Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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EDITORIAL

SARS-CoV-2 detection by self-testing: A method to improve surveillance programmes

La detección del SARS-CoV-2 mediante autodiagnóstico, un método que hace posible y eficaz los programas de vigilancia

The World Health Organization put forth the ''test, treat and trace'' trilogy as the cornerstone of their strategy for containing the COVID-19 pandemic.[1] However, as has been demonstrated in various countries around the world, mass screening presents a pressing logistical challenge.[2] There are several alternatives that could solve this difficulty including novel areas for screening such as non-healthcare facilities (e.g. conference or sport centres), field hospitals, dedicated areas of some hospitals, and pharmacies. Yet, nine months into the pandemic, apart from a few Asian countries,[3] mass testing has not been established and contact tracing with self-quarantining has been limited. Since March 2020, control measures have largely concentrated on implementing interpersonal physical distancing and stay-at-home orders, using facemasks, reducing social activity, restricting movement, and territorial and home lockdowns. However, ongoing levels of COVID-19 transmission, morbidity, and mortality highlight the failures of these measures, leading us to reflect on whether we can change the course of this pandemic with the containment measures applied date.

Rapid tests are essential for controlling the COVID-19 pandemic

The ability of SARS-CoV-2 to spread from individuals, both symptomatic and asymptomatic, means that diagnosis and isolation based on symptoms and contact tracing alone will be unable to prevent ongoing spread. The cornerstone of COVID-19 diagnostic testing is the detection of viral genome by real-time reverse transcription polymerase chain reaction (rRT-PCR) performed with respiratory specimens, especially with nasopharyngeal swabs.[4] In addition to being costly, this technique requires specialised healthcare personnel, centralised laboratory facilities, and time to provide results. However, the progresses made so far in facilitating the study of this infection is impressive. As such, the development of rapid, inexpensive, sufficiently sensitive tests for the diagnosis of large population groups are essential to control the spread of SARS-CoV-2. An example of theses rapid diagnostic methods is the antigen detection test, based on lateral immunochromatography, and already in use for other respiratory viruses (e.g. influenza virus, syncytial virus). These methods have been harshly criticized for their sensitivity. RT-PCR has a lower limit of viral detection (10^3 copies/ml) than rapid antigen tests (around 10^5 copies/ml).[5] Nevertheless, various recent studies demonstrated an absence of contagiousness when the concentration of viral particles is less than 10^6 copies/ml in samples collected from patients.[6,7] Furthermore, the simplicity and low cost of antigen detection tests allow them to be repeated frequently, even daily.

We need our political and health authorities to understand that the diagnostic tests should not necessarily be identical for the diagnosis of a patient (sick with COVID-19) and that of a subject potentially infected by SARS-CoV-2. In the former, we must use the most sensitive and specific diagnostic tools. In the latter, a cheap, simple test that can be easily repeated and that offers rapid results allows for containing the spread of the infection, in spite of its lower sensitivity.[5,8]

The success of COVID-19 pandemic control in some Asian countries is largely due to extensive testing, tracing, and isolating of all cases from the beginning of the outbreak, reinforced by innovative surveillance technology.[3,9,10] Therefore, a combination of massive testing with the support of digital technologies, in addition to screening in all types of centres that bring together a large number of people, such as hospitals, pharmacies, schools, places of work, and sports facilities, would be an effective SARS-CoV-2 surveillance strategy to limit the spread of the disease. The rapid test results from an entire adult population could be obtained quickly and effectively and then uploaded to a technological platform to inform in real-time both

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individuals and health authorities simultaneously. In this way, governments could use surveillance data to establish smaller scale ''surgical'' lockdowns limited to individuals with an active infection and their close contacts. As such, the pandemic can be contained without severely limiting social and economic activity.

Self-testing for SARS-CoV-2 is feasible

The rapid tests for SARS-CoV-2 should not necessarily require healthcare personnel and facilities and people should be able self-administer them. Furthermore, saliva may be used as a reliable diagnostic sample, which has numerous advantages since the subject can easily obtain a sample without discomfort and without management by specialized healthcare personnel.[11] But is it possible for us to self-diagnose? A recently published study from England has demonstrated the acceptability and usability of home-based self-testing for SARS-CoV-2 antibodies using lateral flow immunoassays.[12] Similarly, low-cost blockchain and artificial intelligence-coupled self-testing and tracking systems for COVID-19 and other emerging infectious diseases have been proposed.[13] Let's take another example. In May 2020, our working group analysed the prevalence of SARS-CoV-2 infection in a group of people ($n = 1022$) representative of the general population of the Cantabria region of Spain (unpublished data). We sent participants, by post, a SARS-CoV-2 rapid antibody test, a link where they could access an online epidemiological questionnaire, and a detailed video tutorial showing how to complete the procedure and upload the results to the platform. In effect, we carried out a study in a general population previously untrained and we analysed the effectiveness and potential barriers to the implementation of this type of intervention. Over 95% of the participants were able to correctly perform the self-testing procedure. These results suggest that the use of such a methodology is viable in Spain, and, probably in other high-income countries. Self-testing has been used successfully in other infectious diseases such as HIV and other sexually transmitted infections.[14,15] It can be especially crucial in situations with restricted movement, such as during the COVID-19 pandemic, where access to healthcare services and diagnostic testing become limited due to medical emergencies.

Surveillance programs need additional socio-economic measures

As the OECD notes, rapid tests-based strategies must take into account their strengths but also their limitations.[16] Some of the limitations have been noted in a community testing pilot, not massive, in Liverpool,[17] which derive especially from the lack of information to citizens. Despite the promises of home-based testing, establishing this intervention requires a high level of commitment from the authorities and civil society as a whole.[18] For example, trained personnel will need to assist those with difficulties administering the test, particularly marginalised populations. Additionally, a considerable financial investment in technological material as well as enthusiasm and solidarity from health system stakeholders are required to create effective mass testing campaigns. Furthermore, economic compensation, automatic stigma-free time off of work and/or the implementation of different fiscal measures during the period of self-isolation will be essential to the success of this surveillance strategy. Other measures will also be necessary, such as the availability of quarantine accommodation for people whose homes are not fit for purpose and the availability of social services staff to support the vulnerable. It is true that there will be false negative results;[19,20] but undoubtedly, the diagnosis of many asymptomatic cases and subsequent isolation will be a positive contribution to contain the pandemic, especially since more than 80% of cases remained asymptomatic.[21,22] A negative test may give a false sense of security and lead to riskier behaviour than would have occurred without the test; for this reason, public-awareness campaigns should also encourage continued physical distancing and facemask wearing even after a negative test. In parallel with other measures, including vaccine roll-out, successfully addressing the pandemic must involve self-testing.

A new confinement is looming on the near horizon, weeks of high numbers of cases and hospitalisations that will once again test our healthcare system. We will suffer due to tens thousands of deaths in addition to massive morbidity. But if we can put into practice the aforementioned intervention, which is ambitious but feasible, we can better mitigate the pandemic and mobilise hope. No, we must not get carried away by optimism; but, let's at least allow science to guide us.

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