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## Researchers present an algorithm for the ethical distribution of vaccines and other vital resources in the event of a pandemic

Newswise — In an article published in *Frontiers in Public Health*, researchers Carlos Alós-Ferrer of the Center for Neuroeconomics at the University of Zurich and Jaume García-Segarra and Miguel Ginés Vilar of the Department of Economics at the Universitat Jaume I in Castelló have questioned the distribution of vaccines against COVID-19 and propose an algorithm to satisfy the properties that experts in medical ethics consider fundamental.

In the opinion of the academics, "vaccine rationing procedures violated fundamental ethical principles". In the article "Ethical allocation of scarce vaccine doses: the Priority-Equality protocol" they explain that these criteria were not taken into account in the allocation of vaccines, nor was scientific advice required from specialists in mathematics and economics, who are more accustomed to the allocation of scarce resources.

When COVID-19 vaccines became available, countries around the world embarked on a race to supply themselves with vaccines, with little or no intention to coordinate. To mitigate the potential chaos of these "nationalistic health" policies, the World Health Organisation and other organisations supported a multinational initiative called COVAX to organise the distribution of doses among different countries. Other supranational coalitions such as the European Union also centralised the purchase of vaccines for distribution among its member states.

### **Priority and equity**

In the case of vaccines, two ethical principles are the most important. First, to avoid collapse, medical personnel must be immunised first, then older people and those most at risk, and so on. This principle, called "prioritisation according to need", requires that priority classes be respected (as decided by scientific evidence and competent medical authorities), and immunisation of one priority class does not have to start until the previous classes are already immunised everywhere in the multi-territorial coalition.

Secondly, all persons within a given priority class have to be treated equally. This principle, called "equality among equals", requires that people with the same priority have the same chance of receiving the vaccine, regardless of irrelevant factors such as which country or state within the alliance they may reside in.

As the researchers detail in the article published in *Frontiers in Public Health*, "the allocation protocols applied by COVAX or the EU ignored scientific and ethical criteria". Specifically, the error was in the application of a criterion of proportionality of batches according to the population of the member states without taking into account that the proportion of priority classes was different in each of the territories. "This resulted in some territories vaccinating younger and healthier populations (with lower priority), while in other territories more vulnerable populations (and therefore with higher priority) remained unvaccinated."

### **Allocating vaccines in the face of a pandemic**

The problem can be solved using mathematical social science techniques. The research team has shown mathematically that there is one and only one way to allocate vaccines to ensure that priority classes are respected and people within each priority class are treated equally. The procedure, called the "Priority-Equality Protocol", is a little more complex than the one applied by COVID-19, but not by much.

First, the size of each of the priority classes has to be added up for each of the territories. Second, the vaccine stock is allocated as follows: for all priority classes that can be fully satisfied with the available stock, the corresponding vaccines are delivered to them in each territory, and for the first class to be rationed, the rationing is done proportionally to the number of people in this class in each territory. This protocol has many other interesting additional properties that are explained in the annex to the published article: for example, it cannot be manipulated in the event of separations or unions between territories, it does not matter the sequence in which the new doses are delivered, etc.

The researchers claim that "mathematics show that there is no other method that respects the two ethical principles we have discussed and that any other protocol would violate at least one of these principles". The "Priority-Equality Protocol" is valid for any kind of centralised distribution that has to respect priority classes, for example the distribution of iodine pills in the face of a nuclear threat, and they encourage the relevant authorities to adopt and implement it.

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