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Original Article

Rapid Response and Containment of Varicella zoster Outbreak in a Resource-constrained Hospital ('V-OUTBREAK SOP' Model)

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ABSTRACT

Background: Chicken pox is a highly contagious airborne infection, caused by *Varicella zoster* virus, capable of causing nosocomial outbreaks, particularly in healthcare settings with susceptible healthcare workers (HCWs). Data on structured outbreak investigation in Indian hospitals remains limited.

Methods: An outbreak investigation was conducted in the Department of Internal Medicine, All India Institute of Medical Sciences (AIIMS) Rishikesh, a tertiary care teaching hospital, from 02 November 2025 to 19 January 2026, following the identification of a clinically diagnosed varicella case. A multidisciplinary outbreak response team, comprising an Infectious Disease Physician, an Intensive Care Unit physician, an Infection control nurse, a senior and junior resident, and senior nursing officers, implemented active case finding, contact tracing, immunity assessment, isolation, and post-exposure prophylaxis (PEP). Cases were identified based on clinical criteria.

Results: Institution-wide notification was made with enhanced surveillance. A total of eight cases were investigated, including one index case, two primary cases, and five secondary cases. A total of 110 healthcare workers (HCWs) were assessed. Primary and secondary attack rates were 40% and 50%, respectively, with no tertiary transmission. One HCW (14.2%) had prior history of chickenpox. All cases were isolated and treated promptly. One HCW developed post-herpetic neuralgia; the rest recovered without complications.

Conclusion: Early identification, systematic contact tracing, isolation, and targeted PEP effectively contained this outbreak. This experience highlights the need for structured standard operating protocols - 'V-OUTBREAK SOP' model (can be used by other hospitals) and HCW training in transmission-based precautions in Indian hospitals for effective prevention of nosocomial outbreaks.

KEYWORDS: Epidemiological Investigation; Chicken pox; Viral outbreak; Vaccination; Post exposure prophylaxis

INTRODUCTION

Chickenpox is the result of primary infection with the *Varicella-zoster* virus (VZV). Primarily, the infection is acquired through the airborne route. The skin vesicles of patients with varicella are full of highly infectious virions[1]. The infection is usually self-limiting in children, but it can have a more serious clinical course in adults, immunocompromised, sick and debilitated long-term care patients. Nosocomial outbreaks

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involving healthcare workers (HCWs) are being increasingly reported from diverse settings in India[2].

In one study conducted in a tertiary care hospital, eight cases of varicella were identified among 181 individuals exposed to the index case, highlighting the potential for rapid transmission in hospital environments[3]. In another outbreak investigation, thirty-one HCWs were identified as contacts, of whom three were found to have no evidence of immunity to varicella-zoster virus. Despite post-exposure vaccination, two of these susceptible HCWs subsequently developed chickenpox shortly after receiving the first dose of the varicella vaccine, underscoring the high transmissibility of the virus and the importance of early identification and preventive measures in healthcare settings[4].

In high-income countries, robust vaccination programs and stringent infection control protocols have largely mitigated the nosocomial epidemic due to VZV. However, in India, where universal varicella vaccination is not yet mandated, an outbreak with VZV poses serious risks with a higher proportion of susceptible adults. Standardised protocols for outbreak investigations and data on structured outbreak investigations for a healthcare-associated varicella outbreak from an Indian healthcare setting remain limited. The absence of such knowledge makes an outbreak investigation a reactive rather than proactive management. This report describes the epidemiological characteristics, control measures, and outcomes of a healthcare-associated varicella outbreak in a tertiary care teaching hospital in North India and the description of 'V-OUTBREAK SOP' model for the use in similar outbreaks.

METHODOLOGY

Setting and study period

The outbreak occurred in the Department of Internal Medicine of a tertiary care teaching hospital between 02 November 2025 and 19 January 2026.

Outbreak recognition

The outbreak was suspected following the identification of a hospitalised patient with fever and generalised vesicular rash consistent with varicella (Figure 1). According to the Centers for Disease Control and Prevention (CDC), an outbreak is defined as the occurrence of more cases of a disease than expected in a defined population, geographic area, or time period[5]. The diagnosis was made clinically based on the classical clinical presentation. Laboratory confirmation was not performed due to typical clinical features and logistical constraints.

Figure 1: Photograph of the patient showing confluent vesicular rashes across the face with crusting and erosions

Outbreak response

A multidisciplinary outbreak response team comprising an infectious disease physician, an intensive care unit (ICU) physician, an infection control nurse (ICN), residents, and senior nursing officers was constituted.

In the absence of national guidelines specific to healthcare-associated varicella outbreaks, the Centre for Disease Control and Prevention outbreak investigation principles were adopted as a framework.

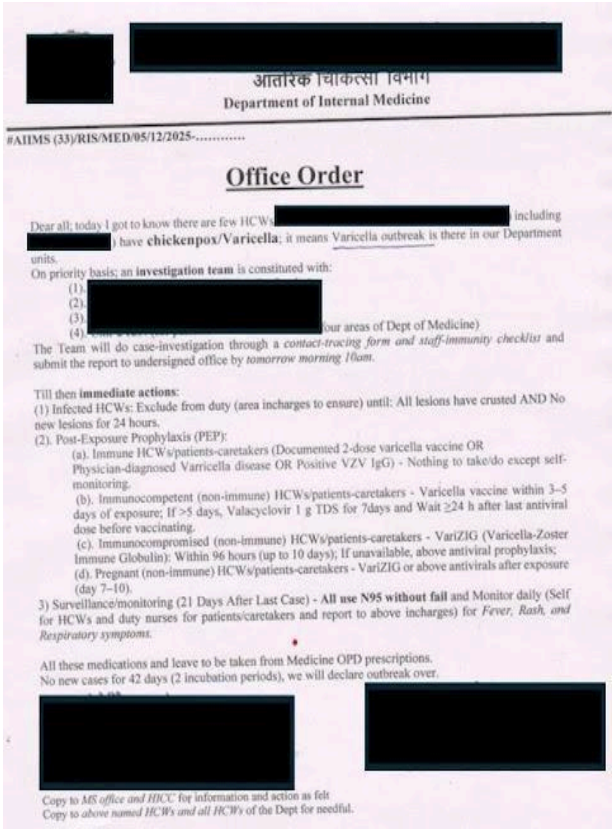
Investigation procedure

The following steps were undertaken:

1. Institution-wide notification and enhanced surveillance (Figure 2).
2. Development of a clinical case definition: a probable case was defined as any HCW presenting with an acute onset fever with vesicular rash between 02/11/2025 to 19/01/2026, with epidemiological linkage to the index case.
3. Active case finding among HCWs in affected units. This was done by actively following up on all the daily details of the Internal Medicine outpatient department, and the Emergency Medicine patient details.
4. Detailed contact tracing by telephonic conversation with all the cases and preparation of a line list.
5. Assessment of prior history of varicella infection and vaccination among all the cases and contacts by individual interview – in person and telephonically.
6. Stratification of exposed HCWS into immune and non-immune categories based on the details shared by the contacts.
7. Administration of post-exposure prophylaxis (PEP) as indicated (vaccination, antivirals

(Acyclovir or Valacyclovir), or Varicella Zoster Immune Globulin, Human (VariZIG) to all those who are immune naive to *Varicella zoster* virus.

8. Isolation of confirmed cases at home until lesions are completely crusted and ensuring adherence to isolation through daily telephonic reassurance and close follow-up of suspected cases for symptoms.
9. Temporary exclusion of affected HCWs from duty during the infectious period.
10. Surveillance for new cases through the maximum incubation period.



आंतरिक चिकित्सा विभाग
Department of Internal Medicine

#AIIMS (33)/RIS/MED/05/12/2025-.....

Office Order

Dear all; today I got to know there are few HCWs [redacted] including [redacted] have **chickenpox/Varicella**; it means Varicella outbreak is there in our Department units.

On priority basis; an **investigation team** is constituted with:

(1). [redacted]
(2).
(3).
(4). [redacted] four areas of Dept of Medicine)

The Team will do case-investigation through a *contact-tracing form and staff-immunity checklist* and submit the report to undersigned office by *tomorrow morning 10am.*

Till then **immediate actions**:

(1) Infected HCWs: Exclude from duty (area incharges to ensure) until: All lesions have crusted AND No new lesions for 24 hours.

(2). Post-Exposure Prophylaxis (PEP):

(a). Immune HCWs/patients-caretakers (Documented 2-dose varicella vaccine OR Physician-diagnosed Varricella disease OR Positive VZV IgG) - Nothing to take/do except self-monitoring.

(b). Immunocompetent (non-immune) HCWs/patients-caretakers - Varicella vaccine within 3–5 days of exposure; If >5 days, Valacyclovir 1 g TDS for 7days and Wait ≥24 h after last antiviral dose before vaccinating.

(c). Immunocompromised (non-immune) HCWs/patients-caretakers - VariZIG (Varicella-Zoster Immune Globulin): Within 96 hours (up to 10 days); If unavailable, above antiviral prophylaxis;

(d). Pregnant (non-immune) HCWs/patients-caretakers - VariZIG or above antivirals after exposure (day 7–10).

3) Surveillance/monitoring (21 Days After Last Case) - **All use N95 without fail** and Monitor daily (Self for HCWs and duty nurses for patients/caretakers and report to above incharges) for *Fever, Rash, and Respiratory symptoms.*

All these medications and leave to be taken from Medicine OPD prescriptions.
No new cases for 42 days (2 incubation periods), we will declare outbreak over.

[redacted] [redacted]

Copy to *MS office and HICC* for information and action as felt
Copy to *above named HCWs and all HCWs* of the Dept for needful.

Figure 2: Photograph of the institution-wide circular notifying the *Varicella zoster* outbreak and outbreak investigation

Statistical analysis

Data is recorded using a Microsoft Excel Sheet. Data is presented with frequencies and percentages. Descriptive statistics are presented with mean and standard deviation. A line list was prepared based on the data.

RESULTS

A total of eight cases of varicella were identified during the outbreak period. This included:

- One index case (12.5%)
- Two primary cases (25%)
- Five secondary cases (62.5%)

The pattern was consistent with propagated transmission.

A total of 110 HCWs were assessed for exposure, of which 82 had contracted chicken pox in the past, and 6 had received the vaccination. The primary attack rate among susceptible contacts of the index case was 40%, while the secondary attack rate among susceptible contacts of primary cases was 50%. No tertiary transmission occurred (tertiary attack rate: 0%). The line list is shown in Figure 3.

Figure 3: Line list prepared for the outbreak investigation of varicella

The outbreak was initiated by a hospitalized patient who served as the index case, presenting with fever and vesicular rash on the face consistent with varicella. Following exposure to the index case, two HCWs developed symptoms during the subsequent incubation period and were identified as primary cases. A total of eight cases of varicella were identified during the outbreak period. This included one index case and seven HCWs who developed varicella infection following exposure within the hospital. The diagnosis of all the cases were made clinically, based on classical presentation with fever and generalized vesicular rash, and no laboratory confirmation was performed. None of the cases required hospitalization. Antiviral therapy was administered to all affected individuals and isolation was maintained until complete crusting of lesions. One HCW developed post-herpetic neuralgia while the remaining cases recovered without sequelae. The epidemiological pattern suggested a propagated outbreak with transmission occurring within the healthcare setting. The transmission chain and chronological distribution of cases are illustrated in **Figure 4**.

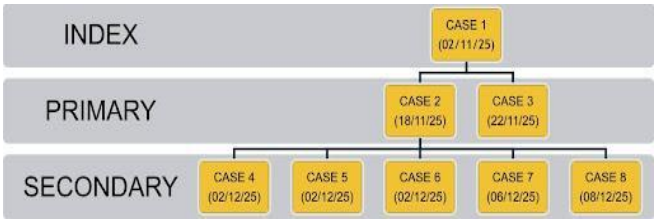


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Figure 4: Epidemic curve showing the temporal distribution of varicella cases during the outbreak investigation from 02 November 2025 to 19 January 2026.

The index case was a hospitalized patient, while all subsequent cases occurred among HCWs with documented exposure within the hospital setting, indicating a nosocomial transmission. Among the seven healthcare workers affected during the outbreak, the mean age was 27.7 ± 2.6 years, with an age range of 23–30 years. Males constituted 5 (71.4%) of cases, while females accounted for 2 (28.6%). Nursing officers represented the majority of affected healthcare workers. Fever and generalised vesicular rash were present in all the affected HCWs (100%), with face and trunk involvement observed in all patients. Limb involvement was noted in 5 (71.4%) of the HCWs.

One healthcare worker (14.2%) reported a prior history of varicella infection, while one individual developed post-herpetic neuralgia as a complication. All affected individuals received antiviral therapy and were isolated promptly, and six HCWs (85.7%) recovered without complications. The exposed individuals, who were deemed to be non-immune were advised postexposure prophylaxis with valacyclovir 1 gm thrice a day for 7 days.

The last case was identified on 08 December 2026; hence outbreak was declared off 42 days from this date as per CDC guideline. No additional cases were detected during subsequent surveillance.

Table 1: Clinical, morbidity, PEP, and vaccination details of the outbreak investigation conducted on the cases with Varicella

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Identification	Age	34	30	30	30	28	27	26	23
	Sex	Male	Male	Female	Male	Male	Male	Female	Male
	Occupation	Social Worker	Nursing Officer	Resident Doctor	Senior Nursing Officer	Nursing Officer	Hospital Attendant	Hospital Attendant	Nursing Officer
	Work area		MICU	Medicine HDU	MICU	MICU	MICU	MICU	MICU
Clinical details	Symptoms s/o chickenpox	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Symptoms	Fever, rash	Fever, Rash, Itching	Fever, Rash, Malaise	Fever, Rash, Itching,Headache , Body aches, Malaise	Fever, Rash, Itching, Headache, Body aches, Malaise, Respiratory symptoms	Fever, Rash, Itching, Headache, Body aches, Malaise	Fever	Fever, Rash, Itching, Headache, Body aches, Malaise
	Rash onset date	2/11/25	18/11/25	22/11/25	02/12/25	02/12/2025	02/12/2025	06/12/25	08/12/2025
	No. Of lesions	<50	<50	<50	>50	<50	>50	>50	>50
	Areas involved	Face	Face, Trunk, Scalp	Face, Trunk, Limb, Mucosa	Face, Trunk, Limb, Mucosa	Face, Trunk, Limb, Mucosa	Face, Trunk	Face, Trunk, Limb	Face, Trunk, Limb
Diagnosis	Clinical	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Lab investigation	No	No	No	No	No	No	No	No
Co-morbidities		HIV reactive	None	None	None	None	None		None
Exposure history	Prior chickenpox history	No	No	No	No	No	No	No	No
	Contact with known chickenpox patient during outbreak period	No	Yes	Yes	Yes	Yes	No	No	Yes

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	If yes, nature of exposure	-	Direct patient contact	Direct patient contact while doing general examination	Direct contact with primary case	Direct contact with primary case	Direct contact with primary case	Direct contact with primary case	Direct contact with primary case
	Mask usage during exposure	Not worn properly	Worn properly	Worn properly	Worn properly	Worn Properly	Worn properly	Worn properly	Worn properly
	Location of maximum exposure	MICU	MICU	HDU	MICU	MICU	MICU	MICU	MICU
Treatment and complications	Did you receive any treatment	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Drug	Tab valacyclovir 1 gm three times a day	Tab Acyclovir 800 mg 5 times a day	Tab valacyclovir 1 gm three times a day	Tab Acyclovir 800 mg 5 times a day Tab Augmentin 625 mg three times a day	Tab Acyclovir 800 mg 5 times a day	Tab Acyclovir 800 mg three times a day	Tab Valacyclovir 1 gm three times a day	Tab Acyclovir 800 mg three times a day
	Route	Oral	Oral	Oral	Oral	Oral	Oral	Oral	Oral
	Duration	7 days	7 days	7 days	10 days	7 days	5 days	7 days	7 days
	Complications	None	None	None	None	None	None	Post varicella neuropathic pain	None
Immunity and prevention	Vaccination history	No	No	No	No	No	No	No	No
Infection control and training	HIC training? Standard precautions	NA	Yes	No	Yes	Yes	No	No	No
	HIC training? Transmission based precautions	NA	No	No	No	No	No	No	No
	Duration of work at AIIMS	NA	>3 years	<1 Year	>3 years	>3 Years	1-3 years	1-3 years	<1 Year

MICU: Medical Intensive Care Unit; **HDU:** High Dependency Unit; **HIV:** Human Immunodeficiency Virus; **NA:** Not Applicable; **AIIMS:** All India Institute of Medical Sciences; **HIC:** Hospital Infection Control

The index case was a hospitalized patient, while all subsequent cases occurred among HCWs with documented exposure within the hospital setting, indicating a nosocomial transmission. Among the seven healthcare workers affected during the outbreak, the mean age was 27.7 ± 2.6 years, with an age range of 23–30 years. Males constituted 5 (71.4%) of cases, while females accounted for 2 (28.6%). Nursing officers represented the majority of affected healthcare workers. Fever and generalised vesicular rash were present in all the affected HCWs (100%), with face and trunk involvement observed in all patients. Limb involvement was noted in 5 (71.4%) of the HCWs. One healthcare worker (14.2%) reported a prior history of varicella infection, while one individual developed post-herpetic neuralgia as a complication. All affected individuals received antiviral therapy and were isolated promptly, and six HCWs (85.7%) recovered without complications. The exposed individuals, who were deemed to be non-immune were advised postexposure prophylaxis with valacyclovir 1 gm thrice a day for 7 days.

The last case was identified on 08 December 2026; hence outbreak was declared off 42 days from this date as per CDC guideline. No additional cases were detected during subsequent surveillance.

DISCUSSION

This study examines the epidemiological characteristics, control measures, and outcomes of a varicella outbreak investigation. In healthcare settings, varicella outbreaks in tertiary care hospitals among HCWs pose a significant risk for rapid nosocomial

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transmission. Consequently, a swift initial response, specifically establishing a clear case definition and a formal outbreak declaration, is critical. In this instance, issuing an institution-wide circular not only raised awareness among HCWs but also facilitated more efficient active case-finding.

The incubation period (IP) for varicella typically ranges from 10 to 21 days; accordingly, active and passive surveillance were maintained for two full IP (42 days) without new cases to confirm the outbreak's end[6]. Defining this window was essential for determining quarantine durations and mapping the propagation pattern. Our investigation traced the transmission from the index case to secondary cases, noting that most of the secondary cases originated from a single primary case. This highlights the influence of occupational roles and exposure intensity. Occurrence of all new cases fell strictly within the pre-defined IP, which helped in easy identification of cases and to establish adequate prevention measures. Early recognition, systematic contact tracing, prompt isolation, and Post-Exposure Prophylaxis (PEP) effectively interrupted the chain of infection, emphasized well with the absence of tertiary transmission in our scenario.

The secondary attack rate (SAR) was 50%, with nursing officers comprising the majority of those affected. While varicella is a highly contagious pathogen typically associated with a high secondary attack rate of 70-90% in susceptible siblings within a household, the rate in this study was comparatively lower than expected[7]. This reduction is likely attributable to high baseline immunity among contacts, resulting from both prior natural infection and previous vaccinations. Furthermore, since the cohort consisted of HCWs, the implementation of PEP using antivirals was strictly and effectively followed (100% of immune-naive HCWs took PEP)[6,8].

An important observation was that none of the affected HCWs had prior training in transmission-based precautions, although 3 out of the 7 had received standard precaution training. This lack of specialised training, not only facilitates "patient-to-HCW" transmission but also enables HCWs to become involuntary vectors, carrying the virus on contaminated skin or clothing to other immunocompromised or immune-naive patients and HCWs. While no additional patients developed the disease during their hospital stay, the post-discharge status of patients remained beyond the scope of this investigation.

The lack of training for every HCW highlights the need to form separate training modules for transmission-based precautions. Without this, HCWs often default to standard hygiene, leaving them dangerously unprotected against the aerosolised particles and respiratory droplets that define varicella's primary spread. By equipping the workforce with these specific competencies, a facility can prevent HCWs from becoming involuntary vectors, thereby protecting immunocompromised patients. Prevention of cross-contamination is to be ensured with staff having documented immunity should provide direct care, and all personnel entering the room must don an N95 respirator, gown, and gloves, and using dedicated medical equipment (such as disposable stethoscopes).

In resource-limited settings, the infrastructural limitations can hamper the routine surveillance and can hinder any successful outbreak investigations. A rapid investigation is essential to prevent localised clusters from overwhelming limited hospital capacity and causing mass casualties. These investigations should be aimed at producing local and regional data to bypass "one-size-fits-all" global policies. This can help competent authorities to target scarce resources, namely vaccines, protective equipment, and training, to reduce transmission. The mapping of transmission chains and sources cab help in providing an evidence-based foundation for changes in the system like improved sanitation or mandatory staff training, which can help towards long-term epidemic preparedness.

In addition, HCW immunity plays an indispensable role in interrupting the transmission pathways of varicella within clinical settings[9]. In many developing nations, a substantial proportion of healthcare workers (HCWs) remains susceptible to varicella, a vulnerability largely driven by the absence of universal vaccination mandates and inadequate records of prior infection [10].

This study highlights the need for a structured standard operating procedure (SOP) for outbreak investigation in resource-limited settings, prioritising rapid communication and systematic contact tracing. These SOPs can serve as a guide for a high-impact, low-cost methods that is both feasible and effective. The SOP serves to bridge the gap between limited infrastructure and the need for a structured and precise epidemiological response. We have developed a structured SOP, 'V-OUTBREAK SOP', that can be used in Indian hospital outbreaks of varicella ahead (Table 2); also, similar SOP can be used for other outbreaks with necessary modifications.

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Table 2: Standard operating procedure and checklist ('V-OUTBREAK SOP') for investigation and containment of varicella outbreaks in tertiary healthcare settings, developed based on findings from the present outbreak investigation.

Letter	Mnemonic Word	Step	Your Description
V	Verify	Outbreak recognition	Identify suspected case. Notify the Infection Control Team immediately. Declare suspected outbreak if ≥2 epidemiologically linked cases are detected. Issue institution-wide alert/circular to increase clinical vigilance.
O	Organize	Formation of outbreak response team	Constitute multidisciplinary team including infectious disease physician, treating physician, infection control nurse and residents. Assign outbreak lead and define roles and responsibilities.
U	Uniform	Case definition development	Establish standardized case definition. Communicate case definition to all departments.
T	Track	Active case finding	Screen healthcare workers and patients presenting with the symptoms and signs of the disease. Review inpatient, emergency, and outpatient records. Maintain enhanced surveillance for new cases.
B	Build	Contact tracing	Identify all exposed healthcare workers, patients, and attendants. Review duty rosters and ward records. Conduct telephonic or in-person interviews. Prepare a line list of exposed individuals.
R	Risk stratify	Immunity assessment and risk stratification	Determine immunity based on prior history of varicella infection or documented vaccination. Categorize contacts into immune and non-immune groups.
E	Expose (protect)	Post-exposure prophylaxis (PEP)	Provide prophylaxis to susceptible individuals as per institutional policy.
A	Apply control	Isolation and infection control measures	Advise isolation of confirmed cases. Exclude infected healthcare workers from duty. Implement the necessary transmission-based precautions and ensure appropriate PPE use.
K	Keep watch	Surveillance and monitoring	Monitor exposed individuals for development of symptoms during the incubation period (10–21 days in case of varicella). Maintain daily surveillance and update the outbreak line list.
S	Stop	Outbreak closure	Continue surveillance for two incubation periods (~42 days in case of varicella). Declare the outbreak to be contained if no new cases are identified during this period.
O	Organize data	Documentation and reporting	Maintain a line list of cases and exposed contacts. Prepare epidemic curve and transmission chain. Report findings to the hospital infection control committee and relevant authorities.
P	Prevent	Prevention and preparedness	Conduct periodic training on infection prevention practices. Maintain records of HCW immunity status. Implement vaccination programs for susceptible healthcare workers.

LIMITATIONS

Laboratory confirmation was not performed as all cases demonstrated classical clinical features with clear epidemiological linkage within a well-defined transmission chain, and priority during the outbreak response was directed toward rapid containment measures. The possibility of recall bias among participants cannot be excluded, as exposure history and prior infection or vaccination status were partly based on self-reporting. The source of infection for the index case could not be definitively established; however, reactivation of latent infection secondary to the patient's immunocompromised state was considered the most likely explanation. Additionally, due to high clinical workload and limited manpower, follow-up of asymptomatic exposed contacts outside hospital premises was restricted.

CONCLUSIONS

A healthcare-associated varicella outbreak in a tertiary care hospital was successfully contained through early recognition, structured investigation, contact tracing, prompt isolation, and targeted post-exposure prophylaxis. No tertiary transmission occurred, and all

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cases recovered. Institutional SOPs (('V-OUTBREAK SOP' model) and regular training in transmission-based precautions are essential to prevent similar outbreaks in healthcare settings.

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CONFLICTS OF INTEREST STATEMENT

Authors declare no conflicts of interest

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No funding was used for this study

AUTHOR'S CONTRIBUTION

AG: Data collection, Data curation, Methodology, Formal Analysis, Writing original draft, Writing – review & editing.

GH: Data collection, Methodology, Formal Analysis, Writing original draft, Writing – review & editing.

BJS: Data collection, Methodology, Project Administration, Writing – review & editing

MG: Data collection, Methodology, Project Administration, Writing – review & editing.

PKP: Conceptualization, Data curation, Supervision, Project Administration, Writing – review & editing.

AK: Visualisation, Data curation, Methodology, Formal Analysis, Project Administration, Supervision, Writing original draft, Writing – review & editing.

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