of life lost (YLL) in the previous paragraph[9]. Other authors suggested refining particular principles, e.g., utilitarian[10] or prioritarian.

Discussing our results, we highlight several issues characteristic for the allocation of preventive interventions that correspond to the three main ethical principles mentioned above (in the following order: utilitarian, prioritarian, and egalitarian).

METHODS

In our research, we systematically examined what schedules regarding COVID-19 vaccines were adopted by national decision-makers. We compared official vaccination schedules, as presented on official government websites, in 29 countries with similar organisational and material resources: 27 European Union members, the UK and Israel. In all research countries, public healthcare had a monopoly on the distribution of COVID-19 vaccines. Since the EU explicitly did not want to give precise guidance to country authorities on vaccine schedules because of different "country-specific epidemiological situations" and "flexibility in terms of changing objectives," we assumed that the various national schedules in the EU represent both different factual circumstances and varying value choices[11]. As the schedules changed in time, we decided to analyse data available on 15 August 2021. We decided not to include the United States in our analysis, as its regulations differ in each of its 64 jurisdictions, especially in adopting policies towards vaccination of disadvantaged communities[12]. In particular, we were interested in setting priorities among different groups within countries. Since an agreement between EU countries[13] aimed at allocating access to vaccine doses according to the population distribution key, we are not discussing the problem of the international distribution of vaccines.

It should be noted that one may apply three main approaches to deriving values from normative regulations (including priority-settings), namely justificatory, expressive, and consequential. These approaches differ in two interconnected respects: each points to a different dimension of a regulation and assumes a different basis on which the ascription of values is made.

According to the justificatory approach, values embedded in a particular schedule are understood as those that have guided an official's decision to adopt this schedule. In this sense, values are assigned to a regulation on the basis of the intentions of the agent, that is, the goals and reasons of a decision maker. However, since there is no direct access to the intentions of decision makers, these goals and reasons must be identified based on available evidence, in particular the official justifications for legal regulations, public statements of government officials, and legislative history (documents produced during the process of decision-making). The justificatory approach tacitly assumes the credibility of such sources, namely, that publicly presented reasons mirror those that, in fact, governed a decision. In turn, the expressive approach refers to the values of a regulation as perceived from the external perspective, that is, by an observer who charitably reads the text of the regulation and strives to make sense of its provisions. In contrast with the previous account, the expressive approach does not assign priority to the viewpoint of the decision maker and focuses on values that provide the best rationale for a given priority setting (no matter how the decision maker sees this rationale). From this perspective, an investigation of official justifications as well as the legislative history is not necessary. The relevant values are to be determined on the basis of content of the setting and interpreted in light of the social context in which the setting was established. Finally, the

consequential approach is focused on the actual results of the implementation of a legal regulation. On this account, neither official justifications nor social context of implementation are necessary to derive values from a particular schedule. All that is needed according to this approach is the knowledge of the social consequences that have occurred due to the establishment of a vaccine priority setting.

Our inquiry is based on the second approach, the expressive. In the context of our research, this means that relevant values are derived from particular schedules on the basis of the content of these schedules and the social circumstances of their establishment. In line with the approach, we adopted an external - observer - perspective, which in our case consists of the point of view of an expert equipped with knowledge regarding the theoretical discussions on priority setting and distributive justice.

There are several reasons for the selection of this approach. First, and most importantly, it provides the most suitable basis for comparing state policies on vaccine prioritisation. It should be noted that different states adopted very different communication strategies – the general aims of the schedules and recommendations were not always explicit in revealing the value judgments, e.g., the German government published extensive justification of priority[14], the Polish one gave no explanation. The same problem applies to the analysis of social consequences of different priority-settings. In contrast, all information required by an expressive approach (in particular, officially published vaccination schedules and data concerning the specificity of SARS-CoV-2 at the time of establishing these schedules) is publicly available with respect to all researched states. Second, it is widely believed that the expressive dimension of legal and

political actions is crucial for understanding the meaning of these actions, as well as for the purposes of their moral assessment. This view is common among contemporary legal scholars[15]. Third, considering the main objectives of COVID-19 vaccination programs, an expressive approach appears to be particularly suitable for the analysis of these programs. Since COVID-19 vaccine policies have attracted considerable social attention and were addressed to each and every citizen, their success was to a large extent dependent on how particular regulations concerning vaccine distribution (including prioritisation schedules) were perceived by ordinary persons. Fourth, a methodology based on an expressive approach is accepted in the relevant research area. A similar research method was applied in the inquiry conducted by Schmidt et al.[16] on vaccine prioritisation in the context of the US.

We know that there are certain limitations to an expressive approach focusing on the perspective of the observer. One particularly important aspect is that it may yield different interpretations of the values embedded in the schedules. This phenomenon may be treated as analogous to the case of the underdetermination of scientific theories, i.e., the situation in which different scientific theories may be observationally equivalent of the same evidence[17]. Proponents of instrumentalism in the philosophy of science claim that this is not a problem because scientific theories are merely instrumentally useful representation devices. In contrast, scientific realists would not agree with the thesis, arguing that there is a fact of the matter as to which theory offers the right explanation of the observations. Analogically, if we substitute schedules for 'evidence' principles for 'scientific theories' and justify 'be observationally equivalent', we can conclude that many different normative principles may justify the same vaccination schedule (or some pattern visible in many schedules). The phenomenon has been

noticed in ethics; for example, Parfit famously argued that some versions of consequentialism, kantianism, and contractualism essentially coincide in their recommendations and can be seen as attempts to climb the same mountain from different sides[18]. However, in this paper, we will not analyse whether this observation has any metaethical implications, particularly whether this speaks for metaethical anti-realism or realism.

In the research we used data (COVID-19 vaccination schedules and recommendations) accessible online on official government websites. The governments presented their policies in various ways. It is especially noticeable when it comes to terminology, eg, with many phases describing corresponding groups (like different variants of 'medical workers' or 'administration workers'). These differences are easily explained by the diversity of languages (only some of the plans were available in English at the time) and the varied legal systems of European countries. There are also notable disparities in the sizes of groups when it comes to vaccination phases: some countries opened the possibility of vaccination for smaller groups one by one, and some vaccinated larger cohorts at bigger intervals.

The collected data are summarized and compared in two tables. Table A in the Supplementary Materials shows the prioritisation adopted by 29 countries, where columns present subsequent groups from those vaccinated as the first ones (group 1) through the groups prioritised next, up until vaccinations are available to the general population. Out of necessity, the table presents a shortened description of vaccinated cohorts, omitting details such as, e.g., specialisations of medical workers or very specific descriptions of occupational groups. Table B in the Supplementary Materials (with an excerpt, Table 1, below) first presents the position in

vaccination schedules of two groups vaccinated in almost all of the researched countries: the frontline medical workers as well as personnel and residents of nursing homes (two first columns). We assume that the reasons why they were prioritised are mixed: both direct and indirect. And then, in the following four columns, we present our interpretation of why the subsequent groups have been prioritised. In these columns, we present only the groups we had reasons to believe to be prioritised with the aim of protecting them directly, not, at least primarily not, because of someone else's interests. In many cases, if someone was vaccinated with priority due to the interest of another person, she would be described in the schedule only in relation to others. For one, contacts of pregnant people (Germany) or household members of patients with certain chronic diseases (Latvia) were described as 'people in contact with' certain persons, not like other groups who are described as being vaccinated because of their own characteristics. On the other hand, home-based nursing care employees were prioritised in several countries, and there may be indirect and direct reasons for their prioritisation. The reason being that they work often with seniors, as well as because they are completing tasks of healthcare workers. The first types of cases were omitted from our analysis, and the second ones were included in it.

We then differentiated between two main types of priority categories: groups that have an increased infection fatality rate (IFR) compared to the average for the general population and groups chosen because their members experience an increased risk of being infected (ROI). The reason for such an interpretation is that in the case of COVID-19, the individual risk of death (for simplicity, we assumed that decision makers focused on preventing deaths) depends on these two factors. Then we distinguished two subcategories in each category. Increased IFR stems from an individual's physical state: suffering from certain health conditions or just being of an older age.

Increased ROI is mainly determined by factors related to measurable social mobility - an increased number of social contacts compared to average in the population. In the analysed schedules, we distinguished between two factors: working and housing conditions.

Such an interpretation excluded certain types of priority groups from Table B that are included in the prioritisation schedules presented in Table A. The first was people vaccinated because of their occupation when their core work is not related to an increased ROI (mostly state and local authorities or small groups like Tokyo 2020 Olympic athletes or Eurovision Song Contest participants). Other than that, analysing the ethical aspects of prioritising some people *only* or *primarily* because of other people's interests goes beyond the scope of this article, but it is a promising field for future research.

RESULTS

Our in-depth analysis of the results presented in Table A shows that all countries incorporated multiple variables to categorise populations, then grouped these subpopulations into a single schedule with three to nine phases in which subsequent subpopulations were allowed to obtain vaccines up until the point when vaccinations are available to the general population.

Two groups were vaccinated first in almost all of the researched countries: frontline medical workers as well as personnel and residents of nursing homes. However, there were a number of exceptions. In Denmark, healthcare professionals were not only vaccinated after the residents of nursing homes, but also after people 85 years and older, as well as after people over 64 years of age and received both personal care and practical assistance. Bulgaria, Poland, and

Slovakia did not specify nursing home residents as a priority group, but since their policies included the rapid vaccination of the oldest residents, most patients at nursing homes would still have been vaccinated almost immediately.

Each analysed country emphasised prioritising senior members of society (either dividing them into a few fine-grained cohorts or treating those above some age threshold as one group, as in, e.g., Croatia, Belgium, Romania, Latvia, and Israel). The other most commonly prioritised groups were the following: people who are more vulnerable to severe symptoms of COVID-19 than the rest of the population due to a preexisting health condition, people with bad health but not necessarily more vulnerable to COVID-19, people vital to maintaining the state apparatus, people who are more exposed to infection than the general population for various reasons (especially occupation or housing conditions). There were also singular cases of the prioritisation of more specific groups. Most of them are those who care for and/or come in contact with vulnerable individuals (e.g., Austria, Finland).

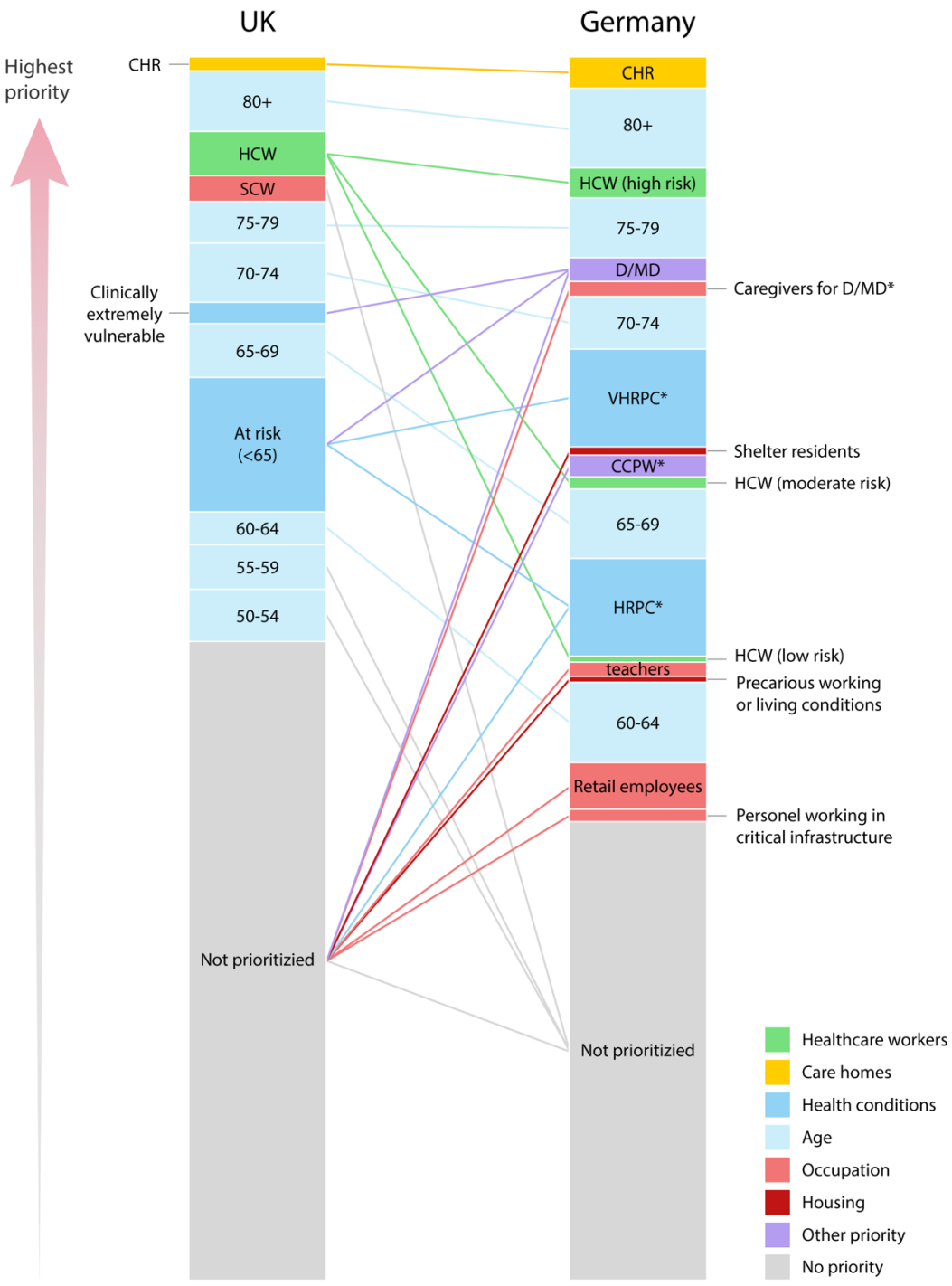
Table 1: COVID-19 vaccination prioritisation in selected countries: increased risk of SARS-Cov-2 infection (ROI) vs. increased infection fatality rate (IFR) (an excerpt from Table B, included in Supplementary Materials)

country	priority	healthcare workers	care homes	infection fatality rate (IFR)		risk of infection (ROI)	
				conditions	old age	occupation	housing
United Kingdom	I		residents and staff				
	II	frontline healthcare workers			80+	frontline social care workers	
	III				75+		
	IV			clinically extremely vulnerable people	70+		
	V				65+		
	VI			people aged 16-64 years with underlying health conditions which put them at higher risk of serious disease and mortality			
Poland	I	all medical workers					
	II				70+		
	III					teachers, academic teachers	
	IV			chronically ill			
	V				60+		
	VI					members of uniformed services	
Slovakia	I	healthcare professionals				social workers, hospitals' and medical service, spiritual service for patients with COVID-19, testing staff, employee sproviding for homeless and Roma communities	
	II				85+		
	III				70+		
	IV				60+		
Germany	I	healthcare workers with a high risk of exposure to COVID-19	residents and staff		80+	nursing staff and carers working for home-based care services	
	II	people working in parts of medical facilities where they are exposed to a high risk of infection with COVID-19		people with intellectual disabilities and people with severe psychiatric conditions, people after organ transplant, cancer patients, people suffering severe lung disease, extreme obesity, severe diabetes mellitus, chronic liver or kidney disease, people with very high or high risk of COVID-19 infection	70+	people working with people with intellectual disabilities, people working in medical facilities, staff of donor services, those working at COVID-19 test centres, selected police and security personnel, people working in the public health service and in relevant positions in hospital infrastructure, people working in refugee homes or facilities for homeless people, people who work regularly in the homes of people in need of nursing care to provide support services	people living in refugee homes or facilities for homeless people
	III	employees in medical facilities not involved in caring for patients with COVID-19		people with underlying health conditions that significantly increase the risk of serious illness from COVID-19	60+	laboratory staff, people working in the food retail trade, nursery and school teachers, people with precarious working conditions	people with precarious living conditions

No priority

Table 1 (an excerpt from Table B): Columns present the categories of vaccination groups. Rows present countries as well as prioritisation. On the top there a country that prioritised people almost entirely based on their increased infection fatality rate (IFR): The United Kingdom. At the bottom is the example of country that additionally also used many other factors that we interpreted as targeting people with increased ROI: Germany. In the middle, there are two countries that implemented a mixed approach: Poland and Slovakia. This first country did not take into consideration the housing condition of individuals, while the second did not consider housing or health condition in its prioritisation schedules. Both also omitted care homes prioritisation.

Figure 1



CHR - Care homes residents and carers
HCW - Healthcare workers
VHRPC - People with very high-risk pre-existing conditions
HRPC - People with high-risk pre-existing conditions

SCW - Social care workers
D/MD - People with dementia or mental disabilities
CCPW - Close contacts of pregnant women and other vulnerable groups

Figure 1 compares Germany and the UK as countries representing contrasting approaches when it comes to their policies concerning COVID-19 vaccination prioritisation. The figure presents vaccination's queues from top to bottom - from highest priority to not prioritised. The estimated sizes of the groups were retrieved from governments materials, with the exception of the groups marked with an asterisk (*) that are estimated by the authors. The corresponding groups are connected with lines, for example, since caregivers have no priority in the UK, caregivers fall into the wide group of vaccinated at the end, so this group is linked with 'not prioritised'.

Our in-depth analysis of the results presented in Table B (and its abbreviated version) concentrates on increased infection fatality rate (IFR) and increased risk of infection (ROI).

Increased infection fatality rate (IFR)

First and foremost, old age was universally treated as a reason for priority in our interpretation, the only difference being the precise age that constitutes membership in the first prioritised group. In 5 cases, it is 85 years of age and more; in 11 cases, it is people over 80 years of age. 2 countries first vaccinated people over 75, and another 2 chose seniors over 70. Six countries vaccinated people over 65 years of age. Israel and Hungary vaccinated the over 60 cohort first and The Netherlands vaccinated by year of birth, starting from the oldest.

As a critical point from which we classify "seniors" as a cohort in the context of SARS-Cov-2 infection, we adopted the age of 65. The IFR of COVID-19 only for people over this age was known to be higher than 1% at the time when schedules were designed - and significantly

higher than amongst all of the younger cohorts (see this meta-analysis published in December 2020[19]). The newest meta-analysis mostly confirms earlier ones: the lowest IFR occurring at age 7 years (0,0023%) and increasing exponentially through age 30 years (0,0573%), 60 years (1,0035%), and 90 years (20,3292%)[20] (COVID-19 Forecasting Team 2022). Most (20) of the countries researched put people over 65 among the initial four phases of vaccinations. The countries that left out some of the people over 65 in the first phases still gave priority to the oldest (70+ people) before those who were younger but still vulnerable. As a result, vulnerable groups with a higher IFR of COVID-19 than seniors were mainly vaccinated later in time, eg, people with Down's syndrome, those with cirrhosis, or people after transplantations[21]. There were some countries that focused almost entirely on age groups in their vaccination policies at the expense of not including other possible prioritisation claims. Among them, the most notable are Slovakia and the United Kingdom. Slovakia, after vaccinating frontline COVID-19 workers from many fields, employed only the age criterion, making no exceptions for any other groups. The UK based its policy on age groups, but in phases 4 and 6 also included groups characterised as suffering from underlying health conditions.

The second universally considered reason for prioritisation, noticeable from the observer's perspective, is health condition increasing the risk of the severe course of COVID-19 and even the death of an individual. There are numerous health problems that are reported to increase the fatality rate in the case of a SARS-Cov-2 infection[22], the most notable being hypertension[23], cardiovascular disease[24], diabetes[25], chronic obstructive lung disease[26], chronic kidney disease[27], and cancer[28], although the catalogue is much wider (for a general estimation of preexisting risk of mortality from COVID-19 see an umbrella review by Robert Koch Institute[29].

All but one of the countries researched (Slovakia) included this factor in their policies, but to a very different extent. In some countries there was an extended list of diseases that qualified people for earlier vaccination. For example, policymakers in Luxembourg divided this category into four extensive groups, including many different kinds of conditions. Similarly, many other countries (e.g. Germany, Italy, or Latvia) covered a wide catalogue of health problems in their prioritisation policies. There are also countries which included significantly fewer conditions, also putting them all in one category and without differentiating between different levels of risk. For example, Poland listed (in phase 4) only dialysis patients, oncological patients treated with chemotherapy or radiation therapy after 31 December 2019, patients after transplants undergoing immunosuppressive therapy, and patients undergoing chronic mechanical ventilation. It greatly narrowed the number of people in this category, as widely occurring conditions such as, e.g., hypertension[30], cardiovascular disease[31], or diabetes[32] were not listed, and priority for cancer patients was also restricted.

Some state schedules mentioned mental health problems among the reasons for prioritisation. Studies have found that preexisting mental health disorders correlate with both high ROI and high IFR in case of COVID-19[33]. The prevalence of physical illnesses and risk factors connected to worse COVID-19 outcomes such as, e.g., obesity, cardiovascular diseases, diabetes, or HIV is higher amongst individuals with mental health problems[34]. It also links to alterations in the immune system, which is a probable cause of increased COVID-19 ROI in this population[35]. In addition, people with mental health disorders are often subjected to socioeconomic risk factors, such as poverty, unstable job situation and working in unsafe conditions, poor access to healthcare, homelessness or living in overcrowded settings, etc[36]. All

of the above make it impossible to place them in only one category of prioritisation rationale, so we decided not to include mental health issues as either IFR or ROI prioritisation.

Among the conditions listed in the prioritisation policies, there are also those that we do not have reasons to believe are responsible for the direct and measurable increase in IFR for patients in the case of COVID-19: Some countries prioritize people who are simply in bad health, receive personal care and practical assistance (Denmark), or have a disability (e.g. Romania).

Increased risk of infection (ROI)

Increased ROI connected with a given occupation is strongly supported by data in the case of healthcare workers, especially those dealing with patients[37]. Other jobs at increased risk include, for example, such large groups as retail workers[38]. Estimates also highlight protective services, including police officers and firefighters, personal care jobs such as childcare workers and domestic caregivers, and social services occupations as those being at risk[39].There were a number of outbreaks in schools that affected teachers and other school staff[40], but these were limited due to lower susceptibility to COVID-19 among children and adolescents as well as the introduction of online teaching[41]. Some models predicted that school and kindergarten teachers who worked in person would be at increased risk of infection[42]. Studies conducted in Norway and Sweden showed that teachers were at medium risk, after the most exposed occupations from the services sector like bartenders, waiters, transportation workers, etc[43]. After initial prioritisation has been done, some findings emerged that measure the incidence of COVID-19

related to in-person teaching with masking requirements lower than its prevalence in general communities[44]. It shows the significant uncertainty faced by policymakers when it comes to measuring ROI.

The vaccination of groups distinguished because of occupational reasons was carried out in most cases after the groups for which we assumed increased IFR, the exception mostly being frontline social workers (e.g. Finland) and sometimes also others engaged directly in the fight with COVID-19, like police forces (e.g. Slovakia), armed forces (e.g. Portugal), firefighters (France), administration (Hungary), etc. Home-based nursing care workers were sometimes also included (Austria, Finland, France, Germany, Italy, Latvia, The Netherlands, Romania, Spain, Sweden). Other groups distinguished by occupation fall behind the biologically vulnerable. In 10 cases (Austria, Czech Republic, Germany, Greece, Latvia, Lithuania, Malta, Poland, Romania, and Spain) the priority was given to teachers, probable cause being the need to end remote teaching. In some cases, people with 'absolutely necessary cross-border travel activity' or diplomats and their families were prioritised (Austria, Lithuania, Romania, Slovenia). Only in six countries (Austria, Germany, Ireland, Latvia, Romania, Slovenia) were grocery store workers prioritised, but only in two of them (Austria and Germany) they were prioritised *not* as a final group before the general population. It is also worth noting that there was no prioritisation for most people working in the service sector, facing high ROI, like waiters, bartenders, caterers, taxi drivers, etc. As many as six countries (Belgium, Croatia, Cyprus, Luxembourg, Israel, the United Kingdom) did not prioritise any occupation, except for medical workers (and social workers in the case of the UK). In some of the countries, there were also categories containing employees who are *critical* for different sectors (Finland, Hungary, Latvia) and providers of vital

services (Estonia). However, the inclusion of these groups might be explained by pragmatic considerations and not only by the increased ROI.

Crowded housing situations are another instance where the risk of SARS-Cov-2 infection increases, as best proved in the case of care homes[45], homeless shelters[46] and prisons[47]. Although WHO[48] recommended taking into account prison populations and people living in precarious living conditions at the end of the second phase of vaccination (i.e. when 20% of the most vulnerable part of the population is vaccinated) this was typically not included in the researched schedules - 20 of them have not mentioned the housing situation (except for care homes). When it has been mentioned, it applied to residents in precarious living conditions (Austria, Germany, Greece, Ireland) or people living in closed structures like prisons, centres for migrants and refugees, or shelters (Cyprus, Germany, Greece, Ireland, Latvia, Romania). Additionally, Bulgaria prioritised 'vulnerable groups from the population due to high epidemiological risk of infection attributable to their way of life' as the last group before the general population. Figure 2 summarises the results described in the last two sections.

Figure 2

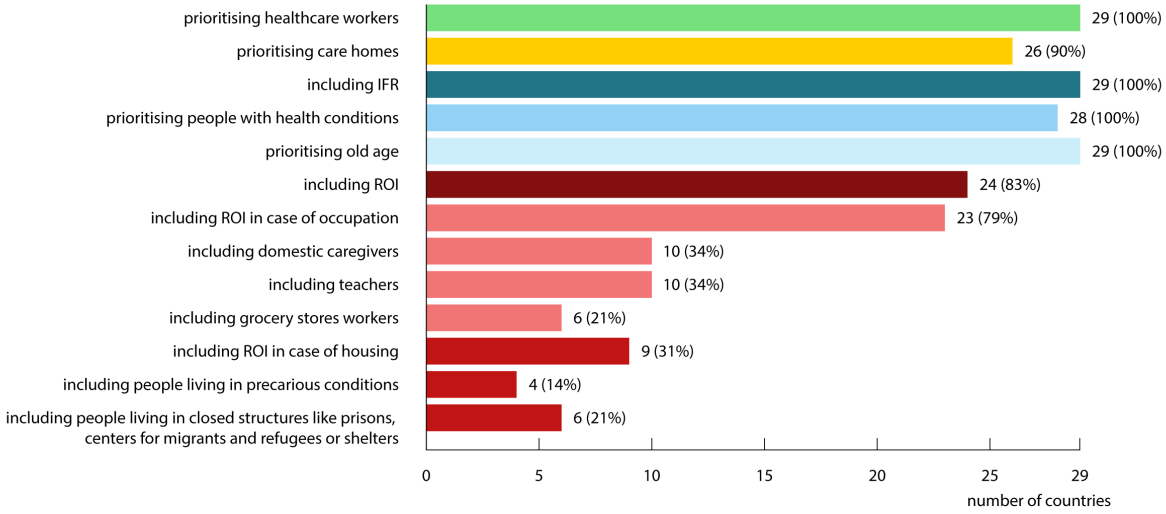


Figure 2: The figure presents the number and percentage of countries researched that include different categories in their COVID-19 vaccination policies.

DISCUSSION

The allocation of healthcare resources occurs on three levels of abstraction: macro, meso, and micro. First, on the most general level (e.g. national) when decision-makers establish general rules of prioritisation between individuals, for example, those with different levels of COVID-19 related risk of death, when not everyone's healthcare needs can be met at the same moment. Prioritisation at this level usually concerns as yet unidentified or statistical individuals[49]. Second, the meso level concerns regional or institutional allocation and may concern both identified and statistical individuals. And third, the micro-level concerns situations where frontline practitioners

allocate resources between two or more identified people when not everyone's needs can be met. This last case is discussed by philosophers and bioethicists in many highly idealised examples, e.g., 'should I save the life of a 70-year-old who can expect to live 20 years more; or a 40-year-old who can expect to live 15 years more?'.

The allocation of therapeutic resources or interventions may operate on all three levels, while the allocation of preventive resources, in particular the COVID-19 vaccine schedules we analyse, is established only on the macro level. Of course, some decisions at the mesolevel may in practice influence the way vaccinations were distributed, but this is not the focus of our paper. Therefore, unlike many therapeutic interventions, in the case of prevention of COVID-19, at the time of intervention, individuals are often classified as eligible for the vaccine not based on their individual current or past conditions, but on the characteristics of the group or cohort to which they belong. In contrast with therapeutic interventions, there are no identified individuals whom we want to help, but only individuals with different levels of risk of COVID-19 related death. These observations are particularly important for the interpretation of the allocation of preventive interventions. After deciding on some prioritisation schedule, we may be able to count effectiveness of this intervention for some group or cohort, that is, for example, evaluate how many people would have died from this group within some period if we had not vaccinated them. However, it is often impossible to determine which particular people are beneficiaries of the vaccination schedule, that is, which particular individuals would have died if a different prioritisation schedule had been chosen instead. In other words, a decision maker may be statistically certain that, let us say, 1000 people out of some particular group of 1 million would

have died if different prioritisation schedule had been chosen instead, but it may be impossible for them to establish the identify of beneficiaries of this schedule.

In this part, we discuss how the comparison of COVID-19 vaccine schedules may be helpful in interpreting the different value choices regarding the prioritisation. In particular, we are interested in how three groups of principles (utilitarian, prioritarian, egalitarian) commonly treated as relevant in the healthcare contexts[50] were embedded in the vaccine schedules in 29 countries.

A utilitarian perspective: currency and epistemic limitations

Let us start with utilitarian principles that require the maximisation of total benefits. We understand this approach as giving recommendations that identify relevant values (conceptual analysis), assign a numerical scale to the identified values (measurement), assume full interpersonal comparability, and finally estimate the size of the overall value in different expected scenarios (aggregation). Therefore, putting aside the problems with measurement, comparability, and aggregation, the crucial question is what values vaccination schedules promote under utilitarian interpretation.

Some authors have postulated that saving the most lives should be the main "currency" of the utilitarian approach in the context of the COVID-19 pandemic[51]. However, some proponents of utilitarian approaches criticise the life-saving view as too narrow. Instead, the quality-adjusted life-years (QALYs)) approach is commonly treated as the 'most' consistent with utilitarian

approaches[52], and some authors defended the years-of-life saved approach as the proper expression of utilitarianism[53]. In the case of COVID-19 Giubilini et al., contrasting the UK approach to some other selected recommendations and schedules (WHO, US, German), noticed that 'It is often taken for granted that the criterion for prioritising access to COVID-19 vaccines is vulnerability to COVID-19: the most vulnerable should get the vaccine first. The term "most vulnerable" is often taken to mean those with the highest probability of dying if infected'[54]. The authors proposed widening the spectrum of utilitarian values relevant in this situation and taking into account different types of intrinsic (numbers of lives saved, years of life saved, quality of the lives saved, quality-adjusted life-years (QALYs)) and instrumental benefits (protecting healthcare systems and broader societal interests, e.g., prioritising critical workers and having dependents). One of Giubilini et al.[55] arguments favouring the diversification of the currency used in the schedules referred to the consistency of the health allocation schedules and guidelines. They suggested that not only saving more life years but also the quality of life and QALYs should be included in the vaccine distribution schedules because, as they argue, it would guarantee consistency within different policies regarding the allocation of scarce healthcare resources in the cases of treatment and prevention.

In fact, in most guidelines regarding treatment (e.g., ventilators in the case of COVID-19), it is not only saving lives that is considered and prioritised, but also a variety of other factors, particularly the probability of short-term survival as well as long-term considerations such as life expectancy and the quality of future life. For example, many guidelines regarding allocating scarce treatment resources take into account the very probability of survival (of some medical procedure), which in the US was very often based on the SOFA

'Sequential Organ Failure Assessment'[56] and in the UK on the frailty scale[57]. In March 2020, the Italian Society of Anaesthesia, Analgesia, Resuscitation and Intensive Care (SIAARTI) issued a series of recommendations that prioritised the allocation of resources to patients that have higher probability of survival and life expectancy[58]. On the contrary, the vast majority of groups with prioritised access to vaccination was included in the schedules not on the basis of their past or current state of their health, but mainly based on their uncertain and narrowly understood prospects related to COVID-19 infection: as one may interpret, the worse their prospects were in this matter and the more probable that they may die because of COVID-19, the higher on the vaccination priority list they found themselves. The 'worstness' of the prospect was established mostly (although not entirely) on the basis of the age and comorbidities of the individuals (see blue areas in Figure 1).

However, it would be a mistake to treat different utilitarian values embedded in vaccination schedules as necessarily conflicting with each other, that is, we should not assume that maximizing one value in some vaccination schedule (e.g. lives saved) must always prevent maximizing other values (e.g. years of life saved or QALYs). Indeed, some models of the effects of different vaccination strategies demonstrated that vaccine prioritisation based on age dominated both in terms of reducing total lives saved and in terms of maximizing QALY[59] or years of remaining life expectancy[60]. Therefore, under some assumptions about vaccine availability, effectiveness, and safety, different values accepted by different types of utilitarian approaches can lead to acceptance of the same schedule. In an extreme case, which is not far from the case of COVID-19 pandemic, when the risk of dying increases dramatically with

increasing age, utilitarian approaches that implement years of life saved might favor the old-first schemes.

One might ask whether these schedules that relied on age to a broader extent (e.g., UK) really represent a pure version of the 'saving the most lives' approach. This is far from obvious. First, the dependence of vaccination schedules mostly on age groups can be controversial even within this framework. It certainly has certain pragmatic advantages, as it eases communication and is simple to verify. However, it leaves out some groups vulnerable to COVID-19 in terms of high IFR, e.g., people with Down's syndrome or those after transplants. Our analysis shows that these populations in most countries faced longer time without access to the vaccine than people over 65 years of age, despite many of them having higher IFRs than many people from the oldest cohorts[61]. What is more, it is relatively easy to verify if someone belongs to those groups[62]. Despite that, only in five countries (Austria, Denmark, Italy, Latvia, and Malta)[63] people with comorbidities associated with extremely high risk of severe COVID-19 were prioritised in earlier phases than those between 65 and 70 years of age. In the next section, we will analyse an additional prioritarian argument stating that some groups vulnerable to COVID-19 in terms of high IFR are worse off since they are less likely to even reach senior age because of their health status.

Furthermore, there is another reason why relying mainly on IFR (and mostly ignoring ROI as in the UK) does not represent a pure version of the 'saving the most lives' approach. It is easy to imagine situations in which members of some group have a lower IFR than members of some other group (on average). However, still, members of this first group have a higher total

risk of death from COVID-19 (on average). As an example, imagine two groups: A (a cohort 55-64) and B (a cohort 65-74), for which real-life estimations of IFRs are the following: 0,75 % and 2,5 %, respectively[64]. For simplicity, we assume that there is no other relevant information about risk factors for any member of these two groups. It is easy to calculate that if only ROI (within some period) is at least about 3.3 times larger for members A than for the members of B, an average member of A still has the greater relative risk of dying for COVID-19 (within some period), even though her IFR is much lower than for an average member of B's. Of course, assuming such a difference in ROI may seem arbitrary and slightly artificial. Still, there are some reasons to believe that a somewhat younger cohort may be more exposed to the virus in real life (e.g., because many of them still have to go to work).

However, one could argue that the concentration on IFR, which is visible in many schedules, particularly in age cohorts, has a pragmatic justification based on the asymmetry of evidence. In the case of COVID-19, including someone in a high-risk group may have a different meaning. On the one hand, it may be based purely on medical premises (IFV); on the other hand, it may be primarily social-based (ROI). We hypothesise that this aspect is particularly interesting while analysing utilitarian principles: schedules implement principles that depend on such social factors to a lesser extend because it is much more difficult to predict the results of their implementation. Moreover, there are also practical reasons underlying this asymmetry, since identifying individuals with higher ROI is much more complicated than identifying those with higher IFR. This may explain why many jobs typically viewed as precarian, such as waiter or Uber driver, were not prioritised, as those jobs can sometimes be additional activities for people generally focused on other careers. In addition, there are many migrants working in those jobs,

not necessarily legally, so the authorities may not have enough resources to even begin the process of prioritisation of those groups.

Considering the context of the situation, one may assume that at the time of establishing schedules there was more evidence of better quality about IFRs for different cohorts and groups than about ROIs, which may be estimated only on very scarce and random data. IFRs for various groups may be established precisely and reliably based on large meta-analyses (e.g., see this meta-analysis of 130 large studies[65], whereas ROI is usually established mainly on small observational studies[66]. We can assume that the confidence of rational agents should adequately reflect the strength of evidence (or lack of it). In situations in which we have incomplete or sparse evidence for a proposition, philosophers like to say that it is rational to have imprecise levels of confidence in the proposition, and such confidence can be represented by an interval.

For example, returning to our earlier example, one may be almost completely confident that IFR for cohort A (55-64) is 0,75 %, because this belief is based on a large and reliable meta-analysis. However, one cannot usually be as confident that ROI is at least about 3.3 times larger for members A than for the members of B (65-74), because in this case (let's assume for the sake of this example), your belief is based only on one study which gave such result, but the study itself was small, observational, and as yet has not been replicated. Therefore, it could be argued that if one wants to minimise the risk of dying for large cohorts of people in such cases, it is rational to prioritise an older cohort (B), since it is rational not to ground your actions on the results of this second, more ambiguous study[67]. One possible explanation for this may refer to the ambiguity aversion: a decision maker can be more certain how many people will be saved if

they prioritize the older cohort (B), in comparison to prioritising the younger cohort (A). In this second case, the number of saved people may be either higher (if ROI is, in fact, larger than 3.3 times for members A than for the members of B), or lower (if ROI is, in fact, smaller than 3.3 times for members A than for the members of B). The other explanation may refer to avoidance of the worst possible scenario, which would be realized when a decision maker would prioritise the younger cohort A believing that its ROI is at least about 3.3 times larger for its members than for the members of B, but their belief would turn out to be false and ROI would be much lower.

This evidential asymmetry may explain why categories concerning social factors that may lead to increased ROI are much less often and less consistently used in the policies of the analysed countries than those justified by increased IFR. For example, no occupation appears on every or almost every list (except for healthcare workers), and housing conditions were typically overlooked in the analysed recommendations (except for nursing homes). Many schedules prioritise public employees when they are engaged in combatting the pandemic but leave out other, often low-paid essential employees working in conditions that may have increased risk of infection, e.g., grocery store workers or delivery persons (e.g., France, Hungary, Slovakia). In many countries, a significant number of those workers are migrants[68] living in more crowded spaces and with worse access to healthcare[69]. The most comprehensive policies in that matter are probably the German and Romanian ones (although the prison population was left out in Germany and precarious living conditions were omitted in Romania), but it comes at the price of intricacy.

However, the asymmetry of reliable information does not explain why vaccination schedules have not apparently incorporated other utilitarian "currencies" for which it is generally possible to have reliable statistical data, particularly years of life saved. In some cases, it would be indeed possible to count how different vaccination schedules would produce different outcomes in terms of, for example, years of life saved and many modelling studies incorporated such statistics[70]. Imagine a hypothetical case where we vaccinate 100 people as early as possible, each 90 years old, preventing 10 people from the earlier death on Covid. However, it is expected that they will live, on average, until 92, so we would save 20 additional years of life in total. Instead, if we prioritise the vaccination of 100 people, each 70 years old, preventing only 2 persons from the earlier death on Covid. But in this case, it is expected that they will live, on average, until 85, so we would save 30 years of life in total. In the first case, of course, we are saving many more lives (10) than in the second case (2). In this second case, we are saving more life years (30) than in the first case (20).

This type of case was mentioned by Giubilini et al.[71], who complained that vaccine schedules in the UK concentrate on 'those with less expected time left to live—say, a 90-year-old man in a care home—are prioritised over those who are still relatively vulnerable to COVID-19 but are likely to live longer —say, an otherwise healthy 70-year-old woman'. In fact, actual priority schemes cannot be justified by utilitarian calculus in the case of care homes. Giving highest priority to nursing home residents, what was commonly implemented in the schedules (see Table A), could only have been justified on a preventing most deaths basis. In fact, their residents had the highest mortality risk from COVID-19, but many of them had the shortest predicted life expectancy and quality of life. For example, Giubilini et al.[72] refer to the case of

dementia arguing that since dementia reduces both length and quality of life and significantly affects an individual's expected QALYs, patients with severe dementia should, in their opinion, have a lower priority. Unfortunately, they do not provide practical guidance on how to incorporate such factors into existing schedules in practice, for example, how to measure the reduction in quality of life due to dementia and how to weigh this reduction with other factors. Instead, they refer only to extreme and catchy examples like this one: 'it is a low priority to spend limited resources on somebody who is permanently unconscious, compared to a person who is in full possession of their mental faculties'.

To summarise, it seems on the one hand that the utilitarian approach promises to provide a straightforward solution to vaccine allocations by calculating and weighing the benefits of particular schemes in a quantifiable manner: '[T]his mathematical certainty that the utilitarian approach provides is appealing, especially in times of uncertainty such as the present one'[73]. On the other hand, the COVID-19 vaccination schedules clearly show the epistemic limits in applying any utilitarian principles, particularly any currency more sophisticated than saving the most lives. This problem is not typical for our case because any principle that includes expected consequences to the moral evaluation of a schedule must take into account the problem of "cluelessness", which states that in many cases, a decision maker has not the faintest idea whether or not a schedule A maximises benefits to a higher extent than B[74]. However, it is particularly important in the case of preventive interventions in general because of many more uncertainties, for example, regarding the social dimension of the recent pandemics, the pattern of social contacts and its influence on the pandemic dynamics, the efficacy of different nonpharmaceutical interventions for the reproduction number, etc. Moreover, any rationing

scheme that would incorporate a more subtle criterion for prevention prioritisation, e.g., quality of life or QALYs, is even more susceptible to critique (although the reasons are similar for both treatment and prevention): it may rely on inaccurate stereotypes about the quality of life; lack the perspective of disabled people; neglect the fact that poorer quality of life often results from social injustice.

Prioritarianism: who counts as the worst off?

Derek Parfit's seminal presentation of prioritarianism states that '[B]enefiting people matters more the worse off these people are'[75]. This view has been thoroughly discussed in philosophy and healthcare ethics, b/ut even among those who agree that the worst off should be given some priority, e.g. within the healthcare domain, there is no agreement on who counts as 'the worst off'[76]. The dimension on which we concentrate in this section is how one can conceptualise someone as the worst off in the context of vaccination prioritisation schedules. In the discussions about prioritarianism in healthcare, some argue that a decision-maker should categorise the worst off by referring only (or primarily) to their entire lifespan (like a life-time prioritarianism concerned with distributions over entire lives[77] or only (or mostly) to some part of their lifespan (like a time-slice prioritarianism[78]). This distinction is also visible in an article by Persad, Wertheimer et al.[79] who distinguished 'youngest first' from 'sickest first' prioritarianism (the first may suggest a lifetime, the second time-slice prioritarianism). However, as we shall see, neither of these understandings of the worst off can be used to interpret the COVID-19 vaccine distribution schedules.

The main motivation for this first view stems from the assumption that individuals are the units of ultimate moral significance for public policies, and the standard account of personal identity asserts that individuals typically extend through time, from birth to death, as single persons. This approach is supported by views that assume that we should categorise the worse off by referring to their age: younger people are relatively worse off than older people because they have lived fewer life years[80]. One possible extension of this form of prioritarianism is 'the complete lives system', which concentrates on the question of how long a patient has been alive, but also takes into consideration prognosis, saving the most lives, equal chances, and instrumental values[81]. In the context of rationing ventilators and critical care beds during the COVID-19 pandemic, supporters of this approach highlighted that younger people should receive priority 'not because of any claims about social worth or utility, but because they are the worst off, in the sense that they have had the least opportunity to live through the stages of life'[82]. This is also the common way in which prioritarianism is interpreted in the health economy: 'prioritarianism is more likely than utilitarianism to prioritise the young in the allocation of vaccine doses, despite the fact that they might have lower overall benefits from being vaccinated'[83]. In this case, 'benefits' are understood as decreasing chances of dying from COVID-19.

One argument in favour of preferring younger refers to the pairwise comparisons of people's claims[84]. The argument can be visualised in the example we used in the previous section when we introduced two cohorts (A: 55-64 and B: 65-74) with different IFR: 0.75 % and 2,5 %, respectively. Even if we assume that the individual risk of death for everyone in the older cohort is higher than for everyone in the younger cohort, one can still argue in favour of prioritising

people from the younger cohort. This is because there is no one among the older cohort who would be harmed by an earlier death as much (or nearly as much) as a person from the younger cohort who would die of COVID-19 as they would have lived much longer otherwise. This argument assumes that what counts is not the number of people saved by a vaccine schedule, but the fulfillment of the strongest individual claims. If it is not possible to vaccinate all, it would be better to vaccinate this group in which there are individuals with the strongest claims (that is, individuals who would lose the most if they died prematurely). This argument corresponds to the claims that prioritising older patients may exacerbate inequalities because early death is strongly correlated with other forms of social disadvantages[85].

In fact, some triage policies during COVID-19 pandemic may be interpreted as implementing "the complete lives system", e.g., about 50% of US ventilator triage policies included an age criterion which prioritised younger (of course, this is not the only possible theoretical justification of using age criterion in such situation, the other is for example survival rates when connecting to a ventilator)[86]. However, including age has been criticized in the US context as 'likely to constitute illegal age discrimination under existing federal law'[87]. In Europe, although the ethical guidelines declaratively were very sensitive to the risk of discrimination arising from strict triage criteria, and particularly regarding age, some of them used the age limit as an exclusion criterion in certain situations[88]. In contrast to treatment guidelines, our analysis clearly shows that this principle has not been implemented in the case of COVID-19 vaccine schedules. On the contrary, we observe blanket exclusions of younger people from early vaccine access.

According to the second understanding of prioritarianism, what matters is only how well-off individuals are in specific periods (where "period" may mean a moment, a day, a week, a year, a decade, etc.). More precisely, what is essential is the level of well-being that accrues to the individuals in the period in which they receive (or could receive) a benefit. This approach, which seems to dominate in healthcare discussions about prioritarianism, treats current severe suffering as something that requires special concern and assumes that the initial state of the patients from which the distributive intervention may occur is the most crucial for evaluation. Shlomi Segall claims that the bedrock prioritarian intuition 'lends itself to, and only to, the shortest temporal unit for which we can speak of a person's welfare'[89]. Under this interpretation, prioritarianism is a principle close to the Rule of Rescue, and the view distinguishes itself from utilitarianism by treating current severe suffering as something that requires special concern. For example, Rulli and Millum[90] claim that the institutional duty of easy rescue 'could be grounded in the same considerations that ground prioritarianism'. Similarly, Torbjörn Tännsjö: '[a]ccording to prioritarianism… severe suffering (at a moment) calls for special concern'[91].

In the theoretical discussions about vaccination schedules there were also voices that postulated a need to pay special attention to groups who are disadvantaged either directly by having been disproportionately impacted by COVID-19 due to persistent structural and systemic disadvantage, or even indirectly, e.g., they are generally marginalised and disenfranchised. Here is an example of such an approach: 'we believe that such plans (for COVID-19 and for other future diseases) should have more targeted and inclusive outreach and be implemented as systemic efforts capable of adequately and effectively protecting marginalised populations and disadvantaged/disenfranchised groups'[92]. One way to implement this type of prioritarian concern

is a categorised priority system, which divides resources into multiple categories, enabling the use of different criteria for the allocation of resources within each category[93]. Some percentage of vaccines may be reserved in every stage of the vaccination schedule to realise a particular principle or principles (e.g., prioritising the worst off, however defined) while the remainder could be allocated in line with the main principle, e.g., saving the most lives. In fact, such a system was introduced in many US states where by 30 March 2021 51 jurisdictions (out of 64) had prioritised specific zip codes in combination with metrics such as COVID-19 incidence or adopted disadvantage indices. For example, Massachusetts officially declared that it would allocate 20% of vaccines to communities with a disproportionate burden of COVID-19 and high social vulnerability[94]. In contrast, no schedule we analysed has used such a system, which may stem from the fact that health inequalities in many analysed countries are not as enormous as in the US. On a more general level, analysed schedules show little sign of prioritisation of people because of their current suffering or any other form of economic or social deprivation. Rare instances of prioritising in those situations may be spotted only in a few countries that prioritise people with disabilities (e.g. Romania, Sweden), even when the specific chronic illness or health problem they suffer from is not a direct risk factor in the case of contracting SARS-Cov-2.

Our results show that the COVID-19 schedules may be interpreted as implementing the prioritarian principle in a different sense from the two discussed above. The fact that in each country, individuals above 65 years were given special access to vaccines very early on, most schedules included people with characteristic comorbidities that increase their expected IFR but ROI-based criteria were not systematically and consistently applied may be interpreted as implementing the very specific prioritarian principle: the worst off are those who have the

highest risk of death if infected, that is, the highest IFR. This index, and more generally, the future health prospects of an individual in the case of COVID-19, can be established either by just categorising one into some age cohort (what does not take into account individual characteristics) or by also taking into account characteristic comorbidities that increase expected IFR (takes into account current or past conditions of particular individuals). These two methods coexisted, although to a very different extent, in all analysed schedules. Only a few schedules recognized that the total risk of death for COVID-19 depends not only on IFR, but also on the very probability of being infected - these schedules (e.g. German) included criteria that we characterised as reflecting ROI.

The difference between these three dimensions may be again visualised in the example of two cohorts (A: 55-64 and B: 65-74) with different IFRs: 0.75 % and 2,5 %, respectively. These countries that prioritised people almost exclusively on the basis of age would order members of these two cohorts in a ranking close to lexical order (i.e., almost every individual belonging to B would be higher on the vaccination schedule than every individual from A, with some minor exceptions concerning, for example, healthcare workers). In contrast, these countries that included more high-risk patients would allow many individuals from A (or even from younger cohorts) with higher IFR than the average for their own cohort to be on the same level (or even higher, since some countries put high-risk patients on the very top of the prioritisation schedule) than individuals from B. Finally, these schedules that used ROI took into account the fact that some subgroups of A may have a similar or even higher risk of death related to COVID-19 because their members have a relatively high probability of being infected.

Of course, since no policy is a pure representation of one particular normative theory, no schedule represents a pure version of these approaches. Nevertheless, these schedules that prioritised people almost exclusively on the basis of age and comorbidities (e.g. UK, see Table 1 and Table B in supplementary materials) and took into account no (or relatively very few) additional factors related to ROI may be interpreted as the closest to this understanding of prioritarianism that defines the worst off as those who have the highest IFR. On the other side of the spectrum, these approaches that included not only cohorts and groups with the highest IFR, but also groups with higher ROI (e.g., Germany, see Table 1 and Table B in the supplementary materials) can be interpreted as closest to this understanding of prioritarianism that defines the worst off as those who have the highest risk of COVID-19 death, which is a different criterion from pure IFR. Interestingly, this last approach overlaps with these utilitarian approaches that concentrate on saving most lives.

However, even in this case there would be an interesting difference between utilitarian and some prioritarian approaches because utilitarianism (and some versions of prioritarianism) does not distinguish the way some consequences appear. The literature on prioritarianism distinguishes two ways to generalise prioritarianism from cases of certainty to those of uncertainty, the so-called 'ex ante' and 'ex post' prioritarianism[95]. The first states that a decision maker should maximise the sum of priority-weighted expected well-being ('ex ante'). Under this interpretation, the assessment concentrates on effects on individuals' chances of death (their 'prospects') and the worst off are those who have the worst prospects. The second states that a decision maker should maximise the expected sum of priority-weighted well-being ('ex post'). Under this interpretation assessment, the assessment focuses on the intervention's expected

effects on the overall pattern of outcomes, and the worst off are those who in fact will die on COVID-19 (even if their identity is not known ex ante).

It is easy to imagine cases where two different vaccination schedules may result in the same number of avoided deaths, but the saved individuals may belong to different groups. Let us go back to our standard case of two cohorts (A: 55-64 and B: 65-74) with different IFRs: 0.75 % and 2,5 %, respectively. Moreover, for the sake of this example, let us assume that both groups are equally numerous (e.g. 1 million people), and ROI (within period t) for A is 33.333… % whereas for B it is 10 %. Under such assumptions we can predict that the number of expected deaths related to COVID-19 will be more or less the same in both groups within period t (about 2500). If we use the individual risk of Covid-19 death as our measure of how well-off people are (and so for fixing prioritarian weights), every member of the younger cohort is equally well off in comparison with members of the older cohort because everyone has the same total individual risk of Covid-19 death (0,25 %). From a utilitarian or ex post-prioritarian perspective, it does not matter which group will be vaccinated first (assuming that we cannot vaccinate both groups simultaneously). However, in A many more people will have COVID-19 than in B (333 333 vs. 100 000), and in B those who will have COVID-19 will die much more often. Therefore, from some ex ante prioritarian perspective, this may be a reason to vaccinate the older cohort B first. Followers of this approach may argue that being infected with SARS-CoV-2 is what makes an individual worse off in the relevant sense (not just belonging to some age cohort). Thus, a vaccination schedule under this interpretation focuses all "moral attention" only on those people who will be infected with SARS-CoV-2 in these two cohorts, even if their identity is not currently known (or even impossible to learn, since the unpredictability of the pattern of social

contacts and spread of the virus). The rationale for this is simple: people in these cohorts who will not be infected with SARS-CoV-2 bear no risk of death because of COVID-19, so we do not have to care about them in this regard. Under this interpretation, the previous case incorrectly generalised risk to every member of these two cohorts. To sum up, from an ex ante prioritarianism two policies might have the same expected outcomes – so, be identical from an ex post perspective (e.g. in terms of number of people who die) – but differ ex ante. The lesson we can learn is that the focus of most analysed schedules on IFR may represent an ex ante prioritarian approach.

Equality: choosing without preferring

The value of equality was almost commonly recognized in international documents as a guiding principle for the allocation of the COVID-19 vaccine. WHO SAGE framework includes equal respect (consisting of recognition and treatment of all human beings as having equal moral status and particular interests as deserving of equal moral consideration) in the list of six principles relevant for the vaccine distribution, while the EU Strategy for COVID-19 vaccines mentions equitable access for all in the EU among three main objectives for the EU policy. Furthermore, some theorists[96] place a special emphasis on equality in this context. In all these cases the principle of equality was distinguished from the prioritarian standard and refers to ex ante

equality, that is, to an equal chance of some vaccine-related benefit (what does not necessary imply an ex post equality, that is, equality in terms of outcome, e.g., vaccination uptake or COVID mortality).

In many papers about the allocation of rare healthcare resources, the principle of equality is understood formally as the requirement to distribute some goods on the basis of the "first-come, first-served" or by chance (i.e., by lottery)[97]. Harris[98] mentions an amendment to these two rules that would allow people the option of giving away their equal priority to others. Most authors reject the 'first come, first serve' approach, considering it inferior to lotteries. The main reason for this is that the 'first come, first serve' approach may unacceptably exacerbate inequalities, i.e., may benefit people who are resourceful and socially privileged to be the first in lines. Schmidt[99] even calls the rule ironically let-me-use-my-connections-and-pointy-middle-class-elbows approach[100]. Moreover, some authors argue that waiting time is not intrinsically morally significant[101].

It has been argued that the random distribution of deficit healthcare resources has many practical advantages: it supports an equal claim to scarce resources, prevents small differences from drastically affecting outcomes, is simple, and does not require any knowledge about recipients from a decision maker. In the context of treatment during the recent pandemic, Harris[102], who treats equality as the main relevant value in many healthcare contexts, suggested that "choosing without preferring" is the only morally justified way of distributing scarce healthcare resources, that is, choosing between lives without doing so in a way that shows a preference for the life or person chosen. Developing his previous ideas on this topic, he argued

that this is the only method that counts every person for one and none for more than one: 'so long as we each wish to live out the rest of our lives, however long that turns out to be, then if we do not deserve to die, we each suffer the same injustice if our wishes are deliberately frustrated, and we are cut off prematurely'.

Harris assumes that every other distribution except the 'choosing without preferring' approach would be 'insulting' because it would treat people's lives as 'worthless' (in the sense that they would be 'worth less' than those of others). According to this reasoning, any allocation rule other than equalitarian must implicitly assume judgments of comparative valuing between lives, which, in fact, is morally impermissible. Although he speaks about treatment, it seems, at first sight, that an analogical argument could be applied to prevention, that is, vaccinations should be randomly assigned among individuals, no matter how vulnerable they are, that is, how high IFR or ROI some of them may have. However, surprisingly, in the context of vaccination he resigns from this categorical stance and allows to prioritise such distribution of vaccines that prioritise 'the most vulnerable to COVID-19 until there is sufficient supply for all'[103]. This proposal resembles earlier approaches that tried to mix an egalitarian approach with some utilitarian components, for example, a weighted lottery approach where, every candidate for life-saving treatment would have some chance in competition with every other candidate, but those who stood to gain more life years would have greater chances[104].

In the debate on COVID-19 vaccines, a weighted lottery allocation approach was conditionally defended by Schmidt[105]. However, he grounded his argument not in equal chances, but in priority for the underprivileged that should reflect different levels of underlying

disadvantages, both health and not-health related. In practice, Schmidt[106] postulates the use of weighing based on measures such as the Area Deprivation Index (ADI), which combines income, education, employment, and housing quality data to rank neighbourhoods by socioeconomic status disadvantage[107]. Alternatively, a categorised priority system mentioned in the previous section[108] could reserve some percentage of vaccines in every stage of the vaccination schedule to be distributed randomly (either in equal chance or weighted lottery).

Considering the unique nature of the egalitarian principle, our analysis shows that this principle was only adopted in the analysed vaccination schemes in a limited form. The egalitarian approach serves there exclusively as a second-order principle, namely, as a pattern of distribution within already prioritised groups (that is, groups which are distinguished on the basis of some other criteria). In particular, the "first come, first serve" approach was to distribute vaccines within subsequent groups. Furthermore, and particularly noteworthy, no researched priority setting adopted any chancy mechanism to distribute COVID-19 vaccines – either in the version of identical chance lottery or a weighted lottery. This may suggest that random distribution, which is often discussed by philosophers, has in fact limited practical applications in the prioritisation of healthcare prevention.

Conclusions

The comparison of COVID-19 vaccine prioritisation schedules from 29 countries shows relevant similarities among state policies. Our crucial finding is that all of the settings researched rely

largely on priority criteria referring to individual IFR. In particular, being over 65 years old was commonly regarded as a reason for prioritisation and coexisting health conditions were almost universally recognized as such a reason. Although particular states introduced IFR criteria in different forms, the common thing was the noticeable priority of IFR criteria over the ROI ones (where the latter includes, e.g. occupation and housing conditions). The IFR criteria were generally placed higher on the priority-settings than the ROI criteria.

This dominance of IFR criteria is certainly not trivial and surprising, since in the context of treatment, it is rather common and justifiable to adopt very different distribution schemes (e.g. introducing saving more life-years approach and prioritising younger patients). Moreover, many authors noticed not only that far more resources are devoted to treating disease than to preventing it, but also that preventive services are usually subject to more scrupulous cost-effectiveness assessment than treatment[109]. As we have argued in the discussion, this justification of this pattern of priority criteria in the case of COVID-19 vaccination is far from clear, with neither utilitarian, prioritarian nor egalitarian principles providing a straightforward basis for this distributive arrangement. From the utilitarian perspective, the dominance of IFR criteria seems to get support from the “saving most lives” principle; however, this support does not come without reservations. According to the account of prioritarianism, this recognized approach might be seen as a specific version of ex ante prioritarianism. Finally, one may also discern some egalitarian traits in the schedules, but only to a very limited extent with the 'first come, first served' version of egalitarianism operating as a second-order principle (that is, a principle that provides a pattern of distribution within first-order groups).

How to interpret the observed patterns of prioritisation in COVID-19 vaccination schedules? Do they stem from some systematic differences between curative and preventive medical interventions that may influence the prioritisation rules? For example, from the fact that prioritisation in the case of preventive interventions always concerns merely statistical individuals? Or from the intricacy of ascribing causal claims to the case of preventive medical interventions which may be understood as 'a matter of causing the nonoccurrence of an event'[110]. Surprisingly, the problem of priority settings in the cases of medical preventive interventions has not been systematically discussed in the literature to such an extent as in the case of treatment[111]. Furthermore, in contrast with many medical treatments (e.g. the allocation of organs for transplantation), there is no well-established expert consensus on this matter.

The better interpretation may come from the analysis of the situation of the urgent healthcare crisis and the peculiar context that influenced the prioritisation schemes for COVID-19 vaccination in a specific way. The theoretical ambiguity of vaccine distribution patterns might paradoxically be regarded as an advantage in political practice. The reason for this is that the legitimization criteria applied by bioethical experts and the general public typically differ, whereas social legitimacy, which is crucial for the effectiveness of vaccine policies, is mainly dependent on the latter. The tension between bioethics experts and public opinion was clearly visible in the case the allocation of respirators in the first phase of the COVID-19 in the US, where the decision not to give the respirator to disabled people or people suffering from certain diseases, albeit motivated on the basis of a well-considered bioethical reasoning, aroused protests and in some cases led to changes in the guidelines[112].

The main challenge for social legitimacy in most cases of political decision-making seems to be that, on the one hand, citizens deeply differ in their moral views, while on the other hand, political regulations (including priority-schedules) should ideally be acceptable to the overwhelming majority of citizens[113]. Since priority schedules are inevitably value-laden, social acceptability becomes difficult to attain. In such circumstances, sticking to particular normative theory (in particular, in the situation where there is no well-established consensus among stakeholders) may be seen by the public as controversial. Knowing this, one may conclude that the fact that established schedules could be interpreted and defended on different grounds may increase their legitimacy in the eyes of the public. Such schedules could be supported by an overlapping consensus of different moral views in John Rawls' terms[114]. Since the effectiveness of vaccination programs depends (at least partly) on their social legitimacy, this openness to various interpretations appears as a crucial factor.

Nevertheless, it should be clear that we do not argue for a more general claim that such vagueness in policy concerning highly disputable issues should be regarded as beneficial in all (or even most) cases. There are many threats involved in policies that seek to gain widespread social legitimacy. First, such policies often lead to decisions which are questionable in the light of well-established democratic standards (such as the principle of equal respect). Furthermore, the growing distrust of experts and the popularity of 'alternative sources of knowledge' seems to push democratic societies into establishing less informed policies[115]. At the same time, in situations where expert input is indispensable, political leaders tend to use scientific expertise as a way to lessen the responsibility placed on them and reduce their accountability[116]. We are aware of these threats, and our conclusion is much more modest for this reason. We claim that

the ambiguity of the researched vaccine policies could be regarded as an advantage considering the very special circumstances in which these policies were adopted. In particular, one should note that the pandemic has pushed public attention to questions about priority settings that are typically not in the spotlight. As it could have been anticipated during early days of the pandemic, the focus on health issues provided grounds for the rise of vaccine hesitancy and anti-vaxx movements. Last but not least, all of this happened on an unprecedented scale and under conditions of high uncertainty about the future dynamics of the pandemic.

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Conflict of interest clause

The authors have no financial, personal, academic, or other conflicts of interest in the subject matter discussed in this manuscript.

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