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SHORT COMMUNICATION

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Dengue and COVID-19, overlapping epidemics? An analysis from Colombia

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Abstract

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has rapidly spread throughout Latin America, a region swept by multiple previous and ongoing epidemics. There are significant concerns that the arrival of COVID-19 is currently overlapping with other viruses, particularly dengue, in various endo-epidemic regions across South America. In this report, we analyzed trends for both viral infections in Colombia during the first 20 epidemiological weeks (EWs) of 2020. From 1st January to 16th May 2020 (EWs, 1-20), a total of 52 679 cases of dengue and 14 943 cases of COVID-19 have been confirmed in Colombia. As both conditions may potentially lead to fatal outcomes, especially in patients with chronic co-morbidities, overlapping infections, and co-occurrence may increase the number of patients requiring intensive care and mechanical ventilation. In regions, such as Valle del Cauca, intensified preparation for such scenarios should be pondered, and further studies should be performed to address this critical issue in a timely matter.

KEYWORDS

Colombia, COVID-19, dengue, Latin America, overlapping, SARS-CoV-2, syndemic

1 | INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has rapidly spread throughout Latin America.[1] However, other emerging and re-emerging diseases already present in Colombia before the pandemic wave arrived should not be overlooked by regional public health authorities. Failure to continue surveillance programs on such concurrent diseases and relocating excessive efforts and resources onto COVID-19 containment may severely impact the public health system as a result of healthcare downturn.[2]

Many examples of concurrent infectious diseases with epidemic potential have been reported as a consequence of the resurgence and spillover of previously controlled vector-borne and vaccine-preventable diseases in Venezuela[3]: dengue, malaria, measles, diphtheria, among others, re-emerged in the country to later spread through the region due to forced migration during an unprecedented humanitarian crisis. In this context, we believe that dengue may follow similar trends in Colombia posing a significant threat to public health.[4-9]

Over the course of 2019, the Americas collectively reported 3 139 335 cases of dengue virus (DENV) infection,[4] and, as expected, in 2020, dengue fever and COVID-19 have now started to overlap within the region and other continents.[10]

2 | METHODS

We performed an observational, ecological study analyzing the current epidemiological trends for both diseases in Colombia at a district and departmental levels (primary administrative level), as well as nation-wide, by epidemiological weeks (EW) using publicly available official data. Dengue and COVID-19 data were obtained from the public epidemiological surveillance system online (www.ins.gov.co), for the study period. We included all COVID-19 cases reported and confirmed by the Colombian Ministry of Health using SARS-CoV-2 reverse transcription-polymerase chain reaction (RT-PCR) detection.

3 | RESULTS

Over the last 5 years (2015-2019) and the first 5 months of 2020, a total of 452 980 dengue cases have been reported in Colombia, ranging from 26 279 (2017) up to 127 553 (2019), with a median of 75 250 cases per year (Figure 1). According to the predetermined endemic corridor for dengue in Colombia, epidemic levels—the number of cases remained above the upper limit of the 95% confidence interval (CI) of the last 7 years—were sustained for most of 2019 and the first 11 weeks of 2020 (Figure 1). To date, the number of dengue cases has persisted above the geometric median (Figure 1). Since 2008, the most important weekly increases in dengue and epidemics have been in 2010, 2013, 2016, and 2019 to 2020 (Figure 1).

From 1st January to 30th May 2020 (EW, 1-22), a total of 55 585 cases of dengue and 28 240 cases of COVID-19 have been confirmed in Colombia (Figure 2). At a national level, increasing reports of COVID-19 interestingly contrasts with a decreased number of reported dengue fever cases (Figure 2). At EW 18, COVID-19 cases surpassed dengue fever as the primary health threat in Colombia,

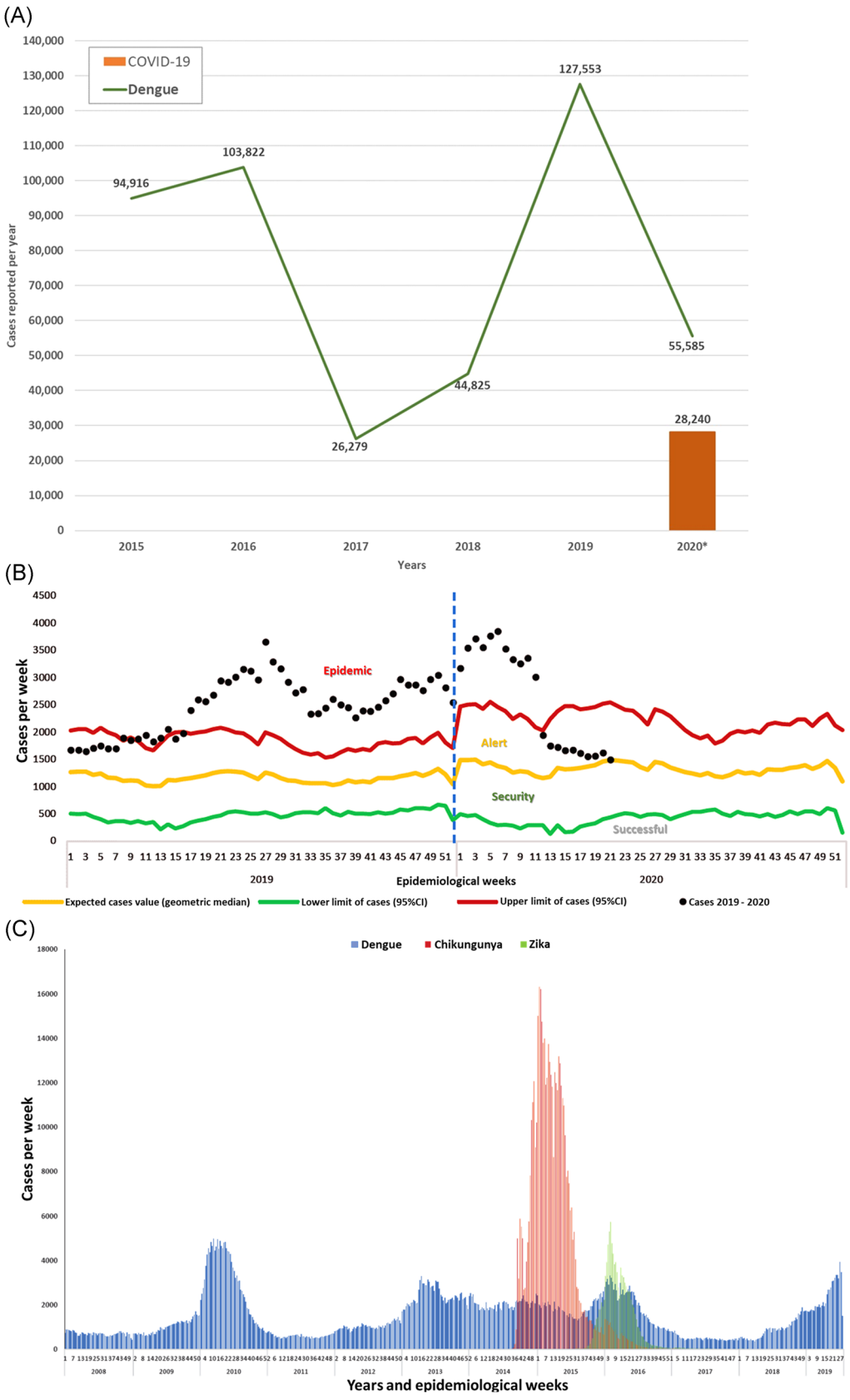

FIGURE 1 Dengue epidemiological background. A, Historical number of dengue cases in Colombia, 2015 to 2020. The year 2020 up to epidemiological week 22. B, Endemic corridors for dengue in Colombia, 2019 to 2020 (modified from www.ins.gov.co). C, Weekly number of cases of dengue, chikungunya and Zika in Colombia, 2008 to 2019

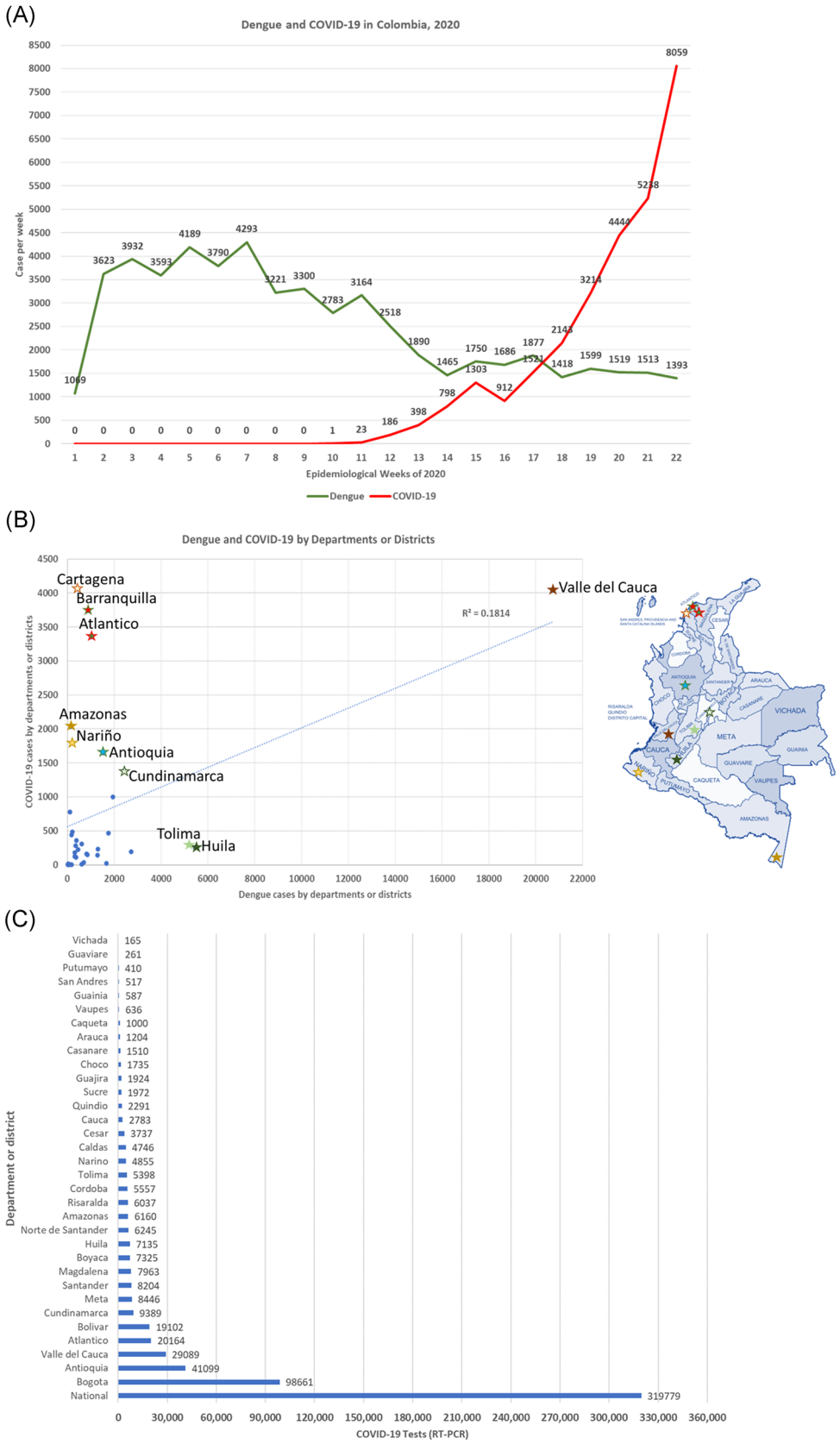

FIGURE 2 A, Weekly report of dengue and COVID-19 cases in Colombia, 2020. B, Relationship between dengue and COVID-19 by departments. The map inserted indicates the places with a higher occurrence of dengue and COVID-19 cases from the graph. C, Number of COVID-19 tests (RT-PCR for SARS-CoV-2) applied by departments. COVID-19, coronavirus disease 2019; RT-PCR, reverse transcription polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2

with 5.8 times more cases of COVID-19 than dengue at EW 22 (Figure 2). It is expected that the total number of COVID-19 cases for 2020 will outnumber those of dengue. As dengue fever endemicity has been sustained in Colombia for decades (Figure 1),[11] data on endemic corridors for 2020 is widely available. For the first 12 EW, dengue reached epidemic proportions; and between EW 13 to 22, dengue cases have remained in the alert zone—between the geometric median and the 95% CI upper limit.

Analysis at a departmental level reveals more interesting data. In some regions, such as Valle del Cauca, both conditions are coexisting at comparatively high rates (Figure 2). In other departments, such as Huila and Tolima, dengue reports have significantly outnumbered COVID-19 cases; and the opposite phenomenon has occurred in different regions of Colombia, where COVID-19 remains as the predominant infectious disease over dengue fever-like currently seen in areas of the Caribbean coastal region of Colombia, such as Cartagena (Figure 2). Valle del Cauca, Cundinamarca, Huila, Caldas, Caqueta, Cauca, and Choco are currently facing epidemic peaks of dengue. At the same time, Amazonas, Nariño, Magdalena, Boyacá, Cesar, Tolima, Risaralda, Putumayo, and San Andrés islands have reached alert levels. The rest of the departments remain below the geometric median.

From the total number of dengue cases, 600 (1.1%) corresponded to severe dengue, and 573 (95.5%) required intensive care unit (ICU) support; 28 684 (51.6%) corresponded to dengue with warning signs with 22 058 (76.9%) requiring hospital admission. A total of 28 dengue fever cases ended in fatal outcomes (0.05%).

From the total number of COVID-19 cases, 243 (0.86%) corresponded to severe disease, with 240 (98.77%) requiring hospitalization at ICU services; 1143 patients (4.06%) presented moderated disease, with 1083 (94.75%) hospitalized. From the total, 1089 COVID-19 cases have resulted in fatal outcomes (3.86%).

Colombia has performed 319 779 SARS-CoV-2 RT-PCR tests to date, but the numbers may drastically vary depending on the department, ranging from 165 in Vichada to 98 661 tests performed in Bogota (Figure 2).

4 | DISCUSSION

We propose different scenarios that might explain the phenomena observed at a departmental and national level: (a) Coincidental seasonal decrease in dengue fever reports with an increasing slope of COVID-19 cases; and (b) viral interference—a process where a virus blocks the entry and replication of another virus—of SARS-CoV-2 over DENV.[12] This could be explained by the high virulence and pathogenicity observed in SARS-CoV-2 infection and the tropism towards endothelial cells displayed by both viruses,[13,14] which could potentially lead to competitive inhibition. Accordingly, studies have reported that the blockade of angiotensin II type 1 (AT1) receptors with losartan and inhibition of angiotensin I-converting enzyme with enalapril reduced the percentage of macrophages expressing DENV2 antigens in vivo, suggesting a decrease in viral entry and a potential role of Ang II in DENV infection.[15] The mechanism by which Ang II affects dengue viral entry remains unclear; however, viral interaction with AT1 or phagocytic receptors could be involved.[15]

The concurrence of COVID-19 and dengue fever should be carefully reported and followed with enhanced surveillance. The impact of COVID-19 containment measures on other infectious diseases is still unknown. However, a rebound peak of dengue might be observed after containment finishes due to the replenishment of susceptible individuals with low exposure to the infection.[16]

Public health officials need to be aware of the possibility of co-infection, as it has already been reported that SARS-CoV-2 can co-exist with other viruses (eg, influenza, parainfluenza) within the same host.[17-19] Coinfections between dengue and influenza have also been reported.[20] Besides dengue, other neglected tropical diseases should be considered in specific areas; such is the case of malaria and acute Chagas disease, which are also febrile conditions.[21]

Initial discrimination of dengue fever from COVID-19 could become challenging given some common clinical and laboratory findings, including fever, malaise, myalgia, headaches, and weakness.[22] In dengue-endemic areas, there is also a reported risk of false-positive DENV testing using serological approaches that have later resulted in a delayed molecular diagnosis of SARS-CoV-2 infection, which may result in an increased risk of poor clinical outcomes as both viruses might lead to severe complications, mainly via cytokine storm in lung tissue caused by macrophage hyperactivation.[5,23] Fortunately, the diagnosis of SARS-CoV-2 infection in Colombia so far is made exclusively by RT-PCR, but this should be considered if the use of serological tests for COVID-19 becomes widespread.

Recently, Brazilian researchers have modeled hypothetical scenarios for dengue fever and COVID-19 co-emergence.[22] However, no conclusive data on disease overlapping has been published so far. Intense interventions, especially in certain areas, may help to keep dengue incidence at lower levels. Other arboviral diseases, such as Chikungunya and Zika have caused recent epidemics in Colombia, with reported cases of coinfection with DENV.[24]

As both COVID-19 and dengue may lead to fatal outcomes, especially in patients with chronic co-morbidities, overlapping infections and their co-occurrence may increase the number of patients requiring intensive care and mechanical ventilation,[25] as suggested for other countries in Latin America.[7] In regions, such as Valle del Cauca, intensified preparation for such scenarios should be considered, and further studies should be performed to address this critical topic promptly to reduce the potential overburden of the national healthcare system.[10]

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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REFERENCES

1. Rodriguez-Moralesodriguez-Morales AJ, Gallego V, Escalera-Antezana JP, et al. COVID-19 in Latin America: the implications of the first confirmed case in Brazil. *Travel Med Infect Dis*. 2020:101613.
2. Sanchez-Duque JA, Arce-Villalobos LR, Rodriguez-Morales AJ. Coronavirus disease 2019 (COVID-19) in Latin America: role of primary care in preparedness and response. *Aten Primaria*. 2020;52(6):369-372.
3. Rodriguez-Morales AJ, Suarez JA, Risquez A, Delgado-Noguera L, Paniz-Mondolfi A. The current syndemic in Venezuela: measles, malaria, and more coinfections coupled with a breakdown of social and healthcare infrastructure. Quo vadis? *Travel Med Infect Dis*. 2019;27:5-8.
4. PAHO. Epidemiological Update Dengue—7th February 2020. 2020. https://www.paho.org/hq/index.php?option=com_docman&view=download&category_slug=dengue-2217&alias=51690-7-february-2020-dengue-epidemiological-update-1&Itemid=270&lang=en
5. Yanan G, Lee CK, Lam LTM, et al. Covert COVID-19 and false-positive dengue serology in Singapore. *Lancet Infect Dis*. 2020;20(5):536.
6. Zambrano LI, Rodriguez E, Espinoza-Salvado IA, Rodriguez-Morales AJ. Dengue in Honduras and the Americas: the epidemics are back! *Travel Med Infect Dis*. 2019;31:101456.
7. Navarro JC, Arrivillaga-Henriquez J, Salazar-Loor J, Rodriguez-Morales AJ. COVID-19 and dengue, co-epidemics in Ecuador and other countries in Latin America: pushing strained health care systems over the edge. *Travel Med Infect Dis*. 2020:101656.
8. Biswaliswal S, Borja-Tabora C, Martinez Vargas L, et al. Efficacy of a tetravalent dengue vaccine in healthy children aged 4-16 years: a randomized, placebo-controlled, phase 3 trial. *Lancet*. 2020;395(10234):1423-1433.
9. Biswalswal S, Reynales H, Saez-Llorens X, et al. Efficacy of a tetravalent dengue vaccine in healthy children and adolescents. *N Engl J Med*. 2019;381(21):2009-2019.
10. Haqqi A, Awan UA, Ali M, Saqib MAN, Ahmed H, Afzal MS. COVID-19 and dengue virus co-epidemics in Pakistan: a dangerous combination for overburdened healthcare system. *J Med Virol*. 2020. https://doi.org/10.1002/jmv.26144
11. Quintero-Herrera LL, Ramírez-Jaramillo V, Bernal-Gutiérrez S, et al. Potential impact of climatic variability on the epidemiology of dengue in Risaralda, Colombia, 2010-2011. *J Infect Public Health*. 2015;8(3):291-297.
12. Pinky L, Dobrovolny HM. Coinfections of the respiratory tract: viral competition for resources. *PLoS One*. 2016;11(5):e0155589.
13. Guzik TJ, Mohiddin SA, Dimarco A, et al. COVID-19 and the cardiovascular system: implications for risk assessment, diagnosis, and treatment options. *Cardiovasc Res*. 2020. https://doi.org/10.1093/cvr/cvaa106
14. Wilder-Smith A, Ooi EE, Horstick O, Wills B. Dengue. *Lancet*. 2019;393(10169):350-363.
15. Hernandez-Fonseca JP, Duran A, Valero N, Mosquera J. Losartan and enalapril decrease viral absorption and interleukin 1 beta production by macrophages in an experimental dengue virus infection. *Arch Virol*. 2015;160(11):2861-2865.
16. Wilder-Smith A, Chiew CJ, Lee VJ. Can we contain the COVID-19 outbreak with the same measures as for SARS? *Lancet Infect Dis*. 2020;20(5):e102-e107.
17. Azekawa S, Namkoong H, Mitamura K, Kawaoka Y, Saito F. Co-infection with SARS-CoV-2 and influenza A virus. *IDCases*. 2020;20:e00775.
18. Rodriguez JA, Rubio-Gomez H, Roa AA, Miller N, Eckardt PA. Coinfection with SARS-COV-2 and parainfluenza in a young adult patient with pneumonia: case report. *IDCases*. 2020;20:e00762.
19. Sánchez-Duque JA, Orozco-Hernández JP, Marín-Medina DS, et al. Are we now observing an increasing number of coinfections between SARS-CoV-2 and other respiratory pathogens? *J Med Virol*. 2020. https://doi.org/10.1002/jmv.26089
20. Perez MA, Gordon A, Sanchez F, et al. Severe coinfections of dengue and pandemic influenza A H1N1 viruses. *Pediatr Infect Dis J*. 2010;29(11):1052-1055.
21. Bokhari SMMA, Mahmood F, Bokhari SMSA. Case report: diagnosis of novel coronavirus disease (COVID-19) versus tropical diseases in Pakistan. *Am J Trop Med Hyg*. 2020. https://doi.org/10.4269/ajtmh.20-0356
22. Lorenz C, Azevedo TS, Chiaravalloti-Neto F. COVID-19 and dengue fever: a dangerous combination for the health system in Brazil. *Travel Med Infect Dis*. 2020:101659.
23. Merad M, Martin JC. Pathological inflammation in patients with COVID-19: a key role for monocytes and macrophages. *Nat Rev Immunol*. 2020;20(6):355-362.
24. Villamil-Gomez WE, Gonzalez-Camargo O, Rodriguez-Ayubi J, Zapata-Serpa D, Rodriguez-Morales AJ. Dengue, chikungunya, and Zika co-infection in a patient from Colombia. *J Infect Public Health*. 2016;9(5):684-686.
25. Díaz-Guio DA, Villamil-Gómez WE, Dajud L, et al. Will the Colombian intensive care units collapse due to the COVID-19 pandemic? *Travel Med Infect Dis*. 2020:101746.

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