

## Original Research Article

# PREDICTION OF ILLNESS SEVERITY AND OUTCOME OF CHILDREN WITH KEROSENE INGESTION USING THE SCORING SYSTEM FOR HYDROCARBON POISONING ADMITTED IN A TERTIARY CARE HOSPITAL IN KOLKATA

Shreya Purkait<sup>1</sup>, Simranjeet Kaur<sup>2</sup>, Nepal Chandra Mahapatra<sup>3</sup>

<sup>1</sup>Senior Resident, Department of Paediatrics, Calcutta National Medical College and Hospital, 32, Gorachand Road, Beniapur, Kolkata, India

<sup>2</sup>Senior Resident, Department of Paediatrics, Infectious Diseases & Beliaghata General Hospital, 57, Beliaghata Main Road, Phool Bagan, Beliaghata, Kolkata, India

<sup>3</sup>Professor and HOD, Department of Paediatrics, Lord Buddha Koshi Medical College and Hospital, 107, National Highway, Baijnathpur, Saharsa, Bihar, India

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**Corresponding Author:**

**Dr. Shreya Purkait,**  
Senior Resident, Department of  
Paediatrics, Calcutta National Medical  
College and Hospital, 32, Gorachand  
Road, Beniapur, Kolkata, India.  
Email: shreyapurkait7995@gmail.com

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**ABSTRACT**

**Background:** Poisoning is a common cause of paediatric admissions, with kerosene poisoning being prevalent among children in developing countries like India. It accounts for 0.23–3.3% of poisoning cases and is a major cause of accidental poisoning in children below five years. Improper storage in attractive containers contributes to accidental ingestion of kerosene. The study aims to predict severity and outcomes in children with kerosene ingestion using a hydrocarbon poisoning scoring system, while assessing epidemiological profile, vomiting-related complications, and score-outcome correlation.

**Materials and Methods:** All children less than or equal to 12 years with history of kerosene oil ingestion admitted in Calcutta National Medical College from January 2023 to January 2024 are evaluated with the Scoring System for Hydrocarbon poisoning at the time of admission and serially every 2 hours up to 8 hours. The maximum score arrived is taken to assess the severity of outcome in the subjects. The development of chemical pneumonitis associated with kerosene ingestion takes up to 8 hours; therefore, the subjects are assessed with the scoring system every two hours up to 8 hours.

**Results:** The study assessed 100 children with kerosene ingestion, identifying complications, vomiting patterns, exposure duration, severity scores, and hospital stay. Higher scoring system values were associated with increased complications, ICU admission, ventilatory support, mortality, and prolonged in-patient treatment duration.

**Conclusion:** Kerosene poisoning remains a preventable cause of paediatric morbidity and mortality, especially among rural children. Proper storage, health education, early risk assessment, and scoring systems can improve outcomes.

**Keywords:** Kerosene poisoning, Children, Hydrocarbon poisoning score, Severity, Outcome, Complications, Admission, Kolkata.

## INTRODUCTION

Poisoning remains a significant cause of hospitalization in pediatric wards worldwide, with children under five years old being particularly

vulnerable to accidental ingestion of toxic substances.<sup>[1]</sup> In developing countries like India, kerosene poisoning is especially prevalent among young children due to its widespread domestic use and unsafe storage practices.<sup>[2]</sup> Kerosene, a

hydrocarbon fuel commonly utilized for cooking and lighting lamps in rural households, is often stored in easily accessible containers such as water or soft drink bottles. Its characteristic color can also attract children, increasing the risk of accidental consumption.<sup>[3]</sup>

Epidemiological data indicate that kerosene poisoning accounts for approximately 0.23% to 3.3% of total poisoning cases in India, ranking as the twelfth most common cause of admission in pediatric age groups.<sup>[4]</sup> This pattern aligns with findings from other developing countries where kerosene remains a primary household energy source, and accidental ingestion among children is frequent.<sup>[5]</sup> The majority of affected children are younger than five years, reflecting their natural exploratory behavior and lack of hazard awareness. The domestic environment is the principal setting for such poisonings, often fueled by inadequate supervision, unsafe storage, and low parental awareness regarding the risks.

Clinically, kerosene ingestion primarily leads to aspiration pneumonitis, a potentially life-threatening pulmonary complication caused by the low viscosity and high volatility of kerosene, which facilitates aspiration into the lungs.<sup>[6]</sup> Management focuses on symptomatic treatment including oxygen therapy and respiratory monitoring, while contraindicating interventions such as emesis and gastric lavage that increase the risk of aspiration. Though mortality rates are generally low, severe cases can require intensive care and mechanical ventilation.<sup>[7]</sup>

The persistence of kerosene poisoning in pediatric populations reflects broader socio-economic and infrastructural challenges. In many rural areas, kerosene remains a primary fuel due to lack of access to electricity or cleaner energy sources. Unsafe domestic storage practices, including keeping kerosene in beverage bottles, compound the risk.<sup>[8]</sup> Prevention hinges on community education, improved storage safety standards (such as using dedicated opaque containers inaccessible to children), and infrastructural developments like electrification of rural homes.<sup>[9]</sup>

Abdel Raouf et al. devised the scoring system for hydrocarbon poisoning.<sup>[10]</sup> Seventy subjects were studied in total out of whom, 50 were classified as test group and rest 20 were classified into confirmatory group. The data obtained from test group were statistically studied and used to establish the scoring system. The data obtained from the confirmatory group were used to assess the validity of the scoring system. The scoring system was devised using the parameters that can be assessed bedside. Score of 0-3 were given to each parameter based on their correlation with the prognosis as observed in the test group. The Same scoring system was applied for every patient in the confirmatory group. The validity of the scoring system was found to be 90 %. In a study at a tertiary care hospital in Tamilnadu, India 40 subjects of kerosene poisoning were included.<sup>[11]</sup> They were assessed serially with

the scoring for hydrocarbon poisoning every 2 hourly since admission up till 8 hours. The score was compared with the complications developed during hospitalization. It was found that higher proportion of developing complications in the score categories 9 to 11 and 12 to 15. Only one subject within the category of score 12 to 15 had died. Also, the duration of hospitalization was compared with the score. The mean duration of hospitalization was 3 days with score 0 to 4, 5 days with score 5 to 8 and 9 days with score 9 to 11. So this scoring system is very useful in predicting the illness severity and clinical outcome with kerosene poisoning. The statistical analysis showed a correlation coefficient of 0.849 which is a very high correlation. Maximum value of correlation coefficient is 1.0

## MATERIALS AND METHODS

**Study Design:** Prospective Observational study.

**Place of Study:** Department of Paediatrics, Calcutta National Medical College and Hospital, Kolkata.

**Period of Study:** One and a half year (from January 2023 to June 2024)

**Study Population:** Children less than or equal to 12 years with a history of kerosene oil ingestion admitted to the paediatric ward of a tertiary care hospital in Kolkata.

**Sample Size:** 100 patients

**Study Variable**

- Distribution of Complication
- Vomiting and development of complications
- Relation of time passed since exposure with complication
- Association Between Score Categories and Clinical Outcomes Among Study Participants
- Pearson Correlation Analysis Between Duration of Hospitalization and Total Score Categories

**Inclusion Criteria**

- All children less than or equal to 12 years with history of kerosene oil ingestion admitted at Department of Paediatrics

**Exclusion Criteria**

- Children with mixed hydrocarbon ingestion or pure hydrocarbon ingestion other than Kerosene oil. Children with known chronic respiratory illness. 40 Children with history of Central Nervous System, Cardiac or Renal.

**Study Protocol**

After written consent from the parents the subjects are included in the study.

The following details are obtained.

- Name, age, sex, residence
- Number of siblings
- Parent's education
- Usage of kerosene at home
- Container used to store kerosene
- Duration between ingestion and admission in hospital

- History of vomiting. If yes, whether it is spontaneous or induced
- Any treatment given before admission
- Past history of significant medical illness
- Clinical examination is performed. Child was assessed for the following parameters
- Cyanosis
- SpO<sub>2</sub> level
- CNS (Conscious/Drowsiness/Coma responding to verbal or painful stimuli/Not responding to verbal or painful stimuli)

- Pulmonary involvement (No lung signs/Wheeze/Crepitation and or diminished air entry)
- Respiratory distress (Cough, tachypnoea, usage of accessory muscle)

The Total Scoring Number (TSN) is obtained at the time of admission and every 2 hours up to 8 hours. X-Ray was taken after 8 hours and assessed for the development lung complications. Child was followed up for the duration of stay in the hospital, development of lung complications and need of ventilator support.

The final outcome obtained in terms of duration of stay, development of lung complications or death.

| Parameter/Score              | Score 0         | Score 1    | Score 2                                      | Score 3                                                 |
|------------------------------|-----------------|------------|----------------------------------------------|---------------------------------------------------------|
| Cyanosis                     | Absent          |            |                                              | Present                                                 |
| SpO <sub>2</sub> level       | >95%            | 81–95%     | 61–80%                                       | ≤60%                                                    |
| Central Nervous System (CNS) | Fully conscious | Drowsiness | Coma responding to verbal or painful stimuli | Deep coma (not responding to verbal or painful stimuli) |
| Pulmonary involvement        | Free chest      | Wheezes    | Crepitations and/or diminished air entry     | Respiratory distress                                    |
| Respiratory distress         | Absent          | Cough      | Cough and tachypnoea                         | Cough, tachypnoea, and/or accessory muscle use          |
| Vomiting                     | Absent          | Present    | —                                            | —                                                       |

#### TOTAL SCORE: 15.

The total score is divided into 4 categories

- 0 to 4
- 5-8
- 9-11
- 12-15

Following outcome were expected-

Score 0 to 4: Excellent prognosis in terms of short duration of admission and no complications

Score 5 to 8: complete cure in terms of no complications developed

Score 9 to 11: Development of chest complications (Chemical pneumonitis) and longer duration of stay

Score 12 to 15: Bad prognosis in terms of ICU admission, ventilator use and may be death

The following observations were obtained for the individual parameters of the hydrocarbon poisoning score.

**Statistical Analysis:** For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analysed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample

t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

#### Ethical Clearance:

- Prior approval was obtained from the Institutional Ethics Committee (IEC) of the concerned tertiary care hospital before commencement of the study.
- Written informed consent was obtained from the parents or legal guardians of all participating children before enrollment
- The study is observational and did not interfere with the standard treatment protocol. All patients will receive routine clinical management as per hospital guidelines.
- Confidentiality and privacy of all participants was strictly maintained by assigning unique study identification numbers and securely storing the collected data.
- The study was conducted in accordance with the Declaration of Helsinki (2013), the ICMR National Ethical Guidelines for Biomedical and Health Research Involving Human Participants (2023), and applicable Good Clinical Practice (GCP) guidelines.

## RESULTS

**Table 1: Distribution of Complication**

| Complication         | No. of subjects |
|----------------------|-----------------|
| No complication      | 45              |
| Chemical pneumonitis | 42              |
| ICU admission        | 9               |
| Ventilators support  | 2               |
| Death                | 2               |
| Total                | 100             |

**Table 2: Vomiting and development of complications**

| Vomiting    | No. of Subjects |
|-------------|-----------------|
| Induced     | 42              |
| Spontaneous | 27              |
| Total       | 69              |

**Table 3: Relation of time passed since exposure with complication**

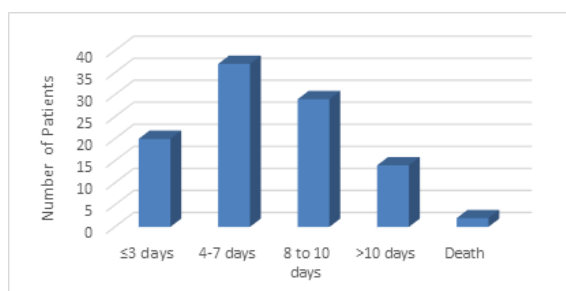
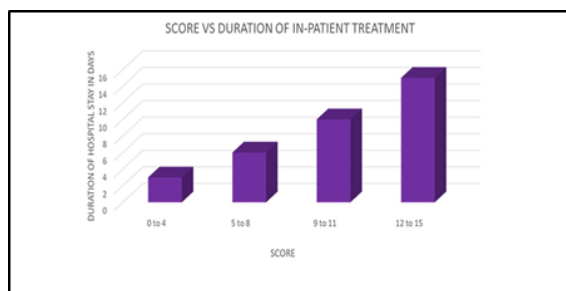
| Time since Exposure | No. of Subjects | No. of Subjects with Complications |
|---------------------|-----------------|------------------------------------|
| <30 minutes         | 4               | 1                                  |
| 30-60 minutes       | 14              | 7                                  |
| 60-120 minutes      | 18              | 15                                 |
| >120 minutes        | 64              | 32                                 |

**Table 4: Association Between Score Categories and Clinical Outcomes Among Study Participants**

| Score Category | No Complication | Chemical Pneumonitis | ICU Admission | Ventilatory Support | Death |
|----------------|-----------------|----------------------|---------------|---------------------|-------|
| 0-4            | 27              | 0                    | 0             | 0                   | 0     |
| 5-8            | 14              | 26                   | 0             | 0                   | 0     |
| 9-11           | 4               | 16                   | 9             | 0                   | 0     |
| 12-15          | 0               | 0                    | 4             | 2                   | 2     |
| Total          | 45              | 42                   | 13            | 2                   | 2     |

**Table 5: Pearson Correlation Analysis between Duration of Hospitalization and Total Score Categories (N = 100)**

| Duration of hospitalization | Variables           | Total score | Remark                    |
|-----------------------------|---------------------|-------------|---------------------------|
|                             | Pearson Correlation | 0.753       | Positive correlation      |
|                             | Sig. (2-tailed)     | <0.0001     | Statistically Significant |
|                             | N                   | 100         | —                         |

**Figure 1: Distribution of outcome****Figure 2: Distribution of score in relation to duration of in-patient treatment**

In the 100 subjects with kerosene ingestion, 45 subjects developed no complications. Chemical pneumonitis was observed in 42 subjects, while 9 subjects required ICU admission. Ventilatory support was needed in 2 subjects, and death occurred in 2 subjects. [Table 1]

History of vomiting was present in 69 subjects with kerosene ingestion. Induced vomiting was reported in 42 subjects, while spontaneous vomiting was observed in 27 subjects. [Table 2]

The majority of subjects presented after more than 120 minutes since exposure, with 64 subjects, of whom 32 developed complications. Among subjects

presenting within 60–120 minutes, 18 subjects were reported, with complications occurring in 15 subjects. A total of 14 subjects presented within 30–60 minutes, of whom 7 developed complications, while 4 subjects presented within 30 minutes, with 1 developing complications. [Table 3]

The outcome of kerosene ingestion showed a progressive increase in severity with higher scoring system values. Among subjects with a score of 0–4, 27 subjects had no complications. In the score range of 5–8, 14 subjects had no complications and 26 developed chemical pneumonitis. Among subjects with scores of 9–11, 4 had no complications, 16 developed chemical pneumonitis, and 9 required ICU admission. Subjects with scores of 12–15 had severe outcomes, including 4 ICU admissions, 2 requiring ventilatory support, and 2 deaths. [Table 4]

Pearson correlation analysis was performed to assess the relationship between the duration of hospitalization and the total score among the study participants. A strong positive correlation was observed between duration of hospitalization and total score ( $r = 0.753$ ), which was found to be statistically significant ( $p < 0.0001$ ). This indicates that patients with higher total scores had a significantly longer duration of hospitalization. The analysis was conducted among 100 study participants ( $N = 100$ ). [Table 5]

The duration of in-patient treatment varied among the subjects with kerosene ingestion. A total of 20 cases required hospital stay for  $\leq 3$  days, 37 cases were treated for 4–7 days, 29 cases required 8 to 10 days of treatment, and 14 cases had an in-patient treatment duration of  $>10$  days. Death occurred in 2 cases. [Figure 1]

The duration of in-patient treatment in each score category is given below. Score 0–4: the duration of in-patient treatment ranged from 2–3 days, with a mean duration of 3 days. Score 5–8: the mean duration in this score category was 6 days, whereas the range was from 3 days to 8 days. Score 9–11: the duration of IP treatment ranged from 5 days to 12 days, with a mean duration of 10 days. Score 12–15: only 2 patients in this score category survived. One of them stayed in the in-patient department for 14 days and the other stayed for 17 days. Therefore, the mean duration was 15 days. [Figure 2]

## DISCUSSION

We found that respiratory problems are the most common clinical consequence of kerosene poisoning, which is still a significant cause of pediatric morbidity. Of the 100 research participants, 45% had no issues, 42% developed chemical pneumonitis, 9% needed to be admitted to the intensive care unit, 2% needed ventilator support, and 2% passed away. Because of the low viscosity and high volatility of kerosene, aspiration-induced chemical pneumonitis has been continuously described as the most prevalent complication of hydrocarbon ingestion, which is consistent with these findings.

69% of participants had vomiting, with 42% of cases involving induced vomiting. Because it raises the danger of aspiration and lung damage, the high frequency of induced emesis is clinically significant. This result emphasizes the ongoing need for community education on proper first-aid procedures and preventing induced vomiting after ingesting kerosene.

Additionally, the study showed a strong correlation between clinical results and the severity ranking method. While increasingly higher scores were linked to chemical pneumonitis, ICU admission, ventilatory support, and mortality, patients with lower scores (0–4) were generally free of complications. This gradual escalation in disease severity suggests that the scoring system is a trustworthy method for identifying high-risk patients early on.

Additionally, a significant positive correlation ( $r = 0.753$ ,  $p < 0.0001$ ) was found between the severity score and length of hospital stay, suggesting that higher scores were linked to longer hospital stays. Patients with low scores spent an average of three days in the hospital, whereas survivors with the highest ratings spent an average of fifteen days. All things considered, these results validate the therapeutic usefulness of the severity score system in forecasting complications, hospital stay, and prognosis, thereby enabling early risk assessment and suitable treatment of pediatric kerosene poisoning.

Dudin et al,<sup>[12]</sup> conducted a 3-year prospective study on accidental kerosene ingestion and reported that

respiratory complications were the major clinical concern following hydrocarbon aspiration, with severity depending on the amount ingested and early clinical presentation. Similar findings were observed in the present study, where chemical pneumonitis was the most common complication, affecting 42 subjects. The development of pulmonary complications highlights the risk of aspiration following kerosene ingestion and emphasizes the importance of early monitoring and supportive management.

Santhanakrishnan and Chithra, et al,<sup>[13]</sup> studied accidental kerosene poisoning in infants and children and reported that young children are particularly vulnerable due to accidental ingestion, improper storage practices, and lack of awareness among caregivers. In the present study, vomiting was reported in 69 subjects, with induced vomiting being more common (42 subjects) compared to spontaneous vomiting (27 subjects). This finding supports previous observations that induced vomiting increases the risk of aspiration and subsequent pulmonary complications, emphasizing the need for public education against harmful first-aid practices.

Venkatesh et al,<sup>[14]</sup> evaluated the clinical profile of children with kerosene aspiration and reported that respiratory symptoms were the predominant manifestation, with pulmonary involvement being the major determinant of morbidity. Similar observations were noted in the present study, where 42 subjects developed chemical pneumonitis and 9 subjects required ICU admission. The presence of respiratory complications reflects the direct toxic effect of kerosene on the lungs and the possibility of aspiration-related injury.

Andleeb et al,<sup>[15]</sup> studied the clinical spectrum and outcome of kerosene poisoning in paediatric patients and highlighted that delayed presentation was associated with increased complications and prolonged hospital stay. In the present study, the majority of subjects (64 subjects) presented after more than 120 minutes of exposure, among whom 32 developed complications. Subjects presenting within 60–120 minutes also showed a higher complication rate, with 15 out of 18 subjects developing complications. These findings indicate that delayed hospital admission may contribute to worsening clinical outcomes and underline the importance of early medical intervention.

Mohammed Anees Ur Rahman et al,<sup>[16]</sup> evaluated kerosene poisoning among children in a rural medical college hospital and reported that accidental kerosene ingestion remains a significant paediatric health problem, particularly in rural settings where kerosene is commonly used and stored at household level. In the present study, the occurrence of complications and need for intensive care support indicate the continued burden of kerosene poisoning among children. Preventive strategies, including safe storage practices and caregiver education, are

essential to reduce the incidence of accidental ingestion.

Gupta et al,<sup>[17]</sup> described kerosene poisoning as a childhood menace and emphasized that severity of poisoning depends on clinical presentation, respiratory involvement, and complications developing after ingestion. Similar findings were observed in the present study, where increasing severity scores were associated with poorer outcomes. Subjects with scores of 0–4 had no complications in 27 cases, whereas subjects with scores of 12–15 developed severe outcomes, including 4 ICU admissions, 2 cases requiring ventilatory support, and 2 deaths. This demonstrates the predictive value of the scoring system in identifying high-risk children at admission.

Ik K et al,<sup>[18]</sup> studied the profile and outcome of childhood hydrocarbon poisoning and reported that clinical scoring systems can assist in early identification of children requiring intensive monitoring and intervention. In agreement with these findings, the present study demonstrated a clear relationship between scoring system categories and duration of hospital stay. Subjects with scores of 0–4 required a shorter in-patient treatment duration of 2–3 days with a mean of 3 days, whereas subjects with scores of 9–11 required 5–12 days of treatment with a mean duration of 10 days. In the 12–15 score category, only 2 patients survived, with hospital stays of 14 and 17 days, resulting in a mean duration of 15 days. These findings suggest that the Hydrocarbon Poisoning Scoring System is a useful bedside tool for predicting disease severity, anticipating complications, and determining the need for referral or intensive care support. Similar findings were reported by Higgins TL et al,<sup>[19]</sup> who observed that higher severity scores were significantly associated with prolonged hospital stay and increased requirement for intensive care management. The author highlighted that severity scoring systems provide an effective method for early identification of high-risk patients and help in predicting clinical progression and resource utilization. The findings of the present study are in agreement with this observation, as increased total scores were associated with longer hospitalization duration.

## CONCLUSION

Kerosene poisoning remains a significant cause of paediatric morbidity and mortality in India, especially among young rural children due to unsafe storage practices. Vomiting particularly induced vomiting, increases complication risk. Respiratory and CNS manifestations are common. The scoring system serves as an effective bedside tool for predicting severity, outcomes, and referral needs. Parental awareness and proper health education are essential for prevention.

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