Coronavirus disease 2019 (COVID-19) is a severe infectious disease caused by a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and has a high mortality rate (1,2). Despite the increased number of patients with COVID-19, the number of reported pediatric cases has remained relatively low (3,4). In February 2020, 3 children with respiratory symptoms were diagnosed with COVID-19 in Japan; here, we describe their diagnostic work-up, clinical course, and management. To our knowledge, these cases were the first cases of COVID-19 in children to be identified in Japan. Furthermore, 2 of the 3 patients experienced co-infection with other respiratory viruses, including influenza virus A or human metapneumovirus. To the authors’ knowledge, the cases described in the present report were the first pediatric patients with COVID-19 in Japan. In children with COVID-19, the possibility of co-infection with other respiratory pathogens should be considered.

On February 18, 2020, a 9-year-old boy (Patient #1) presented with a 4-day history of cough and fever (Fig. 1A). Physical examination revealed a body temperature of 38.9°C, a respiratory rate of 25 breaths/min, and an oxygen saturation of 99%. Lung auscultation revealed clear breath sounds, and chest radiography demonstrated no abnormalities. During this period, however, influenza and hMPV infections were prevalent among children in the Furano region. Laboratory results revealed leukocytopenia, lymphocytopenia, and slightly elevated C-reactive protein levels (Table 1). Pneumonia caused by an unknown pathogen with lymphocytopenia prompted further screens to include nucleic acid detection of...
SARS-CoV-2. Nasopharyngeal and oropharyngeal swab samples were collected from the patient for RT-PCR, and he was hospitalized. He received symptomatic treatment and was given empirical ceftriaxone; oxygen therapy was not required. On February 21, RT-PCR results from the nasopharyngeal and oropharyngeal swabs were reported to be positive. On March 2, the patient was discharged without any residual conditions.

On February 19, an 11-year-old boy (Patient #2) presented with a 2-day history of cough and fever (Fig. 1B). He was the brother of Patient #1. Physical examination revealed a body temperature of 38.4°C, a respiratory rate of 25 breaths/min, and an oxygen saturation of 97%. Lung auscultation revealed clear breath sounds, and chest radiography demonstrated linear infiltrates in the left lung. He tested negative for common respiratory pathogens. Laboratory results revealed leukocytosis, lymphocytopenia, and slightly elevated C-reactive protein levels (Table 1). Nasopharyngeal and oropharyngeal swab samples were obtained for RT-PCR and he was hospitalized. He received symptomatic treatment and empirical ceftriaxone, without the need for oxygen therapy. On February 20, his cough and fever worsened. The nasopharyngeal specimen tested positive for influenza A antigen. He was treated with intravenous peramivir. On February 21, the RT-PCR result from an oropharyngeal swab was reported to be positive for SARS-CoV-2. On March 2, he was discharged in good condition.

On February 25, a 5-year-old boy (Patient #3) presented with a 5-day history of cough and fever. His nasopharyngeal specimen tested positive for hMPV antigen (Table 1). Specimens were obtained for RT-PCR.
because he lived in the same town as Patients #1 and #2. He received symptomatic treatment. On February 27, the RT-PCR result from the nasopharyngeal swab was reported to be positive for SARS-CoV-2. His clinical condition improved and he was followed up without hospitalization.

By March 4, 2020, 2 consecutive negative RT-PCR results for the 3 pediatric patients were confirmed. Individuals who had close contact with these patients were isolated at home and monitored for 14 days; however, no symptoms developed. There have been several reports describing SARS-CoV-2 co-infection with other pathogens in adults and children (6–9). Wu et al. reported co-infection of SARS-CoV-2 and influenza A virus in an adult patient with pneumonia in China (6). The patient was transferred to another hospital for further critical care. Lin et al. reported co-infection with other respiratory viruses in 6 of 92 adults with COVID-19, including respiratory syncytial virus, hMPV, parainfluenza virus type 2, rhinovirus, or coronavirus HKU1; however, the report did not address patient prognosis (7). Fan et al. reported a 36-year-old Chinese man with COVID-19 and *Mycoplasma pneumoniae* co-infection, but with no description of prognosis (8). Xia et al. reported co-infection in 8 of 20 children with COVID-19 and other respiratory pathogens, including cytomegalovirus, influenza A virus, influenza B virus, respiratory syncytial virus, or *mycoplasma*; however, once again, patient prognosis was not addressed in the report (9).

Here, we report 3 cases of pediatric COVID-19, 2 of which involved co-infection with other respiratory viruses; nevertheless, all 3 patients had good prognoses. Co-infections may play an important role in reducing or augmenting disease severity (10). Most children infected with SARS-CoV-2 experience mild clinical manifestations (11,12). Our observations suggest that SARS-CoV-2 co-infection with influenza virus A or hMPV may not necessarily add to the burden of clinical manifestations in children.

A clinical syndrome is traditionally believed to be a consequence of infection by a single pathogen that can be isolated from clinical specimens. However, such an approach may inherently ignore the possible existence of co-infecting pathogens that could contribute to clinical outcomes. Our case series indicates that COVID-19 may be underdiagnosed due to co-infection with other respiratory viruses. Through symptomatic surveillance and contact tracing, Bi et al. reported that children were as likely to be infected with COVID-19 as adults (13). In the absence of serological survey results, it is not possible to determine the exact prevalence in children.

It is expected that children, who experience frequent respiratory infections due to relatively high susceptibility, can readily transmit pathogens to their adult contacts (14). It has been reported that prolonged virus shedding from the respiratory tract and stools at the convalescent stage in children with COVID-19 occurs, and that there is evidence of transmission of SARS-CoV-2 from pediatric patients to adult contacts (15). Physicians should be aware of the possibility of co-infection with SARS-CoV-2 and other respiratory pathogens in children.

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### Conflict of interest
None to declare.
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