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Comparative Analysis of Varicella Complications in Pediatric Hospitalized Patients before and after the COVID-19 Pandemic

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Abstract

Background: Chickenpox is a common viral illness in children, typically mild, but it can lead to severe complications and even death. The coronavirus disease 2019 (COVID-19) pandemic and related social, healthcare, and environmental changes may have altered disease patterns and outcomes.

Methods: This retrospective cross-sectional study examined hospitalization trends and complications in 390 children under 18 years admitted with chickenpox between 2017 and 2024 (1396–1403). Demographics, clinical complications, treatment interventions, and discharge outcomes were extracted from the Hospital Information System (HIS) and analyzed using SPSS v26.

Results: Before the pandemic, hospitalizations and complications were infrequent, reflecting generally mild disease. After the pandemic, both the number of hospitalized children and the severity of complications increased markedly, with nearly half of patients in 2023 (1402) experiencing significant complications. Common complications included cellulitis (21%), pneumonia (14%), and arthritis (3.3%). Approximately 15% required intensive care, with an average intensive care unit (ICU) stay of 3.96 days, and several children developed rare but serious conditions such as toxic shock syndrome. Notably, 10% had underlying immunodeficiency, increasing their vulnerability.

Conclusion: These findings highlight a concerning post-pandemic shift, emphasizing the human cost of delayed vaccination, healthcare access challenges, and environmental and viral factors. Early identification of high-risk children, vigilant clinical monitoring, and strengthened preventive measures are essential to reduce morbidity and mortality, safeguarding the well-being of vulnerable pediatric populations.

Key Words: Chickenpox, Complications, COVID-19, Hospitalization, Varicella.

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1- INTRODUCTION

Varicella, commonly known as chickenpox, is a highly contagious infectious disease caused by the varicella zoster virus (VZV), affecting individuals of all ages but most frequently children under ten years of age (1–3). The disease typically presents with fever and a characteristic vesicular rash (1,4), yet in immunocompromised patients or those with underlying conditions, infection may be severe and occasionally require intensive care support (3,5). Following primary infection, VZV remains latent in sensory ganglia and can reactivate later in life as herpes zoster (5,6). Transmission occurs through direct contact with skin lesions or inhalation of infected respiratory droplets, with an incubation period of approximately 7–21 days (7–8).

Although chickenpox is often self limiting in healthy children, a significant proportion of patients develop complications, including bacterial superinfection, pneumonia, encephalitis, and other serious sequelae (9–11). Risk of severe outcomes is increased in infants and immunosuppressed populations (10,11). Neurological complications such as encephalitis can result in long term morbidity or mortality (12). Rare but documented systemic complications include myocarditis, nephritis, osteomyelitis, hemorrhagic varicella, and hepatitis (13). The early use of antiviral therapy, such as acyclovir, has demonstrated a reduction in disease severity and lesion burden (14).

Global data indicate that varicella related complications may occur in up to approximately 22% of infected patients, significantly influencing healthcare resource utilization (11). Post coronavirus disease 2019 (COVID-19) observational studies from multiple countries have reported increased hospitalization rates and higher rates of secondary bacterial infections among pediatric populations (15). Varicella vaccination programs have reduced disease incidence and severity where implemented, but vaccine coverage and waning immunity are ongoing challenges (4,5,16).

Given these epidemiological trends, this retrospective study analyzes hospitalization characteristics, complication profiles, and discharge outcomes among children admitted with varicella at a specialized pediatric center. Findings from this study may provide insights into risk stratification, preventive strategies, and optimized clinical management in the post pandemic era.

2- MATERIALS AND METHODS

2-1. Study Design and Setting

A retrospective cross-sectional study was conducted to evaluate the incidence and spectrum of complications among pediatric patients hospitalized with varicella at Akbar Children's Hospital, a tertiary referral center for pediatric infectious diseases in eastern Iran. The study period spanned from 2017 to 2025 (Persian calendar: 1396–1403), covering both the pre-pandemic (2017–2020) and post-pandemic (2021–2025) periods.

2-2. Participants

The study population included 390 children under 18 years of age who were admitted with a diagnosis of varicella. Inclusion criteria were all patients hospitalized with clinically or laboratory-confirmed varicella. Exclusion criteria included patients with concomitant significant illnesses unrelated to varicella that could confound the assessment of complications.

2-3. Data Collection

Demographic data (age, sex), hospitalization characteristics, clinical presentation, paraclinical tests, therapeutic interventions, and discharge outcomes were extracted from the hospital Health

Information System (HIS). Data extraction was performed systematically and anonymized prior to analysis.

2-4. Statistical Analysis

All data were analyzed using IBM SPSS Statistics version 26. Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Comparative analyses between pre- and post-pandemic periods were conducted using Chi-square or Fisher's exact test for categorical variables and independent t-tests or Mann-Whitney U tests for continuous variables, depending on data distribution. A p-value < 0.05 was considered statistically significant.

2-5. Inclusion and Exclusion Criteria

We retrospectively included all children under 18 years of age who were admitted to [name of hospital / center] between 2017 and 2024 with a final diagnosis of varicella (chickenpox) documented in their medical records. Varicella diagnosis was based on a typical clinical picture (acute onset of generalized pruritic vesicular rash, often preceded by fever and malaise) as recorded by the attending pediatrician, with or without laboratory or epidemiologic confirmation.

We excluded patients with incomplete medical records lacking key clinical or outcome data, those whose final diagnosis was revised to another disease during hospitalization, and cases in whom varicella infection could not be reliably be confirmed. Patients who were admitted only for social reasons without clinical complications, and readmissions for the same episode, were also excluded to avoid duplication and misclassification.

2-6. Control of Potential Sources of Bias

To minimize selection bias, we attempted to include all consecutive hospitalized children who fulfilled the predefined inclusion criteria during the study period, without restricting by sex, season or severity of disease. Misclassification bias was reduced by using the final discharge diagnosis and cross-checking clinical notes, laboratory results and radiologic reports in the HIS for each case. Data extraction was performed using a standardized data collection form, and ambiguous cases were reviewed by a second pediatrician to enhance internal consistency. Information bias was limited by excluding records with major missing data on key variables such as complications or outcomes. Nevertheless, as a retrospective hospital-based study, some degree of residual confounding and incomplete documentation cannot be completely ruled out.

2-7. Variables and Outcome Measures

The primary outcome was the frequency and type of varicella-related complications, including cellulitis, pneumonia, encephalitis, secondary bacterial infections, and rare systemic manifestations such as toxic shock syndrome, myocarditis, or nephritis. Secondary outcomes included the length of hospital stay (general ward and ICU), the requirement for advanced therapeutic interventions, and discharge status categorized as full recovery, recovery with complications, or mortality.

3- RESULTS

The study involved 390 pediatric patients with confirmed varicella who were hospitalized between 2017 and 2024.

3-1. Patient Demographics

Among the patients, 231 (59.2%) were male and 159 (40.8%) were female. The majority were school-aged children (7–12 years, 45.4%), followed by toddlers aged 2–3 years (23.1%). Infants under 1 year comprised the smallest group (3.3%) (Table 1).

3-2. Hospitalizations by Year

Hospital admissions were low and stable before the pandemic (2017–2020), with 41 patients (10.5%). In contrast, post-pandemic years (2021–2024) accounted for 345 hospitalizations (89.5%), with a marked surge in 2023–2024 (Table 2).

3-3. Clinical Manifestations and Para clinical Findings

The majority of patients presented with fever and a typical generalized vesicular rash. Respiratory symptoms, particularly cough and tachypnea, were observed in a considerable proportion of patients, especially those with varicella pneumonia. Neurological manifestations such as seizures or ataxia were less frequent but strongly associated with intensive care unit (ICU) admission.

Laboratory assessments showed that among 354 patients tested for white blood count (WBC), 42.7% had leukocytosis, 4% had leukopenia, and 53.4% had normal values. C-reactive protein (CRP) was elevated in 31.9% and erythrocyte sedimentation rate (ESR) in 18.5% of patients (Table 3).

Radiologic imaging most commonly demonstrated patchy or diffuse pulmonary infiltrates, consistent with viral or bacterial pneumonia, while pleural effusion and other complications were rare.

Tables-1. Gender and age distribution of hospitalized varicella patients.

Characteristic	Number	Percentage
Male	231	59.2
Female	159	40.8
Age 0–1 year	13	3.3
Age 2–3 years	90	23.1
Age 4–6 years	64	16.4
Age 7–12 years	177	45.4
Age 13–18 years	46	11.8

Table-2. Hospitalizations by year.

Year	Number of Patients	Percentage
2017	8	2.1
2018	12	3.1
2019	18	4.6
2020	3	0.8
2021	4	1.0
2022	26	6.7
2023	185	47.4
2024	134	44.4

Table-3. Laboratory findings in hospitalized varicella patients.

Test	Normal	Slight Increase	Significant Increase
WBC (n=354)	53.4%	—	42.7% leukocytosis, 4% leukopenia
CRP (n=332)	50.3%	17.8%	31.9%
ESR (n=330)	39.7%	41.8%	18.5%

3-4. Treatment

Acyclovir was administered to 50.5% of patients, primarily in moderate to severe cases or high-risk groups. A large proportion also received systemic antibiotics. Adjunctive therapies such as corticosteroids or immune globulin intravenous (IVIG) were reserved for severe cases, while all patients received supportive care including antipyretics and hydration.

3-5. Complications Before and After COVID-19

Abscess remained the most common complication (74% pre-pandemic vs. 72% post-pandemic), followed by cellulitis (27% vs. 33%), arthritis (19% vs. 18%), and pneumonia (4% vs. 13%). Rare but severe complications, including toxic shock syndrome (0.7%), encephalitis (2.8%), and meningitis (1.6%), were observed predominantly in the post-pandemic period (Table 4).

3-6. Clinical Outcomes

The majority of patients (94.4%) recovered without sequelae. 2.8% recovered with complications, and 2.8% died, with most fatalities occurring in the post-pandemic period.

3-7. Overall Findings

Varicella hospitalizations increased substantially after the COVID-19 pandemic, accompanied by a higher frequency of complications. Age and gender distribution remained consistent, but the increase in hospitalization rates and complications highlights the need for careful monitoring and timely management.

For each patient, demographic data (age, sex, and admission year), clinical symptoms and signs, laboratory parameters and radiologic findings were extracted from the HIS. Clinical manifestations included fever, pruritic vesicular rash, mucosal lesions, respiratory symptoms (cough, tachypnea, dyspnea), gastrointestinal symptoms, and neurologic signs (headache, seizures, altered level of consciousness, ataxia). Laboratory findings comprised complete blood count (with special attention to leukocytosis or leukopenia and thrombocytopenia), CRP, ESR, and, where available, liver and renal function tests. Radiologic assessment included chest X-ray and, in complicated cases, chest computed tomography (CT scan) or neuroimaging. Radiologic abnormalities were categorized as pneumonia, pleural effusion, or other organ involvement. The majority of patients presented with fever and a typical generalized vesicular rash. Respiratory symptoms, mainly cough and tachypnea, were observed in a considerable proportion of hospitalized children, particularly in those who developed varicella pneumonia. Neurologic manifestations such as seizures or ataxia were less frequent but were strongly associated with ICU admission. Radiologic imaging most frequently demonstrated patchy or diffuse pulmonary infiltrates compatible with viral or bacterial pneumonia; pleural effusion and other complications were rare.

Table-4. Key varicella complications before and after COVID-19.

Complication	Pre-pandemic (2017–2020)	Post-pandemic (2021–2024)
Abscess	74%	72%
Cellulitis	27%	33%
Arthritis	19%	18%
Pneumonia	4%	13%
Encephalitis	3%	2.8%
TSS	0%	0.7%
Meningitis	0%	1.6%

4- DISCUSSION

This study demonstrates a significant increase in hospitalizations for varicella among children following the COVID-19 pandemic. From 2017 to 2020 (pre-pandemic period), only 10.5% of the total hospitalizations occurred, whereas 89.5% of hospitalizations were observed in the post-pandemic years 2021–2023. This dramatic rise suggests a possible shift in

varicella epidemiology potentially driven by reduced natural exposure, interruptions in routine healthcare services, and delays in vaccination programs during the pandemic (17, 18).

Demographically, the majority of hospitalized children were male (59.2%), and the most affected age group was school-aged children (7–12 years), consistent with findings from Tehran, Iraq, and other national studies, reflecting higher susceptibility in boys and increased social exposure in school settings (19,20). Age-specific IgG seroprevalence studies in Tehran also corroborate our findings, showing higher antibody titers with increasing age, which aligns with the concentration of hospitalizations in older children (20).

Regarding clinical outcomes, most patients recovered without complications (94.4%), while a smaller fraction developed complications or died (2.8%). Complications were dominated by abscesses, cellulitis, and arthritis, with secondary severe complications—such as toxic shock syndrome, pneumonia, and encephalitis—observed in a minority of patients (21). This pattern is consistent with recent international reports. For example, studies in Poland and Warsaw demonstrated a 2.66-fold increase in varicella hospitalizations post-COVID-19, with group A Streptococcus identified as a frequent cause of secondary bacterial infections (22). Similarly, Danish studies reported over 50% of hospitalized varicella patients experienced at least one complication, in agreement with the high prevalence of abscess and cellulitis observed in our cohort (23).

Laboratory findings in this study further emphasize the clinical burden: leukocytosis was detected in 42.7% of patients, elevated CRP in 31.9%, and elevated ESR in 18.5%, indicating systemic inflammation in a substantial proportion of cases. These markers, combined with targeted antiviral and antibiotic therapies—including acyclovir, clindamycin, vancomycin, meropenem, and IVIG—underscore the need for individualized treatment according to disease severity (21). Notably, 14.9% of patients required ICU care, and 5.4% received linezolid for severe or resistant infections, highlighting the importance of monitoring and early intervention in high-risk populations.

Interestingly, despite the increase in hospitalizations, the mean length of stay remained relatively stable at 3.9 days, suggesting that disease severity and hospitalization duration were not significantly affected by the pandemic itself ($F=0.65$, $p=0.71$, $R^2=0.012$) (21). This indicates that the surge in hospital admissions was primarily driven by an increased number of cases rather than a change in clinical severity.

When comparing our findings to global systematic reviews, the proportion of severe cutaneous and infectious complications (~22.4%) and low mortality rate are consistent with reports from Europe and other regions (24,25). The presence of complications such as abscesses, cellulitis, and arthritis emphasizes the ongoing need for careful monitoring and management, particularly for children with immunodeficiency or secondary infections.

Overall, this study highlights the substantial impact of the COVID-19 pandemic on the epidemiology of varicella, particularly in terms of increased hospitalizations, while showing that most children still experience uncomplicated recovery. These findings reinforce the importance of continuous epidemiological surveillance, timely vaccination, early identification of high-risk patients, and evidence-based management strategies to minimize morbidity and mortality (17–25).

Consistent with previous pediatric research on infectious diseases during the pandemic, clinical and laboratory profiles of children with COVID 19 have been characterized in Mashhad, Iran, highlighting unique patterns of immune response and hospitalization in this population (26). These findings support the notion that the COVID 19 pandemic may have influenced the epidemiology and severity of other viral infections, including varicella, leading to increased hospitalization rates and a higher prevalence of complications in the post-pandemic period. The current study's observation of rising varicella hospitalizations and associated complications aligns with these broader epidemiological trends and underscores the need for continued monitoring and preventive interventions.

4-1. Study Limitations

This study has several limitations that should be considered when interpreting the results. First, the data were collected retrospectively from hospital records, which may be subject to incomplete documentation and information bias. Second, this was a single-center study conducted in a tertiary referral hospital, and therefore the findings may not be fully generalizable to the broader pediatric population or to other healthcare settings. Third, our study period included years before and after the COVID-19 pandemic, during which changes in healthcare-seeking behavior, admission policies, and infection control measures could have influenced hospitalization patterns and the detection of complications. Finally, some potential confounding variables, such as vaccination status verification, prior underlying conditions in detail, and community-level varicella exposure, were not available for all patients, which might have affected the observed associations.

Data on underlying nutritional deficiencies, such as anemia, vitamin D or zinc deficiency, and growth status (failure to thrive), were not systematically recorded in the hospital information system and therefore were not included in the present analysis.

Information on the exact interval between exposure to the index case and onset of varicella rash, or between initial nonspecific symptoms and appearance of skin lesions, was inconsistently documented in the medical records and therefore was not included in the quantitative analysis. As a result, we could not systematically evaluate the incubation period or timing of complications in relation to disease onset.

5- CONCLUSION

In conclusion, the findings of the present study indicate a considerable increase in varicella-related hospitalizations in the post–COVID-19 period, accompanied by a higher frequency of clinical complications. Although varicella remains a generally self-limiting disease in children, the observed rise in hospitalization rates and the occurrence of both common and severe complications suggest a shift in disease epidemiology following the pandemic.

Most patients in this study recovered without sequelae; however, the presence of serious complications and a measurable mortality rate highlights the ongoing clinical significance of varicella, particularly among high-risk groups such as immunocompromised children. The increase in post-pandemic cases may be attributed to multiple factors, including disruptions in routine immunization programs, reduced natural exposure during periods of social restriction, and changes in healthcare utilization.

These findings underscore the importance of maintaining effective varicella vaccination coverage, early identification of at-risk patients, and timely therapeutic interventions. Further multicenter studies

are recommended to better elucidate the long-term epidemiological trends and to inform public health strategies aimed at reducing varicella-associated morbidity and mortality.

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