

## **Scientists: We offer a cheaper and more efficient alternative to massive testing**

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The need for regular monitoring of the spread of COVID-19 led us to develop the REDACS method (Regional emergency driven adaptive cluster sampling for effective COVID-19 prevalence). We developed the REDACS methodology in international collaboration and first article is submitted to the scientific journal. The total number of active cases, the total number of cured cases and the total number of COVID-19 deaths are among the indicators monitored by national agencies around the world to monitor the spread of a pandemic. The most important tool for slowing down the spread of the disease is testing, which is also the part of non-pharmaceutical strategies for COVID-19 mitigation. Its purpose is to identify and isolate the infected. Our method is fundamentally different from what is done today in the targeted search for infected. Unlike targeted disease screening, it treats incidence and prevalence as statistical features while taking into account the capacity of the health system to prevent collapse. From the beginning, a nationwide search network has been operating through regional public health offices and collection points and laboratories for PCR diagnostics of the disease, which serve mainly for targeted screening of people suspected of being infected with the SARS-CoV-2 virus. In addition, we have completed several rounds of area testing, in which a large part of the country's population or parts of it were tested at once during two days. Screening is a method for capturing as many infected people as possible in a population. However, we propose a more efficient, more accurate, much less expensive and scientifically based method for targeted search as well as area mapping of the situation. REDACS is a statistically sophisticated alternative to area-wide testing, which cannot be repeated frequently due to the need for a large amount of resources. Some countries preferred testing on small but statistically representative samples. Iceland, for example, tested six percent of the population in February and March. Another example is Austria, which tested less than one percent of its population together in three prevalence studies this year, in April, May and November. Scientific experience and knowledge from viral disease prevalence testing point to the need to modify comprehensive testing plans. What needs to be adjusted? It is necessary to replace area-wide testing with so-called adaptive testing of outbreaks (so-called clusters). Recent research on coronavirus has shown that robust, adaptive and repetitive testing will, in practical terms, result in a significantly safer, significantly cheaper and also significantly more accurate method of monitoring the spread of COVID-19.

Simply put, a test cluster, a group of people that need to be tested, will form around the local outbreak. If we have caught several positive people in one district who got infected in one place, for example at a celebration, we will test everyone around them, all their close contacts. If one of the contacts is positive, we will test everyone around him, all his close contacts. We proceed in this way until we stop catching infected people in the tested "clusters". The size of the REDACS model will determine how large "clusters" need to be tested, in which, in addition to basic information on the incidence of cases in a given region, other data are also entered, especially on the capacity of the health system. The tested clusters are called adaptive, as they adapt to the current situation every time during testing, as well as during each subsequent testing. The REDACS method is suitable both for stopping the spread of COVID-19 infection around the outbreak and for accurately estimating the prevalence in a defined geographical area. The main advantage of this method is that the selection of test sites and the number of test persons uses the already existing infrastructure - districts, regions, regional public health authorities. In each region, the extent of infectivity in each individual outbreak is evaluated and at the same time the risk level of the capacity of hospitals and the emergency medical service system is determined. Based on this, REDACS will identify the regions with the highest incidence of COVID-19.

For example, in the case of Slovakia, in October 2020 it could be the districts of Bardejov and Dolný Kubín. For each local outbreak, REDACS calculates the extent of the adaptive cluster (i.e. the samples needed for testing), taking into account the risk of overloading of the hospitals in the region. The required number of people is then tested and confidence intervals are calculated. In this way, the number of infected is determined statistically for each region. This will allow us not only to stop the spread in the outbreak, but also to accurately estimate the situation in the region. Such an approach is also more suitable for regular repetition than massive testing. This is supported by the opinions of European and world health organizations. Based on the standards, the basic test procedure may be a combination of a PCR test and a subsequent optional antigen test. PCR testing will be voluntary. If the respondent decides not to test, he may be placed in a two-week quarantine. In this case, it will be monitored in a specific cluster and will be evaluated by statistical techniques as "non-response" (the direct contacts will be tested). Here, we draw attention to the fact that antigen tests are only suitable (according to WHO and FDA) for symptomatic patients, and therefore the previous PCR test significantly reduces the diagnostic error. The reason is the recently discussed specificity and sensitivity of the test.

One of the important aspects of the REDACS method is that it takes into account the capacity of the emergency medical service and the health care system - the model will take local data into account when calculating the required size of the tested file. High-quality statistical estimates of the future number of new patients also allow local health services to respond better to the situation.

In Slovakia, the problem of the capacity of the emergency medical service is still little discussed. The availability of free ambulances is also a statistical feature. After transporting a patient with suspected COVID-19 disease, the disinfection of the ambulance takes several hours, and it is necessary to replace such an ambulance with another one. The implications of covid patient transports on the capacity and speed of emergency medical teams need to be investigated using proper statistical modeling. Support for such a simulation can be provided by statistics of departures and arrivals of the emergency medical service, as well as data on departures of ambulances at different times, which are entered into the REDACS method.

REDACS integrates statistical monitoring of the epidemiological situation, the state of emergency of the medical service and the first line staff of hospitals, thus making it possible to prevent and predict the collapse of the hospital system. In this way, it provides a better and more feasible way of population survey and monitoring of the spread of COVID-19 infection for countries with a relatively fragile health system.

If we want to determine the prevalence of COVID-19 disease with the greatest possible statistical accuracy and identify those infected, we need to prepare a correct statistical testing proposal, apply it statistically correctly and then evaluate it statistically correctly.

The term "statistically correct" should be emphasized here, as all the characteristics we collect in such testing are statistical features. For example, prevalence is a statistic that refers to the number of cases of the disease that occur in a particular population at a given time. Without a high-quality statistical design of testing, statistically correct data collection and subsequent statistically correct processing of the data, the data cannot be directly assessed and used at all.

Non-statistical testing will invalidate the data, and even very advanced statistical methods will no longer be able to extract information from them. Properly statistically based data collection and their subsequent processing, correct design of population surveys are very important. REDACS is based on a multidisciplinary combination of the results of statistical, stochastic, mathematical and epidemiological modeling together with known information on prevalence testing, e.g. from available WHO, EU, FDA and CDC documents. This method represents a feasible and more advantageous alternative to massive prevalence testing.

REDACS is an alternative to massive testing, and such an alternative is needed in the long term because COVID-19 is likely to enter an endemic period over time, says Hans Heesterbeek, professor of theoretical epidemiology at Utrecht University in the Netherlands. Before entering this phase, states must survive several more waves of COVID-19 spread.

In summary, multiple iterations of the REDACS method are less costly, more accurate, and ultimately more effective than nationwide testing.