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Letter to the Editor

Persistence of infectious mpox virus on the surfaces of isolation ward in a hospital setting, India

Sir,

We read with great interest the article by Atkinson *et al.*, demonstrating the surface contamination with mpox virus (mpoxv) in an outpatient setting [1]. The survival of mpoxv on contaminated objects and fomites may contribute to its onward transmission [2]. We performed a study to determine the persistence of mpoxv on surfaces of the isolation ward during August–November 2022. In total, eight confirmed mpox cases were isolated in an mpox isolation ward at a tertiary care hospital in New Delhi, India. The surface sampling was conducted on alternate days until the samples tested negative from 38 surfaces of the hospitals from four main zones: zone 1 (donning room), zone 2 (mpox isolation ward), zone 3 (washroom), and zone 4 (doffing room) (Figure 1). Before the environmental sampling, informed consent was obtained verbally by all the eight admitted mpox cases in the ward.

The viral kinetics of the surface samples were compared with the viral load in clinical specimens of human mpox cases. The clinical specimens, i.e. oropharyngeal swab (OPS), nasopharyngeal swab (NPS), lesion samples, serum, EDTA blood, and urine were collected every fourth day until the specimens tested negative. Informed written consent was obtained before collecting clinical specimens. All the samples were transported to ICMR-National Institute of Virology, Pune, and tested using mpox-specific real-time polymerase chain reaction (PCR) [3,4].

All the mpox cases had multiple vesiculo-pustular lesions primarily on their genitals, trunk, face, back, and limbs. However, none of the patients had vomiting, diarrhoea, cough, sneezing, and respiratory distress. Higher viral load was observed in lesion samples of all eight cases (1.1×10^8 to 7.4×10^{10} copies/mL) at the time of admission, while NPS/OPS showed detectable viral load in six cases (1.7×10^5 to 7.7×10^7 copies/mL). Similarly, urine samples were also positive among seven cases (7.1×10^6 to 4.4×10^9 copies/mL). The persistence of viral DNA was observed in lesion samples (2×10^6 copies/mL) until the 23rd post-onset day of illness (POD), while OPS/NPS and urine also had detectable levels of viral DNA till 22nd (1.8×10^5 copies/mL) and 23rd (2.8×10^5 copies/mL) POD respectively.

The specimens collected from the surfaces near the vicinity of the bedside of all the cases showed viral DNA positivity (8.6×10^4 to 1.2×10^8 copies/mL) even after their lesion samples turned negative. Additionally, positivity for mpoxv DNA (8.6×10^4 to 6.1×10^7 copies/mL) was recorded at environmental sites and touch points, e.g. floor (5–500 m), door surfaces, door knob, window surfaces, window knob, biohazard bin, and electric switches. Similarly, equipment also demonstrated persistence of viral DNA including on the gloves of healthcare workers following patient care activities (8.0×10^5 copies/mL), stethoscope (2.8×10^5 copies/mL), ventilator surface (5.3×10^5 copies/mL), sphygmomanometer (5.9×10^6 copies/mL), critical vitals monitors (6.9×10^5 copies/mL), intravenous stand (2.2×10^6 copies/mL), bedside table tops (1.7×10^6 copies/mL), treatment tray (3.3×10^6 copies/mL), and food trolley (9.7×10^6 copies/mL). The high-touch surfaces (basin, water tap, trash can, commode, and bucket) in the washroom also showed the presence of viral DNA ranging from 9.3×10^4 to 1.1×10^8 copies/mL with highest viral load on commode surfaces. However, no mpoxv was detectable from the surfaces of the donning room, whilst the doffing room demonstrated detectable viral DNA (8.6×10^4 to 7.8×10^6 copies/mL) (Figure 1).

The surface samples with high viral load of $>10^4$ DNA copies/mL were also cultured using Vero CCL-81 cell line to determine the viability of the virus [5]. The mpoxv was cultured using swabs collected from the bed ($N = 1$), linen ($N = 2$), bed rails ($N = 1$), floor (below bed) ($N = 1$) on 6th–8th POD of one patient with viral load in the range of 3.9×10^6 to 3.0×10^7 copies/mL. The viral DNA positivity (4.4×10^6 copies/mL) and positive mpoxv cultures were also obtained from the washroom surface, i.e. bucket ($N = 1$) on 6th POD of the same case. This mpox patient had a higher viral load in lesion samples (1.9×10^9 DNA copies/mL) at 5th POD (day of admission) with vesiculo-pustular lesions on face, upper arms, lower limb, trunk, back, and genitals.

Previously, Gould *et al.* have also reported widespread contamination on hospital surfaces occupied by individuals with symptomatic mpox [6]. This study has also shown that viable virus can be detectable on the surfaces of the isolation ward for up to one week following admission of an mpox-infected patient. However, although DNA positivity by PCR was detectable until the last collection point (29th POD), viable mpoxv was not cultured from the surface samples. This study further reinforces the importance of surface cleaning protocols with twice daily cleaning of the isolation ward, washroom, high-touch surfaces, as well as good doffing procedures for personal protective equipment to avoid the onward transmission among healthcare workers and cleaning staff. Second, the persistence of mpoxv DNA near the patient bed and its vicinity reiterates the need for frequent changes in bed linen and covers along with correct handling of the infected laundry to reduce

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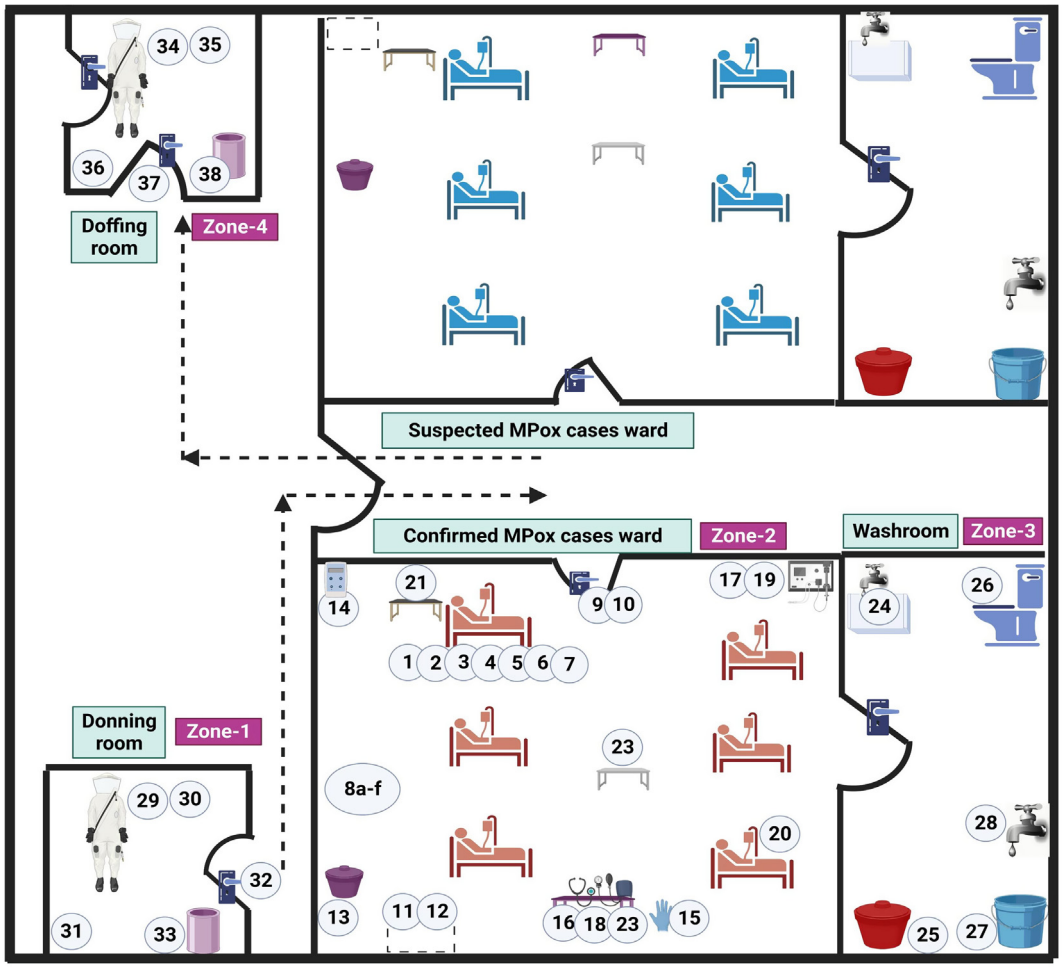

Number	Sampling area	Range of MPoxV DNA copies/ml	Num-ber	Sampling area	Range of MPoxV DNA copies/ml
1	Bed	8.6×10^{4} - 1.2×10^{8}	20	Intravenous stand	9.8×10^{4} - 2.2×10^{6}
2	Pillow	9.8×10^{4} - 7.0×10^{7}	21	Bedside table top	8.6×10^{4} – 1.7×10^{6}
3	Bedding	1.4×10^{5} - 4.2×10^{7}	22	Food trolley	1.5×10^{5} – 9.7×10^{6}
4	Linen	5.3×10^{4} - 9.6×10^{6}	23	Treatment tray	1.3×10^{5} – 3.3×10^{6}
5	Bed rail	8.6×10^{4} - 1.8×10^{7}	24	Washroom basin	1.0×10^{5} – 1.2×10^{7}
6	Floor (below bed)	4.7×10^{4} - 3.2×10^{7}	25	Washroom trash can	1.2×10^{5} – 1.7×10^{7}
7	Floor (1meter)	8.6×10^{4} - 9.8×10^{7}	26	Commode	9.3×10^{4} – 1.1×10^{8}
8 a-f	Floor (5-500 meter)	8.6×10^{4} - 6.1×10^{7}	27	Bucket	8.6×10^{4} – 7.4×10^{7}
9	Door surface	1.2×10^{5} - 4.3×10^{6}	28	Water tap	8.6×10^{4} – 1.7×10^{7}
10	Door knob	1.8×10^{5} - 1.4×10^{6}	29	Donning PPE inner surface	NIL
11	Window surface	8.8×10^{4} - 3.1×10^{6}	30	Donning PPE outer surface	NIL
12	Window knob	2.8×10^{5} - 3.0×10^{5}	31	Donning room floor	NIL
13	Biohazard bin	8.6×10^{5} - 1.7×10^{7}	32	Donning room door knob	NIL
14	Electric switch	2.0×10^{5} - 3.2×10^{6}	33	Donning room biohazard bin	NIL
15	Gloves of healthcare worker	2.7×10^{5} - 8.0×10^{5}	34	Doffing PPE inner surface	4.9×10^{5} – 1.1×10^{6}
16	Stethoscope	2.1×10^{5} - 2.8×10^{5}	35	Doffing PPE outer surface	1.1×10^{5} – 7.8×10^{6}
17	Ventilator surface	1.1×10^{5} - 5.3×10^{5}	36	Doffing room floor	1.3×10^{5} – 1.4×10^{5}
18	Sphygmomanometer	8.6×10^{4} - 5.9×10^{6}	37	Doffing room door knob	8.6×10^{4} – 1.0×10^{6}
19	Critical monitor	4.0×10^{5} - 6.9×10^{5}	38	Doffing room biohazard bin	5.1×10^{5} – 9.0×10^{5}

Figure 1. The layout of mpox isolation ward and surface sampling.

exposure. Appropriate hand hygiene practices, followed by surface disinfection of the patient care equipment, would also be important to reduce onward transmission. Overall, this study demonstrates the detection of mpox viral DNA and infectious virus from the surfaces of the isolation ward supporting the requirement of rigorous hospital infection control practices.

Ethical approval

The study was approved by the Institutional Human Ethics Committee of ICMR-National Institute of Virology, Pune, India under the project 'Providing diagnostic support for referred samples of viral haemorrhagic fever and other unknown aetiology and outbreak investigation'. The clinical data collected were anonymized. The written informed consents were obtained from all the cases under study for the use of the clinical specimens and clinical history. Informed verbal consents were also obtained from patients before collecting the environmental samples in the isolation ward. The study was also approved by Institutional Biosafety Committee of ICMR-National Institute of Virology Pune.

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Author contributions

P.D.Y. and R.R.S. contributed to study design, data analysis, interpretation, writing and critical review. V.R., R.R.S., A.M.S., D.Y.P., L.P.K., A.K., T.M., D.A., P.G., G.L., J.Y., A.B., P.V., A.G., P.S., P.G.M.R., H.D., A.K., R.J., D.M. contributed to sample collection, data collection, interpretation, writing and critical review. P.D.Y., D.Y.P., R.R.S., A.M.S., V.R., B.S., S.K. contributed to the critical review and finalization of the paper.

Conflict of interest statement

None declared.

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