

Recreational Nitrous Oxide Use: A Growing Trend with Unintended Consequences

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Abstract

Aims

To describe the incidence, demographic profile, and clinical characteristics of hospital admissions related to nitrous oxide (NO) misuse in the Republic of Ireland, and to compare these findings with international trends.

Methods

A retrospective observational study was conducted using the National Quality Assurance and Improvement System (NQAIS) Clinical tool. All inpatient discharges between 2020 and 2024 coded for NO misuse or toxicity (ICD-10: T41.0) were included. Demographics, length of stay, specialty involvement, and readmission rates were analysed.

Results

Sixty-three discharges were identified over four years, representing a more than four-fold increase in quarterly admissions when comparing Q1 2020 with Q4 2023. The mean age was 19.7 years (SD 2.4), with 87.3% (n = 55) from the Dublin area. Males accounted for 68.2 % (n = 43). The mean hospital stay was 7.9 days, and 82% (n = 52) had confirmed vitamin B12 deficiency. Neurology and general medicine managed all cases, with frequent allied-health input: physiotherapy (76 %), occupational therapy (64 %), and social work (48 %).

Discussion

Hospitalisations related to NO misuse have risen sharply, affecting predominantly young adults and placing increased demand on inpatient services. Findings align with European data, highlighting the need for youth-targeted prevention, awareness campaigns, and multidisciplinary follow-up pathways.

Introduction

Nitrous oxide (NO) is used in healthcare for its anaesthetic and analgesic properties. It is also a well-documented drug of abuse¹. Recreational abuse of inhaled NO has increased significantly in the last 10 years, particularly amongst younger age groups³. NO leads to a short-lived euphoric sensation when inhaled. Typically, recreational NO users transfer the gas from highly pressurised cannisters into balloons, and inhale from these. These canisters are widely available at low prices for use in the catering industry, where NO is used as a foaming agent, and the sale is not regulated in Ireland⁴. Inhaled NO is also undetectable on routine drug screening⁵.

Recreational NO abuse can cause harm to users. The NO canisters decrease to a temperature of –40 degrees Celsius when opened, and direct contact can cause freeze burns to lips, hands, and throat⁷. More insidiously, inhalation of NO can also trigger inactivation of vitamin B12, reducing the available vitamin B12 for the production of proteins vital for the myelin sheath. This can cause symptoms of paraesthesia and gait abnormalities, with clinical signs including reduced vibration and proprioception, and presents as a clinical picture of subacute combined degeneration of the cord⁸.

As clinicians, we have observed an increase in cases of neurological symptoms in young people in our clinical practice, in association with NO abuse. This study aims to explore the frequency of presentation of neurological symptoms in the setting of inhaled NO abuse in the Irish population. Utilizing the NQAIS Clinical tool, we aimed to analyse four years of data to identify patterns and trends in NO-related admissions, and examine key demographic factors, and healthcare utilisation. This can help guide relevant stakeholders in developing effective responses to nitrous oxide misuse.

Methods

This is a retrospective, observational study of inpatient discharges from acute hospitals in the Republic of Ireland (ROI), with discharge diagnosis codes relating to both NO use and neurological symptoms.

All ROI acute hospitals submit discharge coding data on inpatient discharges to the Hospital Inpatient Enquiry (HIPE) system. The Irish National Quality Assurance and Improvement System (NQAIS) clinical is a tool that presents Hospital Inpatient Enquiry discharge information in an accessible format for clinicians, with an emphasis on quality metrics. Data were accessed via the National Quality Assurance and Improvement System (NQAIS) Clinical platform, accessed via Health Atlas Ireland (<https://www.healthatlasireland.ie/>).

We used NQAIS clinical to explore the frequency and hospital resource metrics around acute hospital discharges with HIPE ICD-10 codes relating to inhaled drugs of abuse and neurological sequelae. Data were abstracted from the period 20 June 2020 to 20 June 2024, with the dataset for analysis accessed for analysis on 27 October 2025. Cases were identified if a key ICD code relating to nitrous oxide use was noted either in the primary or secondary discharge coding. The ICD-10 codes used for case identification are detailed in the Results section (Table 1). Data were then retained for inclusion if a second code which indicated either a neurological condition, or a vitamin B deficiency state was also present in the discharge coding (Table 1). Key ICD codes for nitrous oxide use were found to be T410 and T590 (ICD 10 definitions), as the other codes typically related to multidrug poisoning or smoke inhalation. Therefore, discharges with these two codes were also screened separately for any other neurological code to ensure appropriate case inclusion.

Simple descriptive statistics were used to describe population characteristics, using the parameters available on NQAIS. A measure of healthcare utilisation was generated using the procedure codes for HIP, to determine how many discharges had required support from services allied to medicine such as physiotherapy, and medical social work. Data were analysed using Stata 18 (StataCorp, Texas).

Results

In total, 82 cases were identified for screening based on ICD codes T410 (n = 67) and T590 (n = 13), cross-referenced with neurological and/or vitamin B12 deficiency codes (n = 27). After excluding duplicates, multidrug use without neurological issues (n = 7), NO use without neurology or vitamin B12 deficiency (n = 5), NO use with seizures/headache/dizziness (n = 5), and fire/burn exposure (n = 2), 63 cases remained, all involving NO exposure with sensory or motor problems and/or vitamin B12 deficiency (Figure 1). The ICD-10 codes used for screening and inclusion are shown in Table 1.

Figure 1. Case Identification Flowchart for Nitrous Oxide-Related Presentations, using NQAIS Clinical data on all acute hospital discharges in ROI over a 4-year period.

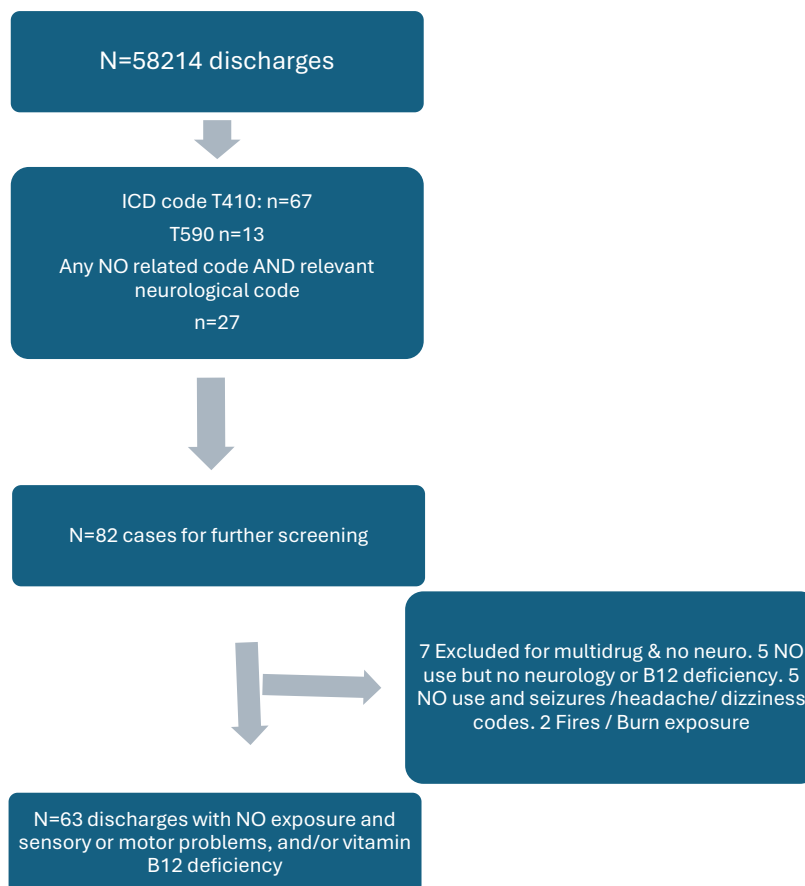


Table 1. ICD-10 codes that were identified as key codes relating to NO misuse and neurological and nutritional codes, for use in the screening of the NQAIS Clinical Acute Hospitals Discharge data.

ICD-10 Codes examined	ICD-10 Code	Description of Code
Toxicology / NO related	T410	Poisoning by adverse effect of and underdosing of inhaled anaesthetics.
	T590	Toxic effect of nitrogen oxides.
	T598	Toxic effect of other specified gases, fumes and vapours.
	T599	Toxic effect of other specified gases, fumes and vapours.
	X44	Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances.
	X478	Accidental poisoning by and exposure to other gases and vapours
	X49	Accidental poisoning by and exposure to chemicals and noxious substances.
	Y14	Poisoning by drugs, medicaments and biological substances, undetermined intent.
	Y178	Poisoning by and exposure to unspecified gases and vapours, undetermined intent
	Y19	Poisoning by and exposure to other and unspecified chemicals and noxious

		substances, undetermined intent.
	Y64	Contaminated medical or biological substance, transfused or infused.
Neurological / Nutritional	D513	Other dietary vitamin B12 deficiency anaemia.
	D519	Vitamin B12 deficiency anaemia, unspecified.
	G320	Subacute combined degeneration of spinal cord in diseases classified elsewhere.
	G62	Other and unspecified polyneuropathies.
	G622	Polyneuropathy, unspecified.
	G629	Polyneuropathy, unspecified.
	G634	Polyneuropathy in nutritional deficiency.

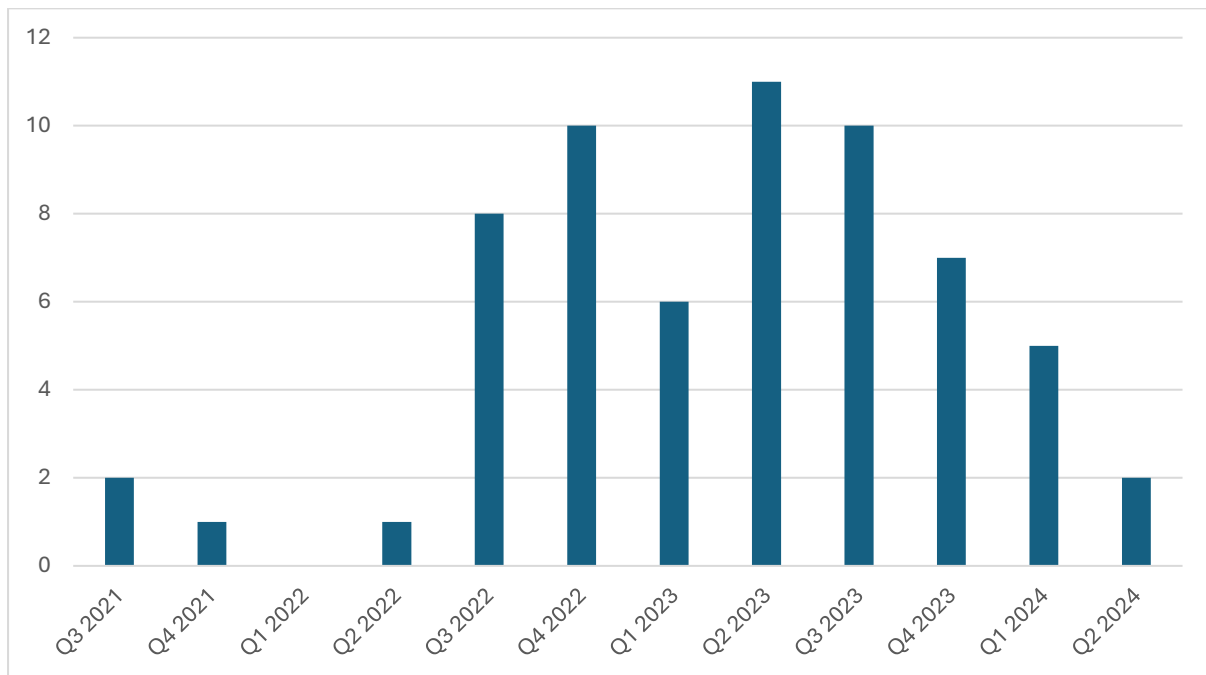
A total of 63 discharges over the four-year period were retained for analysis. Baseline demographics are shown in Table 1. The mean age was 19.68 years (SD 2.40); 71.4% were male, 28.6% female, and 47.6% held a medical card. The average length of stay was 6.26 days (SD 5.77), contributing to 394.5 total bed days (SE 45.86). Most patients (87.3%) were from the Dublin area. Discharge outcomes showed that 90.5% returned home, while a small number self-discharged or transferred elsewhere. No patients were recorded as being discharged to hostel accommodation. Readmission rates were low, with one readmitted within 7 days and another within 30 days (Table 2).

Table 2. Patient Demographics and Clinical Discharge Summary, for N=63 patients admitted with neurological complications of NO use.

Variable	Value
Age in years: Mean (SD)	19.68 (2.40)
Sex	
- Male: n (%)	45 (71.4%)
- Female: n (%)	18 (28.6%)
Medical card eligibility	30 (47.6%)
Length of stay in days	
- Mean (SD)	6.26 (5.77)
Total bed usage	394.5 bed days (SE: 45.86)
Patient origin	55 patients from the Dublin area
Discharge outcomes	
- Directly home	57 (90.5%)
- Absconded/self-discharged	5
- Transferred to another hospital	1
Readmissions	
- Within 7 days	1
- Within 30 days	1

Figure 2 illustrates the rising trend of nitrous oxide use over a very short time, showing a significant increase from Q3 2022, peaking in Q2 2023. This aligns with the clinical observation we had made regarding the increased prevalence of nitrous oxide use. The apparent reduction in cases after Q3 2023 is likely inaccurate due to the nature of HIPE data collection, as there can be a time lag between hospital discharge and actual data submission to HIPE.

Figure 2. Quarterly Trends in Nitrous Oxide-Related Admissions



A range of health and social care profession (HSCP) specialists were involved in patient care, with physiotherapy being the most frequently utilized service, followed by occupational therapy, medical social work, dietetics, pharmacy, and psychology.

Discussion

This study highlights the growing trend of nitrous oxide (NO) misuse, particularly among young adults, with an increasing number of hospital admissions linked to neurological complications and B12 deficiency. Over the four-year period analysed, quarterly presentations increased more than four-fold, mirroring international concerns about rising recreational NO use and resultant harm^{3,6}. This is the first study to describe this increase in incidence in the Republic of Ireland.

Limited national data exist on NO use, but the 2021 European Web Survey on Drugs⁶ (EWSD) and the Planet Youth North Dublin Survey¹⁶ both show that NO use is concentrated in young people. In the EWSD, 5.5 % of 18–24-year-olds in ROI who had used illicit drugs in the previous year reported NO use, and 28 % of these used more than 10 canisters daily. The Planet Youth survey found 6.2 % of males and 5.3 % of females under 18 had tried NO. The age profile reported in our study is also strikingly young (mean age 19.68), and this aligns with European data. The French Poison Control Service, which has a mandated surveillance system for reporting cases of psychoactive substances including NO, reported an average age of 21.6 years¹⁰. Similarly, the Dutch Poison Control data reports a mean age of 23 years of reported NO poisonings⁹.

The attendances to hospital with NO-related harm have also increased. A previous Irish report found fewer than five discharges coded T41.0 between 2018 and 2020⁴. Our study identified 63 in four years, which is a very significant increase. French data also showed a three-fold increase between 2020 and 2021¹⁰. These findings are consistent with recent Irish single-centre data demonstrating increasing presentations of nitrous oxide–associated neurological injury requiring inpatient investigation and management¹⁷. This study offers further important local context, showing that 87.3% of cases were from the Dublin urban area, indicating a concentration of NO misuse in urban settings. Examination of hospital stays, readmission rates, and multidisciplinary care involvement provides valuable data for healthcare planning and resource allocation. This increase in NO-related neurological presentations is also likely contributing to greater use of neurological investigations, including magnetic resonance imaging (MRI) and nerve conduction studies (NCS). Understanding these patterns will help targeted interventions.

The rising presentations with NO-related harm seen in this Irish study mirror broader European trends. However, the high inpatient burden and harm to young people highlight the need for targeted local strategies. Evidence from the Netherlands and France shows that hybrid approaches, combining limited supply controls, school-based education, and harm-reduction messaging, are more effective than legislation alone¹⁴. Dutch municipalities paired local bylaws with community toolkits and awareness programmes, while the UK experience demonstrates that possession bans have little impact without youth engagement¹³. Risk

perception relating to NO-related harm remains low among young people. One study in the UK found 80% of non-drug-using teenagers were likely to try NO within three months, while only 20% of users worried about health effects¹³. This means that interventions must target this understanding gap, as evidence suggests legislation alone does not change youth behaviour¹³. The literature supports peer-led and youth co-designed campaigns, particularly through social media, as more relevant and effective in reducing risky use¹⁵.

A major strength of this study is its use of national hospital data (NQAIS Clinical), ensuring a national analysis of inpatient discharges related to NO misuse. The clear inclusion criteria based on ICD-10 codes enhance reliability. Study limitations include potential underreporting of NO use, as cases without clear diagnostic coding may be missed, and lag times in data submission to HIPE, which means that cases in Q2 and Q3 of 2024 are also highly likely to be under-counted. Our data source (NQAIS Clinical and HIPE) provides simple patient discharge data, but granular detail on patient management or discharge outcomes was not included. Additionally, the lack of long-term follow-up data limits insights into the progression of neurological symptoms post-discharge.

In conclusion, admissions to Irish hospitals with neurological consequences of inhaled NO misuse have greatly increased over the last four years, and this issue is predominantly affecting very young adults. A multi-targeted harm-reduction strategy is needed to reduce preventable harm and to lessen the burden on acute care services.

Declarations of Conflicts of Interest:

None declared.

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