

EMERGENCY DEPARTMENT MANAGEMENT AND IN-HOSPITAL OUTCOMES OF ORGANOPHOSPHATE POISONING IN YOUNG ADULTS AGED 18–35 YEARS PRESENTING TO THE EMERGENCY DEPARTMENT OF TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: To describe the emergency department management and determine the in-hospital outcomes of young adults (18–35 years) with acute organophosphate poisoning presenting to the emergency department of the tertiary care hospital, and to assess the association of presentation delay and admission Peradeniya Organophosphorus Poisoning (POP) severity category with in-hospital mortality.

Study Design: Prospective, observational cohort study.

Setting: Accident & Emergency Department, Jinnah Postgraduate Medical Centre (JPMC), Karachi.

Period: December 2025 to March 2026.

Material & Methods: One hundred and sixty-three patients aged 18–35 years meeting the operational definition of acute organophosphate poisoning were enrolled by non-probability purposive sampling. A structured proforma recorded demographics, exposure and presentation-delay details, arrival vital signs and POP score, emergency management delivered, complications, and final disposition. Data were entered and analyzed in SPSS v26. Quantitative variables were summarized as mean $\pm$ SD or median (IQR) according to normality (Shapiro–Wilk) and compared between survivors and non-survivors using the independent-samples t-test or Mann–Whitney U test; categorical variables were compared using the Chi-square or Fisher's exact test. Associations of presentation delay and POP severity category with mortality were expressed as odds ratios (OR) with 95% confidence intervals (CI); because no deaths occurred in the ≤ 2 -hour delay group (zero-cell/quasi-complete separation), Firth's penalized logistic regression was used for the adjusted analysis. Statistical significance was set at $p \leq 0.05$.

Results: Mean age was 24.9 ± 4.7 years; 96 (58.9%) were male, and 135 (82.8%) presentations followed intentional self-harm. All patients received atropine and 124 (76.1%) also received pralidoxime. Of 163 patients, 17 died, 2 left against medical advice and 2 were transferred (excluded from the mortality denominator per protocol); in-hospital mortality among the remaining 159 was 10.69% (95% CI 6.78–16.46%). All 17 deaths occurred among patients presenting more than 2 hours after exposure (0/55 vs 17/104; Fisher's exact $p = 0.0007$), and mortality rose from 1.3% (Mild) to 10.0% (Moderate) to 41.7% (Severe) across POP severity categories (trend $p < 0.001$). On Firth-penalized logistic regression, Severe admission POP category remained an independent predictor of mortality (adjusted OR 18.26, 95% CI 3.05–109.50, $p = 0.0015$).

Conclusion: Presentation delay and admission POP severity category are strongly associated with in-hospital mortality in young adults with organophosphate poisoning; POP severity independently predicts death even after adjustment, supporting POP-based triage at arrival and renewed efforts to shorten pre-hospital delay.

KEYWORDS: Atropine, In-Hospital Mortality, Organophosphate Poisoning, Peradeniya Organophosphorus Poisoning Score, Presentation Delay, Young Adults..

INTRODUCTION

Organophosphate (OP) pesticide poisoning remains one of the most important causes of preventable toxicological death worldwide, and its burden falls disproportionately on young people in low- and middle-income countries.¹ Suicide is among the leading causes of death in people aged 15–29 years globally, and pesticide self-poisoning continues to account for a substantial share of these deaths in settings where highly hazardous pesticides remain easily accessible.^{1,2} Restricting access to these agents has been shown to reduce mortality substantially among

young people, particularly women, which underscores how modifiable this burden is when addressed at a policy level.² In Pakistan, pesticide self-poisoning continues to claim thousands of young lives despite partial regulatory bans, reflecting persistent gaps in both upstream prevention and downstream emergency management.^{3,4} Local data from Karachi's poison-control and tertiary-care centres have repeatedly shown that adolescents and young adults bear the largest share of OP poisoning presentations, and that survival is closely tied to poisoning severity and to the speed and quality of the emergency care received.⁵ A more recent five-year analysis at a Karachi tertiary centre found pesticides responsible for roughly a quarter of all acute poisoning presentations, while acute kidney injury complicated more than a fifth of OP-poisoned patients, particularly those who presented late.^{5,6} A recent multi-site Pakistani cohort has similarly identified delayed presentation and poisoning severity as major, modifiable predictors of poor outcome across poisoning types.⁷ The Peradeniya Organophosphorus Poisoning (POP) score continues to be validated internationally as a simple, reproducible bedside tool for risk-stratifying these patients and anticipating the need for ventilatory and intensive-care support.⁸ Complications such as intermediate syndrome and cholinergic-driven respiratory failure remain proximate causes of in-hospital death, and both their pathophysiological basis and optimal antidotal management — including the continuing debate over the routine use of oximes such as pralidoxime — are still being actively refined in the recent literature.^{9,10} Despite this body of work, prospective, uniformly defined data on emergency department management and in-hospital outcomes specifically among young adults (18–35 years) presenting to JPMC's Accident & Emergency Department remain limited, and the relative contributions of presentation delay versus admission severity to mortality in this specific age group have not been formally tested locally. This prospective observational cohort study was therefore conducted to describe the emergency department management delivered to young adults with acute organophosphate poisoning at JPMC, to determine their in-hospital outcomes, and to test the hypothesis that presentation delay and admission POP severity category are significantly associated with in-hospital mortality.

MATERIAL & METHODS

Study Design: This was a prospective, observational cohort study.

Settings: The study was conducted in the Accident & Emergency Department of Jinnah Postgraduate Medical Centre (JPMC), Karachi.

Duration: Four months, from December 2025 to March 2026.

Sample Size: Sample size was calculated using the WHO formula for estimating a single population proportion, $n = Z^2p(1-p)/d^2$. The parent study at the National Poison Control Centre, Karachi, reported 28-day survival of 89.45% among 3,300 patients with organophosphate poisoning¹¹; expected mortality (p) was therefore taken as 10.55%. At 95% confidence ($Z=1.96$) and 5% absolute precision ($d=0.05$), the calculated sample was 146 evaluable participants, inflated to 163 to allow for 10% incomplete outcome ascertainment or patients who left against medical advice.

Sampling Technique: Non-probability purposive sampling.

Inclusion Criteria: Patients of either sex, aged 18–35 years, presenting to JPMC A&E within 24 hours of acute organophosphate exposure by ingestion, inhalation or dermal route, meeting the operational definition of acute organophosphate poisoning (a known/suspected organophosphate exposure with at least two compatible cholinergic features), with written informed consent from the patient or a legally authorised representative.

Exclusion Criteria: Mixed/multiple poisoning, carbamate or aluminium phosphide poisoning or an unidentified pesticide without adequate evidence of a cholinergic toxidrome; chronic occupational exposure without an acute episode; known chronic neuromuscular disease or terminal illness likely to independently determine respiratory support or mortality; patients brought dead or dying before baseline assessment; and refusal of consent.

Data Collection Procedure: After REU/CPSP and JPMC IRB approval, all eligible patients presenting during the study period were screened and enrolled purposively; emergency assessment and treatment were never delayed for study procedures. A trained resident investigator recorded demographics, exposure details, pre-referral treatment, presentation delay, arrival vital signs, Glasgow Coma Scale (GCS) and the six POP-scale components on a structured proforma, with exact treatment times transcribed from clinical records. Delivered care — airway/oxygen support, decontamination, atropine, pralidoxime, benzodiazepines, fluids, ventilation and ICU referral — was observed and documented without altering the treating team's decisions. Patients were followed daily until discharge, death, transfer or leaving against medical advice (LAMA), and complications, ventilator/ICU requirement, length of stay and final disposition were recorded. Study IDs replaced patient names in the analytical file.

Data / Statistical Analysis: Data were entered and analyzed in SPSS version 26. Quantitative variables (age, presentation delay, vital signs, GCS, POP score, atropine dose/timing, length of stay) were assessed for normality using the Shapiro–Wilk test and summarized as mean $\pm$ standard deviation or median (interquartile range, IQR) accordingly; categorical variables were summarized as frequencies and percentages. In-hospital mortality was presented with a 95% Wilson-score confidence interval; patients who left against medical advice or were transferred before final vital status could be verified were excluded from the mortality denominator, per the a-priori protocol definition. Survivors and non-survivors were compared using the independent-samples t-test or Mann–Whitney U test for quantitative variables, and the Chi-square or Fisher's exact test for categorical variables. Associations of presentation delay and admission POP severity category with mortality were expressed as crude odds ratios (OR) with 95% confidence intervals (CI). Because no deaths occurred among patients presenting

within 2 hours of exposure (a zero-cell / quasi-complete-separation problem that prevents ordinary maximum-likelihood logistic regression from converging to finite estimates), the adjusted multivariable analysis was performed using Firth's penalized (bias-reduced) logistic regression, a standard remedy for this situation in medical statistics.⁹

Ethical Approval: The study was approved by the Institutional Review Board of JPMC. Written informed consent was obtained from each participant or, where capacity was impaired, from a legally authorised representative, with consent reaffirmed from the participant once capacity returned wherever feasible. Surviving patients with intentional self-poisoning received routine psychiatric assessment or referral before discharge.

RESULTS

A total of 163 young adults met the study's eligibility criteria and were enrolled over the four-month study period. Mean age was 24.9±4.7 years (median 24, IQR 21–28); 96 (58.9%) were male and 130 (79.8%) resided within Karachi. Ingestion was the dominant exposure route (95.7%), and 135 (82.8%) exposures were intentional self-harm. The median exposure-to-JPMC interval was 2.7 hours (IQR 1.5–3.8), and 105 (64.4%) patients presented more than 2 hours after exposure; 76 (46.6%) had Mild, 63 (38.7%) Moderate and 24 (14.7%) Severe poisoning by admission POP category (Table-I).

TABLE-I. Baseline demographic and exposure characteristics (n=163)

Characteristic	n (%) / median [IQR]
Age (years)	24 [21–28]
Sex – Male	96 (58.9%)
Sex – Female	67 (41.1%)
Exposure route – Ingestion	156 (95.7%)
Intent – Intentional self-harm	135 (82.8%)
Presentation delay – >2 hours	105 (64.4%)
Admission POP severity – Mild (0–3)	76 (46.6%)
Admission POP severity – Moderate (4–7)	63 (38.7%)
Admission POP severity – Severe (8–11)	24 (14.7%)
GCS at arrival (/15)	13 [11–14]

Cholinergic features were common at presentation, including miosis (92.6%), excess secretions (93.3%), bronchospasm/bronchorrhoea (36.8%), fasciculations (44.8%), weakness (38.7%) and seizures (7.4%). All patients received atropine; pralidoxime was co-administered in 124 (76.1%) and benzodiazepines in 23 (14.1%). Oxygen was given to 69.3%, and 35 (21.5%) required intubation with mechanical ventilation initiated in the ED in 38 (23.3%). Median time from first atropine dose to clinical atropinisation was 23 minutes (IQR 14.5–30), and median total 24-hour atropine dose was 24.2 mg (IQR 14.6–39.2) (Table-II).

TABLE-II. Emergency department management delivered (n=163)

Management item	n (%) / median [IQR]
Supplemental oxygen	113 (69.3%)
Intubation	35 (21.5%)
Mechanical ventilation in ED	38 (23.3%)
Pralidoxime	124 (76.1%)
Benzodiazepine	23 (14.1%)
IV fluids	147 (90.2%)
Vasopressor	20 (12.3%)
Time to atropinisation (min)	23 [14.5–30]
Total atropine dose, first 24 h (mg)	24.2 [14.6–39.2]

Of 163 patients, 142 (87.1%) were discharged alive, 17 (10.4%) died, 2 (1.2%) left against medical advice and 2 (1.2%) were transferred; the latter four were excluded from the mortality denominator because final vital status could not be verified, per protocol. Among the remaining 159 patients, in-hospital mortality was 10.69% (17/159; 95% CI 6.78–16.46%). Mechanical ventilation was required during admission in 38 (23.3%) and ICU admission in 44 (27.0%) patients; at least one complication occurred in 77 (47.2%), most commonly respiratory failure (27.0%), acute kidney injury (22.1%) and aspiration pneumonitis (12.9%). Median hospital length of stay was 4 days (IQR 3–6) (Table-III).

TABLE-III. In-hospital outcomes (n=163)

Outcome	n (%) / median [IQR]
In-hospital mortality (of 159 with determinable outcome)	17 (10.69%; 95% CI 6.78–16.46)
Mechanical ventilation during admission	38 (23.3%)
ICU admission	44 (27.0%)
Any complication	77 (47.2%)
– Respiratory failure	44 (27.0%)

Outcome	n (%) / median [IQR]
– Acute kidney injury	36 (22.1%)
– Aspiration pneumonitis	21 (12.9%)
Hospital length of stay (days)	4 [3–6]

All 17 deaths occurred among patients who presented more than 2 hours after exposure; none occurred among the 55 patients presenting within 2 hours (0/55 vs 17/104; Fisher's exact $p=0.0007$; crude OR 22.20, 95% CI 1.31–376.65). Mortality also rose steeply across POP severity categories, from 1/75 (1.3%) in Mild to 6/60 (10.0%) in Moderate and 10/24 (41.7%) in Severe poisoning ($\chi^2=31.0$, $df=2$, $p<0.001$; test for trend, Spearman $\rho=0.38$, $p<0.001$) (Figure-1, Table-IV).

TABLE-IV. Mortality by presentation delay and admission POP severity category (analytic n=159)

Category	Died / Total (%)	Crude OR (95% CI)	p
Delay ≤ 2 h	0 / 55 (0%)	1 (reference)	—
Delay > 2 h	17 / 104 (16.3%)	22.20 (1.31–376.65)	0.0007 ^a
POP Mild (0–3)	1 / 75 (1.3%)	1 (reference)	—
POP Moderate (4–7)	6 / 60 (10.0%)	8.22 (0.96–70.30)	—
POP Severe (8–11)	10 / 24 (41.7%)	52.86 (6.26–446.37) ^b	<0.001

^aFisher's exact test (2×2 table). ^bOdds ratio for Severe vs Mild POP category (Haldane–Anscombe corrected for the zero cell).

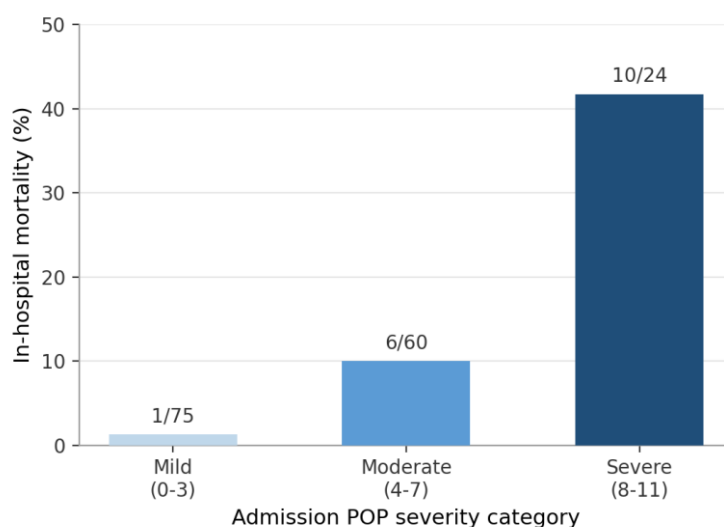


FIGURE-1. In-hospital mortality (%) by admission POP severity category

Non-survivors differed significantly from survivors on several arrival and treatment parameters: lower heart rate (66.4 ± 10.1 vs 76.2 ± 14.3 /min, $p=0.001$), lower systolic BP (100.4 ± 19.0 vs 112.1 ± 17.8 mmHg, $p=0.026$), lower SpO₂ (87.0 [85.0–94.0] vs 94.0 [88.0–97.0]%, $p=0.004$), lower GCS (9.0 [7.0–12.0] vs 14.0 [11.0–14.0], $p<0.001$), higher POP score (8.0 [5.0–10.0] vs 3.0 [1.0–6.0], $p<0.001$), longer time to atropinisation (32.0 [24.0–38.0] vs 22.5 [14.0–28.0] min, $p=0.005$) and higher atropine dose (43.0 [34.9–60.5] vs 23.0 [13.6–35.2] mg, $p<0.001$). Non-survivors also more frequently had seizures (29.4% vs 4.9%, $p=0.004$), required intubation (58.8% vs 16.2%, $p<0.001$) and mechanical ventilation in the ED (64.7% vs 17.6%, $p<0.001$), developed any complication (100% vs 40.8%, $p<0.001$), and required ICU admission (70.6% vs 22.5%, $p<0.001$). Age, sex, residence, exposure route, intent, agent evidence, pre-referral atropine, oxygen/suction use, decontamination, pralidoxime, IV fluids and length of stay did not differ significantly between the two groups (all $p>0.05$).

On Firth's penalized (bias-reduced) logistic regression — used because ordinary maximum-likelihood logistic regression does not converge given zero deaths in the ≤ 2 -hour delay group — admission POP severity remained an independent predictor of in-hospital mortality: patients with Severe poisoning had approximately 18-fold higher adjusted odds of death than those with Mild poisoning (AOR 18.26, 95% CI 3.05–109.50, $p=0.0015$), while Moderate poisoning showed a non-significant trend (AOR 4.47, 95% CI 0.76–26.33, $p=0.098$). Presentation delay >2 hours retained a large point estimate (AOR 8.64) consistent with its strong crude association, but its 95% CI was wide and crossed 1 ($p=0.134$) once POP severity was accounted for, suggesting delay acts substantially through its effect on presenting severity (Table-V).

TABLE-V. Firth penalized logistic regression for in-hospital mortality (analytic n=159)

Predictor	Adjusted OR	95% CI	p
Presentation delay >2 h (ref: ≤ 2 h)	8.64	0.51–145.13	0.134
POP severity: Moderate (ref: Mild)	4.47	0.76–26.33	0.098
POP severity: Severe (ref: Mild)	18.26	3.05–109.50	0.0015*

* $p < 0.05$.

DISCUSSION

In this prospective cohort of young adults with acute organophosphate poisoning at JPMC, in-hospital mortality was 10.69% (95% CI 6.78–16.46%), closely matching the 10.55% mortality assumed for sample-size estimation from earlier Karachi poison-control data¹¹, and comparable to the range reported by other recent South Asian and Pakistani cohorts, which have generally placed OP poisoning mortality between 7% and 15% depending on case-mix and severity at presentation.^{5,7,12}

Both components of our hypothesis were supported. Presentation delay beyond 2 hours was very strongly associated with death — all 17 deaths in this cohort occurred in patients who presented late — echoing the broader literature linking delayed antidotal treatment to worse outcomes in pesticide self-poisoning and reinforcing why community-level barriers to rapid transfer remain a key preventable driver of mortality in this setting.^{3,4} Admission POP severity category was an even more consistent predictor: mortality rose from 1.3% in Mild to 41.7% in Severe poisoning, a gradient similar in direction and magnitude to that reported in recent validation studies of the POP scale and of alternative severity-scoring systems for predicting ICU admission and mortality in acute organophosphate poisoning.^{8,13} On adjusted (Firth-penalized) logistic regression, Severe POP category remained independently predictive of death (AOR 18.26) even after accounting for presentation delay, whereas delay's own adjusted effect, though still large in magnitude, lost statistical significance — a pattern consistent with delay acting largely through its effect on worsening presenting severity rather than as a fully independent pathway to death, and consistent with recent work showing that early clinical severity, more than time alone, drives short-term mortality risk in OP-poisoning-induced shock.¹⁴

Complications tracked closely with severity and outcome: respiratory failure and acute kidney injury were the leading complications overall, and non-survivors had far higher rates of intubation, mechanical ventilation and ICU admission than survivors. This mirrors recent evidence that respiratory failure and cardiac complications are the principal proximate causes of death in hospitalized OP poisoning¹⁵, and that the neuromuscular dysfunction underlying intermediate syndrome — itself linked to inadequate or delayed atropinisation — remains a major contributor to ventilatory failure in this population.⁹ Our finding that non-survivors required a longer time to atropinisation and a higher total atropine dose than survivors is in keeping with recent reviews emphasizing rapid, adequately titrated atropine as the cornerstone of emergency management, while the continuing debate over routine pralidoxime use — which was given to just over three-quarters of our cohort, largely independent of outcome — reflects genuine uncertainty in the current literature about the incremental benefit of oximes once atropine and supportive care are optimized.^{16,10}

These findings have practical implications for emergency department triage: they support incorporating the POP score into routine bedside assessment of OP-poisoned patients at arrival, as recent umbrella reviews of OP-poisoning therapeutics continue to endorse severity-based triage alongside prompt, protocolized atropine administration and early recognition of evolving respiratory failure.^{17,18} More broadly, the very high proportion of intentional self-harm in our cohort (82.8%) is consistent with recent Pakistani data on pesticide self-poisoning and underscores that reducing access to highly hazardous pesticides, alongside faster emergency transfer, is likely to yield larger mortality reductions than acute-care interventions alone.^{3,19}

This study has several limitations. It was conducted at a single tertiary-care centre using non-probability purposive sampling, which may limit generalizability to other settings with different referral patterns or resource availability. The relatively small number of deaths ($n=17$), while adequate for the pre-specified analysis and appropriately handled with Firth's penalized regression, limited the number of covariates that could be modelled simultaneously, and residual confounding by unmeasured factors (such as ingested agent quantity or exact pesticide formulation) cannot be excluded. Because emergency management was observational and driven by clinical judgement rather than randomization, and was itself confounded by presenting severity, treatment–outcome associations in this study should not be interpreted as causal. Finally, the four-month study duration, while adequate to reach the pre-calculated sample size, did not allow assessment of seasonal variation in poisoning incidence.

CONCLUSION

Presentation delay and admission POP severity category are strongly associated with in-hospital mortality in young adults with organophosphate poisoning at JPMC, and POP severity independently predicts death even after adjustment for delay. These findings support routine POP-based severity triage at first contact and renewed efforts — both clinical and public-health — to shorten the interval between exposure and emergency antidotal treatment.

LIMITATIONS

As a single-centre study with purposive sampling and a modest number of deaths, larger multicentre prospective studies are needed to validate these predictors of mortality and to permit fuller multivariable adjustment for additional confounders.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

1. [Author Name]: Conception, data collection, manuscript drafting.
2. [Co-Author Name]: Data analysis and interpretation.
3. [Co-Author Name]: Critical revision and final approval.