Detection of norovirus in air samples in a non-vomiting patient: implications of testing saliva for norovirus in an immunocompromised host

Sir,

Norovirus is a highly contagious infectious disease which is transmitted from person to person via faecal—oral or vomitus—oral routes, or indirectly via contaminated food or the environment. Airborne transmission of norovirus was implicated in an epidemiological study during an outbreak in a hotel restaurant [1], but only recently was detection of norovirus RNA demonstrated in air samples collected in patients' rooms and at the nurse's station during hospital outbreaks [2], presumably due to projectile vomiting of patients, toilet flushing or floor cleaning, as described previously [3,4]. However, airborne norovirus in a non-vomiting patient in the absence of the environmental factors mentioned above has not been investigated to date.

Norovirus RNA was detected in air samples collected from a bed-bound patient, with no vomiting or cough, who was using nappies for his diarrhea. The patient was nursed in a single room in an intensive care unit. Air samples were collected from both sides of the patient approximately 80 cm from the patient's head, at the end of the patient's bed (approximately 200 cm from the patient's head), in the corner of the patient's room (approximately 300 cm from the patient's head), and in the corridor immediately outside the patient's room. The air samples were taken 4 h after floor cleaning and a nappy change by supporting staff.

Air samples for norovirus RNA were collected using an SAS Super ISO 180 model 86834 air sampler (VWR International PBI S.r.l., Milan, Italy), modified as described previously [5]. Briefly, the air sampler was positioned perpendicularly, and 2000 L of air was collected at a rate of 180 L/min for each culture plate containing 3 mL of viral transport medium (VTM). VTM was transferred to the laboratory within 1 h and was subjected to reverse transcriptase polymerase chain reaction (RT-PCR) for the detection of norovirus RNA. The clinical specimens and air samples were subjected to total nucleic extraction using an eMAG automated extraction system (bioMérieux, Marcy-l'Étoile, France). Real-time RT-PCR for norovirus was performed using AgPath-ID One-Step RT-PCR reagents (Applied Biosystems, Foster City, CA, USA) in accordance with the manufacturer's instructions. The primers and probe targeting the ORF1—ORF2 junction region of norovirus used in the RT-PCR have been described elsewhere with modification [6]. Ten-fold serial dilutions of a recombinant plasmid were used to generate a standard curve for viral load measurement. All reactions were performed using a LightCycler 96 real-time PCR system (Roche, Basel, Switzerland).

The patient was a 70-year-old male with chronic lymphocytic leukaemia treated with rituximab in 2011. Persistent marrow hypoplasia had been noted since 2011 and his cell counts, including lymphocytes, remained low [lymphocytes

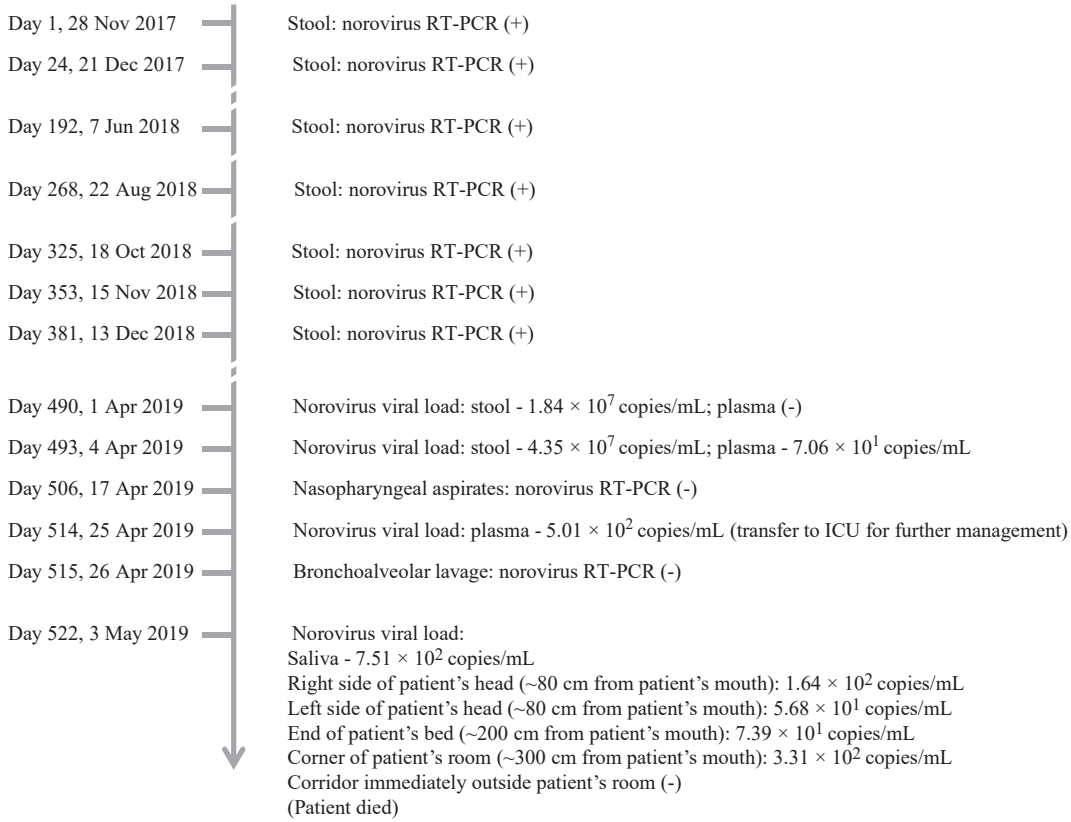

Figure 1. Shedding of norovirus in the patient's clinical samples and air samples. The first detection of norovirus by reverse transcriptase polymerase chain reaction (RT-PCR) in stool on 28 November 2017 is defined as day 1. ICU, intensive care unit.

0.16–2.20 × 10^9/L (normal 1.06–3.61 × 10^9/L)]. He developed intermittent watery diarrhoea with persistent detection of norovirus RNA by RT-PCR in stool samples for 18 months, from 28 November 2017 (day 1) to 3 May 2019 (day 522, when the patient succumbed) (Figure 1). Concomitant presence of norovirus RNA in plasma was found on days 493 and 514. The patient deteriorated with nosocomial pneumonia requiring support by continuous positive airway pressure (CPAP) via nasal mask in the intensive care unit from day 514 until he died.

All air samples collected inside the single room and the patient's saliva were positive for norovirus RNA by RT-PCR (Figure 1), but nasopharyngeal aspirates and bronchoalveolar lavage were negative. The corridor, which served as the control sampling point, was negative. Norovirus was detected throughout the entire alimentary tract from the oral cavity (viral load of 7.51×10^2 copies/mL) to the rectum (viral load of 4.35×10^7 copies/mL) in an immunocompromised host.

Dispersal of airborne norovirus could occur in a debilitated patient with terminal illness when norovirus was detected in saliva, and previously described airborne-norovirus-generating activities (e.g. vomiting, cough, nappy change, toilet flushing and floor cleaning) were absent in this patient. The use of CPAP via a nasal mask may have indirectly facilitated the dispersal of norovirus in bioaerosols in this patient. As mouth breathing is a common problem among CPAP users, norovirus in the oral cavity may have been dispersed to the air through exhalation.

Saliva has been used to monitor norovirus infection in community settings, where the use of a multiplex immunoassay to measure salivary immunoglobulin G responses to the five common norovirus genotypes had sensitivity and specificity of 71% and 96%, respectively, compared with RT-PCR-diagnosed norovirus infection in stool samples [7]. However, saliva has not been used for testing of norovirus RNA by RT-PCR previously, but has now been proven to be possible. In contrast to the contact transmission of norovirus which could be mitigated by enhancement of hand hygiene and environmental cleaning [8], bioaerosol generation may pose an additional risk of nosocomial transmission of norovirus. Further investigation is required to validate the performance of salivary testing in both immunocompetent and immunocompromised patients, and the relationship with bioaerosol generation of norovirus.

Conflict of interest statement
None declared.

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Lessons learnt from influenza POCT implementation in an acute medical unit

Sir,

Influenza point-of-care tests (POCTs) can speed up diagnosis and improve management of patients with influenza [1–3]. Young *et al.* discussed the impact of a POCT for influenza in an emergency department [4]. The POCT was associated with reduced nosocomial transmission of influenza and improved patient flow [4]. We previously reported the impact of a POCT for influenza in an acute medical unit (AMU) [1]. Following the introduction of the POCT, there was an increase in appropriately targeted oseltamivir prescribing, shorter time to isolation, proportionally fewer post-72-h influenza virus cases and