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REFLECTION PAPER

Delta variant of SARS-CoV-2: characteristics and implications for public health in Colombia

Variante delta del SARS-CoV-2: características e implicaciones para la salud pública en Colombia

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Abstract

The SARS-CoV-2 Delta variant has become one of the greatest public health challenges worldwide since, after being first identified in India in December 2020, it has spread rapidly, affecting mainly countries with low vaccination rates and those that have relaxed the public health and social measures implemented to control the COVID-19 pandemic.

The Delta variant has a higher replication capacity and is associated with viral loads up to 1 260 times higher than those of infections caused by the original strain, which may be associated with an increased likelihood of hospitalization, ICU admission, need for oxygen therapy, pneumonia, or even death.

Fully vaccinated individuals have almost similar protection against both Delta and Alpha variants. Given the impact of Delta in countries where it is the dominant variant, it is necessary for all countries to develop systematic action plans focused on implementing strict public health and social measures in the context of the COVID-19 pandemic and on increasing vaccination coverage. Bearing this in mind, the objective of this reflection paper is to describe the main characteristics of the Delta variant, its impact on the dynamics of the pandemic in some of the countries where it has been detected, the effectiveness of vaccines against this variant, and its implications for public health in Colombia.

Resumen

La variante delta del SARS-CoV-2 se ha convertido en uno de los mayores desafíos en salud pública a nivel mundial, ya que, luego de su identificación en la India en diciembre de 2020, se ha extendido de manera rápida, afectando principalmente a los países con bajas tasas de vacunación, y aquellos que han flexibilizado las medidas de salud pública establecidas para controlar la pandemia por COVID-19.

La variante delta tiene una mayor capacidad de replicación y se asocia con cargas virales hasta 1 260 veces más altas en comparación con las de infecciones causadas por la cepa original, lo cual puede estar asociado a mayores probabilidades de hospitalización, ingreso a UCI, necesidad de oxigenoterapia, neumonía, o incluso muerte.

Las personas con vacunación completa tienen una protección casi similar contra las variantes delta y alfa. Dado el impacto de delta en los países afectados en los que es la variante dominante, es necesario que todos los países desarrollen planes de acción sistemáticos enfocados en implementar estrictas medidas de salud pública y sociales en el contexto de la pandemia por COVID-19, y aumentar la cobertura de vacunación. Teniendo en cuenta lo anterior, el objetivo de esta reflexión es describir las principales características de la variante delta, su impacto en la dinámica de la pandemia en algunos de los países en que ha sido detectada, la efectividad de las vacunas contra esta variante, y sus implicaciones para la salud pública en Colombia.

Introduction

The Delta variant of SARS-CoV-2 has spread rapidly in some countries where social and public health measures to control the COVID-19 pandemic have become more flexible. This variant has led to an increase in the number of cases and mortality and, as a result, to the collapse of health systems, particularly in low- and middle-income countries.

The countries most affected by the Delta variant have limited vaccination coverage and were already dealing with the severe impact of the third wave of the pandemic, which exacerbated the lack of resources and increased the fatigue of health professionals.[1,2]

Phylogenic analysis performed on the complete genome of SARS-CoV-2, identified on January 3, 2020, by scientists at the National Institute for Viral Disease Control and Prevention in China, confirmed that it is a novel coronavirus of the genus β (2019-nCoVs).[3]

The World Health Organization (WHO) has worked with networks of experts around the world to assess the evolution of SARS-CoV-2. In doing so, variants that pose an increased risk to global public health have been identified and termed "variants of interest" (VOI) and "variants of concern" (VOC). A third category, called "variants under monitoring" (VUM) was also established, including variants that may pose a risk to global public health but for which there is still insufficient evidence of their epidemiological impact.[4]

WHO[5] defines VOIs as those variants with changes in the genome that have been shown or are expected to have an impact on certain characteristics of the virus such as transmissibility, disease severity, the ability to escape the action of the immune system, the possibility of being detected by diagnostic methods, and changes in response to medications. In this sense, it is necessary to monitor variants that have an increasing relative prevalence with respect to others, or those with characteristics that indicate that they may pose a new risk to global public health.[6]

On the other hand, a VOC is defined as a variant associated with one or more of the following changes: 1) increased transmissibility or adverse change in the epidemiology of COVID-19, 2) increased virulence or change in the clinical presentation of the disease, and 3) decreased efficacy of public health measures implemented to counter its spread, or decreased effectiveness of diagnoses, vaccines or therapies.[6]

The Delta variant (B.1.617.2) was first reported in December 2020 in India, where it caused a public health crisis. It has quickly become the dominant variant in the places where it has been identified because it is more transmissible: it is 40-60% more contagious than the Alpha variant (B.1.1.7).[7,8]

Similarly, Delta has the potential to be more lethal because it is associated with more cases, greater capacity to bind to lung cell receptors, and a possible reduction in response to antibody neutralization, including some of the monoclonal antibodies available for treatment.[9,10] Furthermore, it affects vulnerable populations more, particularly in countries with fragile health systems, without strong and predictive public health policies, and with low rates of vaccination against COVID-19. For all of the reasons listed above, WHO declared Delta a VOC on May 24, 2021.[4,11]

Delta has rapidly become the dominant lineage in the countries in which it has emerged. According to WHO,[11] as of June 27, 2021, Delta had been reported in 96 countries, although this is likely to be an underestimate as the sequencing capabilities required to identify variants are limited. In the same report, WHO also indicated that several of the countries with Delta are attributing surges in infections and hospitalizations to this variant,[11] and, in fact, as of July 25, 2021, Delta had already been detected in 130 countries, including Colombia.[12]

Considering the above, the objective of this reflection is to describe the main characteristics of the SARS-CoV-2 Delta variant, how the dynamics of the pandemic has changed in some of the countries where it has been detected, as well as the effectiveness of vaccines against this variant and its implications for public health in Colombia.

Is the Delta variant more contagious?

The Delta variant spreads 40-60% faster than Alpha.[7,8] This increased transmissibility can be explained by changes in its constituent proteins, since Delta has mutations in the receptor-binding domain (RBD) of protein S (L452R, E484Q, and D614G being the main ones), which interacts with the angiotensin-converting enzyme receptor 2 (ACE2) in host cells. This results in a noticeable increase in transmissibility due to greater affinity and significant conformational changes important for binding with ACE2.[13] The P681R mutation, located at the furin cleavage site, has also been identified; this mutation optimizes the cleavage of protein S by furin, which ultimately results in increased transmissibility and pathogenicity.[14] Transmission of infection in people with Delta takes seconds and occurs at a shorter distance compared to the Alpha variant, which required at least 15 minutes of contact and a distance of <1.5m.[15]

The latest report from the Imperial College of London and studies from the University of Warwick and the London School of Hygiene and Tropical Medicine (LSHTM)[16-19] suggest that by June 2021 it had become the dominant variant in the UK. According to mathematical modeling carried out by these institutions, in England, it is estimated that the effective reproduction number (R) for the Alpha variant is approximately 0.8, while for Delta it is 1.5, with an overall R value of around 1.4 for both variants. In view of the above, they recommend strengthening public health measures to reduce the number of cases and deaths, as well as ensuring that all countries work together to control global transmission by promoting equitable access to vaccines, thus preventing the emergence of new variants that would perpetuate the severity of subsequent waves of infection.

Is the Delta variant a threat to populations with inadequate vaccination coverage?

In April 2021, the United Kingdom was preparing to open spaces for the development of economic and social activities as the numbers of cases, hospitalizations and deaths due to COVID-19 had decreased; however, after the first cases of the Delta variant were detected, economic and social reactivation plans were suspended. By June 14, 2021, Delta already accounted for 91% of cases in that country, and it had been established that children and adults under 50 years of age were 2.5 times more likely to be infected with this variant.[9,20,21]

Despite the millions of doses of COVID-19 vaccines administered in the United States, the Delta variant is a real threat there given the large disparities and inequities in health care and access to vaccination, the vulnerability of ethnic minorities, the influence of anti-vaccine movements, and the low vaccination coverage in adolescents (<10%).[22]

Cases of COVID-19 in the United States have increased mainly in territories with low vaccination rates. In this regard, the Centers for Disease Control and Prevention (CDC)[23] reported that the weekly number (7 days) of hospitalizations for COVID-19 has been steadily increasing since June 25, 2021, and that between July 21 and July 27, 2021, there were 5 475 hospitalizations, which represented an increase of 46.3% compared to the figure reported in the previous week (from July 14 to 20; n=3 742). In addition, when comparing the week of July 21 to 27 with that of July 14 to 21, there was also a 64.1% increase in the number of new cases (66 606 vs. 40 597) and a 33.3% increase in the number of deaths from this disease (296 vs. 222). Finally, according to the CDC, and based on preliminary data, weekly hospitalization rates for COVID-19 have increased significantly in adults aged 18 to 49 years, rising by nearly 40% between the week ending June 26 and the week ending July 10, 2021.

Bolze *et al.*[24] established, by sequencing 19 987 samples obtained in the United States since April 2021, that Delta spread faster in counties with a low vaccination rate (defined as less than 28.5% of residents with a full vaccination schedule as of May 1), compared with those with a high vaccination rate (>28.5%).

Do people infected with the Delta variant have different manifestations and a greater likelihood of hospitalization and death?

THE ZOE Health Study[25] reported that there are some differences between classic and specific symptoms of the Delta variant, since headache, sore throat, runny nose and fever are more frequent with the latter, while cough and loss of smell are less common.

In a study conducted in Scotland, Sheikh *et al.*[26] established that, compared with people infected with Alpha, Delta cases had an increased risk of hospital admission due to COVID-19 (HR: 1.85; 95%CI: 1.39-2.47) after adjusting the Cox regression model for age, sex, deprivation, temporal trend, and comorbidities. These authors also found that the risk of hospital admission was particularly higher in patients with 5 or more relevant comorbidities.

Similarly, based on a record linkage of sequence-confirmed Delta and Alpha cases in England analyzed between March 29 and May 23, 2021, and with hospitalization data up until June 5, 2021, a preliminary analysis of 43 338 cases found that there was a significantly increased risk of hospitalization within 14 days after taking the sample (HR: 2.26; 95%CI: 1.32-3.89) for Delta compared to Alpha cases after adjustment for confounding variables (age, sex, ethnicity, area of residence, vaccination status).[27]

Moreover, in an analysis of surveillance data on all COVID-19 cases reported to the European Surveillance System by 10 countries for the period between December 28, 2020, and May 16, 2021, the hospitalization rate was 3.3% for cases aged 40 to 49 years and then nearly doubled with the increase of the decade of age, reaching 25.3% for people aged 70 to 79 years and 36.2% for those aged 80 and over. In addition, during the same study period, cases aged 50 years or older accounted for 39% of all cases and 83% of hospital admissions.[28]

Likewise, in Ontario, Canada, Fisman & Tuite[29] estimated the risk of hospitalization caused by the Delta variant using a retrospective cohort of patients who tested positive for SARSCoV-2 and screened for VOC between February 7 and June 22, 2021 (n=211 197). They found that, compared with non-VOC SARS-CoV-2 strains, the adjusted increase of the risk associated with N501Y-positive variants was 59% (95%CI: 49-69) for hospital admission, 105% (95%CI: 82-134) for admission to the intensive care unit (ICU), and 61% (95%CI: 40-87) for death.

Finally, in the United Kingdom, according to a technical report from Public Health England, a case fatality rate of 0.2% (95%CI: 0.2-0.3) was reported on July 5, 2021, after 28 days of follow-up among cases with the Delta variant, whereas the case fatality rate in cases infected with the Alpha variant was 1.9% (95%CI: 1.8-2.0).[15] However, these are preliminary studies and further evidence is required to conclude whether fatality is similar or not for these two variants.

Are vaccines effective against the Delta variant?

The emergence of new VOC of SARS-CoV-2 poses a potential threat to the effectiveness of available vaccines. Evidence shows that people who have only received the first dose of a two-dose scheme are less protected against Delta-variant infection, regardless of the type of vaccine. However, full vaccination provides very similar protection against the Delta and Alpha variants.[26,30,31]

In this regard, Lopez-Bernal *et al.*,[30] in a case-control study of negative tests carried out to estimate the effectiveness of vaccination against symptomatic disease caused by the Delta and Alpha variants, established that the effectiveness of one dose of Pfizer-BioNTech and Oxford/AstraZeneca BNT162b2 vaccines was significantly lower among people with Delta (30.7%; 95%CI: 25.2-35.7) than among people with Alpha (48.7%; 95%CI: 45.5-51.7). The authors also found that the results for two doses of both vaccines were similar: the effectiveness of the Pfizer-BioNTech vaccine was 93.7% (95%CI: 91.6-95.3) among people with Alpha and 88.0% (95%CI: 85.3-90.1) among those with Delta, whereas the effectiveness of two doses of Oxford/AstraZeneca was 74.5% (95%CI: 68.4-79.4) among people with Alpha and 67.0% (95%CI: 61.3-71.8) among people with Delta.[30]

In turn, Stowe *et al.*,[32] in a study that included 14 019 symptomatic cases of the Delta variant between April 12 and June 4, 2021, in England, reported that the effectiveness of the Pfizer-BioNTech vaccine against hospitalization was 94% after one dose and 96% after two doses, while the effectiveness of the Oxford/AstraZeneca vaccine was 71% after one dose and 92% after two doses.

Finally, in a cohort study conducted to describe the demographic profile of patients with COVID-19, investigate the risk of hospital admission due to COVID-19, and estimate the effectiveness of the vaccine in preventing hospital admissions due to COVID-19 in cases with the Delta variant, Sheikh *et al.*[26] found that, compared with unvaccinated individuals, at least 14 days after the second dose, the Pfizer-BioNTech vaccine offered 79% protection against the Delta variant and 92% protection against the Alpha variant, while the protection offered by the Oxford/AstraZeneca vaccine was 60% against Delta and 73% against Alpha.

This shows that, as with all known variants, complete vaccination schedules work against the Delta variant and prevent severe presentations of the disease. Therefore, given the high transmissibility of Delta, in countries with greater social inequities and low vaccination coverage, the risk of contagion is maintained and the risk of hospitalization increases (Table 1).

Table 1. Characteristics of the Delta variant in relation to the vaccines.

Characteristics	Delta variant
Transmissibility	Increased transmissibility and secondary attack rate[15,20]
Severity of the disease	Possible increased risk of hospitalization
Risk of reinfection	Reduction of the neutralizing activity of vaccines[10]
Impact on diagnostic methods	None reported
Efficacy/Effectiveness (%)	Protection against severe COVID-19 remains the same, but protection against symptomatic disease and infection may be reduced
Severe disease	Oxford/AstraZeneca and Pfizer-BioNTech: reduction in efficacy <10% or efficacy >90% without comparator, or <2-fold reduction in neutralization[32]
Symptomatic disease	Pfizer-BioNTech: reduction in efficacy <10% or efficacy >90% without comparator, or <2-fold reduction in neutralization[26]. Reduction in efficacy from 10% to <20%, or 2-fold to <5-fold reduction in neutralization[30] Oxford/AstraZeneca: reduction in efficacy from 20% to <30%, or 5-fold to <10-fold reduction in neutralization[29,31]
Infections	Oxford/AstraZeneca and Pfizer-BioNTech: reduction in efficacy from 10% to <20%, or 2 to <5-fold reduction in neutralization[31]
Neutralization	Janssen-Ad.COV 2.5: <2-fold reduction in neutralization[33] AstraZeneca-Vaxzevria and Moderna-mRNA-1273: 2 to <5-fold reduction in neutralization [34-36] Pfizer-BioNTech: 2 to <5-fold reduction in neutralization, or 5 to <10-fold or more reduction in neutralization

Source: Own elaboration.

What are the characteristics of the immune response to vaccines in vaccinated people?

Adaptive humoral and cell-mediated immune responses to infections depend on the pathogen and protect against future reinfections. Thus, vaccine-induced immune responses are usually multifaceted; however, most of the currently accepted correlates of protection are based on antibody measurements.[37] Although it is known that these correlates are not the only mechanism of protection, they are often much easier to measure than cellular responses and, therefore, neutralizing antibody responses to SARS-CoV-2 are analyzed in most studies to evaluate the efficacy of vaccines against this virus.[34]

Results from a neutralizing antibody titer assay suggested that titers in people who received two doses of the vaccine decreased by 5.8-fold against the Delta variant compared to wild-type virus when the Pfizer-BioNTech vaccine was used.[38]

Jongeneelen *et al.*[33] analyzed sera from recipients of a single dose of Ad26.COV2.S/Janssen vaccine to determine the neutralizing activity against several SARS-CoV-2 VOCs and found that Delta showed only a 1.6-fold reduction in neutralization sensitivity. However, Tada *et al.*[39] reported that neutralizing antibody titers were decreased by 5.4-fold for Delta.

On the other hand, Barouch *et al.*,[31] based on a study of 25 participants —20 who received 1 or 2 doses of the Ad26.COV2.S/Janssen vaccine (either 5×1010 viral particles or 1011 viral particles) and 5 who received placebo— reported that this vaccine caused long-lasting humoral and cellular immune responses with minimal decreases for at least 8 months after immunization, and that there was also an expansion of the amplitude of neutralizing antibodies against the Delta, Beta, and Gamma variants. This suggests maturation of B cell responses, even without additional booster.

In a study intended to update on the neutralization activity of the mRNA-1273/Moderna vaccine sera against some newly emerged variants (including Delta) compared to the neutralization of wild-type SARS-CoV-2 virus, Choi *et al.*[40] found minimal effects on neutralization titers against Alpha (1.2-fold reduction compared to wild-type variant); but they observed reductions in neutralization of titers ranging from 2.1 to 8.4 times for the Beta, Delta and Gamma variants, compared to the wild-type variant, although all remained susceptible to serum neutralization caused by this vaccine.

What is the viral load in people with the Delta variant and how is it affected by vaccination?

So far, evidence shows that the Delta variant has greater transmissibility, which may be associated with a mutation found in its spike[41] and a higher viral load.

Li *et al.*[42] conducted a study that characterized a large transmission chain that originated from the first local infection of the SARS-CoV-2 Delta variant in mainland China and found evidence of a potentially higher viral replication rate of this variant because viral loads in Delta infections are about 1 000 times higher than those of infections with other variants on the day of the first positive PCR test.

Brown *et al.*[43] published an analysis of an outbreak of SARS-CoV-2 infections in Barnstable County, Massachusetts, in July 2021. According to this report, vaccination coverage among Massachusetts residents was 69%, and 469 COVID-19 cases were associated with various cultural events with a large number of attendees in a town in this county. Of these 469 cases, 74% occurred in people who were fully vaccinated (46% with Pfizer, 38% with Moderna, and 16% with Janssen). In addition, 113 patients underwent initial genomic sequencing of specimens, which identified the Delta variant in 119 (89%) cases and the

Delta AY.3 sublineage in one case (1%); genomic sequencing was unsuccessful in 13 (10%) specimens. In general, the symptoms of the people infected were mild and only 5 patients were hospitalized, 4 of whom were fully vaccinated.

What is the risk of the Delta variant in countries that relax social and public health measures implemented to control the spread of SARS-CoV-2?

The Delta variant is spreading rapidly as some countries reactivate their economic and social activities and make public health measures more flexible, as these actions undoubtedly lead to an increased risk of viral transmission and, thus, to an increase in the number of cases, hospitalizations, and deaths.[44]

Model based analyzes conducted in the United Kingdom[45-49] indicate that any relaxation of non-pharmacological measures implemented to control the spread of SARS-CoV-2 could lead to a rapid and significant increase in daily cases in all age groups, with a higher incidence in people under 50 years of age, particularly young people, and an associated increase in the number of hospitalizations. Therefore, it is of vital importance to avoid the relaxation of these measures, which include isolation, quarantine, testing, follow-up of positive cases, the use of face masks, social distancing, and the promotion of respiratory hygiene measures.

In this sense, despite the risk that the Delta variant implies for world public health, the reduction in the rigor of social and public health measures in many countries without complete vaccination coverage in people at greater risk is striking.[28]

Baker *et al.*[50] established that countries that implemented non-pharmacological interventions to eliminate SARS-CoV-2 transmission had better results in controlling the pandemic than those that opted for mitigation strategies, which aimed at establishing gradual measures to reduce cases and not overburdening health systems.

Likewise, Oliu-Barton *et al.*,[51] in a study comparing the number of deaths by COVID-19, gross domestic product (GDP) growth, and the strictness of containment measures during the first 12 months of the pandemic in Organisation for Economic Co-operation and Development (OECD) countries, found that COVID-19 deaths per million population in the 5 OECD countries that opted for the elimination of SARS-CoV-2 (Australia, Iceland, Japan, New Zealand, and South Korea) were about 25 times lower than in countries that favored SARS-CoV-2 mitigation.

Oliu-Barton *et al.*[51] also established that there is increasing consensus that elimination is preferable to mitigation in relation to a country's economic performance since they found that GDP growth returned to pre-pandemic levels in early 2021 in the 5 countries that opted for elimination, while growth remained negative for the other 32 countries.

In this sense, it can be concluded that the countries that took preventive measures and acted quickly against local outbreaks were able to control the virus and reduce the impact on public health. However, given the complexity of the potential impact of Delta circulation, it is necessary to implement a multidimensional approach combining public health and social measures from different perspectives and disciplines.

What can be learned in Colombia?

On July 24, 2021, the first case of Delta in Colombia was reported, raising the need to assimilate the lessons learned in other countries in a timely manner to avoid the complications they have experienced with this variant. These lessons are mainly related to the fact that public health strategies that have been relaxed in recent months must be re-implemented, including isolation, testing, and promotion of vaccination.

The Delta variant is yet further evidence of how SARS-CoV-2 continues to evolve to spread more rapidly. In this regard, it is important to bear in mind that this variant can be transmitted both in vaccinated and unvaccinated populations and, therefore, mass vaccination against COVID-19, although one of the most important measures to counteract its rapid spread, cannot be the only one. Considering this is also of paramount importance given that the impact of Delta may be much greater in Colombia, where COVID-19 vaccination coverage at the end of July 2021 is low compared to vaccination rates in England, where Delta quickly became dominant and its impact has caused major consequences; at this point, it should also be noted that public health measures have been relaxed there (reduction in capacity has been lifted and crowded events are performed).

According to Lazarus,[52] some members of the Lancet COVID-19 Commission working group on public health called for urgent action in response to the new variants: "these new variants mean we cannot rely only on vaccines alone to provide protection but must maintain strong public health measures to reduce the risk from these variants. At the same time, we must accelerate the vaccine program in all countries in an equitable way." In this sense, the presence of VOIs requires a unified and non-isolated response from the competent entities, which should include the acceleration of vaccination and the implementation of effective non-pharmacological measures.

Undoubtedly, evidence on the mechanisms involved in the transmission and morbidity and mortality of SARS-CoV-2 has increased considerably. However, the way this knowledge has been translated into the design of public health and containment policies is the subject of intense debate[53] because there are multiple pressing, and often conflicting, societal objectives that create a fundamental problem when deciding on what aspects should be prioritized, such as short-term reduction of COVID-19 morbidity and mortality, mitigation of long-term social impacts caused by containment policies (increased social inequalities, mental health problems due to social isolation, lack of access to health services, and intergenerational conflicts), or adverse financial and social consequences.[54,55] For this reason, the COVID-19 pandemic has been considered a true "wicked problem,"[56] since it not only caused an unprecedented global health crisis, but has also led to an economic and social crisis[35] that is difficult to address from classical linear or traditional analytical approaches.

Individual and community non-pharmacological interventions, such as mobility restrictions, testing strategies, tracing and isolation of confirmed cases and their contacts, as well as other social and biosecurity measures, have shown to be effective even in the absence of pharmacological interventions such as vaccines, because in countries where these first interventions have been consistently implemented, the results are positive and satisfactory, not only in reducing the incidence of infection and mortality rates, but in economic and social recovery.[45,46]

On the basis of the evidence presented here, it could be said that the evolution of SARS-CoV-2 towards more transmissible, virulent and lethal variants, with a greater capacity to evade the host immune response, requires the development of multidimensional strategies that consider not only the control of the pandemic, but also the economic and social needs of the population. The design of these strategies should combine mass and rapid vaccination with non-pharmacological interventions and social support, education and assertive communication strategies that enable the empowerment and self-management of individuals, families and communities.

Given the characteristics of Delta and because it has begun to be the dominant variant around the world, health systems in several countries, including those with high and moderate rates of vaccination coverage such as Israel, England, China, Australia, and New Zealand, have had to accelerate mass vaccination among uncovered populations (e.g. youth and adolescents) and implement public health and social strategies and non-pharmacological measures to control the spread of the pandemic and sustain the economic and social reactivation achieved.[45,47]

In this sense, it is necessary to design synergistic and transdisciplinary solutions based on evidence and susceptible to systematic evaluation[53] to solve the wicked problems created by the pandemic in Colombia. To achieve this, it is necessary to take into account that public health strategies during a pandemic, and any disaster, must be based on an analysis of the available evidence and take into account the economic and social consequences it may cause; therefore, their effectiveness should be evaluated before they are implemented.

The following are some of the strategies that should be improved in order to respond adequately to the pandemic in the presence of the Delta variant in Colombia:

1. The vaccination plan should be accelerated by ensuring compliance with complete schemes, particularly for vulnerable populations.
2. Barriers to access to the vaccine in the global market must be overcome, requiring decisions to release patents and strengthen national production capacities.
3. Effective and sustainable health surveillance measures should be put in place to control the potential circulation of the Delta variant, eliminate community-based transmission of SARS-CoV-2, and strengthen non-pharmacological interventions and primary health care aimed at preventing infection, detecting the virus early and managing cases and their contacts through tracing and isolation.
4. Diagnostic testing capacity should be increased to detect positive cases so that they and their contacts can be adequately traced.
5. Genomic surveillance of circulating variants should be strengthened, including weekly representative samples of sufficient size and specific samples from special environments and populations (travel-related cases or cases associated with a special clinical presentation and outbreaks).
6. Control measures should be adopted for the entry of travelers; taking into account the evidence, the National Government should assess the country's vulnerability in terms of vaccination coverage and the circulation of new variants in order to determine whether or not measures should be implemented for travelers from other nations. These measures may include requesting RT-PCR tests and quarantine for five to seven days.
7. Education and literacy programs aimed at the general community should be strengthened to enable people to understand the health implications of the new variant and to strengthen individual biosafety measures.
8. The capacity of venues and enclosed areas should be monitored, and biosecurity controls that have been methodically planned and reviewed should be applied at workplaces, educational institutions, and recreation and cultural events.
9. Finally, a panel discussion should be created with academics and experts from different disciplines to analyze the available evidence, support decision-making, and evaluate the public health measures implemented.

Conclusions

Due to its high transmissibility, Delta has become the dominant variant in the countries where it has been identified. This variant is associated with higher rates of transmission and mortality, and mainly affects unvaccinated people. However, available vaccines are effective in preventing severe forms of disease and death.

In this regard, addressing the crisis and the impact of the pandemic, as well as the uncertainties raised by the evolution of SARS-CoV-2 and the emergence of new variants, requires a truly multidisciplinary and transdisciplinary approach that provides simultaneous solutions, which should be subject to frequent data-driven evaluation. Evidence-based public health containment measures to deal with the pandemic can be ethically justifiable and understood through a clear and transparent comprehension of the values underpinning political decisions.

Conflicts of interest

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