**Table 1:** Commonly reported microbial co-pathogens amid COVID-19, their transmission pattern along with the possible mechanism of co-infections and outcomes.

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| --- | --- | --- | --- | --- | --- |
| **Type of co-infection** | **Co-pathogens** | **Route of transmission** | **Person to person transmission** | **Possible Mechanism of co-infection and pathogenesis** | **Possible Outcomes** |
| Viral | Influenza | Respiratory | Yes | IFN induced overexpression of ACE2 triggered by influenza virus aids SARS-CoV-2 infection [[1](#_ENREF_1)]. | Influenza co-infection can provoke COVID-19 hyper-inflammatory states. Higher incidence of acute cardiac injury was reported [[2](#_ENREF_2)] |
| HBV | Body fluid | Yes | Increased liver tissue damage and inflammatory responses due to COVID-19 may aid HBV co-infection by overexpressing host cell receptors [[3](#_ENREF_3)]. It may also fuel the reactivation of pre-existing chronic HBV [[4](#_ENREF_4)]. | Elevation of ALT, AST, TBIL, ALP, and γ-GT. [[5](#_ENREF_5)] Higher risk of liver injury. [[6](#_ENREF_6)] |
| Dengue | Mosquito bite | No | NR | Increase the severity of symptoms [[7](#_ENREF_7)]. Decrease in white blood cell, neutrophils, lymphocytes and platelets count and eventual higher mortality rate [[8](#_ENREF_8)] |
| HIV | Body fluid | Yes | Suppression of T lymphocyte mediated immunity (as observed in HIV patients) leads to the prognosis of increased disease severity and higher mortality rate during COVID-19 co-infection [[9](#_ENREF_9)]. | HIV Patients under ART exhibits mild COVID-19 symptoms. But ART-naïve patients show acute COVID-19 clinical representation [[10](#_ENREF_10)]. Higher maximum body temperatures, longer duration of fever and longer improvement time of chest CT image was reported due to co-infection [[11](#_ENREF_11)] |
| HCV | Body fluid | Yes | Both SARS-CoV-2 E and HCV p7 proteins can form similar ion channels which ensure their success in attacking their host and effective replication during co-infection [[12](#_ENREF_12)]. | The actual outcome is not reported till date. It has been speculated that some investigational COVID‐19 drugs may adversely affect the HCV‐related decompensated cirrhosis patients [[13](#_ENREF_13)]. |
| Rhinovirus | Respiratory | Yes | Major disease-causing rhinovirus serotype HRV-A16 infection upregulates ACE2 and TMPRSS2 expression in epithelial cells by inducing by IFNb1. This event facilitates SARS-CoV-2 transmission and further disease severity [[14](#_ENREF_14)] | One case has been reported in a young patient expressing critical illness as the outcome of co-infection [[15](#_ENREF_15)] |
| Adenovirus | Respiratory | Yes | Similar ion channel forming capability of SARS-CovV-2 E and Adenovirus 6K proteins facilitates co-infection [[12](#_ENREF_12)] | Unfavorable prognostic outcome including ARDS [[16](#_ENREF_16)] |
| Bacterial | Streptococcus pneumoniae | Respiratory | Yes | Opportunistic normal flora of human upper respiratory track | Severe respiratory distress followed by pleural effusion and necrotizing pneumonia [[17](#_ENREF_17)], higher mortality rate [[18](#_ENREF_18)] |
| *Staphylococcus aureus* | Respiratory/  Digestive/ Contact | Yes | Opportunistic normal flora of human upper respiratory track, gut mucosa and skin | Necrotizing pneumonia [[19](#_ENREF_19)].  Bacteremia and higher mortality [[20](#_ENREF_20)] |
| *Pseudomonas aeruginosa* | Contact | Yes | Opportunistic pathogen causing HAI mostly related with poor hygiene, mechanical ventilation and urinary catheterization. | NR |
| *Acinetobacter baumannii* | Contact | Yes | Mechanical ventilation | NR |
| *Klebsiella pneumoniae* | Respiratory/ Contact | Yes | Opportunistic normal flora of human mouth, skin, and intestines | Fatal sepsis [[21](#_ENREF_21)] |
| Mycoplasma pneumoniae | Respiratory/ contact | Yes | NR | Severe pneumonia [[22](#_ENREF_22)]. Increased morbidity, mortality and disease severity [[23](#_ENREF_23)] |
| Clamydia pneumoniae | Respiratory/ contact | Yes | NR | Severe pneumonia [[22](#_ENREF_22)]. |
| Legionella pneumophila | Digestive/ Respiratory | Yes | NR | Elevated aspartate aminotransferase, blood urea nitrogen, creatinine, lactate dehydrogenase and C-reactive protein [[24](#_ENREF_24)] |
| *Haemophilus inﬂuenzae* | Respiratory/ contact | Yes | Opportunistic normal flora of human upper respiratory track | NR |
| *Neisseria meningitides* | Respiratory/ contact | Yes | NR | Convulsion [[25](#_ENREF_25)], elevated C-reactive protein, headache, neck stiffness, rigors, confusion, and a new purpuric rash over hands and feet [[26](#_ENREF_26)] |
| *Mycobacterium tuberculosis* | Respiratory | Yes | Cytokine storm produced by COVID-19 may reactivate latent TB or boost the development of active TB. Lung damages caused by TB may also escalate the disease severity caused by SARS-CoV-2 [[27](#_ENREF_27)]. | Co-infection is associated with disease severity and disease progression rate [[28](#_ENREF_28)]. 2.17 times higher risk-of-death and 25% lower risk-of-recovery was reported. Also shorter time-to-death and longer time-to-recovery was found [[29](#_ENREF_29)]. |
| Fungal | *Aspergillus* spp*.* | Respiratory | No | Pro-inflammatory cytokines (especially IL-6 and IL-10 released during COVID-19 results in tissue necrosis and ARDS, which eventually makes patient more vulnerable to Aspergillosis [[30](#_ENREF_30)]. | Invasive pulmonary aspergillosis, higher case fatality rate (64.7% reported) [[30](#_ENREF_30)] |
| *Candida* spp*.* | Perinatal/ Contact | No | Opportunistic pathogen found in human skin. | Candidemia and increased mortality rate [[31](#_ENREF_31)]. |

IFN: Interferon; ACE2: Angiotensin-converting enzyme 2; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; COVID-19: Coronavirus disease-19; HBV: Hepatitis B Virus; HIV: Human Immunodeficiency Virus; HCV: Hepatitis C Virus; ALT: Alanine transaminase; AST: Aspartate transaminase; TBIL: Total bilirubin; ALP: Alkaline phosphatase; γ-GT: Gamma-glutamyltransferase; ART: Antiretroviral therapy; CT: Computed Tomography; HRV-A16: Human rhinovirus A16; TMPRSS2: Transmembrane protease, serine 2; IFNb1: Interferon Beta 1; ARDS: Acute respiratory distress syndrome; HAI: Hospital Acquired Infections TB: Tuberculosis; IL-6: Interleukin 6; IL-10: Interleukin 10; NR: Not Reported