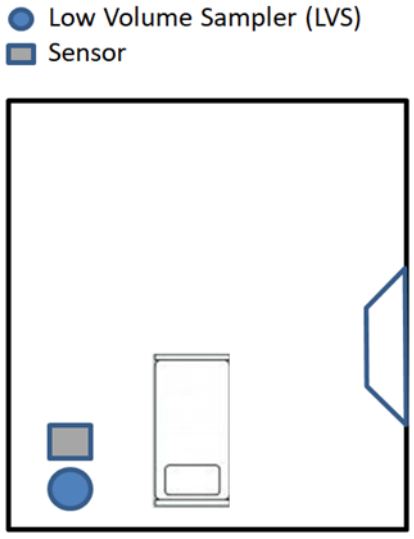
Additional information

Supplementary Information:

Methods

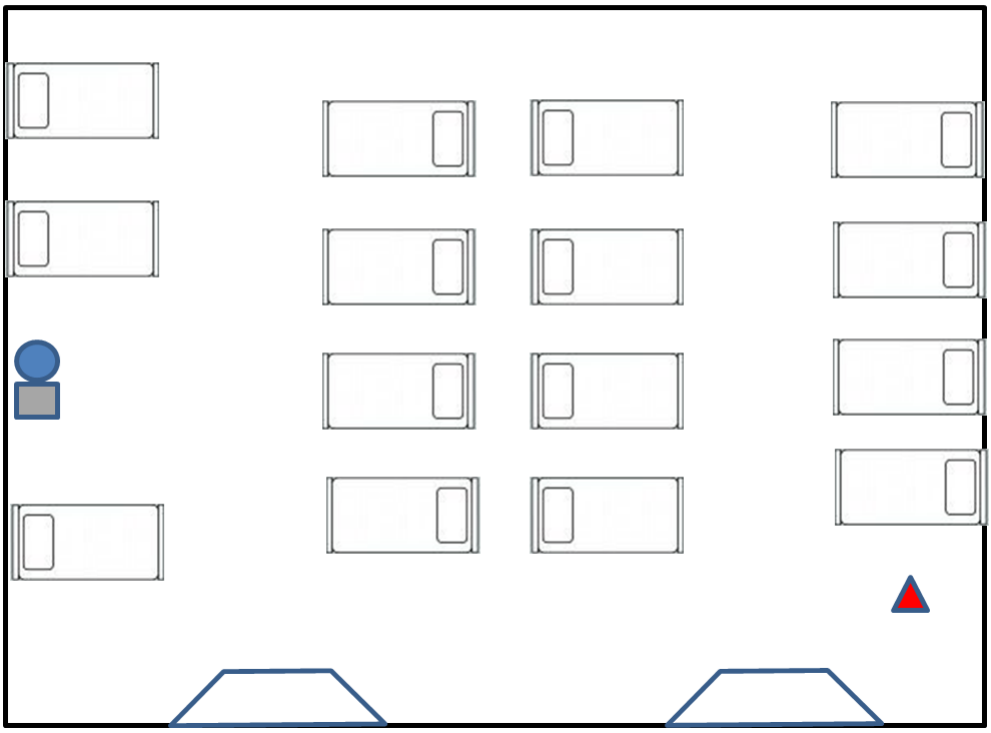
Indoor air sampling: In this study, air sampling was conducted for 48 hours during a four-week sampling period using two types of instruments, a light scattering technique (*AiRBOXSense*)[26,12] and an air filter sampling technique (Low Volume Sampler or LVS). Both instruments were run side by side in two type of wards (a single room and general wards) at a teaching hospital known as Hospital Canselor Tuanku Muhriz UKM in an urban area in Kuala Lumpur (HCTM). $PM_{2.5}$ was sampled in an executive single-bed ward (31st March to 4th April 2020) and general wards (4th to 29th April 2020), respectively. *AiRBOXSense* was used to continuously measure $PM_{2.5}$, while the LVS was used to determine the virus loading in $PM_{2.5}$ trapped on filter paper (Whatman® glass microfiber filters, Grade GF/F) with a tight specification of 0.6 µm - 0.8 µm particle retention and pure borosilicate glass structure, GF/F is the material upon which the EPA Method TCLP 1311. Each ward had different clusters of infected groups as illustrated in Table 1 (in the main text) and Figure 1. Details of *AiRBOXSense* are described in[26]. Each ward contained between one and eighteen patients suffering from COVID-19. The LVS used in this study was AirMetricsMiniVol®, USA.

a)



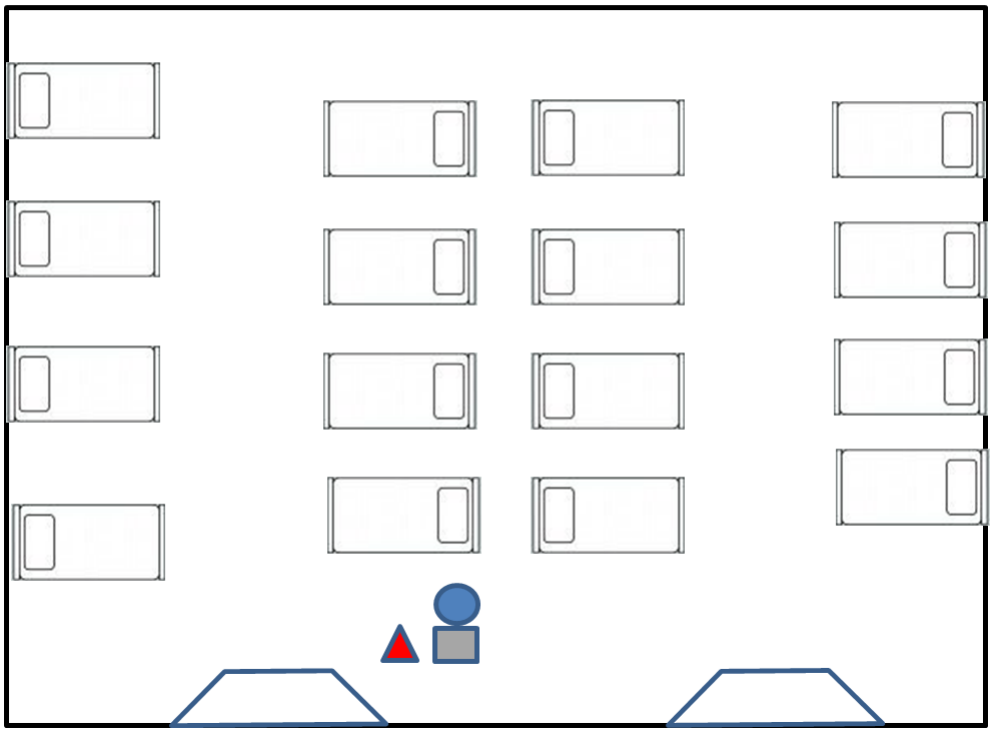
b)

Low Volume Sampler (LVS) Air Purifier
Sensor



c)

Low Volume Sampler (LVS) Air Purifier
Sensor



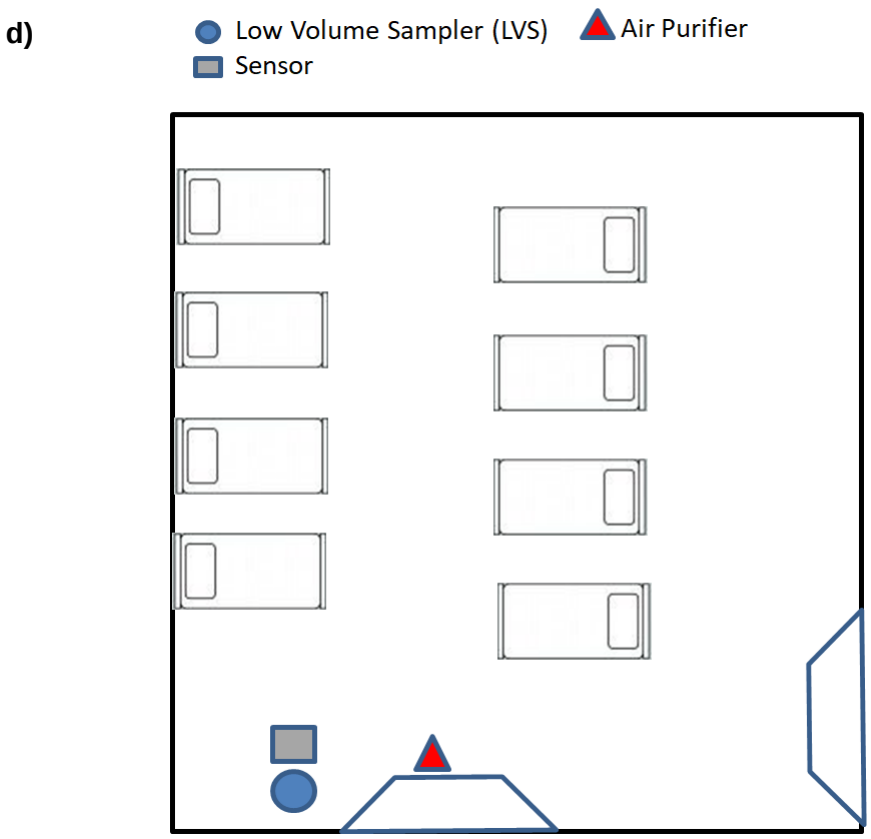


Fig. 1| Characteristics of the wards and instrumentation deployment in this study a) Single room A b) General ward B, b) General ward C and c) General ward D. (Note: The total bed in the figure is not represents the actual total bed in all ward).

Viral Nucleic Acid Extraction: Prior to viral nucleic acid extraction, the membrane filter was processed according to[39] with slight modifications. The membrane was first divided into four parts and immersed in 1 mL sterile RNase-free water in separate tubes. Each part of the membrane was vortexed for 2 minutes in 30 second-intervals to help release viral particles attached on the membrane. The tubes were then centrifuged at 500 rpm for 1 minute to remove debris and the supernatants were transferred into new microcentrifuge tubes for viral nucleic acid extraction. This process was repeated twice to ensure all virus particles were resuspended into the water. Subsequently, viral nucleic acid extraction was performed using a Viral Nucleic Acid Extraction Kit II (Geneaid Biotech Ltd., Taiwan) according to the manufacturer's protocol. The purified nucleic acid containing the samples was then kept at -80 °C for further analysis.

Reverse-Transcription Quantitative Real-Time Polymerase Chain Reaction (RT-qPCR): The primers and probes used in the detection of SARS-CoV-2 were 2019-nCoV_N1 and 2019-

nCoV_N2 combined primer/probe mixes purchased from Integrated DNA Technology (IDT). Human RNase P primer was not included as a control in this analysis because this study was not conducted using human specimens. RT-qPCR was carried out using a THUNDERBIRD One-step RT-qPCR kit (Toyobo Co., Ltd., Japan) according to manufacturer's protocol. The annealing temperature of the primers was set at 55 °C as suggested by CDC (2020). Detection of SARS-CoV-2 using the RT-qPCR approach with a Biorad iQ5 Real-Time PCR machine (Biorad, USA) as described by CDC (2020) with slight modifications. A standard curve was also generated using 2019-nCoV Positive Control (nCoVPC) with a series of 10-fold dilutions from 2 × 105 copies/µL to 2 copies/µL of control template. The amplification efficiency and R2 value were recorded and the standard curve was used to estimate the viral RNA of SARS-CoV-2 on the membrane.