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Brief report

Routine monitoring of adenovirus and norovirus within the health care environment

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This study investigated the presence of adenovirus and norovirus on ward surfaces using real-time polymerase chain reaction (PCR) to assist in the development of evidence-based infection control policy. Screening was carried out weekly for 6 months in the common areas of 2 pediatric wards. Additionally, a one-off screening was undertaken for adenovirus and norovirus on a day unit and for adenovirus only in patient cubicles while occupied. Over the 6-month screening of common areas, 2.4% of samples were positive for adenovirus or norovirus. In rooms occupied with adenovirus-infected children, all cubicle screening sites and almost all swabs were contaminated with adenovirus. In the day unit, 13% of samples were positive. Cleaning and environmental interaction strategies must therefore be designed to control nosocomial transmission of viruses outside of outbreak scenarios.

The development of evidence-based infection control policy is essential to reduce health care–associated infections. It has been demonstrated that when 82% of ward sites were visually clean, only 30% of sites were considered bacteriologically clean.[1] Consequently, it has been proposed that hospitals should monitor the level of microbial contamination within the environment either through aerobic colony counts or the presence of indicator organisms, such as methicillin-resistant *Staphylococcus aureus*.[2] These recommendations do not currently extend to encompass viruses.[1,2]

Studies have demonstrated how viral contamination can be widespread in the hospital environment. Despite the suggestion that routine monitoring of hospital surfaces should be carried out to prevent infectious disease outbreaks, this has not yet been implemented widely.[3-6] There remains no consensus on the methods and cutoffs that could be used in viral monitoring schemes. This study investigated the presence of adenovirus (AV) and norovirus (NV) within the pediatric health care environment under nonoutbreak settings and established whether these viruses are suitable targets for routine microbial surveillance of cleaning efficacy and to assist in the prevention of transmission.

METHODS

Environmental screening for AV and NV was undertaken weekly on 2 wards within the Great Ormond Street Hospital National Health Service Foundation Trust for 6 months (January-June 2011). Twelve sites were sampled within the shared ward area on each ward (Table 1). The first ward was an 11-bed inpatient hematopoietic stem cell transplantation unit (HSCTU), and the second ward was a 10-bed immunology/infectious disease unit (IIU). Further sampling for AV was undertaken within 3 occupied cubicles on the IIU where AV-positive patients had been admitted for at least 1 week. Routine cleaning on the HSCTU and IIU was undertaken with 1,000 ppm chlorine (Chlor-Clean, Guest Medical, Aylesford, UK).

Finally a one-off environmental screen for AV and NV was undertaken on a hematology/oncology day unit (HODU). Sampling

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Table 1
Locations and area sampled and the results for each sampling strategy

Unit and sample number	Location	Area	Positives (n) AV	Positives (n) NV
HSCTU				
1	Floor outside known negative patient room	10 cm^2	0 (25)	1 (25)
2	Filing cabinet	10 cm^2	0 (25)	1 (25)
3	Floor outside known positive patient room	10 cm^2	0 (25)	1 (25)
4	Nurse's station	10 cm^2	0 (25)	0 (25)
5	Sluice or medication room door handle	Entire handle	0 (25)	1 (25)
6	Floor by main exit doors	10 cm^2	1 (25)	4 (25)
7	Notes trolley	10 cm^2	0 (25)	1 (25)
8	Computer keyboards	Every key and surface on the right 50%	0 (25)	0 (25)
9	Telephone on nurse's station	Entire key and handset	0 (25)	0 (25)
10	Ward exit door handle	Entire handle	0 (25)	0 (25)
11	Chair arm/crash trolley	Where hand rests (~10 cm^2) or 10 cm^2	0 (25)	0 (25)
IIU				
1	Floor outside known negative patient room	10 cm^2	1 (24)	0 (24)
2	Filing cabinet	10 cm^2	0 (24)	0 (24)
3	Floor outside known positive patient room	10 cm^2	1 (24)	0 (24)
4	Nurse's station	10 cm^2	0 (24)	0 (24)
5	Sluice or medication room door handle	Entire handle	0 (24)	0 (24)
6	Floor by main exit doors	10 cm^2	1 (24)	0 (24)
7	Notes trolley	10 cm^2	0 (24)	0 (24)
8	Computer keyboards	Every key and surface on the right 50%	0 (24)	0 (24)
9	Telephone on nurse's station	Entire key and handset	0 (24)	0 (24)
10	Ward exit door handle	Entire handle	0 (24)	0 (24)
11	Chair arm/crash trolley	Where hand rests (~10 cm^2) or 10 cm^2	0 (24)	0 (24)
Cubicles				
1	Floor under sink	10 cm^2	2 (3)	
2	Clinical waste bin inner rim (under lid)	Entire rim	3 (3)	
3	Chair with arms (right)	Where hands rests (10 cm^2)	3 (3)	
4	Door handle into patient bathroom	Entire handle on cubicle side	3 (3)	
5	Telephone keypads	Entire keypad	3 (3)	
6	Taps in patient bathroom	Entirety of both taps	2 (3)	
7	Mattress top	10 cm^2	3 (3)	
8	Bed or cot frame under bed	10 cm^2	3 (3)	
9	Trolley surface (in ante room if present)	10 cm^2	3 (3)	
10	Side window sill (right side)	10 cm^2	3 (3)	
11	Cubicle room exit door handle	Entire handle on cubicle side	3 (3)	
12	Corridor floor outside of cubicle or ante room entrance	10 cm^2	2 (3)	

HODU No.	Location	No. sites in location (10 cm^2 each)	Positives (n) AV	Positives (n) NV
1	Day procedure bay	5	0 (5)	0 (5)
2	Recovery bay	6	0 (6)	0 (6)
3	Procedure room	5	0 (5)	0 (5)
4	Assisted toilet 1	2	0 (2)	0 (2)
5	Assisted toilet 2	3	0 (3)	0 (3)
6	Ensuite cubicle	5	0 (5)	0 (5)
7	Bay 1	5	1 (5)	0 (5)
8	Corridor	3	1 (3)	0 (3)
9	Bay 2	5	2 (5)	0 (5)
10	Bay 3	5	2 (5)	0 (5)
11	Height and weight room	6	1 (6)	0 (6)
12	Reception	5	0 (5)	0 (5)
13	Reception seating	5	0 (5)	0 (5)
14	Cubicle 2	5	0 (5)	0 (5)
15	Cubicle 2 (preclean)	5	0 (5)	1 (5)
16	Treatment room 1	5	2 (5)	0 (5)
17	Treatment room 2	5	1 (5)	0 (5)
18	Treatment room 3	5	0 (5)	0 (5)
19	Treatment room 4	5	1 (5)	0 (5)

AV, adenovirus; *HODU*, hematology/oncology day unit; *HSCTU*, hematopoietic stem cell transplantation unit; *IIU*, immunology/infectious disease unit; *NV*, norovirus.

included both bed spaces and shared ward areas (Table 1) and was undertaken before cleaning was performed. Routine cleaning on the HODU was undertaken with chlorine dioxide, Tristel Fuse (Tristel, Snailwell, UK). The clinical equipment was cleaned separately with Tuffie 5 Universal Wipes (Vernacare, Bolton, UK).

Nucleic acids were extracted using the RNeasy Mini Kit (Qiagen, Crawley, UK) with the addition of a 56°C 10-minute heat step prior to extraction; subsequent procedures were carried out according to the manufacturer's protocol. All samples were subject to a complementary DNA step. All samples were subject to a complementary DNA step where 21.2 μL of nucleic acid extract added to 0.24 μg/μL random primers (Life Technologies, Paisley, UK); 0.02 mM dNTPs (Bioline, London, UK) was heated at 65°C for 5 minutes then 4°C for 2 minutes. Then, 1X first-strand buffer (Life Technologies, UK), 0.05 mM DTT (Life Technologies, Paisley, UK), 2 units/μL of RNaseOUT (Life Technologies, UK), and 15 units/μL of M-MLV (Life Technologies, Paisley, UK) were added per sample, and the mixture was heated at 37°C for 30 minutes and then 70°C for 15 minutes. Samples were stored at −20°C until quantitative polymerase chain reaction (PCR) was performed.