Analysis of the calls made to the Malta National Poisons Centre

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MSc (Clinical Pharmacotoxicology), 2025

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Abstract

Background: The Malta National Poisons Centre (MNPC) commenced operations in October 2023, initially serving Healthcare Professionals (HCP) before extending access to the public in May 2024. Poison centres serve as critical epidemiological resources providing essential data on poisoning incidents while offering expert clinical consultation for exposure management. The centre provides telephone consultation services to both HCP and the public for toxicological emergencies.

Aim: To analyse the nature and characteristics of all toxicological exposure calls received by the MNPC during its first months of operation, from October 2023 to May 2025, and examine insights regarding poison types and severity in Malta.

Methods: A retrospective quantitative analysis was conducted using anonymised call-log data from the MNPC database. The study included all 654 toxicology-related calls meeting inclusion criteria. Data encompassed caller demographics, patient characteristics, exposure circumstances, substance categories, clinical severity using the Poisoning Severity Score (PSS), and documented outcomes. Statistical analysis employed descriptive methods and chi-square tests using SPSS version 29.

Results: HCP constituted 76.6% of callers, with 23.4% from the public. Patient gender distribution was balanced (50.8% male, 48.9% female). The largest age groups exposed were 30-39 years (17.4%) and children under 5 years (16.4%). Accidental exposures predominated (40.1%), followed by deliberate exposures (36.2%). Pharmaceutical agents comprised most exposures, with paracetamol-containing analgesics being most frequently reported (15.1%); 59.6% of paracetamol cases involved deliberate poisoning. Most exposures occurred in domestic settings (85.5%) via oral route (84.4%). PSS distribution showed 34.6% asymptomatic, 40.2% minor, 16.8% moderate, 8.3% severe, and 0.2% fatal outcomes. Hospital admission was required in 52.4% of cases, with 60.7% involving clinical toxicologist consultation. Non-Maltese residents comprised 28.3% of cases, with disproportionate representation in workplace exposures (58.3% of occupational cases).

Conclusions: The MNPC has successfully integrated into Malta's healthcare system, demonstrating appropriate utilisation and effective outcomes. The epidemiological profile reveals distinct age-related intentionality patterns requiring targeted prevention strategies. Paracetamol prominence in deliberate exposures and significant non-Maltese representation in occupational exposures indicate specific risk factors requiring public health intervention. These findings provide essential baseline data for evidence-based prevention strategies and clinical protocol optimisation.

Keywords: Poison centre, toxicology, epidemiology, Malta, paracetamol, clinical outcomes, public health surveillance

Dedication

To my loving family, whose endless support made this achievement possible

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Contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation- Expanded name

BPCC- Banner Poison Control Centre

DAMA- Discharged against medical advice

EAPCCT- European Association of Poison Centres and Clinical Toxicologists

ED- Emergency Department

EMS- Emergency Medical Services

EU- European Union

FREC- Faculty Research and Ethics Committee

GCS- Glasgow Coma Scale

GGH- Gozo General Hospital

GP- General Practitioners

HC- Health Centre

HCP- Health Care Professional

KAP- Knowledge, Attitude, and Practices

MCH- Mount Carmel Hospital

MDH- Mater Dei Hospital

MNPC- Malta National Poisons Centre

NPDS- National Poison Data System

OTC- Over the Counter

PC- Poisons Centre

PIC- Poisons Information Centre

PID- Poisons Information Database

PSS- Poisoning Severity Score

SPSS- IBM® SPSS® Statistics; Statistical Product and Service Solutions, previously referred to as Statistical Package for the Social Sciences

SVP- Saint Vincent de Paul Long Term Care Facility

UK- United Kingdom of Great Britain and Northern Ireland

US- United States of America

WHO- World Health Organization

CHAPTER 1

Introduction

1.0 Introduction

Poison exposure represents a substantial public health challenge globally, and poison centres (PCs) play a critical role in mitigating its impact (Kader et al. 2025) . Internationally, PCs function as essential epidemiological resources, generating data on the incidence, typology, and severity of poisoning events (Kader et al. 2025). Moreover, they provide expert guidance on the prevention, diagnosis, and management of toxic exposures, thereby helping to reduce associated morbidity and supporting public health systems (Kader et al. 2025). These specialised units also contribute to research, toxicovigilance, and public education, reinforcing their relevance within modern healthcare infrastructures (Rajabali et al. 2024). Reflecting this global importance, the World Health Organization (WHO) recommends that every country maintain at least one dedicated PC (WHO, 2023).

Within this broader international framework, Malta has faced significant challenges in addressing poisoning incidents, which contribute meaningfully to national morbidity rates. As of 2024, Malta's population stands at 563,443 residents across Malta and Gozo (NSO, 2024). The islands' healthcare system is centred on a single acute general teaching hospital, Mater Dei Hospital (MDH), which provides more than 1,000 beds, including a 20-bed intensive care unit, and managed 99,388 inpatient admissions in 2019 (Cuschieri et al. 2020). Additional acute care is provided by the 159-bed state General Hospital in Gozo (Attard Montaldo and Gatt 2014). Despite this infrastructure, Malta historically lacked a specialised toxicology unit or formal PC capable of offering immediate, expert toxicological consultation.

Prior to the establishment of a national poisons centre, the Medicines Information Service at MDH served as the primary point of contact for pharmaceutical queries since its inception in 2002 at the now defunct St. Luke's Hospital. The service delivered evidence-based

pharmaceutical information and therapeutic guidance to healthcare professionals (HCP), caregivers, and patients across Malta and Gozo, contributing to the safe and effective use of medicines and producing educational resources such as drug information leaflets and alert cards. Although primarily designed for routine pharmaceutical inquiries, the service occasionally received calls related to pharmaceutical overdoses, particularly from paediatric departments. However, its pharmacists were not trained in clinical toxicology, and the service lacked the specialist expertise required for acute poisoning management. This gap highlighted the limitations of relying on a pharmaceutical information service for urgent toxicological advice and underscored the need for a dedicated, specialist-led poison control service in Malta.

In response to this need, the Malta National Poisons Centre (MNPC) commenced operations in October 2023. Initially providing consultative support to HCP for both acute and chronic poisoning cases, the service expanded its accessibility to the public in May 2024. The MNPC operates as an interdisciplinary unit comprising clinical toxicologists, a practice nurse, an advanced pharmacist practitioner, professional practice pharmacists, a senior pharmacist and scientific officers. Through continuous emergency telephone support and evidence-based toxicological guidance, it contributes to clinical decision-making, research, and public health education, aligning Malta with international standards for poison control services.

1.1 Background

The WHO recognises poisoning as a significant threat to global public health. In their analysis of the WHO Global Burden of Disease project (2019) , Vos et al. (2020) claim that in 2004, approximately 345,814 individuals across all age groups died worldwide due to 'accidental' poisoning. More recent data from Ghannoum et al. (2023) indicates that in 2020, PCs throughout the United States (US) documented more than 2 million cases of toxic substance exposure. Concurrently, approximately 100,000 individuals succumbed to drug overdose in 2020 in the US, establishing this as the predominant cause of mortality among young adults during this period (Ghannoum et al. 2023).

According to a recent scoping review conducted by Cowans et al. (2023), pharmaceutical poisoning constitutes a substantial public health challenge on a global scale, resulting in approximately 190,000 fatalities per annum. A report disseminated by the WHO in 2020 indicated that poisoning incidents were responsible for approximately 500,000 mortalities on an annual basis, culminating in the loss of 6.3 million disability-adjusted life years (WHO 2020). Moreover, in 2016, suicide claimed an estimated 800,000 lives globally (representing 10.5 per 100,000 population), with a disproportionate concentration of these fatalities occurring in nations with low to middle socioeconomic status (Salem et al. 2024).

Notably, low and middle-income countries, such as Syria and Malaysia, exhibit higher rates of poisoning-related fatalities compared to high-income nations like Qatar (Kouli et al. 2023, Tangiisuran et al. 2018, Salem et al. 2024). This disparity is further supported by Abubaker et al. (2020)’s retrospective analysis conducted in Pakistan, claiming that income status constitutes a significant determinant influencing the epidemiological distribution of poisoning incidents. The prevalence and nature of poisoning incidents differ markedly across various regions, influenced by factors such as socioeconomic status, cultural practices, and local industrial and agricultural activities (Tangiisuran et al. 2018). For instance, in their

systemic review, Boedeker et al. (2020) documented high rates of pesticide-related poisonings in agricultural regions like South-East Asia, while Mottla et al. (2023) reported pharmaceutical overdoses as the predominant cause of poisonings in urban areas of developed countries such as the US (Arnold, Borger and Nappe 2023). In response to this public health challenge, PCs have been established to facilitate the assessment, management, and ongoing monitoring of poisoning cases within a country (Pacini et al. 2023).

To enhance the understanding of the subject matter, a comprehensive literature review was conducted utilising Hydi and PubMed as the primary search platforms. This literature review examines existing research on the analysis of calls received by PCs abroad, focusing on key themes such as demographics of callers, characteristics of exposures, trends in poisoning incidents and challenges faced by poison control specialists. A selection of specific keywords was employed to refine the search and identify pertinent studies. These keywords included "Poison Centre," "Poison Control Centre," "Poison Information Centre," "PC calls," "acute poisoning AND PC calls," "overdose AND PCs," and "poisons-related calls."

Only full-text articles published in the English language within the last 25 years, and that pertained to PC calls associated with poisoning or overdose were included in the review. Following a comprehensive examination of numerous abstracts and a subsequent refinement based on their relevance to this study, the primary focus was directed toward studies conducted in Europe, North America, and Australia, as these regions have established PCs with substantial data collection systems (Gummin et al. 2022, Jollant et al. 2022, Hunyh et al. 2020).

1.2 The role of poison centres

The WHO recognises PCs as crucial components of national health systems, serving as valuable resources for the management of poisoning cases and toxic exposures (WHO 2023).

These centres receive calls related to poisoning or overdose and provide rapid, reliable information and support to HCP, patients, and the public regarding potential poisoning incidents (WHO 2023).

Nicholls (2022) reports that the New Zealand National Poisons Centre's poisons line annually receives approximately 23,000 public inquiries seeking consultation regarding suspected poisoning incidents. Of these cases, roughly 70% of individuals contacting the service do not necessitate clinical intervention but rather are provided with guidance for appropriate home management of the exposure, ensuring optimal operational efficiency (Nicholls 2022). Niżnik et al. (2024) claim that PCs play a significant role in the prevention and treatment of poisoning by offering expert advice on the appropriate management of toxic exposures and facilitating timely interventions. In the United Kingdom (UK), most hospitals lack specialised clinical toxicology services, making 24-hour access to quality poison information and clinical advice crucial for safely managing patients exposed to drugs and chemicals (National Poisons Information Service report 2024).

The integration of PCs into broader healthcare systems has been associated with improved outcomes for poisoned patients (Abubaker et al. 2020). Abubaker et al. (2020) demonstrated that regions with well-established PC services experienced lower mortality rates from poisoning compared to areas with limited access to such services. Furthermore, Huynh et al. (2020) demonstrated that Poison Information Centres (PIC) in Australia generate annual conservative cost savings of approximately $10.1 million per year with a three to fourfold return on investment ratio for every dollar spent on PICs through prevention of unnecessary medical resource utilisation, highlighting the cost- effectiveness of these services.

1.3 Call taking from the public and health care professionals

According to Gummin et al. (2024), PCs inform the public about poisoning exposures and respond to inquiries related to poisons. The public can contact these centres directly via a toll-free number or through emergency services like 112 (Hahn 2020, Guyer and Mavor 2005). Support provided includes assessing the type and severity of poisoning, offering at-home care advice, reassuring callers, and referring them to healthcare providers as needed (Kingsley et al. 2017). Follow-up calls ensure the resolution of the situation (Vodovar et al. 2023). PCs also recommend preventive measures to avoid future poisoning incidents, such as securing hazardous items (Amir et al. 2023). When referrals to healthcare facilities are made, the centres communicate relevant case details and toxicology information to the facilities (Descamps et al. 2021).

PCs offer critical information to various HCP about exposures to toxic substances. With a growing focus on adult exposures, which have higher risks of severe health outcomes, these centres play an essential role in consulting HCP. Users of poison control services range from emergency medical technicians to hospital staff, including nurses, physicians, and public health officials (Krenzelok et al. 2014). A study by Brassard et al. (2020) found that some clinicians reported that engaging with a PC strengthened their professional autonomy, as it enabled them to make more confident and self-assured clinical decisions.

Staff employed at PCs provide expert consultation regarding toxin identification, projected clinical manifestations, and therapeutic intervention protocols for individuals receiving care in acute and critical healthcare environments (Brassard et al. 2020). Furthermore, as articulated by Brassard et al. (2020), these specialised personnel facilitate diagnostic differentiation, laboratory investigation selection, and coordination of patient transfer to facilities possessing requisite resources for optimal management.

Approximately 20% of exposure calls to these centres originate from healthcare facilities, according to Graves et al. (2021). Follow-up calls are made to monitor patient progress, treatment compliance, and outcomes after discharge (Vodovar et al. 2023). Beuhler et al. (2013) highlighted the importance of these follow-up procedures, in their analysis of unintentional insulin overdoses managed across three PCs, conclusively demonstrated the critical importance of systematic follow-up protocols in poisoning cases. Their findings substantiate that structured post-incident monitoring significantly improves clinical outcomes and enhances the identification of delayed complications, thereby establishing follow-up procedures as an essential component of comprehensive toxicological management services.

1.4 Types of calls

The calls received pertain to either accidental or intentional exposure to a poison (Koh et al. 2024). In cases of accidental poisoning that do not necessitate medical assessment, the poison specialist advises the caller on how to manage symptoms at home following exposure (Pacini et al. 2023). In contrast, in instances of deliberate poisoning, the specialist ensures that the individual involved is referred to a hospital for a medical and psychiatric evaluation, as the poison was ingested with the intent to self-harm (Descamps et al. 2021). This binary classification, while clinically useful, may oversimplify the complex spectrum of poisoning intent, particularly in cases involving substance misuse or therapeutic errors that blur the distinction between accidental and intentional exposure.

Johnson et al. (2020) investigated the role of PCs in minimising unnecessary Emergency Department (ED) visits for unintentional paediatric poisonings at a large US children's hospital. Researchers analysed ED cases from October 2014 to September 2015, focusing on exposures to pharmaceuticals, chemicals, and fumes. They found that 42.4% of the 231 encounters were triaged by the PC, while 57.6% were self-referred by caregivers. Notably,

46.6% of the self-referred cases could have been managed at home with PC guidance. The most common exposures were to analgesics and household cleaning products. The study concluded that nearly half of the paediatric ED visits for poisoning could have been avoided with earlier PC consultation and recommended initiatives to promote increased use of PC services among the public. However, the retrospective determination that cases "could have been managed at home" may not fully account for the legitimate concerns of caregivers at the time of exposure or the medicolegal considerations that might appropriately prompt ED referral despite low clinical risk.

These findings align with the investigation conducted by Bier et al. (2010), wherein their analysis of 386 cases indicated that the predominant recommendation issued by the PC entailed domiciliary observation for the manifestation of clinically significant symptomatology. This evidence strongly supports the conclusion that most unintentional poisonings can be safely managed in the home environment with appropriate guidance from PCs. Pharmacological intervention was recommended in a mere 6% of encounters, underscoring the typically non-interventional nature of management for many exposures. Notably, only 63 subjects (16%) necessitated medical transport, thereby substantiating both the safety and efficacy of PC triage protocols in facilitating appropriate home management while simultaneously mitigating unnecessary healthcare resource utilisation, resulting in substantial healthcare cost savings.

Levine et al. (2017) demonstrated that implementation of the Emergency Medical Services (EMS) protocol, which mandates consultation with the regional PC preceding initial dispatch for selected cases of unintentional ingestions, was associated with statistically significant reductions in emergency resource deployments and patient transports, thereby yielding substantial cost efficiencies within the EMS system. While these cost savings are substantial, the study does not address potential delays in care that might result from mandatory PC

consultation before dispatch, nor does it examine whether certain patient populations might be disadvantaged by this protocol.

A study by Chidiac et al. (2024) examines unintentional paracetamol overdoses reported to an Australian PC, analysing trends related to demographics, dosing errors, and health impacts. Paracetamol overdoses can cause acute liver injury due to the close margin between therapeutic and toxic doses. The researchers evaluated records from individuals aged 12 and older in the New South Wales PIC from January 2017 to June 2023. A focused review of 2021 data highlighted 1,899 cases, 26.8% of which required hospitalisation. The study found a total of 14,380 dosing error cases, predominantly among women (62.6%) with a median age of 43. There was a 2.5% annual increase in such incidents. Many hospitalised patients used paracetamol for dental pain and ingested higher doses over prolonged periods. Over half of the hospitalised patients (52%) were treated with the antidote N-acetylcysteine, and 6% showed signs of liver injury. The study underscores the ongoing issue of paracetamol dosing errors, suggesting enhancements in ingredient labelling and public education on safe dosing practices to reduce related health risks.

1.5 Toxicovigilance and toxicosurveillance

Additionally, PCs can contribute to public health surveillance by collecting and analysing data on poisoning incidents, which aids in the identification of trends, risk factors, and the development of effective prevention strategies (Pujo et al. 2024). Toxicovigilance, a term that combines 'toxicology' and 'surveillance,' is a crucial and developing field that lies at the crossroads of public health, environmental science, and pharmacology (Niżnik et al. 2024). As noted by Balme et al. (2020), the implementation of telephone consultations with PC specialists to track poisoning trends has enhanced toxicovigilance while also decreasing the number of hospital visits (Chitungo et al. 2021).

The importance of PCs in toxicovigilance has been well-documented in recent literature. Boyle et al. (2024) documented the implementation of an innovative real-time surveillance mechanism utilising PC data that successfully identified an outbreak of synthetic cannabinoid poisonings. America's PCs oversee the National Poison Data System (NPDS), which aggregates de-identified exposure data submitted by all 53 PCs throughout the US. These exposure reports, which do not necessarily represent confirmed poisonings or overdoses, originate from both individual callers and HCP contacting national PCs. The practical utility of this surveillance infrastructure has been demonstrated through several epidemiological findings, including the correlation between increased cannabis exposures reported to PCs following state-level adult cannabis use legalisation (Shi and Liang 2021), as well as the documented rise in paediatric exposures to edible cannabis products between 2017 and 2019 (Whitehill, 2021).

Similarly, Hoojiman et al. (2022) examined temporal trends in opioid poisoning calls to the Swiss National PC alongside opioid sales data. Their research revealed significant increases in both PC consultations and opioid sales over the past two decades in Switzerland, primarily driven by oxycodone and tramadol, though sales have moderated since 2016. The researchers noted these patterns mirror trends in other European countries and emphasized the importance of ongoing surveillance and monitoring systems. However, the correlation between sales data and PC calls, while informative, does not establish causation. The increase in calls may reflect heightened public awareness or changes in prescribing patterns rather than solely increased problematic use.

Hondebrink et al. (2020) conducted a comprehensive national observational study examining the trends of New Psychoactive Substances (NPS) in relation to the broader recreational drug market in the Netherlands. The research utilised a triangulated methodological approach, integrating data from three complementary sources: forensic

samples, consumer samples submitted to drug-checking services, and exposure cases reported to the Dutch Poisons Information Centre (PIC). This multi-perspective analytical framework offers a uniquely holistic insight into both the national drug market dynamics and localised patterns of drug consumption within the Netherlands. By synthesising these diverse data streams, the researchers were able to elucidate the evolving landscape of NPS availability, usage patterns, and associated health implications within the context of the broader Dutch recreational drug ecosystem.

Ultimately, the WHO emphasizes that PCs are essential for enhancing patient outcomes and improving health system resilience in the face of toxicological emergencies (WHO 2020). Temporal trends in poisoning incidents offer valuable information for identifying emerging risks and evaluating the impact of preventive measures (Niżnik et al. 2024).

Giordano et al. (2021) highlight the critical role of PCs in toxicovigilance and chemical surveillance systems. The detection of increasing paediatric intoxications related to colourful laundry detergent pods through systematic monitoring by European PCs, particularly Milan PC, demonstrates the effectiveness of centralised toxicological surveillance networks in identifying emerging chemical hazards (Giordano et al. 2021). The subsequent regulatory response, EU Commission enforcement of safer packaging requirements through modification of EC regulation no. 1272/2008 (CLP), illustrates how PC surveillance data can drive evidence-based policy interventions, highlighting the essential function of these institutions in protecting public health through early hazard detection and risk mitigation strategies (Giordano et al. 2021).

Waring et al. (2007) argue that PCs serve as optimal platforms for surveillance systems due to their established local networks and specialised staff expertise. These centres are strategically positioned to detect chemical and poison release incidents, particularly valuable

in the contemporary context of heightened awareness regarding toxic exposure risks and terrorism concerns. The authors suggest that the existing infrastructure of PCs provides a foundational framework upon which toxicological surveillance activities can be effectively developed and implemented.

The study by Milella et al. (2024) focuses on medication poisoning as a common form of self-harm during pre- and post-COVID-19. The researchers conducted a retrospective analysis of calls to the PC at Poli-clinico Umberto I Hospital in Rome from January 2018 to December 2022. Findings revealed 756 cases of self-harm through medication poisoning, with a decrease in cases in 2020, followed by a return to pre-pandemic levels in 2021. A significant rise in single-agent cases was noted starting in early 2021, peaking at 7.8% in 2022 compared to 4.9% in 2018. This trend was particularly prominent among individuals aged 12 to 21, with single-agent cases increasing from 42.6% in 2018 to 78.6% in 2022. Paracetamol was the most frequently involved medication, and an increase in psychiatric backgrounds was observed in this age group. The study concludes that single-agent medication self-harm is becoming more prevalent among young adolescents with psychiatric issues in the wake of the COVID-19 pandemic. While these temporal associations are striking, the single-centre design and lack of control group limit the ability to distinguish pandemic-specific effects from broader secular trends in adolescent mental health and self-harm behaviours.

Martinez-De la Torre et al. (2020) examined the effects of 1000-mg paracetamol tablets, rather than the 500-mg tablets, on drug usage and poisoning cases in Switzerland. The study, which analysed 15,790 poisoning reports from the National Swiss PC from 2000 to 2018, highlighted a significant rise in paracetamol-related poisonings, particularly after the introduction of 1000-mg tablets on October 3, 2003. Key findings included that 67.3% of poisoning cases involved women, with an average age of 25.2 years. After the 2003

intervention, incidents of poisonings, especially accidental overdoses, increased markedly, with cases involving doses exceeding 10,000 mg rising from 15.3% to 30.6%. Additionally, sales of 1000-mg tablets saw a sharp increase, while sales of 500-mg tablets declined slightly. The study concluded that the availability of 1000-mg paracetamol tablets led to both higher sales and increased poisoning incidents, prompting recommendations to reconsider the availability of this formulation to reduce accidental overdose risks. This analysis provides compelling evidence for regulatory reconsideration, though the analysis does not account for potential confounders such as concurrent changes in healthcare access, mental health services, or other regulatory modifications during the study period.

Becker et al. (2022) investigated cocaine exposures reported to US PCs from 2000 to 2020, analysing data from the NPDS. They found 59,466 cocaine-related calls, with males accounting for 70.3% of the cases, and the highest exposure rates among individuals aged 20-29. Approximately 38.9% of cases resulted in hospital admissions, while 41.1% indicated serious medical outcomes. Individuals aged 13 and older were at greater risk for both severe outcomes and admissions, particularly when cocaine was used in conjunction with other substances. The study observed a rise in serious outcomes from 39.9% in 2000 to 60.4% in 2020, and hospital admissions increased from 49.1% to 54.4%. Moreover, there was a notable increase in fatal cocaine cases from 2012 to 2020 due to polydrug use. The authors emphasised that cocaine exposure is a significant public health concern, underscoring the need for improved prevention, treatment and surveillance strategies for high-risk populations.

Building on these findings, Becker et al. (2022) conducted a follow-up study that examined the changing patterns of cocaine co-exposures, finding a significant increase in cocaine-fentanyl combinations from 1.2% in 2015 to 18.7% in 2022. This dangerous trend was associated with a 3.4-fold increase in mortality risk compared to cocaine alone, highlighting

the evolving nature of substance use patterns and the role of PCs in identifying these emerging threats.

Similarly, Choi et al. (2020) examined trends in cannabis use among older adults (aged 50+) and its implications for PC cases using data from the US NPDS from 2009 to 2019, focusing on 5,201 cases where cannabis was the primary substance. The researchers found an 18-fold increase in cannabis-related cases in older adults, from 61 to 1,074 over the decade. Recent years saw a rise in reports of cannabis preparations other than plant forms, while the use of synthetic cannabinoids/e-cigarettes initially grew but later declined. Other cannabis preparations were linked to older age, adverse reactions, and suicide attempts but were less common in states with legal medical cannabis. Conversely, synthetic cannabinoids/e-cigarettes were more associated with male users and intentional misuse. Users of other preparations had lower chances of severe medical outcomes than plant users, whereas synthetic cannabinoid users faced higher risks of serious outcomes or death. The study highlights the growing trend of alternative cannabis use among older adults and its associated medical risks, necessitating further attention from HCPs. However, the correlation between medical cannabis legalisation and reduced problematic use requires cautious interpretation, as legalisation states may also differ in healthcare access, socioeconomic factors, and surveillance practices.

1.6 Occupational exposures

Exposure to hazardous substances in the workplace, whether acute or chronic, poses a significant public health issue (Wijnands et al. 2024). The International Labour Organization (2024) reports that over 650,000 deaths globally each year are attributable to workplace exposure to hazardous materials. PCs systematically gather data on acute occupational exposures, offering valuable insights into demographics, exposure characteristics (such as substances and routes of exposure), health effects, and treatments (Wijnands et al. 2024).

Wijnands et al. (2024) studied occupational exposures to hazardous substances reported to the Dutch PIC from January 2016 to December 2022, examining trends. The study found 5,508 reports of acute exposures, nearly doubling from 475 in 2016 to 936 in 2022. While the number of reports stabilised during and after the COVID-19 pandemic, the overall upward trend persisted. Most exposures occurred via inhalation (44%), followed by ocular (32%) and dermal contact (30%), with acids and alkalis being common agents. Among 6,334 patients, 76% reported mild to moderate symptoms, while 3% experienced potentially severe symptoms. The study underscored the urgent need for poisoning prevention strategies to mitigate work-related incidents involving hazardous substances. The apparent increase in such incidents necessitates a multidisciplinary approach to understand and address occupational exposure risks effectively.

In a recent epidemiological study, Wijnands et al. (2025) analysed 516 occupational hazardous materials incidents (2016-2023) reported to the Dutch PIC. The study revealed inhalation as the primary exposure route (89%), with fixed-facility incidents (n=447) predominantly involving gas/vapor exposures (n=421). Chemical asphyxiants and acids were the most frequent causative agents, with industrial settings accounting for 20% of cases. The authors emphasise that PCs provide critical surveillance infrastructure for identifying risk factors in occupational exposures, thereby enabling the development of targeted preventive strategies to mitigate future workplace HAZMAT incidents. Yet the reliance on voluntary reporting to PCs likely underestimates the true burden of occupational exposures, particularly mild cases that workers may manage without seeking medical advice.

1.7 The role of PC in decreasing hospital length of stay and hospital costs

PCs are essential in lowering hospital costs by offering consultations to help prevent unnecessary hospital visits and admissions, reducing the financial strain on healthcare systems while ensuring patients receive the appropriate care. PCs improve the efficiency of

healthcare expenditure and contribute to the sustainability of the healthcare system (Galvao et al. 2012). Galvao et al. (2012) argued that an investment in PCs is a rational public health policy approach that contrasts the current trend of reducing spending on PCs. Moreover, a cost-effectiveness analysis showed that each successful outcome achieved by a PC avoids a minimum of 12,000 USD to 56,000 USD in other healthcare spending (Galvao et al. 2012).

Expanding on these economic benefits, LoVecchio et al. (2008) examined the economic benefits of the Banner Poison Control Centre (BPCC) in Arizona, which serves about 4 million residents. Their research demonstrated that in 2007, BPCC managed nearly 29,000 cases at home, with 70% of these callers indicating they would have sought ED care without PC guidance. Using conservative calculations, researchers estimated BPCC prevented approximately $33 million in unnecessary healthcare charges that year. This represented a substantial return on investment, with every dollar of state funding yielding approximately $36 in prevented healthcare costs, highlighting the significant economic value PCs provide through home management of non-toxic exposures. This finding is consistent with the earlier work of Williams et al. (2012), who demonstrated that PC phone consultation was sufficient for safe management in over 70% of paediatric exposures, indicating the effectiveness of this approach across different populations and time periods. Nevertheless, the reliance on self-reported counterfactual behaviour introduces substantial recall bias and social desirability effects that may inflate estimated savings.

Farkas et al. (2022) examined how consulting a US PC affects hospital stay lengths for toxicology patients from 2010 to 2017. Analysing data from the Wisconsin Hospital Association and the Wisconsin PC, the study found 127,224 hospital cases, with 44,628 analysed for hospitalisation outcomes and costs. Results indicated that PC consultation led to an average reduction of 11.6 hours in hospital stays, with young children (0-6 years) seeing

a greater decrease of 1.18 days. While total charges were $600 higher for cases involving PCC consultation, paediatric patients' charges were significantly lower by $6,695.

Elamin et al. (2018) reported similar benefits, demonstrating that the National Poisons Information Service reduced ED referrals by 17.7% through telephone consultations and 8.1% through online guidance. Extrapolated annually, these services prevented approximately 41,000 ED visits, generating estimated savings of £6.4 million through appropriate home management of low-risk exposures (Elamin et al. 2018).

However, the study's online survey component suffered from an exceptionally low response rate of 2.7%, raising significant concerns about selection bias and the generalisability of the findings.

These findings are consistent with the earlier work of Huynh et al. (2020), who evaluated the cost savings generated by Australian PCs by minimising unnecessary healthcare use related to low-toxicity poisonings. Researchers conducted two telephone surveys: one to assess what callers might do without PC support and another to measure adherence to PC advice. Analysis of 2017 data revealed that out of 958 surveyed callers, 91% were advised to stay home, with 5% referred to hospitals and 3% to General Practitioners (GPs). An impressive 97.6% followed PC guidance. Had the PC not been available, 22% of those advised to stay home would have sought hospital care, including 3% by ambulance. With approximately 94,913 unintentional poisoning cases reported in 2017, PICs resulted in estimated savings of at least $10.1 million and demonstrated a three-fold return on investment, highlighting their effectiveness and cost efficiency in healthcare.

1.8 The role of PC in public education

PCs play a crucial role in educating the public about preventing poisoning incidents (Zuvekas et al. 1997). AB Rahman et al. (2021) explored the Malaysia National PC's role in public education about household chemical poisonings, which are the most common poisoning cases in the country. The study reported a 94% increase in poisoning incidents due to ingestion at home, highlighting the impact of demographic factors. The researchers aimed to develop a Knowledge, Attitude, and Practices (KAP) framework to better understand these poisonings, which focuses on community health and well-being. The KAP framework consists of four key dimensions: demographic variables, knowledge, attitude, and practices. This study emphasises the importance of raising awareness about household chemical product poisoning and reinforces the PC's vital role in educating the public.

Achana et al. (2015) conducted a network meta-analysis examining intervention efficacy for household poison prevention behaviours. Their findings demonstrated that combined approaches incorporating both educational components and safety equipment provision yielded superior outcomes compared to single-strategy interventions. The research underscores the pivotal role of PCs in delivering targeted educational programming, as these specialised institutions possess the toxicological expertise necessary for effective risk communication. The study suggests that PCs function as critical nodes in comprehensive poisoning prevention frameworks, particularly when their educational initiatives are integrated with tangible safety resources. This evidence supports the strategic positioning of PCs as authoritative educational entities in multi-modal approaches to reducing paediatric poisoning exposures in domestic settings.

Makalinao and Awang (2005) examine how PCs in developing countries have evolved beyond clinical functions to prioritise public education initiatives. Their analysis emphasises that effective toxicology education by PCs addresses region-specific poisoning patterns

while building local capacity. The researchers document how the Philippine and Malaysian PCs demonstrate successful educational interventions despite resource constraints. The study positions public education as a fundamental PC function, enabling preventive approaches to chemical safety through targeted knowledge dissemination. The authors conclude that collaborative educational networks between regional PCs facilitate the sharing of pedagogical resources and expertise, thereby establishing sustainable public education frameworks that respond to distinct toxicological challenges in developing Asian nations.

Additionally, social media platforms play a crucial role in PCs by enhancing public education, crisis communication, and direct engagement with communities (Vo and Smollin 2015). The MNPC established its official Facebook and Instagram pages on July 24, 2024. Its inaugural post introduced the MNPC's free helpline, 1774, a service dedicated to providing professional advice and assistance. These social media platforms help spread awareness about toxic substances, provide real-time alerts during emergencies, and monitor emerging poisoning trends (Vo and Smollin 2015).

Gussow (2015) explores the strategic implementation of social media by a PC to enhance public health communication and outreach. Given the increasing tendency of individuals, particularly caregivers of young children, to seek immediate health-related information online, the PC established an active presence on social media platforms such as Facebook and Twitter. The initiative aimed to disseminate evidence-based poison prevention information, address common toxicological concerns, and mitigate the spread of misinformation. Key engagement strategies included the use of educational content, anonymised case examples to illustrate real-world scenarios, and a conversational, occasionally humorous, tone to enhance accessibility and user engagement. The study underscores the role of social media as a valuable extension of traditional PC services,

facilitating real-time interaction with the public and improving the dissemination of accurate toxicology-related information.

PCs also use social media to collaborate with healthcare professionals. On March 28, 2025, the MNPC collaborated with the Maltese Emergency Nurses' Association, a non-government organization responsible for providing education to emergency nurses, to promote preventative measures and increase awareness of helpline services. By leveraging these platforms effectively, they can improve public safety, prevent poisonings, and ensure timely access to life-saving information.

This collaborative approach aligns with best practices identified by Pomerleau et al. (2014) who documented improved outcomes when PCs established formal partnerships with professional healthcare organisations. Pomerleau et al. (2014) highlight the essential role of PCs in radiation emergency preparedness, noting their expertise in toxicology, public communication, and crisis response. The authors emphasise that effective response to radiological incidents requires stronger collaboration between PCs, public health agencies, emergency management organisations, and radiation control programs. Without formal partnerships and coordinated planning, the full potential of PCs in emergency preparedness may not be realised.

1.9 Poisoning Severity Score

One metric that has gained prominence in this regard is the Poisoning Severity Score (PSS), a tool that is used to quantify the severity of poisoning incidents. The PSS is a simple grading system developed by the European Association of Poison Centres and Clinical Toxicologists (EAPCCT), designed to assess the severity of poisoning based on clinical signs and symptoms (Persson et al. 1998). It uses a scale from 0 to 4, where a score of 0 indicates asymptomatic status, 1 denotes minor effects, 2 indicates moderate symptoms, 3 signifies

severe poisoning, and 4 is assigned in cases of death. The score considers factors such as symptoms, vital signs, laboratory results, and clinical outcomes, providing an assessment of poisoning severity. The PSS enables standardised documentation of poisoning incidents, facilitates communication among health care workers, and aids in prioritising resource allocation and medical interventions. It also acts as a standardised comparator across different studies

The study by Çaliskan et al. (2021) examines the effectiveness of the PSS alongside the Glasgow Coma Scale Score (GCS) for predicting outcomes in children with acute poisoning. The GCS, which evaluates consciousness and neurological function through eye-opening, motor, and verbal responses (Andraos et al. 2025), serves as a complementary assessment tool in this predictive framework. Conducted through a retrospective review of 222 patients under 18 years admitted to the paediatric ED of Ondokuz Mayıs University, Turkey in 2018, the research found that 66.7% of the patients were female, with a mean age of 8.8 years. The PSS classification indicated that 37.4% of cases were asymptomatic, 38.7% minor, 21.6% moderate, and 1.8% severe. The study highlights that combining PSS with biochemical and physiological assessments can enhance the diagnostic accuracy and severity evaluation in paediatric poisoning cases, leading to better management and prognostic outcomes.

1.10 Conclusion

Examining international studies deepens our understanding of drug overdoses and poisonings as critical global public health issues. The analysis of PC call data reveals important trends in poison exposures, including demographics, substances, and routes of exposure. This information is useful for identifying high-risk groups and common toxins, which can guide public health strategies. The review emphasises the vital role of PC in

tracking toxic exposures, supporting clinical responses, and raising community awareness about substance hazards. Ongoing research is crucial for improving response protocols and reducing the public health consequences of poisoning incidents.

As evidenced by the literature presented epidemiological investigation holds particular significance as it offers an opportunity to analyse and derive insights from the local context. Comparative studies have demonstrated substantial variation in poisoning typologies and caller demographics across PCs worldwide (Khoja et al. 2024, Mullins 2024, Gummin et al. 2020). To optimise the quality and relevance of the MNPC's advisory services, a thorough analysis of these incoming telephone poison consultations is imperative (WHO 2023). Through systematic evaluation of the characteristics and severity of regional poisoning incidents, the MNPC can implement targeted preventive interventions, refine poison management protocols, and enhance patient outcomes (Niżnik et al. 2024). Moreover, analysis of incoming calls will inform the ongoing development and refinement of MNPC services (Alharbi et al. 2025, Nicholls 2022).

The overall aim of the present study is to determine the nature of the calls received by the MNPC since its inception, 29th of October 2023 to May 31st, 2025.

Specific objectives:

- To establish an anonymised database documenting the calls received by the MNPC
- To conduct a comparative analysis between the calls initiated by HCPs and those originating from the public
- To examine the demographic characteristics of individuals involved in poisoning exposures and those who initiated contact with the MNPC
- To compare the frequency of calls related to intentional versus unintentional poisoning exposures

- To identify the predominant substances implicated in poisoning incidents reported to the MNPC
- To evaluate the PSS of the calls received by the MNPC
- To provide a detailed epidemiological profile of poisoning exposures since the establishment of the MNPC
- To assess the MNPC service and guide improvements in care provision

The upcoming Methodology chapter will provide a detailed overview of the research setting, design, data collection and management, analysis methods, and ethical considerations implemented throughout the study.

CHAPTER 2

Methodology

2.0 Introduction

This chapter outlines the research methodology employed in this study, including the rationale for methodological choices, data collection procedures, analytical approaches, and ethical considerations. The primary research utilised a retrospective quantitative analysis of anonymised call-log data from the MNPC. A detailed justification for the selected methods is provided, alongside the ethical framework that guided this investigation, which encompasses both compliance with data protection regulations and adherence to institutional approval processes.

With respect to its operational structure, the MNPC functions daily, including weekends and public holidays, from 08:00 to 20:00. Outside these hours, calls are redirected to the 112 helpline or to Telemedicine services, which subsequently notify the toxicologist on call, contingent on whether the HCP elects to request toxicological consultation. All HCPs working within the MNPC are authorised to respond to toxicology-related calls upon completion of the Centre's in-house training programme. In managing enquiries, staff utilise specialised online toxicology databases, including TOXBASE®, Micromedex, and Therapeutic Guidelines, to retrieve evidence-based information on poisons. Regarding documentation procedures, MNPC personnel record all case-related data directly into the centre's electronic Poisons Information Database (PID). The PID system was derived from the National Poisons Information Service in Edinburgh, Scotland, providing a standardised framework for documentation and data management aligned with international poison centre best practices.

2.1 Research setting and design

The research methodology adopted for this study involved the analysis of call-log data extracted from the PID maintained by the MNPC. Prior to obtaining ethical clearance, necessary approvals were obtained from the former Director General for Healthcare Services at the Ministry for Health and the data controller for the MNPC (Appendix 1). Ethical clearance was subsequently obtained from the Medical School Faculty Research and Ethics Committee (FREC), University of Malta (reference: MED-2024-00078, approved 12/09/2024) prior to data access (Appendix 2).

The dataset comprised retrospective records of poison exposure incidents reported to the MNPC between October 2023 and May 2025, which had been anonymised through a secure third-party intermediary (Appendix 3) to ensure patient confidentiality. The analysed data encompassed multiple variables including caller demographics, poison agent classifications, exposure severity assessments, and documented clinical outcomes. All patient information was systematically de-identified using a coding protocol approved by FREC and securely stored in password-protected Microsoft Excel files throughout the research duration. This methodological approach aligned with established practices in international PC research (Milella et al. 2023, Parekh and Gupta 2019, Kumpula et al. 2023, Kumpula et al. 2021, Hooijman et al. 2022), enabling identification of patterns in poisoning incidents and characterisation of commonly implicated toxic substances within the local Maltese context. The study maintained strict adherence to ethical research standards and General Data Protection Regulation guidelines, ensuring comprehensive protection of patient anonymity and data security.

2.2 Inclusion and exclusion criteria

The following inclusion and exclusion criteria were set to ensure the integrity of the data within this study:

Inclusion criteria: All incoming calls received by the MNPC related to poison exposure.

All the calls related to both adult and paediatric poisoning.

Exclusion criteria: All the calls originating outside Malta and Gozo were excluded.

Follow-up outgoing calls made by the MNPC staff.

Non-toxicology-related inquiries. Some examples of such non-toxicology-related calls included the request for information regarding the proper disposal of empty nitrous oxide containers discovered in a rental property, and an inquiry regarding the safety of consuming charred baked pasta.

2.3 Data collection

Only incoming calls were included in the dataset. Follow-up outgoing calls made by the MNPC staff were not analysed, as the focus of this study was on the initial contact and reporting of poisoning exposures. Outgoing calls were excluded because they did not represent new poisoning cases and primarily related to ongoing management rather than new exposure events. Furthermore, during data verification, no instances were identified in which the MNPC received multiple calls from the same individual regarding the same poisoning case.

In this study, the terms 'poison exposure,' 'poisoning,' and 'overdose' encompass calls made to the MNPC related to intentional, accidental, supratherapeutic, or recreational exposures

to one or more substances. These situations may result in potential toxicity and symptomatology, occasionally necessitating medical and/or psychological evaluation. Research conducted internationally has similarly analysed data from PCs to identify patterns and trends in poison exposure (Parekch and Gupta 2019, Tangiisuran et al. 2018, Ghane et al. 2013). The classification of the different types of poisoning agents was adopted from similar studies by Gummin et al. (2023) and Huynh et al. (2018) which cover a wide range of poisoning substances including pharmaceuticals, household agents, industrial agents, garden and agricultural agents, vitamins and supplements, natural toxins, foreign bodies, gases, fumes and vapours, recreational drugs, veterinary agents and miscellaneous agents. The information collected covered a range of valuable information including:

- Caller's gender
- Whether the call was made by a HCP or the public
- Location of the caller included: Health Centres (HC), Hospitals (MDH, Private Hospitals, Mount Carmel Psychiatry Hospital, Gozo General Hospital (GGH), and Saint Vincent De Paul (SVP) Long Term Care Facility), Private GP Clinics, Community Pharmacies, Private Residences and Care Homes.
- Date and time log of the call, including calls which were received by the Clinical Toxicologists on-call outside office hours (from 20:00 till 07:59)
- The gender, age and place of residence of the individual exposed to the poison
- The location where the poisoning took place (Home/Private Residence, Work, Non-residence/Non-work/Other, Hospital or Unknown)
- The nationality of the individual experiencing poisoning exposure
- The intention of the poisoning exposure (accidental, deliberate, recreational, therapeutic excess, iatrogenic and other)

- The number of agent/s involved and their classification according to Toxbase and the British National Formulary
- Co-ingestions with alcohol
- Drug-route of administration (oral, inhalation, parenteral, other, mixed routes and unknown)
- Patient management (administration of an antidote, the need of intubation and intensive care)
- Whether the medical toxicologist on-call was informed about the case
- Patient disposition (managed and observed at home, referred for medical assessment at either the HC or the ED, discharged from the ED from a toxicological-point-of-view, the need for further hospital observation and discharged against medical advice (DAMA)
- The PSS of the calls received by the MNPC

Lastly, a systematic verification process was conducted through random cross-referencing with the original case data to ensure accurate correspondence between PID numbers and their respective anonymised case identifiers.

2.4 Validity and reliability

Moreover, measures of validity and reliability were integral to the methodological design. Validity was supported by the MNPC's reliance on established, peer-reviewed toxicology resources, TOXBASE, Micromedex, and Therapeutic Guidelines, when providing clinical advice. These databases are continuously updated and based on expert toxicological

consensus, thereby reinforcing the accuracy and credibility of the information recorded in the MNPC database and subsequently used for analysis.

Reliability was enhanced through the structured documentation processes employed by MNPC staff. Direct entry of case data into the electronic database minimises the risk of transcription errors, while standardised data-entry procedures promote consistency across cases. Such uniformity in documentation supports the reproducibility and integrity of the dataset, ensuring that findings derived from the analysis are methodologically robust.

2.5 Method of data analysis

The data analysis for this investigation was conducted using the IBM® SPSS® Statistics (Statistical Product and Service Solutions) (SPSS) software version 29, employing primarily descriptive statistical methods to address the research objectives. Prior to starting analysis, the data was checked and cleaned to ensure the integrity of the data and veracity of ensuing results.

Given the exploratory nature of this study and the aim to provide an epidemiological profile of calls received by the MNPC, descriptive analytics were deemed most appropriate for characterising the dataset and identifying patterns within the poisoning exposure data. The analytical approach encompassed the calculation of frequencies, percentages, and measures of central tendency to examine the distribution of variables across different categories. Cross-tabulations were performed to facilitate comparative analyses between calls initiated by HCPs versus those originating from the public. Demographic characteristics of both poisoning exposure victims and callers were analysed through frequency distributions and descriptive summaries to identify predominant patterns and trends. Categorical variables,

including caller type, intentionality of exposure, substance categories, and demographic characteristics, were analysed using frequency tables and percentages. The PSS distribution was examined through descriptive statistics to evaluate the severity profile of reported cases. Temporal analysis was conducted to assess call patterns since the MNPC's establishment, providing insight into service utilisation trends over time.

This descriptive analytical framework enabled the systematic characterisation of the MNPC call database while addressing each of the specified research objectives, ultimately contributing to an understanding of the nature and characteristics of poisoning exposures reported to the service.

In addition to descriptive statistics, 95% confidence intervals were calculated for key proportions within the dataset, including caller type, poisoning intention, substance categories, and PSS classifications. Confidence intervals were used to quantify the precision of these estimates and to provide a range within which the true population parameter is expected to lie. Their inclusion enhances interpretation by reflecting the degree of uncertainty inherent in retrospective call-log data, particularly for subgroups with lower frequencies. Narrower intervals indicate greater precision and stability of the observed estimates, whereas wider intervals reflect increased variability within the data. The application of confidence intervals therefore strengthens the epidemiological characterisation of poisoning exposures reported to the MNPC by providing a clearer assessment of the reliability of the proportions derived from the dataset.

2.6 Chi-Square Test

The Chi-square test was selected as the primary statistical method due to its appropriateness for analysing associations between categorical variables within the dataset. The null

hypothesis states independence between the two categorical variables and is retained when $p>0.05$. Conversely, the alternative hypothesis indicates a significant association between the variables and is accepted when $p<0.05$ (McDonald 2014). This non-parametric test provides a robust framework for determining whether observed relationships between variables represent statistically significant associations or occur due to random variation, thereby ensuring methodological rigor in the analysis of demographic and attitudinal variables central to this research.

2.7 Ethical Considerations

This research was conducted in accordance with established ethical principles and guidelines to ensure the protection of participant welfare and data integrity. Given the sensitive nature of poison control data and the vulnerability of individuals seeking emergency toxicological assistance, particular attention was devoted to maintaining rigorous ethical standards throughout all phases of the investigation. The following ethical considerations were strictly observed throughout this research:

Confidentiality: All data acquired from the MNPC's electronic database underwent anonymisation by the designated data intermediary to safeguard caller and patient confidentiality. Personal identifiers were systematically removed or encoded to preclude individual identification by the data intermediary. Neither the data intermediary nor the principal investigator retained any personal information obtained during data collection, with such details being permanently destroyed upon completion of the coding and anonymisation process.

Beneficence: The fundamental objective of this investigation was to enhance poison management protocols and improve patient care services delivered by the MNPC. Through

the identification of trends and areas requiring improvement, this study endeavoured to benefit both current and prospective MNPC service users.

Non-maleficence: Appropriate measures were implemented to ensure that the evaluation methodology did not inflict harm or distress upon callers or patients. Data analysis was conducted with appropriate sensitivity, and any potentially distressing findings were managed with due consideration.

Data Security: The research team maintained strict adherence to data security protocols to prevent unauthorised access or disclosure of sensitive information. Data were stored in secure environments and accessed exclusively by authorised personnel directly involved in the study.

2.8 Conclusion

This methodology chapter has outlined the research framework employed to investigate the nature and characteristics of calls received by the MNPC since its establishment. The quantitative research design, utilising retrospective analysis of anonymised MNPC data, provides an appropriate methodological foundation to address the stated research objectives and aim of the study. The methodological procedures detailed in this chapter establish the foundation for generating reliable and valid findings that will contribute to the understanding of poisoning epidemiology in Malta. The descriptive analytical approach will enable the systematic examination of caller demographics, exposure characteristics, substance categories, and severity profiles, thereby addressing each of the specified research objectives. The implementation of this methodology will facilitate the creation of an epidemiological profile of poisoning exposures reported to the MNPC. The findings derived

from this methodological framework will be presented and discussed in detail in the following chapter, Chapter 3.

CHAPTER 3

Results

3.0 Introduction

This chapter presents the findings from the thorough analysis of call-log data obtained from the MNPC database. The analysis encompasses the complete dataset from the centre's inception in October 2023 through May 2025, providing an epidemiological profile of poisoning exposures reported to the service during this 19-month operational period (Figure 3.1).

Since its establishment on October 29th 2023 until May 31st 2025, the MNPC received a total of 660 calls. Of these, 654 calls were related to toxicological exposures and met the inclusion criteria for this study, while 6 calls were excluded as they involved non-toxicology-related inquiries. The analysed dataset therefore comprises 654 toxicology-related calls, representing all poison exposure incidents reported to the MNPC during the study period.

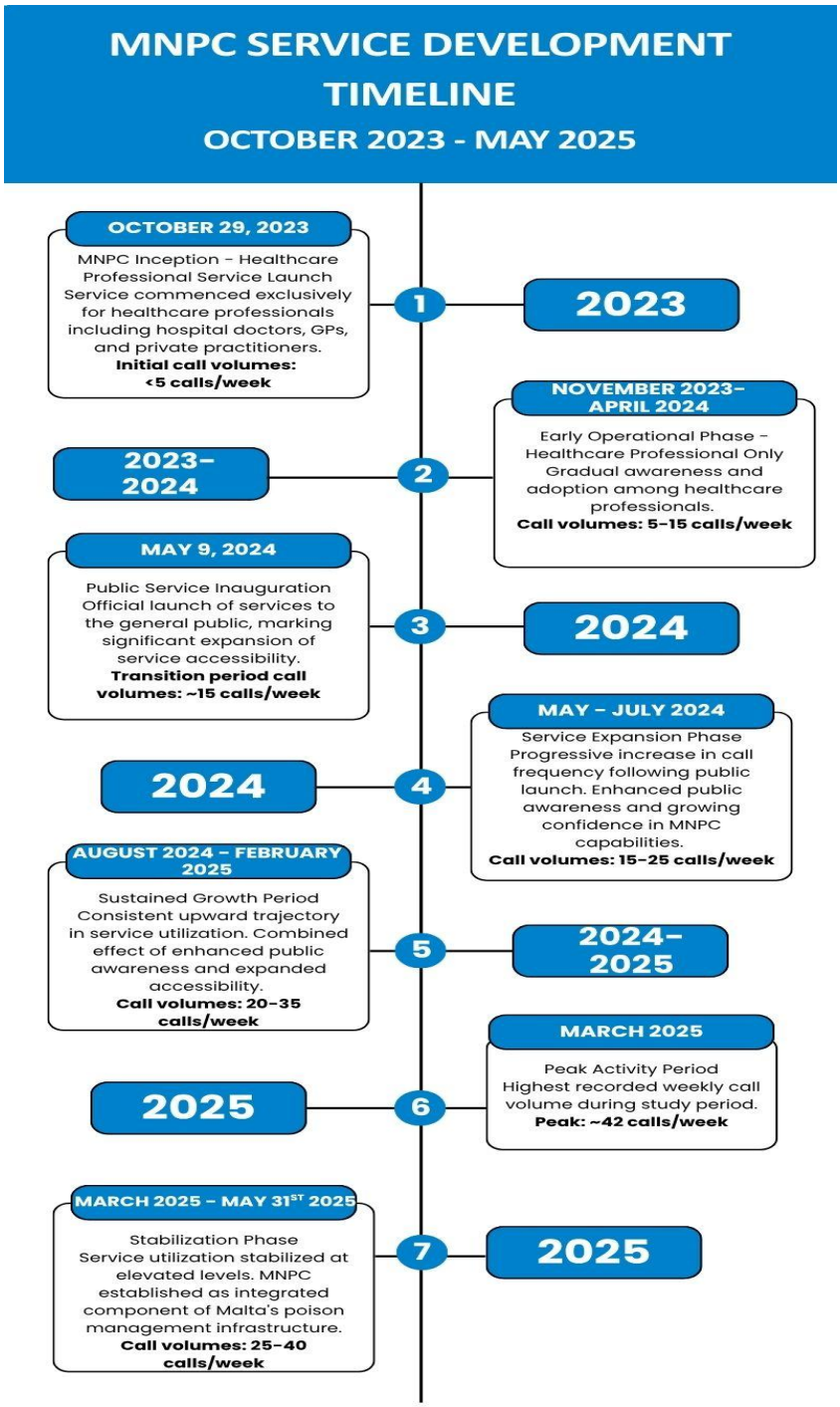


Figure. 3.1. MNPC Service development timeline

The results are presented systematically to address each of the research objectives, beginning with an overview of call distribution patterns and caller demographics, followed by detailed analysis of exposure characteristics, substance categories, severity profiles, and temporal trends. Cross-tabulations between HCP and public caller groups are provided where relevant to identify differences in service utilisation patterns.

The findings presented in this chapter represent the first in-depth analysis of poisoning exposure data collected by the MNPC and contribute significantly to the understanding of toxicological epidemiology in the Maltese healthcare context.

3.1 Characteristics of the calls

3.1.1 Frequency of calls to the MNPC since its inception

Figure 3.2 illustrates the weekly call frequency patterns received by the MNPC throughout the 19-month study period. The data reveals a progressive increase in service utilisation

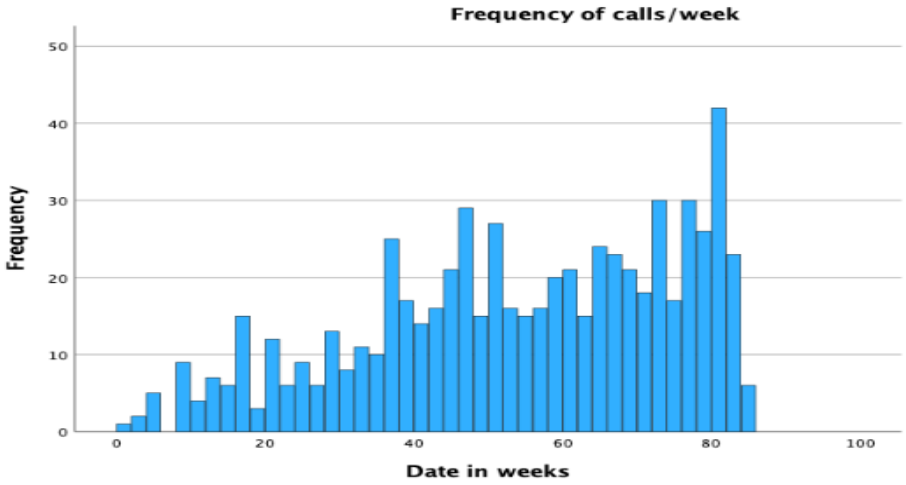


Figure. 3.2. Number of calls since the inception of the MNPC.

following the centre's establishment, with call volumes demonstrating considerable weekly variation. The initial operational phase was characterised by relatively low call frequencies, with fewer than 10 calls per week during the first several weeks of operation. A notable upward trajectory in service utilisation became evident from approximately week 20 onwards, with call volumes gradually increasing and stabilising at higher levels. Peak activity occurred around week 80, where weekly call frequency reached approximately 42 calls, representing the highest single-week volume recorded during the study period. The distribution pattern suggests a maturation phase in service awareness and utilisation, with HCPs and the public gradually becoming more familiar with the MNPC's services over time. The substantial variation in weekly call volumes reflects the episodic nature of poisoning incidents and potential seasonal or circumstantial factors influencing exposure patterns. Following the peak period, call frequencies demonstrated some decline but remained elevated compared to the initial operational months, suggesting establishment of the MNPC as a recognised resource within Malta's healthcare infrastructure.

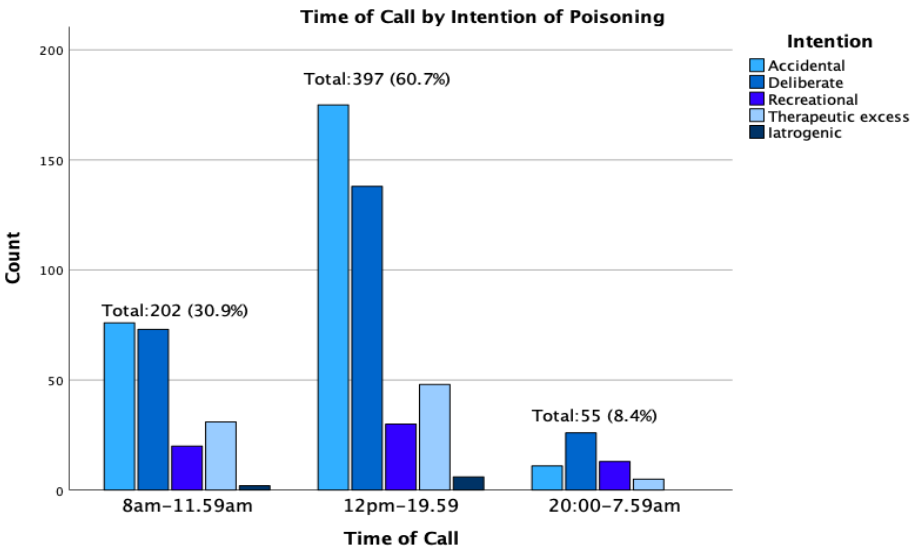


Figure. 3.3. Temporal distribution by time of day and exposure intent

3.1.2 Calls according to time groupings

Figure 3.3 illustrates the distribution of calls received across three distinct time periods, stratified by the intention underlying each poisoning exposure. The selection of 4-hour and 8-hour intervals reflects established practices in the literature, where similar temporal groupings are commonly employed to enable methodological consistency and facilitate comparison across studies (Abubaker et al. 2020, Salem et al. 2024) The resulting analysis demonstrates clear variations in both call volume and exposure patterns over the course of the day. The analysis reveals marked variations in both call volume and exposure patterns throughout the day. The peak calling period occurred during standard working hours (12pm-19:59), accounting for the highest volume of calls across all exposure categories. During this timeframe, accidental exposures represented the predominant category with 175 calls, followed by deliberate exposures at 135 calls. Morning hours (8am-11:59am) exhibited a moderate call volume, with accidental and deliberate exposures showing similar frequencies of approximately 70 calls each. Recreational exposures appeared consistently across all time periods but remained relatively infrequent compared to other categories. Out-of-hours calls (20:00-7:59am) demonstrated the lowest overall volume yet maintained a concerning pattern of higher deliberate exposures (chi-square = 25.3, df = 8, p <0.001); Table 3.1)) as compared to other exposure types during this period. Iatrogenic exposures and other miscellaneous categories represented minimal proportions across all time periods.

Table 3.1 Time period vs intention of poisoning

Time Period	Accidental	Deliberate	Recreational	Therapeutic Excess	Iatrogenic	Total	*p-value*
8:00am - 11:59am	76 (29%)	73 (30.8%)	20 (31.7%)	31 (36.9%)	2 (25%)	202 (30.9%)	0.001
12:00pm - 7:59pm	175 (66.8%)	138 (58.2%)	30 (47.6%)	48 (57.1%)	6 (75%)	397 (60.7%)	
8:00pm - 7:59am	11 (4.2%)	26 (11%)	13 (20.6%)	5 (6%)	0 (0%)	55 (8.4%)	
Total	262 (100%)	237 (100%)	63 (100%)	84 (100%)	8 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square.

3.1.3 Profiles of callers

Table 3.2 presents the demographic profile of callers to the MNPC during the study period (N=654). HCPs constituted most callers, accounting for 501 calls (76.6%), while members of the public initiated 153 calls (23.4%).

Table 3.2: Demographic characteristics of callers (N=654)

Characteristic	N (%)
Caller type	
Healthcare professional	501 (76.6%)
General Public	153 (23.4%)
Caller Gender	
Male	267 (40.8%)
Female	373 (57%)
Unknown	14 (2.1%)
Caller Location	
Primary healthcare	80 (12.2%)
Hospital incl. SVPR	404 (61.8%)
Private GP Clinic	3 (0.5%)
Community Pharmacy	3 (0.5%)
Private Residence	134 (20.5%)
Care home	6 (0.9%)
Private hospital	1 (0.2%)
Mount Carmel Hospital	3 (0.5%)
Gozo General Hospital	20 (3.1%)

*Statistical test used: Pearson's Chi-square

Gender analysis revealed a female predominance among callers, with 373 calls (57.0%) originating from female callers compared to 267 calls (40.8%) from male callers. Among

HCPs, the gender distribution was relatively balanced, with 262 female healthcare workers (52.3%) and 225 male healthcare workers (44.9%) contacting the MNPC. Female callers were significantly more prevalent among the public compared to HCPs (Table 3.3.1; chi-square = 21.5, df =2, p<0.001). Since the calls from unknown gender were all from the HCP group, which might have affected the significance of the gender difference, the analysis was conducted again after removing the unknown group (Table 3.3.2). This confirmed that there was still a strong significant difference between genders amongst public callers being mostly of the female gender.

Table 3.3.1: Gender distribution by caller type (Health Care Professional or General Public)

Caller Gender (All participants):	Caller Type:			
	HCP	Public	Total	*p-value*
Male	225	42	267	<0.001
Female	262	111	373	
Unknown	14	0	14	
Total:	501	153	654	

*Statistical test used: Pearson's Chi-square

A chi-square test of independence (Table 3.3.2) revealed a statistically significant association between gender and professional status (chi-square = 16.8, df = 1, p < 0.001). HCPs had a more balanced gender distribution (44.9% male, 55.1% female), while the public sample was predominantly female (27.5% male, 72.5% female).

Table 3.3.2: Gender distribution by caller type (Health Care Professional or General Public)				
Caller Gender (Only Male/Female Participants)	Caller Type:			
	HCP	Public	Total	*p-value*
Male	225	42	267	<0.001
Female	262	111	373	
Total:	501	153	640	

*Statistical test used: Pearson's Chi-square

The geographical distribution of caller locations demonstrated that hospital settings, including SVP, generated the highest call volume with 404 calls (61.8%), followed by private residences at 134 calls (20.5%). There were notable patterns in gender distribution across different healthcare and community settings (Table 3.4). Calls from the Primary Health Care and from Private Residences were more likely to be from the female gender (63.8% and 70.1% respectively), however overall, this association did not reach statistical significance (P> 0,05) (Table 3.4).

Table 3.4. Caller gender distribution by caller location											
	Location of Call										
	Primary Health	Hospital (incl. SVP)	Private GP Clinics	Community Pharmacies	Private Residence	Care Homes	Private Hospitals	MCH	GGH	Total	*p-value*
Male	27 (33.8%)	181 (44.8%)	2 (66.7 %)	1 (33.3%)	40 (29.9%)	1 (16.7 %)	1 (100.0 %)	2 (66.7 %)	12 (60 %)	267	0.065
Female	51 (63.8%)	211 (52.2%)	1 (33.3%)	2 (66.7%)	94 (70.1%)	5 (83.3 %)	0 (0%)	1 (33.3 %)	8 (40 %)	373	
Unknown	2 (2.5%)	12 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	14	
Total	80	404	3	3	134	6	1	3	20	654	

*Statistical test used: Pearson's Chi-square

3.2 The profile of the individuals exposed to poisons

3.2.1 Patient demographics and characteristics

Table 3.5: Patient demographics and characteristics (N=654)	
Characteristics	N (%)
Gender:	
Male	332 (50.8)
Female	320 (48.9)
Unknown	2 (0.3)
Age Groups:	
<5 years	107 (16.4)
5-9 years	23 (3.5)
10-19 years	61 (9.3)
20-29 years	93 (14.2)
30-39 years	114 (17.4)
40-49 years	75 (11.5)
50-59 years	59 (9)
60-69 years	56 (8.6)
>70 years	62 (9.5)
Unknown	4 (0.6)
Nationality:	
Maltese Residents	467 (71.4)
Non-Maltese Residents	185 (28.3)
Unknown	2 (0.3)
District (Patient Residence):	
Southern Harbour	121 (18.5)
Northern Harbour	218 (33.3)
Southeastern	84 (12.8)
Western	67 (10.20)
Northern	112 (17.1)
Gozo/Comino	28 (4.3)
Unknown	24 (3.7)
Location of Poisoning:	
Home/Private Residence	559 (85.5)
Work	12 (1.8)
Other	65 (9.9)
Hospital	14 (2.1)
Unknown	4 (0.6)

*Statistical test used: Pearson's Chi-square

Table 3.5 presents the demographic characteristics of patients involved in poisoning exposure incidents reported to the MNPC (N=654). The gender distribution among patients demonstrated near-perfect equilibrium, with males representing 332 cases (50.8%) and females accounting for 330 cases (48.9%). Gender information was unavailable for only 2 cases (0.3%).

3.2.2 Age distribution of the persons exposed to a poison

The age distribution of patients involved in poisoning exposures demonstrates distinct patterns across different age groups (Table 3.5). Adults aged 30-39 years represented the largest single age group with 114 cases (17.4%). Children under 5 years represented the second largest single age group, accounting for 107 cases (16.4%), whilst children aged 5-9 years were the least common age group amongst all age groups (23 calls, 3.5%). There was no difference between genders across the age groups (Table 3.6, chi-square 13.1, df=18, p>0.05).

Table 3.6. Age groups by gender

Gender	Age Groups											
	<5 years	5-9 years	10-19 years	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years	70+ years	Unknown	Total	*p-value*
Male	62 (57.9%)	11 (47.8%)	30 (49.2%)	47 (50.5%)	60 (52.6%)	40 (53.3%)	28 (47.5%)	22 (39.3%)	29 (46.8%)	3 (75%)	**332 (50.8))**	**0.784**
Female	44 (41.1%)	12 (52.2%)	31 (50.8%)	46 (49.5%)	54 (47.4%)	34 (45.3%)	31 (52.5%)	34 (60.7%)	33 (53.2%)	1 (25%)	**320 (48.9)**	
Unknown	1 (0.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**2 (0.3)**	
Total	107 (100%)	23 (100%)	61 (100%)	93 (100%)	114 (100%)	75 (100%)	59 (100%)	56 (100%)	62 (100%)	4 (100%)	**654 (100%)**	

*Statistical test used: Pearson's Chi-square

3.2.3 Patient nationality

The nationality profile of patients reveals that Maltese residents comprised most poisoning exposure cases, accounting for 467 incidents (71.4%). Non-Maltese residents represented 185 cases (28.3%), while nationality information was unavailable for only 2 cases (0.3%). There was a statistical difference between age groups according to nationality (Table 3.7; chi-square = 144.0, df=18, p<0.001). Maltese were the most common in all age groups, especially in the 70+ year age group (95.2%), however the 20-49 years age group demonstrated the greatest nationality diversity within the caller population, with non-Maltese individuals comprising a substantially higher proportion compared to other age groups (Table 3.7). In the 20-29 years age group, nearly half (47.3%) were non-Maltese.

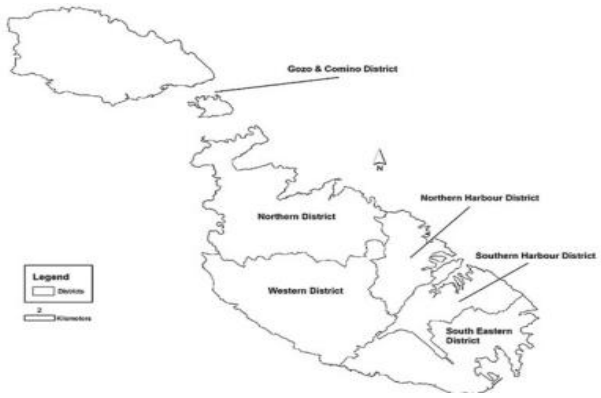
Table 3.7. Age groups by nationality

Nationality	<5 years	5-9 years	10-19 years	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years	70+ years	Unknown	Total	*p-value*
Maltese	77 (72%)	20 (87%)	42 (68.9%)	49 (52.7%)	70 (61.4%)	47 (62.7%)	51 (86.4%)	50 (89.3%)	59 (95.2%)	2 (50%)	**467**	**<0.001**
Non-Maltese	30 (28%)	3 (13%)	19 (31.1%)	44 (47.3%)	44 (38.6%)	27 (36%)	8 (13.6%)	6 (10.7%)	3 (4.8%)	1 (25%)	**185**	
Unknown	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.3%)	0 (0%)	0 (0%)	0 (0%)	1 (25%)	**2**	
Total	**107**	**23**	**61**	**93**	**114**	**75**	**59**	**56**	**62**	**4**	**654**	

*Statistical test used: Pearson's Chi-square

3.2.4 Patients' place of residence by district

The geographic distribution of patients by district of residence reveals significant variation in poisoning exposure patterns across Malta's administrative regions (Table 3.5, Figure 3.4).



Districts:

1 – Southern Harbour

2 – Northern Harbour

3 – Southeastern

4 - Western

5 – Northern

6 - Gozo & Comino

Figure. 3.4. The six districts of Malta, adapted from Bajada, Satariano and Chavoshi, 2024

The Northern Harbour district demonstrated the highest incidence with 218 cases (33.3%), followed by the Southern Harbour district with 121 cases (18.5%). These two harbour districts combined accounted for over half (51.8%) of all reported exposures. While most other districts show either relatively balanced gender distributions or slight male majorities (ranging from 44-58% male), District 4 stands out as the only district with a clear female predominance (74.6%) (Table 3.8; chi-square = 39.3, df = 12, $p<0.001$, Figure 3.5).

Table 3.8. District by gender

Gender	District 1	District 2	District 3	District 4	District 5	District 6	District Unknown	Total	*p-value*
Male	67 (55.4%)	122 (56%)	48 (57.1%)	17 (25.4%)	50 (44.6%)	14 (50%)	14 (58.3%)	332 (100%)	<0.001
Female	53 (43.8%)	96 (44%)	36 (42.9%)	50 (74.6%)	62 (55.4%)	14 (50%)	9 (37.5%)	320 (100%)	
Other	1 (0.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (4.2%)	2 (100%)	
Total	121 (100%)	218 (100%)	84 (100%)	67 (100%)	112 (100%)	28 (100%)	24 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

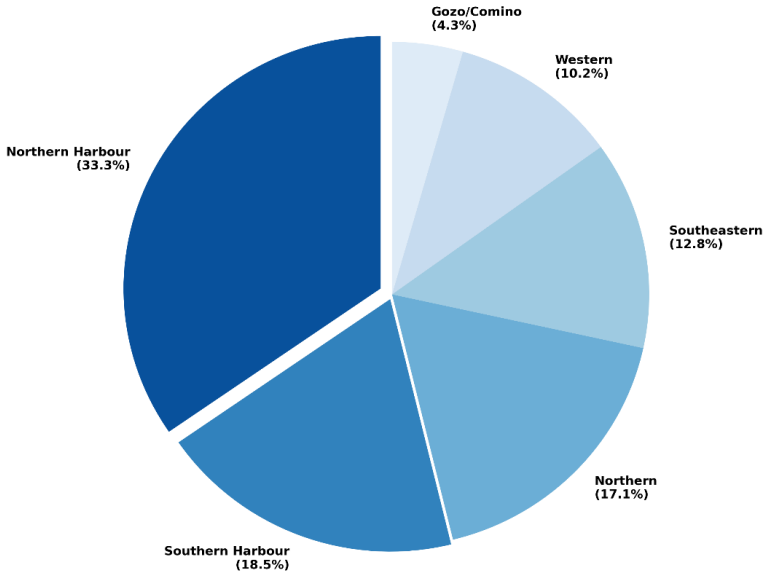


Figure. 3.5 Geographic distribution of poisoning exposures by district

3.2.5 Location of poisoning exposure

The location where poisoning exposures occurred demonstrates a pronounced concentration within domestic settings (85.5%), (Table 3.5). Workplace exposures were relatively infrequent, with only 12 cases (1.8%) occurring in occupational settings. There was no statistical difference between gender and location of poisoning (chi-square=3.3, df=8, p>0.05 (Table 3.9).

Table 3.9. Gender distribution by location of poisoning exposure

Gender	Private Residence	Work	Other	Hospital	Unknown	Total	*p-value*
Male	280 (50.1%)	9 (75.0%)	34 (52.3%)	7 (50.0%)	2 (50.0%)	332 (50.8%)	0.915
Female	277 (49.6%)	3 (25.0%)	31 (47.7%)	7 (50.0%)	2 (50.0%)	320 (48.9%)	
Unknown	2 (0.4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (0.3%)	
Total	559 (100%)	12 (100%)	65 (100%)	14 (100%)	4 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

There was however a highly significant association between patient age and the location of poisoning exposure (chi-square = 112.0, df=36, p < 0.001; Table 3.10). Young children demonstrated overwhelming concentration in domestic settings, with children under 5 years showing 102 home exposures (95.3%) out of 107 total cases, and children aged 5-9 years recording 22 home exposures (95.7%) out of 23 cases (Table 3.10). Older adults similarly demonstrated high rates of home-based exposures, with individuals aged 50 and more having around 90% of exposures at home (Table 3.10).

Table 3.10. Location of poisoning exposure by age groups

Location	<5 years	5-9 years	10-19 years	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years	>70 years	Unknown	Total	*p-value*
Private Residence	102 (95.3%)	22 (95.7%)	54 (88.5%)	69 (74.2%)	86 (75.4%)	62 (82.7%)	53 (89.8%)	52 (92.9%)	57 (91.9%)	2 (50%)	559	<0.001
Work	0 (0%)	0 (0%)	0 (0%)	2 (2.2%)	5 (4.4%)	1 (1.3%)	2 (3.4%)	1 (1.8%)	0 (0%)	1 (25%)	12	
Other	4 (3.7%)	1 (4.3%)	5 (8.2%)	20 (21.5%)	16 (14.0%)	11 (14.7%)	4 (6.8%)	3 (5.4%)	1 (1.6%)	0 (0%)	65	
Hospital	1 (0.9%)	0 (0.0%)	2 (3.3%)	1 (1.1%)	5 7(4.4%)	1 (1.3%)	0 (0%)	0 (0%)	4 (6.5%)	0 (0%)	14	
Unknown	0 (0%)	0 (0%)	0 (0%)	1 (1.1%)	2 (1.8%)	0 (0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (25%)	4	
Total	107 (100%)	23 (100%)	61 (100%)	93 (100%)	114 (100%)	75 (100%)	59 (100%)	56 (100%)	62 (100%)	4 (100%)	654	

*Statistical test used: Pearson's Chi-square

While most poisoning cases occurred in private residences across all nationality groups, notable differences emerged in the distribution patterns (Table 3.11; chi-square = 119.3, df=8, p<0.001). Among Maltese individuals, 90.8% of poisoning exposures occurred in

private residences, compared to 72.4% among non-Maltese individuals. Conversely, non-Maltese individuals were disproportionately represented in workplace poisoning incidents (58.3% of all work-related cases) and other locations (56.9% of all cases in other settings), despite comprising only 28.3% of the total sample. Work-related poisoning exposures were rare overall (n=12), but when they occurred, non-Maltese individuals were significantly more likely to be affected (3.8% vs 1.1% of their respective groups).

Table 3.11. Location of exposure by nationality

Nationality	Private Residence (%)	Work (%)	Other (%)	Hospital (%)	Unknown (%)	Total	*p-value*
Maltese	424 (75.8%)	5 (41.7%)	28 (43.1%)	9 (64.3%)	1 (25%)	467	<0.001
Non-Maltese	134 (24%)	7 (58.3%)	37 (56.9%)	5 (35.7%)	2 (50%)	185	
Unknown	1 (0.2%)	0 (0%)	0 (0%)	0 (0%)	1 (25%)	2	
Total	559 (100%)	12 (100%)	65 (100%)	14 (100%)	4 (100%)	654	

*Statistical test used: Pearson's Chi-square

Home or private residence exposures constituted 559 cases (85.5%) of all exposures (Table 3.12). District 2 recorded the highest number of domestic exposures with 189 cases, followed by District 1 with 109 cases. Whilst there was a statistically significant association between Location of exposure and District (chi-square=44.6, df=24, p=0.006), this is attributed to the much lower exposure occurring at home/private residence when the district was not known.

Table 3.12. Location of exposure by geographical district

Location	District 1 (%)	District 2 (%)	District 3 (%)	District 4 (%)	District 5 (%)	District 6 (%)	District unknown (%)	Total	*p-value*
Private Residence	109 (90.1%)	189 (86.7%)	76 (90.5%)	54 (80.6%)	92 (82.1%)	25 (89.3%)	14 (58.3%)	559	0.006
Work	1 (0.8%)	2 (0.9%)	4 (4.8%)	1 (1.5%)	2 (1.8%)	0 (0%)	2 (8.3%)	12	
Other	9 (7.4%)	23 (10.6%)	2 (2.4%)	8 (11.9%)	13 (11.6%)	3 (10.7%)	7 (29.2%)	65	
Hospital	1 (0.8%)	3 (1.4%)	2 (2.4%)	4 (6.0%)	4 (3.6%)	0 (0%)	0 (0%)	14	
Unknown	1 (0.8%)	1 (0.5%)	0 (0%)	0 (0%)	1 (0.9%)	0 (0%)	1 (4.2%)	4	
Total	121 (100%)	218 (100%)	84 (100%)	67 (100%)	112 (100%)	28 (100%)	24 (100%)	654	

*Statistical test used: Pearson's Chi-square

3.3 Profiling of poisoning exposure

3.3.1 Exposure characteristics

Table 3.13 and Figure 3.6 present the clinical and exposure characteristics of poisoning incidents reported to the MNPC (N=654). Accidental exposures represented the most frequent calls to the MNPC with 262 cases (40.1%), followed closely by deliberate exposures at 237 cases (36.2%).

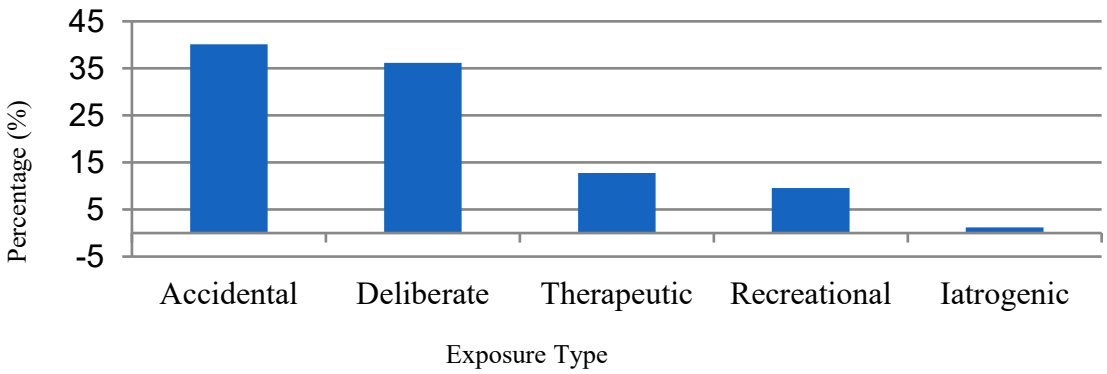


Figure. 3.6. Exposure intent

Most exposures (584 cases, 89.3%) occurred without concurrent alcohol consumption. The oral route of exposure dominated with 552 cases (84.4%). Inhalational exposures accounted for 82 cases (12.5%), while parenteral and mixed routes of exposures were rare with only 20 cases (3.0%). Most of the ingestions reported involved a pharmaceutical drug (54.7%), however more than a third involved a non-pharmaceutical xenobiotic. (Table 3.13)

Table 3.13: Poisoning profile (%)	
Gender:	**N (%)**
Male	332 (50.8%)
Female	330 (48.9%)
Unknown	2 (0.3%)
Age Groups:	**N (%)**
<5 years	107 (16.4%)
5-9 years	23 (3.5%)
10-19 years	61 (9.3%)
20-29 years	93 (14.2%)
30-39 years	114 (17.4%)
40-49 years	75 (11.5%)
50-59 years	59

	(9%)
60-69 years	56 (8.6%)
>70 years	62 (9.5%)
Unknown	4 (0.6%)
Alcohol Co-ingestion:	**N (%)**
Yes	70 (10.7%)
No	584 (89.3%)
Intention:	**N (%)**
Accidental	262 (40.1%)
Deliberate	237 (36.2%)
Recreational	63 (9.6%)
Therapeutic Excess	84 (12.8%)
Iatrogenic	8 (1.2%)
Route:	**N (%)**
Oral	552 (84.4%)
Inhalation	82 (12.5%)
Parenteral	4 (0.6%)
Mixed	16 (2.4%)
Number of Agents:	**N (%)**
1	481 (73.5%)
2	91 (13.9%)
3	34 (5.2%)
4 and over	44 (6.7%)
Unknown	4 (0.6%)
Agents:	**N (%)**
Pharmaceutical	358

	(54.7%)
Non-pharmaceutical	236 (36.1%)
Mixed (pharmaceutical + non-pharmaceutical in same ingestion)	31 (4.7%)
Other (Vitamins, nicotine, miscellaneous ingestions)	29 (4.4%)

3.3.2 Association between intention of poisoning and age group

There were distinct age-related patterns across different types of intentions (chi-square =315.2, df=35, p<0.001; Table 3.14). Accidental cases were predominantly found in very young children, with those under 5 years accounting for 38.5% of all accidental cases (Table 3.14). Deliberate cases showed a concentration in young to middle-aged adults, particularly those aged 30-39 years (23.2%) and 20-29 years (19.0%), with no deliberate cases in children under 10 (Table 3.14). Recreational use was exclusively concentrated in younger adults, with the 20-29- and 30-39-year age groups comprising 36.5% and 33.3% of recreational cases respectively, and no recreational cases reported in children under 10 or adults over 70 (Table 3.14). In contrast, therapeutic excess cases were more prevalent among older adults, with those aged 70+ years, 60-69 years, and 50-59 years accounting for 23.8%, 19.0%, and 17.9% of therapeutic excess cases respectively (Fig. 3.7). Iatrogenic cases were rare overall (n=8) but occurred most frequently in the 30-39 and 70+ year age groups (Table 3.14).

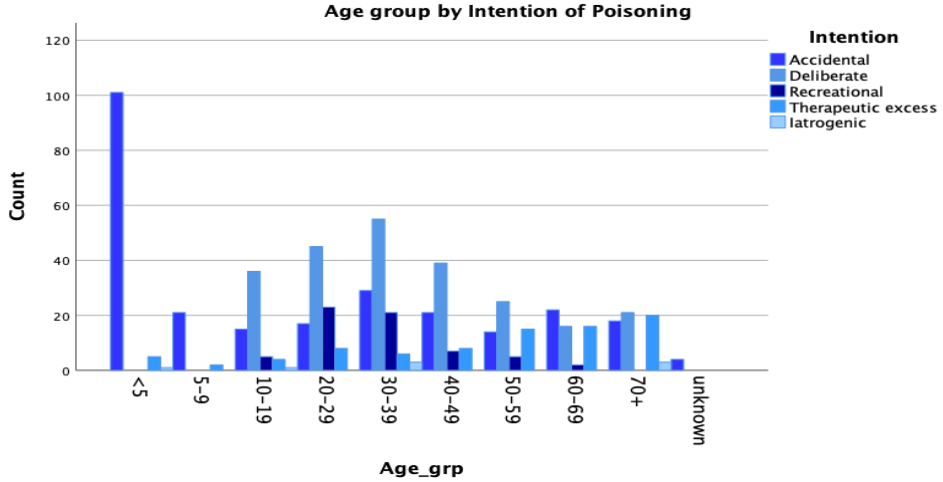


Figure. 3.7. Age group by intention of poisoning

Table 3.14: Age group by intention of poisoning							
Age Group	Accidental (%)	Deliberate (%)	Recreational (%)	Therapeutic Excess (%)	Iatrogenic (%)	Total (%)	*p-value*
< 5 years	101 (38.5%)	0 (0%)	0 (0%)	5 (6%)	1 (12.5%)	107 (16.4%)	<0.001
5-9 years	21 (8%)	0 (0%)	0 (0%)	2 (2.4%)	0 (0%)	23 (3.5%)	
10-19 years	15 (5.7%)	36 (15.2%)	5 (7.9%)	4 (4.8%)	1 (12.5%)	61 (9.3%)	
20-29 years	17 (6.5%)	45 (19.0%)	23 (36.5%)	8 (9.5%)	0 (0%)	93 (14.2%)	
30-39 years	29 (11.1%)	55 (23.2%)	21 (33.3%)	6 (7.1%)	3 (37.5%)	114 (17.4%)	
40-49 years	21 (8%)	39 (16.5%)	7 (11.1%)	8 (9.5%)	0 (0%)	75 (11.5%)	
50-59 years	14 (5.3%)	25 (10.5%)	5 (7.9%)	15 (17.9%)	0 (0%)	59 (9%)	
60-69 years	22 (8.4%)	16 (6.8%)	2 (3.2%)	16 (19%)	0 (0%)	56 (8.6%)	
70+ years	18 (6.9%)	21 (8.9%)	0 (0%)	20 (23.8%)	3 (37.5%)	62 (9.5%)	
Unknown	4 (1.5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (0.6%)	
Total	262 (100%)	237 (100%)	63 (100%)	84 (100%)	8 (100%)		

*Statistical test used: Pearson's Chi-square

3.3.3 Alcohol co-ingestion

Only 10.7% of the calls to MNPC reported alcohol co-ingestion (Table 3.15). However, alcohol co-ingestion was statistically more likely when the poisoning was deliberate or when taken recreationally (Table 3.15; chi-square = 68.3, df = 4 $p<0.001$). Conversely, accidental exposures showed minimal alcohol involvement, with only 4 cases (1.5%) involving concurrent alcohol consumption (Table 3.15).

Table 3.15. Alcohol co-ingestion by intention of poisoning							
	Intention – Count (%)						
Alcohol	Accidental (%)	Deliberate (%)	Recreational (%)	Therapeutic Excess (%)	Iatrogenic (%)	Total (%)	*p-value*
Yes	4 (1.5%)	47 (19.8%)	17 (27%)	2 (2.4%)	0 (0%)	70 (10.7%)	<0.001
No	258 (98.5%)	190 (80.2%)	46 (73%)	82 (97.6%)	8 (100%)	584 (89.3%)	
Total	262 (100%)	237 (100%)	63 (100%)	84 (100%)	8 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.3.4. Association between intention of poisoning and route of administration

The route of administration varied significantly across different intention categories (Table 3.16; chi-square = 98.3, df=12, p<0.001) with recreational cases showing the highest rates of inhalation (27.0%) and mixed routes (7.9%), while deliberate and therapeutic excess cases were predominantly oral (94.1% and 96.4%, respectively).

Table 3.16: Intention vs. route of administration						
	Route of Administration:					
Intention:	Oral (%)	Inhalation (%)	Parenteral (%)	Mixed (%)	Total (%)	*p-value*
Accidental	203 (77.5%)	54 (20.6%)	2 (0.8%)	3 (1.1%)	262 (100%)	<.001
Deliberate	223 (94.1%)	5 (2.1%)	0 (0%)	9 (3.8%)	237 (100%)	
Recreational	40 (63.5%)	17 (27%)	1 (1.6%)	5 (7.9%)	63 (100%)	
Therapeutic Excess	81 (96.4%)	3 (3.6%)	0 (0%)	0 (0%)	84 (100%)	
Iatrogenic	4 (50%)	3 (37.5%)	2 (12.5%)	0 (0%)	8 (100%)	
Total	55 2 (84.4%)	82 (12.5%)	4 (0.6%)	16 (2.4%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.3.5 Association between exposure intent and number of agents

There was a highly statistically significant association between intention and number of agents taken (chi-square = 97.7, df = 16, p < 0.001) (Table 3.17). Deliberate cases showed the highest rate of multiple agent ingestion with only 51.9% (123/237) involving a single agent, compared to 86.6% (227/262) for accidental cases, 88.1% (74/84) for therapeutic excess, 77.8% (49/63) for recreational cases, and 100% (8/8) for iatrogenic cases (Table 3.17, Fig. 3.8).

Table 3.17: Intention of poisoning by the number of agents taken

	No. of agents taken:						
Intention:	1 (%)	2 (%)	3 (%)	>3 (%)	Unknown (%)	Total (%)	*p-value*
Accidental	227 (86.6%)	20 (7.6%)	4 (1.4%)	10 (3.8%)	1 (0.4%)	262 (100%)	<0.001
Deliberate	123 (51.9%)	57 (24.1%)	25 (10.5%)	29 (12.2%)	3 (1.3%)	237 (100%)	
Recreational	49 (77.8%)	9 (14.3%)	4 (6.3%)	1 (1.6%)	0 (0%)	63 (100%)	
Therapeutic Excess	74 (88.1%)	5 (6.0%)	1 (1.2%)	4 (4.8%)	0 (0%)	84 (100%)	
Iatrogenic	8 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	8 (100%)	
Total	481 (73.5%)	91 (13.9%)	34 (5.2%)	44 (6.7%)	4 (0.6%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

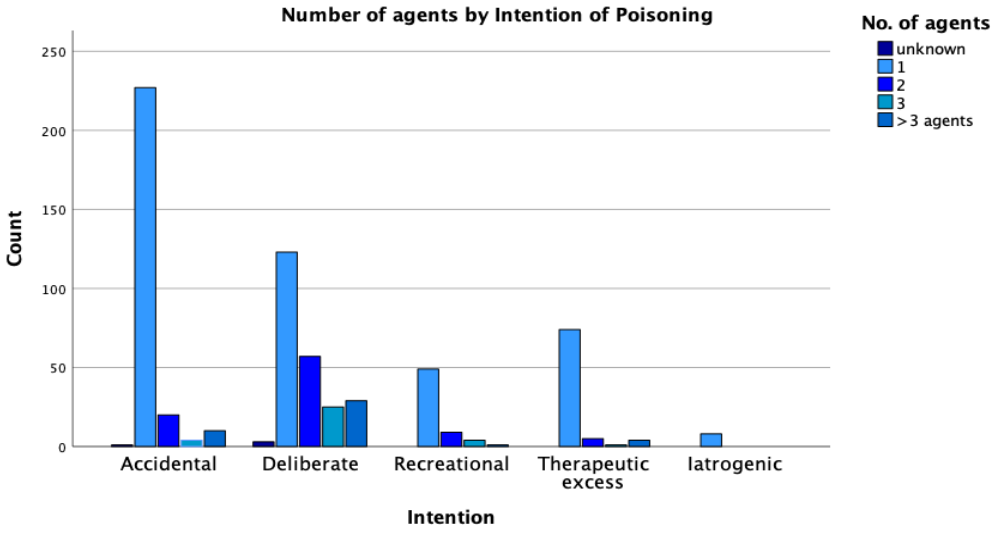


Figure. 3.8 Number of agents by intention of poisoning

3.3.6 Association between intention of poisoning and type of agent involved

There was a statistically significant association between agent type and intention (chi-square = 292.0, df=12, p<0.001) (Table 3.18). Accidental exposures involved non-pharmaceutical agents more frequently than pharmaceutical agents (59.5% vs 32.4%). Deliberate exposures predominantly involved pharmaceutical agents (78.4% vs 8.9% non-pharmaceutical). Recreational exposures were primarily non-pharmaceutical agents (87.3% vs 11.1% pharmaceutical). Therapeutic excess cases were mostly pharmaceutical agents (85.7%), and all iatrogenic cases (100%) involved pharmaceutical agents (Table 3.18).

Table 3.18: Intention by agent type

Intention:	Pharma (%)	Non-Pharma (%)	Mixed (Pharma + Non-Pharma) (%)	Other (%)	Total (%)	*p-value*
Accidental	85 (23.7%)	156 (66.1%)	2 (6.5%)	19 (65.5%)	262 (40.1%)	**<0.001**
Deliberate	186 (52.0%)	21 (8.9%)	26 (83.9%)	4 (13.8%)	237 (36.2%)	
Recreational	7 (2.0%)	55 (23.3%)	1 (3.2%)	0 (0%)	63 (9.6%)	
Therapeutic Excess	72 (20.1%)	4 (1.7%)	2 (6.5%)	6 (20.7%)	84 (12.8%)	
Iatrogenic	8 (2.2%)	0 (0%)	0 (0%)	0 (0%)	8 (1.2%)	
Total	358 (100%)	236 (100%)	31 (100%)	29 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.3.7 Association between intention of poisoning and gender distribution

Gender distribution across intention categories showed no statistically significant association (Table 3.19). The overall sample was nearly equally distributed between males (n=332, 50.8%) and females (n=320, 48.9%). While some descriptive differences were observed across intention types, these did not reach statistical significance (chi-square = 13.0, df=8, p>0.05, Table 3.19). Males comprised a higher proportion of recreational cases (n=41, 65.1%) compared to females (n=22, 34.9%), while females were slightly more

represented in deliberate cases (n=127, 53.6% vs. n=110, 46.4% male) and therapeutic excess cases (n=47, 56.0% vs. n=36, 42.9% male). Accidental cases showed a modest male predominance (n=141, 53.8% vs. n=120, 45.8% female). Iatrogenic cases, though infrequent (n=8), were equally distributed between males and females (n=4, 50.0% each).

Table 3.19. Intention of poisoning by gender distribution							
Gender	Accidental (%)	Deliberate (%)	Recreational (%)	Therapeutic Excess (%)	Iatrogenic (%)	Total (%)	*p-value*
Male	141 (53.8%)	110 (46.4%)	41 (65.1%)	36 (42.9%)	4 (50%)	332 (50.8%)	0.111
Female	120 (45.8%)	127 (53.6%)	22 (34.9%)	47 (56%)	4 (50%)	320 (48.9%)	
Other	1 (0.4%)	0 (0%)	0 (0%)	1 (1.2%)	0 (0%)	2 (0.3%)	
Total	262 (100%)	237 (100%)	63 (100%)	84 (100%)	8 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.3.8 Association between route of exposure and type of agent involved

There was a statistically significant association between route of ingestion and agent type (chi-square = 161.2, df=9, p<0.001) (Table 3.20). Oral ingestion predominantly involved pharmaceutical agents compared to non-pharmaceutical agents (62.3% vs 28.9%). Inhalation exposures were primarily non-pharmaceutical agents (80.5% vs 15.9% pharmaceutical). Parenteral exposures involved mostly non-pharmaceutical agents (75.0% vs 25.0% pharmaceutical), though numbers were small (n=4). Mixed route exposures showed equal proportions of non-pharmaceutical and mixed agents (47.1% each) with minimal pharmaceutical involvement (5.9%) (Table 3.20).

Table 3.20: Route of ingestion by agent type						
Route of ingestion:	Pharma (%)	Non-Pharma (%)	Mixed (pharma + non pharma) (%)	Other (%)	Total (%)	*p-value*
Oral	343 (95.8%)	159 (67.4%)	23 (74.2%)	26 (89.7%)	551 (84.3%)	<0.001
Inhalation	13 (3.6%)	66 (28.0%)	0 (0%)	3 (10.3%)	82 (12.5%)	
Parenteral	1 (0.3%)	3 (1.3%)	0 (0%)	0 (0%)	4 (0.6%)	
Mixed	1 (0.3%)	8 (3.4%)	8 (25.8%)	0 (0%)	17 (2.6%)	
Total	358 (100%)	236 (100%)	31 (100%)	29 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

There was a statistically significant association between age group and agent type (chi-square = 115.6, df=27, p<0.001). Non-pharmaceutical agents were most prevalent in children under 5 years (22.5%), while mixed agents peaked in the 30-39 age group (54.8%). Pharmaceutical agents showed a more even distribution across age groups, with the highest representation in the 70+ age group (14.0%) (Table 3.21).

Table 3.21 Age group by type of agent						
Age group	**Pharmaceutical**	**Non-Pharma**	**Mixed**	**Other**	**Total**	***p-value***
<5yrs (%)	41 (11.5%)	53 (22.5%)	1 (3.2%)	12 (41.4%)	107 (16.4%)	<0.001
5-9yrs (%)	12 (3.4%)	7 (3%)	1 (3.2%)	3 (10.3%)	23 (3.5%)	
10-19yrs (%)	43 (12%)	13 (5.5%)	1 (3.2%)	4 (13.8%)	61 (9.3%)	
20-29yrs (%)	45 (12.6%)	40 (16.9%)	5 (16.1%)	3 (10.3%)	93 (14.2%)	
30-39yrs (%)	45 (12.6%)	49 (20.8%)	17 (54.8%)	3 (10.3%)	114 (17.4%)	
40-49yrs (%)	45 (12.6%)	25 (10.6%)	5 (16.1%)	0 (0%)	75 (11.5%)	
50-59yrs (%)	45 (12.6%)	13 (5.5%)	1 (3.2%)	0 (0%)	59 (9%)	
60-69yrs (%)	32 (8.9%)	21 (8.9%)	0 (0%)	3 (10.3%)	56 (8.6%)	
70 and over (%)	50 (14%)	11 (4.7%)	0 (0%)	1 (3.4%)	62 (9.5%)	
Unknown (%)	0 (0%)	4 (1.7%)	0 (0%)	0 (0%)	4 (0.6%)	
Total (%)	358 (100%)	236 (100%)	31 (100%)	29 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.4 Agents reported

3.4.1 Poisoning agents reported

A total of 909 agents were reported in these 654 MNPC calls (Table 3.22; Figure 3.9; Appendix 4). Paracetamol containing analgesics (n= 99, 15.1%) were the most common agents reported in all categories (pharmaceutical, non-pharmaceutical or other ingestions (Vitamins, miscellaneous, nicotine products), followed by sedatives (n= 92, 14.1%), non-pharmaceutical recreational drugs (n=83, 12.7%) and antidepressants (n= 82, 12.5%).

Table 3.22 Agents category	
Pharmaceuticals taken	N (%)
Paracetamol containing analgesics	99 (15.1%)
Sedatives	92 (14.1%)
Antidepressants	82 (12.5%)
Anti-psychotics	57 (8.7%)
Anti-epileptics/mood stabilisers	47 (7.2%)
Non-paracetamol containing analgesics	35 (5.4%)
Cardiovascular	30 (4.6%)
Anti-microbials	21 (3.2%)
Steroids	19 (2.9%)
Anti-diabetics	14 (2.1%)
Gastrointestinal	14 (2.1%)
Antihistamines	13 (2%)
ADHD treatment	10 (1.5%)
Anti-spasmodics	9 (1.4%)
Veterinary treatment	9 (1.4%)
Decongestants	8 (1.2%)
Anti-coagulants	7 (1.1%)
Anti-lipids	7 (1.1%)
Antiplatelets	5 (0.8%)
Immunosuppressants	5 (0.8%)
Topical/Dermatological	6 (0.9%)
Respiratory treatment	1 (0.2%)
Non-Pharmaceutical	
Non-pharmaceutical recreational drugs	83 (12.7%)
Industrial	40 (6.1%)
Household cleaning agents	32 (4.9%)
Gases/fumes/vapours	31 (4.7%)
Natural toxins	19 (2.9%)
Essential oils	11 (1.7%)
Hand sanitisers	10 (1.5%)
Garden/agriculture	9 (1.4%)
Cosmetics	8 (1.2%)
Arts/Crafts/Office	5 (0.8%)
Foreign bodies	4 (0.6%)
Others	
Vitamins and supplements	32 (4.9%)
Miscellaneous	32 (4.9%)
Nicotine products	3 (0.5%)

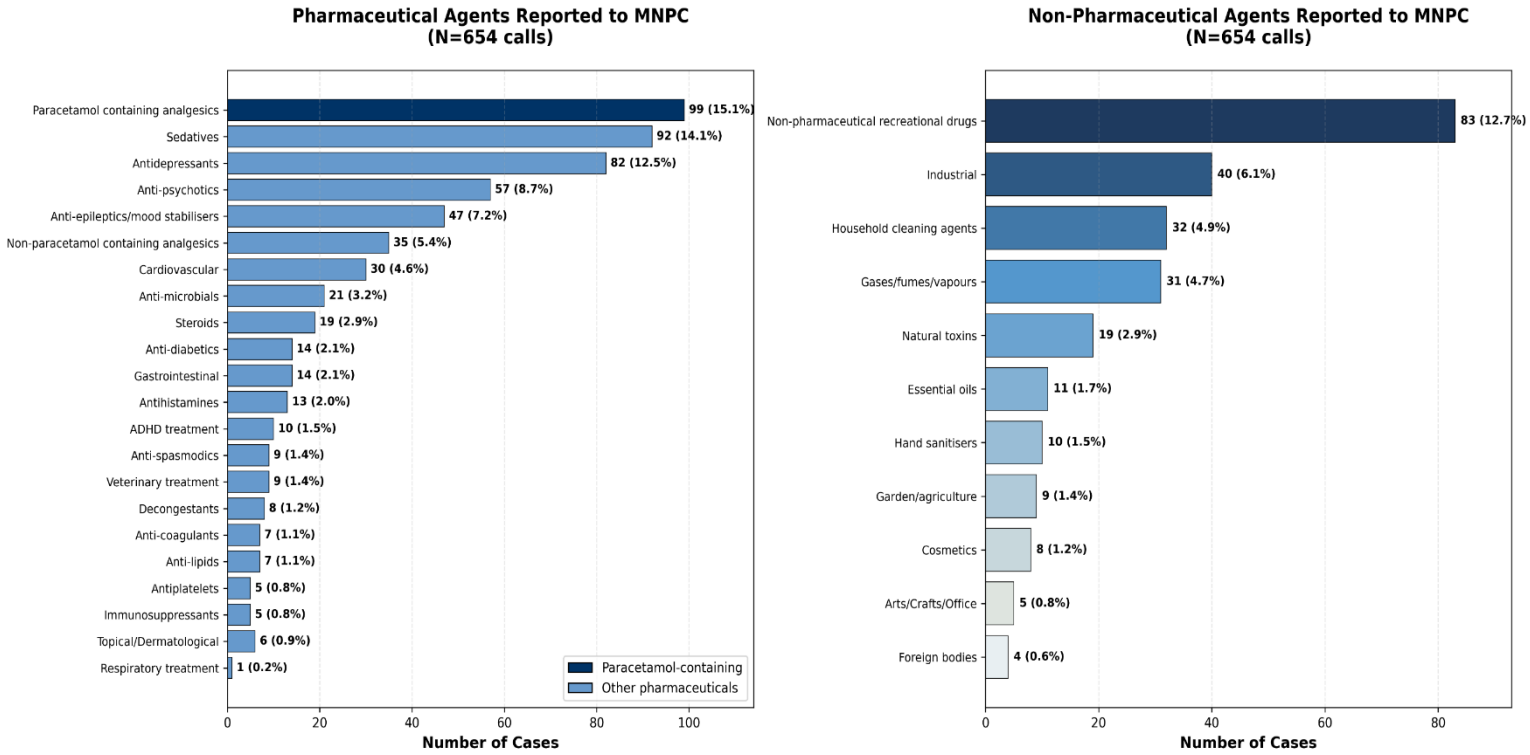


Figure. 3.9. Poisoning agents reported

3.4.2 Association between paracetamol-containing medications and intention of poisoning

There was a statistically significant association between intention and paracetamol-containing analgesics (chi-square = 68.2, df= 4, p<0.001). Deliberate poisoning was significantly more common with paracetamol-containing analgesics (59.6% vs 32.1%), while accidental poisoning was more frequent with non-paracetamol analgesics (45.0% vs 12.1%). Recreational use occurred exclusively with non-paracetamol analgesics (11.4%). Therapeutic excess was also more prevalent with paracetamol-containing preparations (26.3% vs 10.5%) (Table 3.23).

Table 3.23 Paracetamol-containing agents by intention				
	Paracetamol-containing medications			
Intention	yes	no	Total	*p-value*
Accidental (%)	12 (12.1%)	250 (45.0%)	262 (40.1%)	<0.001
Deliberate (%)	59 (59.6%)	178 (32.1%)	237 (36.3%)	
Recreational (%)	0 (0%)	63 (11.4%)	63 (9.6%)	
Therapeutic excess (%)	26 (26.3%)	58 (10.5%)	84 (12.9%)	
Iatrogenic (%)	2 (2%)	6 (1.1%)	8 (1.2%)	
Total (%)	99 (100%)	555 (100%)	654 (100%)	
*Statistical test used: Pearson's Chi-square				

3.4.3 Association between paracetamol-containing medications and age group.

The distribution of paracetamol-containing analgesic use varied across age groups. The highest proportion of users was observed in the 30-39 age group, which represented 20.2% of all paracetamol users, followed by the 20-29 age group (15.2%) and 10-19 age group (14.1%). The lowest usage rate was found in the under-5 age group, accounting for 8.1% of paracetamol users. The chi-square test revealed no statistically significant association between age group and paracetamol-containing analgesic use (chi-square = 10.481, df = 9, p = 0.313) (Table 3.24).

Table 3.24 Age group by paracetamol-containing analgesics

			Paracetamol-containing analgesics		Total	*p-value*
			yes	no		
Age group	<5 yrs	Count	8	99	107	0.313
		% within paracetamol-containing analgesics	8.1%	17.8%	16.4%	
		% of Total	1.2%	15.1%	16.4%	
	5-9 yrs	Count	4	19	23	
		% within paracetamol-containing analgesics	4.0%	3.4%	3.5%	
		% of Total	0.6%	2.9%	3.5%	
	10-19 yrs	Count	14	47	61	
		% within paracetamol-containing analgesics	14.1%	8.5%	9.3%	
		% of Total	2.1%	7.2%	9.3%	
	20-29 yrs	Count	15	78	93	
		% within paracetamol-containing analgesics	15.2%	14.1%	14.2%	
		% of Total	2.3%	11.9%	14.2%	
	30-39 yrs	Count	20	94	114	
		% within paracetamol-containing analgesics	20.2%	16.9%	17.4%	
		% of Total	3.1%	14.4%	17.4%	
	40-49 yrs	Count	13	62	75	
		% within paracetamol-containing analgesics	13.1%	11.2%	11.5%	
		% of Total	2.0%	9.5%	11.5%	
	50-59 yrs	Count	10	49	59	
		% within paracetamol-containing analgesics	10.1%	8.8%	9%	
		% of Total	1.5%	7.5%	9%	
	60-69 yrs	Count	6	50	56	
		% within paracetamol-containing analgesics	6.1%	9.0%	8.6%	
		% of Total	0.9%	7.6%	8.6%	
	70 yrs and over	Count	9	53	62	
		% within paracetamol-containing analgesics	9.1%	9.5%	9.5%	
		% of Total	1.4%	8.1%	9.5%	
	unknown	Count	0	4	4	
		% within paracetamol-containing analgesics	0%	0.7%	0.6%	
		% of Total	0%	0.6%	0.6%	
Total		Count	99	555	654	
		% within paracetamol-containing analgesics	100%	100%	100%	
		% of Total	15.1%	84.9%	100%	

*Statistical test used: Pearson's Chi-square

3.5 Disposition

Table 3.25 Management characteristics	
Outcome	**N (%)**
Observed at home	138 (21.1%)
Referred for med assessment HC/ED	36 (5.5%)
Called from ED and discharged	134 (20.5%)
Admitted to hospital	343 (52.4%)
Discharged against medical advice (DAMA)	3 (0.5%)
Poison Severity Score (PSS)	
No score (Asymptomatic)	226 (34.6%)
Minor	263 (40.2%)
Moderate	110 (16.8%)
Severe	54 (8.3%)
Fatal	1 (0.2%)
Discussed with Clinical Tox. On Call	
Yes	397 (60.7%)
No	253 (38.7%)
Unknown	4 (0.6%)
Intensive Care bed	
Yes	36 (5.5%)
No	618 (94.5%)
Intubated	
Yes	31 (4.7%)
No	623 (95.3%)
Antidote given	
Yes	51 (7.8%)
No	603 (92.2%)

*Statistical test used: Pearson's Chi-square

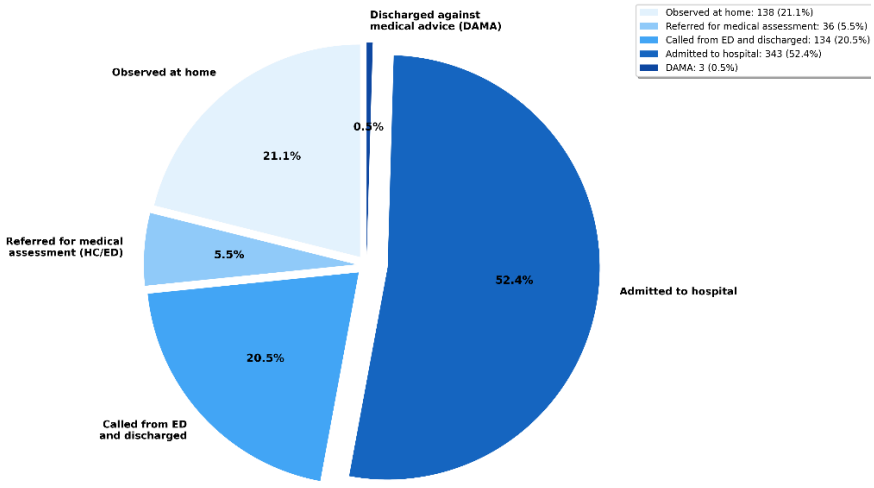


Figure. 3.10. Patient outcomes following MNPC consultation

3.5.1 Association between route of outcome and the PSS

As shown in Table 3.26, there was a statistically significant association between PSS and patient outcomes (chi-square = 371.9, df = 16, p<0.001). The distribution of PSS categories varied markedly across different clinical pathways. Patients observed at home predominantly had no poisoning symptoms (94.2%, n=130), with only 5.1% (n=7) having minor symptoms and 0.7% (n=1) having moderate symptoms. No patients with severe or fatal PSS were managed at home.

In contrast, hospital admissions showed a broader distribution of severity levels: 12.5% (n=43) had no symptoms, 42.9% (n=147) had minor symptoms, 28.9% (n=99) had moderate symptoms, and 15.5% (n=53) had severe symptoms. One fatal case (0.3%) was recorded among hospital admissions.

Patients referred for medical assessment and those called from the ED showed intermediate patterns, with the majority having minor symptoms (52.8% and 66.4% respectively). Severe poisoning cases were predominantly managed through hospital admission, with 98.1% (53/54) of severe PSS cases being admitted to hospital (Table 3.26).

Table 3.26 PSS by outcome of case

PSS	Observed at Home	Referred for Med Assessment HC/ED	Called from ED - Discharged	Admitted to Hospital	DAMA	Total	*p-value*
No (0) (%)	130 (94.2%)	16 (44.4%)	36 (26.9%)	43 (12.5%)	1 (33.3%)	226 (34.6%)	<0.001
Minor (1) (%)	7 (5.1%)	19 (52.8%)	89 (66.4%)	147 (42.9%)	1 (33.3%)	263 (40.2%)	
Moderate (2) (%)	1 (0.7%)	1 (2.8%)	8 (6%)	99 (28.9%)	1 (33.3%)	110 (16.8%)	
Severe (3) (%)	0 (0%)	0 (0%)	1 (0.7%)	53 (15.5%)	0 (0%)	54 (8.3%)	
Fatal (4) (%)	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)	0 (0%)	1 (0.2%)	
Total (%)	138 (100%)	36 (100%)	134 (100%)	343 (100%)	3 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.5.2 Association between outcome and cases discussed with clinical toxicologist on-call

There was a statistically significant association between clinical toxicology consultation and patient outcomes (Table 3.26; chi-square 254.6, df = 8, p<0.001). The frequency of toxicology consultation varied substantially across different clinical management pathways.

Patients observed at home had the lowest rate of clinical toxicology discussion, with only 8.0% (n=11) of cases involving specialist consultation, while 91.3% (n=126) were managed without toxicology input (Table 3.26; Figure 3.10). In contrast, patients admitted to hospital had the highest consultation rate, with 85.4% (n=293) of admissions involving clinical toxicology discussion and only 14.0% (n=48) managed without specialist input (Table 3.27).

Table 3.27 Consultation with clinical toxicologist by outcome

Discussed with Clinical Toxicologist	Observed at Home	Referred for Med Assessment HC/ED	Called from ED - Discharged	Admitted to Hospital	DAMA	Total	*p-value*
Yes (%)	11 (8.0%)	19 (52.8%)	72 (53.7%)	293 (85.4%)	2 (66.7%)	397 (60.7%)	<0.001
No (%)	126 (91.3%)	17 (47.2%)	61 (45.5%)	48 (14%)	1 (33.3%)	253 (38.7%)	
Unknown (%)	1 (0.7%)	0 (0%)	1 (0.7%)	2 (0.6%)	0 (0%)	4 (0.6%)	
Total (%)	138 (100%)	36 (100%)	134 (100%)	343 (100%)	3 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.5.3 Association between intensive care admission and PSS category

As expected, there was a statistically significant association between PSS and intensive care admission (chi-square = 346.5, df = 4, p<0.001; Table 3.28). Intensive care requirements showed a clear PSS relationship: 0% for no symptoms, 0.4% for minor, 1.8% for moderate, 59.3% for severe, and 100% for fatal cases. Severe PSS cases were over 30 times more likely to require intensive care compared to moderate cases (Table 3.28).

Table 3.28 Intensive care by PSS							
Intensive Care	PSS Category					Total	*p-value*
	No (PSS 0)	Minor (PSS 1)	Moderate (PSS 2)	Severe (PSS 3)	Fatal (PSS 4)		
Yes (%)	0 (0%)	1 (0.4%)	2 (1.8%)	32 (59.3%)	1 (100%)	36 (5.5%)	<0.001
No (%)	226 (100%)	262 (99.6%)	108 (98.2%)	22 (40.7%)	0 (0%)	618 (94.5%)	
Total (%)	226 (100%)	263 (100%)	110 (100%)	54 (100%)	1 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.5.4 Association between being administered an antidote and discussion with clinical toxicologist on call

There was a statistically significant association between clinical toxicology consultation and antidote administration (chi-square 25.9, df = 2, p<0.001). Of the 51 cases requiring antidote therapy, 94.1% (n=48) involved clinical toxicology discussion, while only 5.9% (n=3) were managed without specialist consultation (Table 3.29).

Table 3.29 Consultations with clinical toxicologist by antidote administration				
Discussed Clinical Toxicology	Antidote Given		Total (%)	*p-value*
	Yes (%)	No (%)		
Yes	48 (94.1%)	349 (57.9%)	397 (60.7%)	<0.001
No	3 (5.9%)	250 (41.5%)	253 (38.7%)	
Unknown	0 (0%)	4 (0.7%)	4 (0.6%)	
Total	51 (100%)	603 (100%)	654 (100%)	

*Statistical test used: Pearson's Chi-square

3.6 Conclusion

This chapter presented the analysis of 654 toxicological exposures reported to the MNPC during its first 19 months of operation. The results revealed distinct patterns in caller demographics, exposure characteristics, and clinical outcomes, representing the first comprehensive epidemiological analysis of poisoning exposures in Malta since the establishment of the national poison control service. The following chapter will delve into a discussion of these results, highlight limitations of the study, and provide recommendations for clinical practice and future research.

CHAPTER 4

Discussion, Conclusion and Recommendations

4.0 Introduction

This chapter presents a discussion of the findings from the systematic examination of calls received by the MNPC during its first 19 months of operation. The dataset encompassed multiple variables including caller demographics, poison agent classifications, exposure severity assessments, and documented clinical outcomes, all systematically de-identified to ensure patient confidentiality while maintaining research integrity. This methodological approach aligned with established international PC research by Kumpula et al. (2021), Marano et al. (2021), Hughes et al. (2022), Islam et al. (2022), Kumpula, Paterson and Pomerleau (2023), Pacini et al. (2023) and Wijnands et al. (2024), enabling identification of patterns in poisoning incidents and characterisation of commonly implicated toxic substances within the local Maltese context.

The findings presented in this discussion address each of the specified research objectives systematically, providing insights into service utilisation patterns, demographic characteristics of both callers and patients, exposure intentionality, substance categories, severity profiles, and clinical outcomes. Through comparison with international PC literature, this analysis contextualises Malta's poisoning epidemiology within the broader global landscape while identifying unique characteristics specific to the local healthcare environment.

4.1 Service evolution and healthcare integration

The progressive increase in MNPC call volumes throughout the study period demonstrates successful establishment of poison control services within Malta's healthcare infrastructure. This growth pattern mirrors the developmental trajectory observed in other newly established PCs globally (Kharel et al. 2024, Milella et al. 2021, Hitti et al. 2020, Oder and Põld 2013), characterised by an initial period of gradual adoption that subsequently

transitions to accelerated utilisation as both HCPs and the public develop greater awareness and confidence in the service.

The MNPC formally initiated its operations in October 2023, initially providing consultative services exclusively to HCPs regarding acute and chronic poisoning cases. This targeted approach allowed the centre to establish its credibility and refine its protocols within the medical community before extending access to the public seven months later in May 2024. The predominance of HCP callers (76.6%) during this initial phase reflects the centre's appropriate integration into clinical decision-making processes and the natural evolution of poison control services.

International literature consistently demonstrates that HCP utilisation typically precedes public awareness in newly established PCs, with mature centres eventually achieving more balanced caller distributions as community education programs develop and public confidence grows (Shobha et al. 2013, Fernando 2002). This sequential rollout, beginning with HCPs and subsequently expanding to public access, represents a strategic approach that mirrors successful poison control centre implementations globally. The MNPC's current caller pattern suggests successful penetration into professional networks while simultaneously indicating significant potential for expanded public education initiatives as the centre continues to mature and build community awareness. Nevertheless, this phased implementation may have skewed the caller pattern data, as the initial HCP-only period would naturally inflate the proportion of professional calls relative to public calls in the overall dataset. While phase-specific analysis would be valuable for future reporting, the current study was designed to portray the timeline of the national service from its inception, capturing the complete evolution of the MNPC as a nationally accessible resource.

The temporal distribution of calls, with peak activity during standard working hours (60.7% between 12pm-19:59), reflects both healthcare facility operating patterns and the timing of typical exposure scenarios. However, the concerning pattern of increased deliberate exposures during out-of-hours periods ($p<0.001$) underscores the critical importance of maintaining 24-hour specialist coverage. This finding aligns with international studies documenting increased self-harm presentations during evening and overnight hours, when mental health support services are typically less accessible (Milella et al. 2024, Evoy, Clarke and Joyce 2023). Bergen and Hawton (2007) found that 72% of deliberate self-harm presentations occurred outside standard office hours in their Oxford general hospital study, with peaks during night-time (8pm-3am). Similarly, the MNPC data demonstrates this after-hours pattern for deliberate poisoning, with deliberate exposures comprising 47.3% of out-of-hours calls compared to their overall representation of 36.2%, confirming the established international pattern of deliberate self-harm clustering during nighttime periods.

4.2 Demographic patterns and population characteristics

The near-perfect gender equilibrium among patients (50.8% male, 48.9% female) contrasts markedly with the female predominance among callers (57.0%), particularly public callers (72.5% female). This discrepancy reflects differential help-seeking behaviours, with females demonstrating greater propensity to seek assistance for poisoning exposures irrespective of the victim's gender (Ghane, Behmanesh and Khazaei 2015). Such patterns align with well-established international healthcare utilisation trends, where women consistently exhibit higher rates of healthcare engagement and advocacy, both for themselves and family members (Neuman et al. 2022). Bertakis et al. (2000) demonstrated this phenomenon in their one-year observational study, finding that women had significantly higher rates of primary care visits and health service utilisation, resulting in greater overall healthcare service engagement compared to men.

This gender-based healthcare utilisation pattern is also evident locally, with Baldacchino et al. (2017) reporting that 51.8% of patients requiring GP consultation at Maltese primary HCs were female, further supporting the broader trend of women's increased healthcare-seeking behaviour across different healthcare contexts.

The bimodal age distribution, with peaks in children under 5 years (16.4%) and adults aged 30-39 years (17.4%), reflects two distinct poisoning epidemiologies. The paediatric peak aligns with developmental milestones associated with increased mobility and oral exploration behaviours, consistent with international patterns of childhood poisoning (King et al. 2025, Petit-Frere and Miltenberger 2021, Rodgers, Franklin and Midgett 2012). A UK and Ireland surveillance study of severe accidental poisonings, requiring intervention, in children under 15 years (2018-2019) by King et al. (2025), found that children under 5 years comprised 71% of cases, with those under 2 years facing the highest risk at 7.3 cases per million compared to 2.4 per million for all children under 15. The study demonstrates that very young children are disproportionately vulnerable to severe accidental poisoning events. The adult peak corresponds to life phases characterised by increased stressors, medication availability, and mental health challenges, reflecting the complex interplay between psychological, social, and pharmaceutical factors in adult poisoning incidents (Mesgarpour et al. 2024).

The substantial representation of non-Maltese residents (28.3%) in poisoning exposures, particularly pronounced in the working-age population (47.3% in the 20-29 years group), reflects Malta's diverse demographic composition and potential occupational exposure risks. This finding suggests the need for effective, culturally appropriate prevention messages and multilingual educational materials to effectively reach Malta's diverse population groups (Pandey et al. 2022).

4.2.1 Intentionality patterns and risk factors

The near-equal distribution between accidental (40.1%) and deliberate exposures (36.2%) indicates that both categories represent major public health concerns requiring distinct prevention strategies. The age-specific patterns of intentionality provide crucial insights for targeted interventions: paediatric accidental exposures (38.5% of accidental cases under 5 years) suggest the need for enhanced childproofing and parental education (Budnitz, Lovegrove and Geller 2020), while adult deliberate exposures concentrated in the 20-39 years age group indicate requirements for mental health support and means restriction strategies (Yip et al. 2012).

The exclusive concentration of recreational exposures in younger adults (20-29 and 30-39 years comprising 69.8% of recreational cases) reflects substance use patterns typically associated with social and recreational contexts. The absence of recreational cases in children under 10 or adults over 70 years demonstrates age-specific risk profiles that can inform targeted prevention efforts (Tyrrell et al. 2018).

The higher prevalence of therapeutic excess among older adults (23.8% in those aged 70+ years) likely reflects polypharmacy, cognitive changes, and medication management challenges commonly encountered in aging populations. This pattern supports international literature documenting increased medication errors among elderly populations and suggests the need for enhanced medication reconciliation and support systems (Sharma, Prakash and Medhi 2024). The study by Sharma, Prakash and Medhi (2024) highlights evidence of successful medication safety improvements through enhanced reconciliation and support systems. The study demonstrates that implementing evidence-based strategies such as electronic health records, clinical decision support systems, and barcode-assisted medication administration significantly reduces medication errors during prescribing, dispensing, and administration phases (Sharma, Prakash and Medhi 2024). The success is further evidenced

by international programs like WHO's "Medication Without Harm" initiative, which aims to reduce serious preventable medication harm by 50% globally within 5 years, and various national pharmacovigilance programs that track adverse drug reactions to ensure safer medication use across healthcare systems (WHO 2017).

The pervasive role of alcohol in high-risk poisoning scenarios is strikingly evident across multiple contexts, with co-ingestion rates demonstrating consistent patterns in both deliberate and recreational exposures. The strong association between alcohol and deliberate self-harm (19.8%) alongside recreational substance use (27.0%) reflects a troubling trend that transcends age groups and circumstances, aligning with broader international research highlighting alcohol's contribution to both intentional self-harm and recreational drug use (Daly et al. 2020, Turcu et al. 2024).

This pattern becomes even more pronounced when examining deliberate self-harm specifically. Chitty et al.'s (2017) analysis of 7,270 patients presenting with intentional self-poisoning revealed that alcohol co-ingestion occurred in over one-third of cases (36.2%), underscoring just how commonly alcohol consumption accompanies deliberate self-harm incidents. Meanwhile, Turcu et al.'s (2024) study of 562 Romanian adolescents engaged in recreational substance use found ethanol co-ingestion in 20.1% of cases, demonstrating that even among younger populations, alcohol frequently serves as a dangerous secondary substance that amplifies the toxicity and clinical risks of primary recreational drug exposures.

These converging findings illuminate the substantial risk of polysubstance use across different populations and contexts, highlighting the critical need for integrated approaches that address not only individual substances but the dangerous practice of combining alcohol

with other drugs of abuse, while simultaneously addressing underlying substance use and mental health concerns.

4.2.2 Substance patterns and availability

The predominance of paracetamol-containing analgesics, constituting 15.1% of all MNPC calls, demonstrates a significant epidemiological pattern that reflects both the ubiquitous availability of these pharmaceutical preparations and their substantial involvement in poisoning incidents across international healthcare systems. The notable finding that 59.6% of paracetamol exposures were classified as deliberate corresponds with established global epidemiological data indicating that paracetamol consistently ranks among the most frequently utilised substances in intentional self-harm attempts, a phenomenon attributable to its widespread accessibility and public misperceptions regarding its safety profile in overdose scenarios (Martinez-De la Torre et al. 2020, Shoib et al. 2022, Tyrrell et al. 2024, Kubicka et al. 2025, Szydlowska 2025).

This epidemiological trend is substantiated by Shoib et al.'s (2022) scoping review, which synthesised data from 27 studies encompassing 1,816,228 participants to examine over the counter (OTC) drug utilisation patterns in suicidal and self-harm behaviours on a global scale. Their systematic analysis demonstrated that OTC analgesics and sedative-hypnotic agents represent the most frequently employed substances in suicidal behaviour across diverse demographic and geographic contexts. The meta-analysis revealed that paracetamol was consistently identified across multiple studies as a predominant method for self-harm, with prevalence observed among female adolescent populations. Notably, a South African epidemiological study within this review reported that OTC analgesics, with paracetamol as the primary agent, constituted the leading methodology employed in deliberate self-harm incidents (Pieterse et al. 2020).

The clinical significance of paracetamol's role in self-harm attempts stems from the convergence of two critical factors: its status as a non-prescription medication and the prevalent public misconception regarding its benign nature in supratherapeutic doses. This combination generates a particularly hazardous scenario for vulnerable populations, where perceived accessibility intersects with inadequate risk perception. Consequently, evidence-based prevention strategies must prioritise dual interventions: regulatory measures to restrict package quantities and public health education initiatives to enhance awareness of paracetamol's significant toxicological potential in overdose situations (Shoib et al. 2022).

This finding is particularly concerning given paracetamol's potential for severe hepatotoxicity and the narrow window for effective antidote administration. The high representation of paracetamol in therapeutic excess cases (26.3%) suggests that public education regarding appropriate dosing and the risks of exceeding recommended doses remains inadequate.

The analysis demonstrates that the highest proportion of paracetamol users occurred in the 30-39 age group (20.2%), followed by the 20-29 age group (15.2%) and 10-19 age group (14.1%), with notably lower usage rates in the under-5 age group (8.1%). While the chi-square analysis indicated no statistically significant association between age groups and paracetamol use ($p = 0.313$), this distribution pattern warrants closer examination in the context of overdose aetiology.

The study by Weisbrod and Provenzani (2025) highlights a critical dimension to paracetamol toxicity that directly relates to these age-related usage patterns. Their analysis demonstrates that paracetamol-related liver injury frequently results from unintentional overdose due to concurrent use of multiple paracetamol-containing preparations or exceeding maximum daily doses.

The relatively lower incidence in paediatric populations (under-5 group: 8.1%) may reflect different exposure mechanisms, where paediatric cases are more likely to represent acute accidental ingestions rather than the chronic cumulative overdose patterns observed in adults. Conversely, the sustained usage rates across adult age groups underscore the need for enhanced public health interventions targeting medication literacy and concurrent paracetamol exposure awareness, particularly among the 20–39-year demographic that represents nearly 35% of all paracetamol exposures in the MNPC data.

The prominence of sedatives (14.1%) and antidepressants (12.5%) in poisoning exposures reflects both the therapeutic utilisation of these medications in Malta and Gozo and their potential for misuse in deliberate self-harm scenarios. The retrospective study by Pereira (2023) examined 252 poisoning-related ITU admissions at MDH spanning seven years from 2015 to 2021. Sedatives and antidepressants emerged as the predominant causes, accounting for 13.9% and 11.3% of cases respectively (Pereira 2023). This pattern underscores the dual nature of these medications within Malta and Gozo's healthcare landscape - while serving as essential therapeutic tools, they simultaneously present considerable risk for misuse in deliberate self-harm situations, highlighting the complex balance between accessibility for legitimate treatment and potential for harmful abuse. The pharmaceutical profile observed in MNPC calls suggests that prescription medications readily available through Malta's healthcare system constitute primary substances of concern, indicating the need for enhanced prescribing vigilance and patient education regarding safe storage and use (Weisbrod and Provenzani 2025, Tanti et al. 2017, Tanti et al. 2013).

The significant representation of non-pharmaceutical recreational drugs (12.7%) such as cocaine and cannabis indicates active recreational substance use within Malta's population, with inhalation representing the predominant route for these exposures (27.0% of recreational cases). Analysis of the 83 non-pharmaceutical recreational drug exposures

provides insight into substance-specific patterns within Malta (Figure 4.1). Cocaine was the most frequently reported recreational substance with 26 cases (31.3% of recreational drug exposures), followed by cannabis with 16 cases (19.3%) and synthetic cannabinoid receptor agonists with 16 cases (19.3%). The remaining exposures comprised methamphetamine (n=7, 8.4%), heroin (n=6, 7.2%), GHB (n=4, 4.8%), ketamine (n=4, 4.8%), unknown synthetic substances (n=3, 3.6%), and psilocybin mushrooms (n=1, 1.2%).

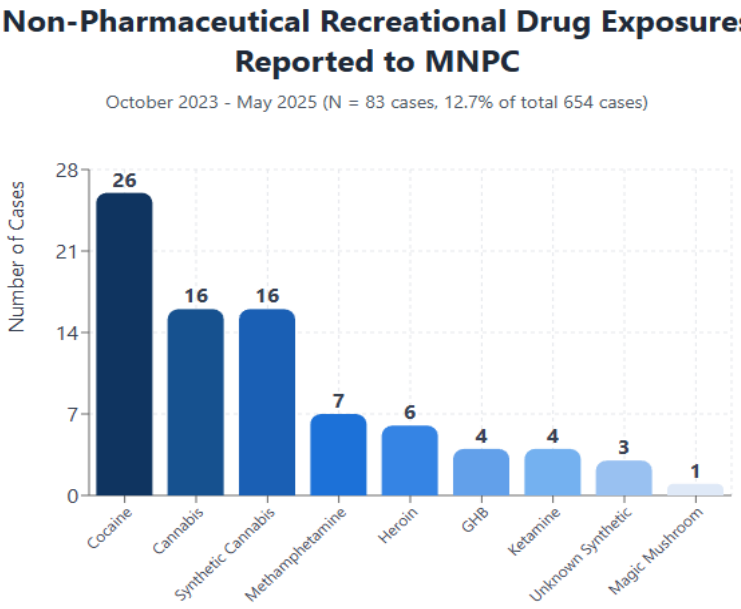


Figure. 4.1. Distribution of non-pharmaceutical recreational drug exposures reported to MNPC, N=83 cases)

The epidemiological trajectory of recreational substance use in Malta reflects a concerning escalation documented through both national hospital surveillance and European monitoring networks. The study by Bonnici et al. (2017) analysed MDH admissions between 2010-2015 establishes critical evidence of sustained active recreational substance use within Malta's population, documenting 286 patients requiring hospitalisation for acute recreational drug intoxication, with presentations culminating at 71 cases in 2015.

Malta's participation in the European Drug Emergencies Network Plus (Euro-DEN Plus) since 2016, provides important context for interpreting MNPC recreational drug data. Euro-DEN Plus, which systematically collects data on ED presentations with acute drug toxicity across participating European countries, has documented notably high prevalence rates for Malta. Cannabis-related presentations constitute 22.8% of Malta's ED drug toxicity presentations, while cocaine-associated toxicity accounts for 22.9%, positioning Malta among European centres with the highest prevalence rates for both substances.

When MNPC call log data are compared with these Euro-DEN Plus figures, a substantial discrepancy becomes evident. While cannabis and cocaine together represent 45.7% of Malta's ED drug toxicity presentations in Euro-DEN Plus surveillance (22.8% + 22.9%), these same substances accounted for only 6.4% of all MNPC consultations (42 of 654 cases). This marked divergence indicates considerable under-reporting of recreational drug exposures to the MNPC. The most likely explanation is that emergency physicians routinely manage familiar recreational drug presentations without seeking poison centre consultation, particularly for uncomplicated cases where clinical management protocols are well-established. This autonomous management approach, while clinically appropriate, results in systematic under-capture of recreational drug epidemiology through poison control surveillance systems.

4.2.3 Severity patterns and clinical outcomes

The Poisoning Severity Score (PSS) distribution observed in MNPC calls demonstrates that while most exposures result in minor or no symptoms (74.8% PSS 0-1), a substantial proportion (25.2%) require significant medical intervention (PSS 2-4). This severity profile supports international PC data, where most exposures are relatively benign, but a significant

minority require intensive medical management (Lecot et al. 2023, Torrents et al. 2023, Hondebrink et al. 2020, Rhalem et al. 2013).

The Italian COVID-19 study (Schicchi et al. 2025) reported intermediate severity patterns, with PSS grades predominantly distributed as: 36% (grade 0), 42% (grade 1), 17% (grade 2), and 5% (grade 3), representing typical deliberate self-poisoning presentations with neuropsychotropic medications. The US-based suicidal behaviour study (Conner et al. 2019) demonstrated mean PSS scores of 1.30 (SD 1.02) across 673 intentional self-poisoning cases, with higher scores consistently correlating with greater organ system involvement and treatment complexity. Notably, the study validated PSS utility in capturing both severity intensity and breadth of toxicological impact.

The strong association between PSS severity and clinical outcomes ($p<0.001$) demonstrates appropriate clinical triage within Malta's healthcare system. The observation that 98.1% of severe poisoning cases (PSS 3) required hospital admission indicates effective recognition of high-risk exposures and appropriate resource allocation. Similarly, the correlation between intensive care requirements and PSS severity (59.3% of severe cases requiring ICU admission) reflects appropriate escalation of care for critically ill patients.

The clinical toxicology consultation rate of 60.7% overall, with marked variation across clinical pathways (8.0% for home management versus 85.4% for hospital admissions), demonstrates appropriate utilisation of specialist expertise. The strong association between antidote administration and toxicology consultation (94.1% of antidote cases involved specialist input) indicates effective coordination between front-line clinicians and toxicology specialists.

4.2.4 Geographic and occupational patterns

The concentration of exposures in the Northern Harbour (33.3%) and Southern Harbour (18.5%) districts reflects both population density and industrial activity patterns within Malta. These districts encompass Malta's primary urban areas and major healthcare facilities, which may contribute to higher reporting rates. However, the geographic distribution also suggests potential environmental or occupational exposure risks associated with these regions' industrial activities (Fenech and Aquilina 2021).

The higher rate of workplace exposures among non-Maltese residents (58.3% of work-related cases) indicates potential occupational health disparities affecting migrant workers. A systematic review by Hargreaves et al. (2019) of 36 studies encompassing 12,168 international migrant workers from 25 low-income and middle-income countries revealed severe occupational health disparities, with 47% experiencing at least one work-related morbidity and 22% suffering workplace injuries. These findings highlight critical occupational health inequities affecting millions of migrant workers, who predominantly engage in hazardous unskilled manual labour across agriculture, construction, domestic services, and manufacturing sectors while lacking adequate safety protections and healthcare access (Hargreaves et al. 2019).

This pattern suggests that non-Maltese residents may face increased exposure to workplace hazards, possibly due to language barriers, inadequate safety training, or employment in higher-risk occupations. This finding aligns with international literature documenting occupational health disparities among migrant worker populations and indicates the need for targeted occupational safety interventions (Wijnands et al. 2024, Shankar et al. 2022, Kim et al. 2020).

The predominance of home-based exposures (85.5%) across all demographic groups reflects the domestic environment as the primary setting for poisoning incidents. This pattern is consistent with international data and underscores the importance of home safety measures, appropriate storage of hazardous materials, and public education regarding poison prevention in domestic settings (Budnitz, Lovegrove and Geller 2020, Achana et al. 2015). A meta-analysis of 28 studies conducted by Achana et al. (2015) found that multi-component home safety interventions combining education with practical elements (free safety equipment, home inspections) were significantly more effective than education alone in promoting poison prevention behaviours in households, especially with children. The most effective interventions included education plus low-cost/free safety equipment for medicine storage, and education combined with equipment provision and home safety inspections for securing household products and poison control centre contact information.

4.3 The local context and international comparisons

The predominance of HCP callers during the initial operational phase reflects the natural progression of service adoption, where clinical users typically represent the primary user base before broader community utilisation develops. The age distribution, with peaks in young children and young adults, mirrors international trends documented in established PCs across Europe (Marano et al. 2021), the UK (King et al. 2025), the US (Gummin et al. 2024) and Australia (Huynh et al. 2018).

However, several features distinguish Malta's poisoning epidemiology from international patterns. The substantial representation of non-Maltese residents (28.3%) reflects Malta's unique position as a European Union (EU) member state with significant international migration and tourism. This demographic diversity requires culturally appropriate prevention strategies and multilingual service provision not typically required in more homogeneous populations.

Lindhout et. al. (2012) identified significant safety and economic risks in multilingual EU workplaces, where language barriers contribute to production losses and accidents that are often overlooked in risk management strategies. The research outlines five key risk control measures: guidance provision, lingua franca adoption, health literacy improvement, controlled readability, and practical interventions, while highlighting several unresolved policy dilemmas that require EU-level language policy development to effectively address workplace safety challenges in diverse linguistic environments.

The substance profile documented in MNPC consultations, characterised by paracetamol predominance, demonstrates concordance with broader European epidemiological patterns while contrasting markedly with regions where alternative agents, including agricultural pesticides in rural contexts or culturally specific recreational substances, constitute the primary toxicological burden (Peshin and Gupta 2018). This alignment suggests that Malta's poisoning epidemiology fundamentally reflects European pharmaceutical accessibility frameworks and standardised healthcare practices rather than region-specific risk factors or unique environmental exposures.

Contemporary Croatian poison control surveillance data (Babić 2023) further substantiates these European trends, revealing psychoactive medications as the predominant pharmaceutical exposure category (43%), encompassing neuroleptics, benzodiazepines, antidepressants, and hypnotics, with analgesics and NSAIDs comprising the subsequent category (19%), followed by cardiovascular medications (9%). This pharmacological distribution demonstrates remarkable concordance with MNPC's deliberate exposure profiles, thereby establishing consistent European patterns in neuropsychotropic medication availability and intentional poisoning scenarios. The convergence of these epidemiological patterns across Croatian and Maltese populations underscores the homogenizing influence of European pharmaceutical regulation, prescribing practices, and healthcare infrastructure

on national poisoning profiles, suggesting that toxicological surveillance data from smaller European nations can provide meaningful insights into broader regional trends and risk management strategies.

The severity profile and clinical outcomes observed in Malta appear consistent with international standards, suggesting appropriate clinical care and effective healthcare system responses to poisoning emergencies. The integration of specialist toxicology consultation into clinical decision-making reflects best practices observed in established PC networks internationally (Pomerleau et al. 2023).

4.4 Implications for public health and clinical practice

4.4.1 Prevention strategy development

The findings from this study provide essential data for developing evidence-based poison prevention strategies tailored to Malta's specific epidemiological profile. The age-specific patterns of intentionality indicate that prevention efforts must address distinct demographic groups with targeted approaches: enhanced childproofing education for parents of young children, mental health support and means restriction for young adults, and medication management support for elderly populations experiencing therapeutic excess (Camilleri, Vassallo and Sant 2025, Khoja et al. 2024, Petit-Frere and Miltenberger 2021, Grech et al. 2004).

The substantial representation of non-pharmaceutical recreational drugs indicates the need for harm reduction strategies addressing recreational substance use among young adults (Malta et al. 2025). These interventions should focus on reducing exposure risks rather than solely promoting abstinence, recognising the persistent nature of recreational substance use in this population (Malta et al. 2025).

4.4.2 Healthcare system optimisation

The clinical outcomes data demonstrate that while the MNPC is effectively integrated into Malta's healthcare system, opportunities exist for optimising resource utilisation. The hospital admission rate of 52.4% suggests potential for increased home management of low-risk exposures with appropriate follow-up protocols. This could reduce healthcare costs while maintaining patient safety, particularly for the 34.6% of cases that remained asymptomatic (Han et al. 2021).

The strong association between specialist toxicology consultation and appropriate antidote administration indicates successful knowledge transfer and clinical decision support (Pomerleau et al. 2023). However, the variation in consultation rates across clinical pathways suggests opportunities for standardising poison management protocols and enhancing the consistency of specialist involvement in complex cases.

4.4.3 Occupational health considerations

The disproportionate representation of non-Maltese residents in workplace exposures indicates the need for enhanced occupational health protections for migrant workers. This may require multilingual safety training, culturally appropriate hazard communication, and enhanced regulatory oversight of industries employing significant numbers of foreign workers (Kim et al. 2020).

4.5 Conclusion

This investigation provides the first thorough epidemiological analysis of poisoning exposures reported to the MNPC during its initial 19 months of operation. The establishment of the MNPC has successfully created a critical healthcare resource that is becoming increasingly integrated into Malta's clinical decision-making processes, as evidenced by progressive utilisation growth and appropriate clinical consultation patterns.

The demographic and clinical characteristics of poisoning exposures in Malta and Gozo demonstrate both alignment with international patterns and unique features reflecting the country's distinctive population composition and healthcare environment. The near-equal distribution between accidental and deliberate exposures, the prominence of paracetamol-containing analgesics, and the age-specific patterns of intentionality provide essential data for evidence-based prevention strategy development.

The clinical outcomes demonstrate appropriate triage and resource allocation within Malta's healthcare system, with strong correlations between exposure severity and clinical interventions. The integration of specialist toxicology consultation into clinical care reflects best practices and contributes to optimal patient outcomes. However, opportunities exist for enhanced prevention efforts, particularly regarding medication safety education and harm reduction strategies for recreational substance use.

The substantial representation of non-Maltese residents in poisoning exposures, particularly in occupational settings, highlights the need for culturally appropriate prevention strategies and enhanced occupational health protections. This finding reflects Malta's evolving demographic composition and requires tailored public health responses.

The success of the MNPC's initial operational phase provides a strong foundation for continued service development and expansion. The data generated through this analysis will inform ongoing quality improvement efforts and support evidence-based policy development regarding poison prevention and clinical care optimisation.

4.6 Strengths and limitations of the study

This study demonstrates several significant strengths that enhance the validity and reliability of its findings. The nature of the dataset, encompassing all toxicology-related calls received by the MNPC during its initial 19 months of operation, provides complete coverage of

poisoning exposures reported to MNPC. This population-based approach eliminates selection bias and provides genuine epidemiological insights into poisoning patterns within Malta.

The systematic data collection methodology, utilising standardised PC documentation protocols with international practices, ensures data quality and enables meaningful comparisons with international poison centre literature (Adullah et al. 2025, Wijnands et al. 2024, Kumpula, Paterson and Pomerleau 2023, Pacini et al. 2023, Hughes et al. 2022, Islam et al. 2022, Kumpula et al. 2002, Marano et al. 2021). The rigorous ethical framework, including anonymisation procedures and institutional oversight, maintains research integrity while protecting patient confidentiality (Aslam et al. 2019).

The statistical analysis approach, employing appropriate chi-square tests for categorical variables and systematic examination of associations between key variables, provides robust evidence for the relationships identified in the findings. The use of established clinical assessment tools, particularly the PSS, enables standardised severity assessment and international comparability (Sam et al. 2009).

However, several important limitations must be acknowledged when interpreting these findings. The study's observational design limits the ability to establish causal relationships between identified variables, restricting interpretations to associations rather than causality. The 19-month study period, while comprehensive for the MNPC's initial operational phase, may not capture seasonal variations or longer-term trends that could influence poisoning patterns.

4.6.1 Data capture limitations

The reliance on calls reported to the MNPC introduces significant reporting bias, as not all poisoning exposures in Malta result in poison centre consultation. Several specific factors contribute to under-reporting in this dataset:

After-hours calls (8pm-8am) taken by the toxicologist on-call were sometimes not recorded in the PID due to documentation oversights during busy overnight periods. This represents a systematic under-reporting of out-of-hours exposures, which may be particularly problematic given the study's finding of increased deliberate exposures during these time periods.

Many toxicology-related ED presentations, particularly paracetamol overdoses, were managed without MNPC consultation as HCPs frequently followed established MNPC paracetamol treatment guidelines rather than seeking direct consultation. This autonomous management approach, while clinically appropriate, results in substantial under-representation of paracetamol cases in the PC database.

While the data demonstrates strong correlation between antidote administration and clinical toxicologist involvement through MNPC consultation, antidote therapy may have been administered without formal toxicological consultation, as current Maltese healthcare protocols do not mandate clinical toxicologist approval for antidote administration. Given that antidotes represent finite therapeutic resources with significant economic implications, optimal utilisation would be enhanced through systematic integration of clinical toxicologist expertise into antidote decision-making processes. This gap in consultation practice may result in missed opportunities for optimised treatment protocols and systematic under-reporting of antidote usage patterns.

Recreational drug intoxications, despite representing 12.7% of recorded exposures, are likely significantly under-reported as emergency physicians are experienced in managing these common presentations autonomously. The routine nature of recreational substance presentations may lead to reduced consultation seeking, particularly for familiar intoxication syndromes.

The remarkably low incidence of iatrogenic cases (n=8, 1.2% of all exposures) warrants consideration, as this figure likely represents substantial under-reporting rather than reflecting the true prevalence of medication errors within Malta's healthcare system. International literature consistently documents higher rates of iatrogenic poisoning incidents in comparable healthcare settings (Stevens et al. 2019, Leonard et al. 2020). The discrepancy between expected and observed iatrogenic case frequencies may reflect healthcare professionals' reluctance to formally report medication errors through the MNPC consultation pathway due to concerns regarding potential litigation, professional liability, and medicolegal consequences. The existence of this reporting barrier undermines complete toxicosurveillance and limits opportunities for systematic quality improvement initiatives targeting medication safety. Establishing robust non-punitive reporting frameworks and explicit legal protections for healthcare providers who seek toxicological consultation regarding medication errors could enhance reporting compliance and ultimately improve patient safety outcomes through better identification of systemic medication administration vulnerabilities.

4.6.2 Additional study limitations

The study's focus on the initial operational period may reflect patterns specific to service establishment rather than steady-state operations. HCPs awareness and utilisation patterns

may continue evolving as the service matures, potentially affecting the generalisability of current findings to future operational periods.

The demographic coding systems, while comprehensive, may not capture all relevant population characteristics that could influence poisoning risk or healthcare-seeking behaviour. Cultural, socioeconomic, and educational factors that may significantly impact poisoning prevention and management are not systematically documented in the poison centre database.

The severity assessment relies on PSS, which depends on accurate clinical documentation and may be subject to inter-observer variability. Additionally, the PSS focuses on immediate clinical effects and may not capture delayed toxicity or long-term consequences of poisoning exposures. Furthermore, given its age, more recent literature has raised questions regarding its continued relevance and validity as a severity assessment tool in modern poisoning management (Schwarz et al. 2017).

4.7 Recommendations for Practice and Policy

4.7.1 Clinical practice recommendations

Based on the study findings, several recommendations emerge for optimising clinical practice in poisoning management. Healthcare providers, particularly ED staff, should receive enhanced training regarding appropriate utilisation of PC services and awareness of when specialist consultation provides the greatest clinical benefit (Muralidharan et al. 2022). The identification of systematic under-reporting in key areas including after-hours exposures, paracetamol overdoses managed via guidelines, antidote administrations, and recreational drug presentations, indicates the need for comprehensive education programs targeting emergency HCPs.

4.7.2 Emergency department training programs

ED should implement standardised training programs to increase awareness of MNPC services and clarify when consultation is most beneficial versus when autonomous management is appropriate (Muralidharan et al. 2022). Training should emphasise that even when following established guidelines (such as the MNPC paracetamol protocol as well as MNPC guidelines and monographs), consultation can provide valuable clinical decision support, particularly for complex cases or when complications arise (Liakoni et al. 2019).

According to Liakoni et al. (2019), educational initiatives should specifically address antidote administration protocols, clarifying that specialist consultation is expected and beneficial even when healthcare providers are experienced with specific antidotes. This consultation provides quality assurance, dose optimisation guidance, and systematic documentation of antidote usage patterns that inform ongoing service improvement (Liakoni et al. 2019).

For recreational drug presentations, training should distinguish between routine intoxications that can be managed autonomously and cases where specialist input regarding novel substances, unusual presentations, or potential complications would benefit patient care (Pomerleau et al. 2023). The recent surge in synthetic cannabinoid exposures exemplifies scenarios where PC expertise regarding emerging substances provides significant clinical value.

The strong association between paracetamol exposures and deliberate poisoning (59.6% of paracetamol cases were deliberate) indicates the need for systematic mental health screening and intervention protocols for patients presenting with paracetamol overdose, regardless of whether PC consultation occurs (Borg et al. 2022).

Primary care providers should receive education regarding early identification of therapeutic excess, particularly among elderly patients taking multiple medications. The age-specific patterns of therapeutic excess suggest opportunities for medication reconciliation and patient education in primary care settings (Thoonen et al. 2024, Vincent et al. 2024, Hughes et al. 2023; Kooppen et al. 2023, Kumpula, Paterson and Pomerleau 2023).

4.7.3 Public health policy recommendations

The epidemiological patterns identified in this study support several public health policy initiatives. Child poisoning prevention programs should focus on the under-5 age group, where accidental exposures predominate (Li et al. 2021). These programs should emphasise proper medication and household product storage, childproofing measures, and immediate response protocols for suspected exposures (Li et al. 2021).

Mental health support services should be enhanced for young adults aged 20-39 years, where deliberate exposures are most concentrated. Yip et al. (2012) claim that the integration of means restriction counselling and toxicological risk assessment into mental health care could reduce both the frequency and severity of intentional poisonings.

Occupational health regulations should be strengthened to address the disproportionate representation of non-Maltese residents in workplace exposures. This may require enhanced safety training requirements, multilingual hazard communication standards, and increased regulatory oversight of industries employing significant numbers of foreign workers (Wijnands et al. 2024, Millard et al. 2014).

4.7.4 Public education and social media strategy development

The MNPC's establishment of official Facebook and Instagram pages in July 2024 represents a critical foundation for public education initiatives. The findings from this study provide essential data to inform evidence-based social media content development that addresses

Malta and Gozo's specific poisoning epidemiology. Given that only 23.4% of calls originated from the public, substantial opportunity exists to increase direct public utilisation of PC services through targeted digital engagement strategies.

The prominence of paracetamol-containing analgesics (15.1% of all agents) in poisoning exposures provides a clear focus for social media educational campaigns. Content should emphasise the serious nature of paracetamol overdose despite its over-the-counter availability, maximum daily dose limits, and the risks of concurrent use of multiple paracetamol-containing preparations. Interactive content, such as dose calculation tools and medication checking features, could provide practical value while educating users about safe medication practices (Schück et al. 2021). Furthermore, the pharmacy-only status of all paracetamol-containing products creates a valuable intervention point. Pharmacists are uniquely positioned to counsel patients on appropriate dosing and administration schedules for both adults and children at the point of purchase. Collaborative initiatives between the MNPC and pharmacy professionals could develop targeted educational campaigns promoting safe paracetamol use practices.

The findings that non-pharmaceutical recreational drugs comprised 12.7% of all exposures, with recreational use concentrated exclusively in younger adults aged 20-39 years, highlights the urgent need for targeted social media campaigns addressing emerging synthetic substance threats. Content should emphasise the availability of the MNPC helpline (1774) for expert, confidential advice regarding recreational substance exposures, promoting early intervention that could prevent severe complications.

The age-specific patterns identified in this study indicate that social media campaigns should be strategically tailored to reach different demographic groups through targeted platforms and messaging approaches (Vo and Smollin 2015). For parents of young children, who

represent the significant 16.4% of cases in the under-5 age group, Vo and Smollin (2015) suggest that Facebook content should emphasise practical childproofing techniques, safe storage practices, and immediate response protocols for suspected poisoning incidents. They recommend that visual content, particularly infographics and demonstration videos, can serve as highly effective communication tools for conveying poison prevention strategies to busy parents who may benefit from easily digestible, actionable information.

According to Marshall et al. (2024), for young adults aged 20-39 years (where deliberate exposures were most concentrated), Instagram and Facebook content should incorporate mental health awareness messaging alongside toxicological education. This dual approach recognises that substance-related harm in this demographic often occurs within complex psychological and social contexts (Watt et al. 2025). Collaborative posts with mental health organisations and the Maltese Emergency Nurses' Association (as demonstrated in the March 2025 collaboration) could enhance credibility and reach.

The substantial representation of non-Maltese residents (28.3% of cases) indicates the need for multilingual social media content to effectively reach Malta's diverse population. Educational materials should be developed in multiple languages commonly spoken by Malta's international community, with culturally appropriate messaging that recognises different healthcare-seeking behaviours and poison prevention practices (Vo and Smollin 2015).

Vo and Smollin (2015) claim that real-time social media engagement during poison prevention awareness campaigns could amplify traditional media efforts and provide opportunities for direct public education. The MNPC's social media platforms could serve as rapid information dissemination channels during public health emergencies involving widespread exposures, complementing traditional emergency communication systems.

Schein, Wilson, and Keelan (2011) state that social media analytics should be systematically collected and analysed to assess the effectiveness of educational campaigns and inform ongoing content development. Metrics such as engagement rates, reach demographics, and content sharing patterns could provide insights into which messages resonate most effectively with different population groups (Schein, Wilson, and Keelan 2011). This data could guide optimisation of educational content and help identify emerging public education needs (Vo and Smollin 2015). Furthermore, the MNPC's social media presence should also serve as a platform for correcting misinformation about poisoning management that may circulate online (Vo and Smollin 2015). Proactive monitoring of poison-related discussions on social media platforms could identify opportunities to provide accurate information and direct users to appropriate resources, including the MNPC helpline (1774) (Lim et al. 2022).

Partnership opportunities with HCP organisations, as demonstrated through the collaboration with the Maltese Emergency Nurses' Association, should be expanded to include other professional groups such as pharmacists, primary care physicians, and emergency physicians. These partnerships could provide professional endorsement for public education messages while ensuring consistency of information across different healthcare communication channels (Hahn 2011).

4.7.5 Healthcare system development recommendations

Sutter et al. (2010) maintain that public awareness campaigns should be developed to increase direct public utilisation of PC services, potentially reducing unnecessary ED visits for minor exposures while ensuring appropriate care for serious incidents. Given that only 23.4% of current calls originate from the public, substantial opportunity exists for enhanced community engagement.

Clinical decision support tools should be developed to assist healthcare providers in determining when poison centre consultation is most beneficial, addressing the systematic under-reporting identified in this study (Muralidharan et al. 2022). The variation in consultation rates across different clinical pathways suggests opportunities for standardising these decisions and optimizing specialist resource utilisation. Moreover, enhanced after-hours documentation systems should be implemented to address the identified under-reporting of overnight consultations.

4.7.6 Systematic quality assurance programs

Quality assurance programs should be established to monitor consultation patterns and identify cases where PC input could have provided additional clinical benefit (Muralidharan et al. 2022). Regular audits of ED management of common poisoning presentations (particularly paracetamol, recreational drugs, and antidote administration) could identify opportunities for enhanced collaboration and improved documentation practices.

4.7.7 Data collection and surveillance enhancements

Koskela, Raatiniemi, and Liisanantti (2020) state that the PC database should be enhanced to capture additional variables that could inform prevention strategies, including socioeconomic indicators, educational levels, and cultural factors that may influence poisoning risk. Enhanced geographic coding could facilitate identification of environmental exposure risks and inform targeted prevention efforts (Koskela, Raatiniemi, and Liisanantti 2020).

Integration with other health surveillance systems should be pursued to provide better understanding of poisoning epidemiology in Malta. Linkage with hospital databases, ED records, and mortality data could enhance understanding of clinical outcomes and identify cases not captured through PC consultation (Hoppe-Roberts, Lloyd and Chyka 2000).

Regular analysis and reporting of PC data should be institutionalised to support ongoing surveillance, quality improvement, and policy development. Annual epidemiological reports, such as reports by Huynh et al. (2018) and Gummin et al. (2021), could inform healthcare planning and prevention strategy development while providing benchmarks for international comparison.

4.8 Future research recommendations

4.8.1 Longitudinal studies

Future research should examine longer-term trends in poisoning exposures as the MNPC continues to mature and integrate more fully into Malta's healthcare system. Multi-year analyses such as analyses by Li et al. (2021) and Mowry (2023), could identify seasonal patterns, secular trends, and the impact of prevention interventions on poisoning incidence and severity. Such studies could also assess whether the current patterns observed during the initial operational phase persist or evolve as service awareness and utilisation patterns mature (Mowry 2023).

Cairns et al. (2024) suggest that longitudinal follow-up studies of patients with severe poisoning exposures could provide valuable insights into long-term outcomes, recovery patterns, and factors associated with recurrent exposures. This information could inform both clinical management protocols and prevention strategies, particularly for deliberate exposures where repeat incidents are common (Cairns et al. 2024).

4.8.2 Intervention studies

Randomised controlled trials of prevention interventions could be designed based on the epidemiological patterns identified in this study. Building on successful approaches such as those demonstrated by Kendrick et al. (2008), childproofing education programs could be

systematically evaluated for their effectiveness in reducing paediatric accidental exposures within the Maltese context.

Harm reduction interventions for recreational substance use could be piloted and evaluated among the young adult population identified as high-risk in this study. Such interventions might focus on reducing exposure risks rather than eliminating substance use, recognising the persistent nature of recreational drug use in this demographic. Evidence supporting this approach comes from research by Stockings et al. (2016), whose systematic review of reviews demonstrated the effectiveness of harm reduction strategies alongside prevention, early intervention, and treatment approaches for problematic substance use among young people across multiple substances including tobacco, alcohol, cannabis, opioids, amphetamines, and cocaine. Such interventions might focus on reducing exposure risks rather than eliminating substance use, recognising the persistent nature of recreational drug use in this demographic.

4.8.3 Health economics research

Economic evaluations of PC services could demonstrate the cost-effectiveness of specialist consultation and guide resource allocation decisions. The finding that 21.1% of cases were managed at home suggests potential for cost savings through enhanced PC utilisation and appropriate triage of low-risk exposures.

Cost-benefit analyses of prevention programs could inform public health investment decisions. The concentration of exposures in specific age groups and substance categories provides opportunities for targeted interventions that could be evaluated for their economic efficiency as well as health impacts.

4.8.4 Comparative studies

Cross-national comparisons with other European PC could provide insights into factors influencing poisoning epidemiology and identify best practices for prevention and clinical management. Malta's unique demographic composition and healthcare system characteristics could provide valuable contrast points for understanding how local factors influence poisoning patterns. Comparative analyses between Malta and other island nations or small states could identify common challenges and successful strategies relevant to similar healthcare environments. Such comparisons could inform policy development and service planning for poison control services in comparable settings.

4.8.5 Methodological research

Research into optimal data collection methods for PCs could enhance the quality and utility of surveillance data. Investigation of standardised data elements, validation of severity assessment tools, and development of outcome measures specific to PC services could improve the evidence base for clinical and policy decision-making. Wood, Hill and Dargan (2014) demonstrated the considerable potential of PC surveillance data through analysis of novel psychoactive substances, specifically mephedrone and synthetic cannabinoid receptor agonists, and advocated for the development of more robust and systematic reporting frameworks. Such networks of poison information services, operating both nationally and internationally, could complement existing datasets on acute substance toxicity and facilitate improved data triangulation for enhanced surveillance capabilities.

Studies examining the relationship between PC consultation and clinical outcomes could provide evidence for the impact of specialist toxicology services on patient care. Such research could support advocacy for PC services and guide optimisation of consultation protocols.

4.9 Final Conclusions

The establishment of the MNPC represents a significant advancement in Malta's healthcare infrastructure and public health capabilities. This thorough analysis of the centre's initial 19 months of operation demonstrates successful integration into clinical practice, appropriate utilisation by HCP, and effective contribution to patient care outcomes.

The epidemiological profile of poisoning exposures in Malta reveals both similarities to international patterns and unique characteristics reflecting the country's distinctive population composition and healthcare environment. The findings provide essential evidence for developing targeted prevention strategies, enhancing clinical protocols, and informing public health policy development.

The success of the MNPC's establishment provides a strong foundation for continued service development and expansion. The data generated through this analysis will support evidence-based improvements in poison prevention, clinical care, and health system optimisation. Most importantly, the MNPC has demonstrated its value as both a clinical resource and a surveillance system, contributing to improved outcomes for individuals affected by poisoning exposures while generating essential data for ongoing public health efforts.

The overall aim established at the initiation of this study was to comprehensively analyse the nature of calls received by the MNPC since its inception and to examine the insights these calls provide regarding the types and severity of poisons reported. This aim has been comprehensively addressed through this systematic analysis.

The nature of calls received reflects the full spectrum of poisoning exposures affecting Malta's population, from paediatric accidental ingestions to adult deliberate self-harm, with substance patterns reflecting both therapeutic pharmaceutical use and recreational drug consumption. The insights gained from this analysis extend beyond simple descriptive

epidemiology to provide actionable intelligence for prevention, clinical care, and policy development. The identification of high-risk populations, problematic substances, and critical time periods for intervention provides the foundation for evidence-based approaches to reducing the public health burden of poisoning exposures in Malta.

As the MNPC continues to evolve and expand its services, ongoing evaluation and research will be essential to ensure continued effectiveness and optimisation of outcomes. This initial comprehensive analysis provides the baseline data necessary for measuring future progress and demonstrates the critical importance of systematic data collection and analysis in supporting public health objectives.

The MNPC has successfully established itself as an essential component of Malta's healthcare system, providing critical expertise for clinical decision-making while generating valuable surveillance data for public health action. The evidence presented in this analysis supports continued investment in and development of poison control services as an effective strategy for protecting public health and improving healthcare outcomes in Malta.

References

AB RAHMAN, I., SAMSURIJAN, M.S., AZZALIA, N., KAMARUZAMAN, N.A. and JAAFAR, M.H., 2021. A framework for interpreting knowledge, attitude and practices in poisoning incidents of household chemical products. Journal of Sustainability Science and Management, 16(5), pp.102-114. http://doi.org/10.46754/jssm.2021.07.008

ABUBAKER, Z.J., NISAR, M., JAMSHED, A., ABBAS, M.Z., HASHMI, K.N. and ARSALAN, M., 2020. A retrospective analysis on poison related mortalities in a tertiary care centre in Pakistan. Asia Pacific Journal of Medical Toxicology, 9(3). http://apjmt.mums.ac.ir

ACHANA, F.A., SUTTON, A.J., KILLAMPALLI, V., HUBBARD, S.J., COURT, R., COOPER, N.J., CARTER, P., GURUNG, T., JOHNSON, M., DIAS, S. and WELTON, N.J., 2015. The effectiveness of different interventions to promote poison prevention behaviours in households with children: A network meta-analysis. PLoS One, 10(4) pp. 30-36. https://doi.org/10.1371/journal.pone.0121122

ALHARBI, A.A., MUADDI, M.A., BINHOTAN, M.S., ALQASSIM, A.Y., ALSULTANl, A.K., ARAFAT, M.S., ALDHABIB, A., ALASKA, Y.A., ALWAHBI, E.B., ALMUTAIRI, M.A. and ALHARTHI, M., 2025. Poisoning Epidemiology, Clinical Outcomes and Management Decisions for General Public Calls: A Cross-Sectional Analysis of a Nationwide Telehealth Toxicology Consultation Service Data in Saudi Arabia. Journal of Epidemiology and Global Health, 15(1), pp.60. https://doi.org/10.1007/s44197-025-00404-y

ALWAN, I.A., BRHAISH, A.S., AWADH, A.I., MISNAN, A., RAHIM, N.A.A., TANGIISURAN, B. and ABDUL MAJID, M.I., 2022. Poisoning among children in Malaysia: A 10-years retrospective study. PLoS one, 17(4), pp.1-10. https://doi.org/10.1371/journal.pone.0266767

AMIR, N.A., TANGIISURAN, B., SAMSUDIN, S., ABD RANI, N.A., FATHELRAHMAN, A.I., MOHAMED, F. and KAMARUZAMAN, N.A., 2023. Trends in the intentional and non-intentional poisoning-related calls among adolescents reported to the Malaysia National Poison Centre (2010-2020). Public Health, 11(5), pp.573-583. doi: 10.13189/ujph.2023.110505

ANDRAOS, C., SIDDIQI, A., BRAZDZIONIS, J. and SIDDIQI, J., 2025. Limitations of the Glasgow Coma Scale: Challenges and Considerations. *Cureus*, *17*(2).doi: 10.7759/cureus.78900

ARNOLD, J.K., BORGER, J. and NAPPE, T.M., 2023. Poison Control in the United States. In StatPearls. StatPearls Publishing. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537316/

ASLAM, U., SOHAIL, A., AZIZ, H.I.T. and VISTRO, M., 2019. The importance of preserving the anonymity in healthcare data: a survey. International Journal of Scientific & Technology Research, 8(11), pp.2216-2220.

ATTARD MONTALTO, S. and GATT, M., 2014. Changing clinical activity in Paediatrics in Malta. *Malta Medical Journal*, *26*(01), pp. 3-7. 417.pdf

BABIĆ, Ž., 2023. Report of the Poison Control Centre for 2022. Arhiv za higijenu rada i toksikologiju, 74(1), pp.69-73.

BAJADA, T., SATARIANO, B. and CHAVOSHI, S.H., 2024. The importance of location for coworking spaces and the timed city concept. Experiences, perceptions, and reality in Malta. In: Evolution of new working spaces: Changing nature and geographies. Cham: Springer Nature Switzerland, pp.107-118. https://doi.org/10.1007/978-3-031-50868-4_10

BALDACCHINO, M., ABELA, J., REIFF, E. M., GRIMA, J., ATTARD, L. and ELLUL, R., 2017. Patient attendance at a primary health care centre in Malta : a cross-sectional observational study. The Journal of the Malta College of Family Doctors, 6(3), pp.1-8.

BALME, K., STEPHEN, C., CURLING, L., MOHAMMED, F., DU PLESSIS, C., MARKS, C., PILLAY-FUENTES LORENTE, V., VAN RENSBURG, R. and VOIGT, G., 2020. The economics of poisoning: The role of telemedicine and toxicovigilance. South African Medical Journal, 110(12), pp.1152-1152. https://doi.org/ 10.7196/SAMJ.2020.v110i12.15296

BECKER, S., SPILLER, H.A., BADETI, J., FUNK, A.R., CASAVANT, M.J., ZHU, M., MICHAELS, N.L. and SMITH, G.A., 2022. Cocaine exposures reported to United States poison control centres, 2000–2020. Clinical Toxicology, 60(7), pp.827-837. https://doi.org/10.1080/15563650.2022.2042011

BERGEN, H. and HAWTON, K., 2007. Variations in time of hospital presentation for deliberate self-harm and their implications for clinical services. Journal of Affective Disorders, 98(3), pp.227-237.

BERNASCONI, L., CARNAVOLE, M., LONATI, D., PETROLINI, V.M., SCHICCHI, A., BROLLI, B., NEGRINI, V.M., GRAZIOLI, C., MAYSTROVA, O., BUSCAGLIA, E., SCARAVAGGI, G., CREMA, F. and LOCATELLI, C.A., 2023. Hydrogen cyanamide

exposure: a case series from Pavia Poison Control Centre. *Occupational Medicine*, 73, (8), pp.500–506. https://doi.org/10.1093/occmed/kqad108

BERTAKIS, K.D., AZARI, R., HELMS, L.J., CALLAHAN, E.J. and ROBBINS, J.A., 2000. Gender differences in the utilisation of health care services. *Journal of family practice*, *49*(2).

BEUHLER, M.C., SPILLER, H.A. and ALEGUAS, A., 2013. Demographics and outcome of unintentional insulin overdoses managed by three poison centers. *Clinical Toxicology*, *51*(8), pp.789-793.

BIER, S.A. and BORYS, D.J., 2010. Emergency medical services' use of poison control centres for unintentional drug ingestions. *The American Journal of Emergency Medicine*, 28(8), pp.911-914. https://doi.org/10.1016/j.ajem.2009.05.015

BOEDEKER, W., WATTS, M., WATTS, M., CLAUSING, P. and MARQUEZ, E., 2020. The global distribution of acute unintentional pesticide poisoning: estimations based on a systematic review. *BMC public health*, 3(20), pp.1-19. https://doi.org/10.1186/s12889-020-09939-0

BONNICI, J., COULSON, J. and GAUCI, D., 2017. Recreational drug use and the emerging challenges of psychoactive substances in Malta. A case series. *Malta Medical School Gazette*, *1*(4), pp.23-35. mmsjournals.org

BORG, A., SAMMUT, A., GRECH, A., LAUTIER, E.C., PRIEBE, S. and AZZOPARDI-MUSCAT, N., 2022. Developing the 2020-2030 mental health strategy for Malta: Addressing the needs of a small island state undergoing rapid socioeconomic transition. *Health Policy*, *126*(8), pp.744-748. https://doi-org.ejournals.um.edu.mt/10.1016/j.healthpol.2022.06.001

BOYLE, E.B., HURD, Y.L., TEUTSCH, S.M. and NATIONAL ACADEMIES OF SCIENCES, ENGINEERING AND MEDICINE, 2024. Data sources available for cannabis surveillance. *Cannabis Policy Impacts Public Health and Health Equity*. In National Academies Press (US). ttps://www.ncbi.nlm.nih.gov/sites/books/NBK609481/

BRASSARD, E., HOFFMAN, R.S., GOSSELIN, S., MONTE, A.A., BOSACK, T. and BURDA, A., 2020. To call or not to call: behavioural determinants influencing the decision of intensivists to consult poison centres for calcium channel blocker poisoning. *Clinical Toxicology*, 58(9), pp.913-921. https://doi.org/10.1080/15563650.2019.1708376

BUDNITZ, D.S., LOVEGROVE, M.C. and GELLER, R.J., 2020. Prevention of unintentional medication overdose among children: time for the promise of the poison prevention packaging act to come to fruition. *JAMA*, *324*(6), pp.550-551.

CAIRNS, R., NOGHREHCHI, F., RAUBENHEIMER, J.E., CHITTY, K.M., ISBISTER, G.K., CHIEW, A.L., BRETT, J., DAWSON, A.H., BROWN, J.A. and BUCKLEY, N.A., 2024. Poisoning and envenomation linkage to evaluate outcomes and clinical variation in Australia (PAVLOVA): a longitudinal data-linkage cohort of acute poisonings, envenomation, and adverse drug reactions in New South Wales, Australia, 2011–2020. *Clinical Toxicology*, 62(10), pp.615-624. https://doi.org/10.1080/15563650.2024.2398119

ÇALISKAN, F., AKCA, G., ÇALISKAN, B. and AKCA, U., 2021. Clinical use of the poisoning severity score in acute paediatric poisoning. *Journal of Experimental and Clinical Medicine,* 38(4), pp.565-570. doi: 10.52142/omujecm.38.4.30

CAMILLERI, E., VASSALLO, C. and SANT, K., 2025. Psychiatric Admissions amongst the Substance Use Disorder Population to Malta's Mental Health Hospital: Admissions

related to substance use disorder in Malta. *Malta Medical Journal*, 37(1), pp.48-54. http://mmsjournals.org/index.php/mmj/43

CHARTIER, C., PENOUIL, F., BLANC--BRISSET, I., PION, C., DESCATHA, A. and DEGUIGNE, M., 2021. Paediatric cannabis poisonings in France: more frequent and severe. *Clinical toxicology,* 59(4), pp. 326–333. https://doi.org/10.1080/15563650.2020.1806295

CHIDIAC, A.S., BUCKLEY, N.A., NOGHREHCHI, F. and CAIRNS, R., 2024. Paracetamol Dosing Errors in People Aged 12 Years and Over: An Analysis of Over 14,000 Cases Reported to an Australian Poisons Information Centre. *Drug Safety*, 47(12), pp.1293-1306. https://doi-org.ejournals.um.edu.mt/10.1007/s40264-024-01472-y

CHITTY, K.M., DOBBINS, T., DAWSON, A.H., ISBISTER, G.K. and BUCKLEY, N.A., 2017. Relationship between prescribed psychotropic medications and co-ingested alcohol in intentional self-poisonings. *The British Journal of Psychiatry*. 210(3), 203-208. doi:10.1192/bjp.bp.115.172213

CHITUNGO, I., MHANGO, M., MBUNGE, E., DZOBO, M., MUSUKA, G. and DZINAMARIRA, T., 2021. Utility of telemedicine in sub-Saharan Africa during the COVID-19 pandemic. A rapid review. *Human Behaviour Emergency Technology*, 3(5), pp.843–853. https://doi.org/ 10.1002/hbe2.297.

CHOI, N. G., MARTI, C. N., DINITTO, D. M. and BAKER, S. D., 2020. Cannabis and synthetic cannabinoid poison control centre cases among adults aged 50+, 2009–2019. *Clinical Toxicology*, 59(4), pp.334–342. https://doi.org/10.1080/15563650.2020.1806296

SHOBHA,C., LOVIN, L., RAMESH, M. and NARAHARI, M. G., 2013. Evaluation of poison information services provided by a new poison information centre. *Indian Journal of Pharmacology,* 45(5), pp. 496-501. DOI: 10.4103/0253-7613.117781

CONNER, K.R., WIEGAND, T.J., GORODETSKY, R., SCHULT, R., PIZZARELLO, E. and KAUKEINEN, K., 2019. Validation of the Poisoning Severity Score (PSS) in suicidal behavior by self-poisoning. *Behavioral sciences and the law*, *37*(3), pp.240-246.

COOK, M. A. and BROOKE, N., 2021. Event-Based Surveillance of Poisonings and Potentially Hazardous Exposures over 12 Months of the COVID-19 Pandemic. *International journal of environmental reseah and public health*, 18(21), pp.11133-11140. https://doi.org/10.3390/ijerph182111133

COWANS, C., LOVE, A., TANGIISURAN, B. and JACOB, S.A., 2023. Uncovering the hidden burden of pharmaceutical poisoning in high-income and low-middle-income countries: A scoping review. *Pharmacy*, 11(6), pp.184. https://doi.org/10.3390/pharmacy11060184

CUSCHIERI, S., FALZON, C., JANULOVA, L., AGIUS, S., BUSUTTIL, W., PSAILA, N., FARRUGIA, K., DEBONO, J. and GRECH, V., 2021. Malta's only acute public hospital service during COVID-19: a diary of events from the first wave to transition phase. *Journal of the International Society for Quality in Health Care*, 33(1), pp.138-145. https://doi.org/10.1093/intqhc/mzaa138

DALY, C., GRIFFIN, E., MCMAHON, E., CORCORAN, P., WEBB, R.T., WITT, K., AASHCROFT, D.M. and ARENSMAN, E., 2020. Repeat self-harm following hospital-presenting intentional drug overdose among young people—a national registry

study. *International journal of environmental research and public health*, 17(17), pp.6159. doi: 10.3390/ijerph17176159

DAS, A., DATTA, A., NATH, A. and BHOWMIK, A., 2022. Profile of poisoning cases treated in a teaching hospital of Northeast India with special reference to Poison severity score: A cross-sectional study. *Journal of family medicine and primary care*, *11*(11), pp.7072-7076.

DESCAMPS, A. K., VANDIJCK, D., BUYLAERT, W., MOSTIN, M. and DE PAEPE, P., 2021. Hospital referrals of patients with acute poisoning by the Belgian Poison Centre: analysis of characteristics, associated factors, compliance and costs. *Emergency Medicine Journal, 38*(7), pp. 511-519. https://doi.org/10.1136/emermed-2019-209202
doi: 10.7416/ai.2021.2454

EIZADI-MOOD, N., LALEHZAR, S.S., NIKNAM, S., MAHVARI, R., MIRMOGHTADAEE, P. and MEAMAR, R., 2022. Toxico-clinical study of patients poisoned with household products; a two-year cross-sectional study. *BMC Pharmacology and Toxicology*, 23(1), pp.96. https://doi.org/10.1186/s40360-022-00640-z

ELAMIN, M. E. M. O., JAMES, D. A., HOLMES, P., JACKSON, G., THOMPSON, J. P., SANDILANDS, E. A., … THOMAS, S. H. L., 2017. Reductions in emergency department visits after primary healthcare use of the UK National Poisons Information Service. *Clinical Toxicology*, 56(5), pp.342–347. https://doi.org/10.1080/15563650.2017.1390120

EVOY, D.M., CLARKE, M. and JOYCE, M., 2023. Time of self-harm presentations to hospital emergency departments: a scoping review. *Social psychiatry and psychiatric epidemiology*, *58*(3), pp.335-354. https://doi.org/10.1007/s00127-022-02353-4

FARKAS, A., KOSTIC, M., HUANG, C. C. and GUMMIN, D., 2022. Poison centre consultation reduces hospital length of stay. *Clinical Toxicology*, *60*(7), pp. 863–868. https://doi.org/10.1080/15563650.2022.2039686

FENECH, S. and AQUILINA, N.J., 2021. Estimation of the NO2 population exposure in the Northern Harbour district of Malta. *Atmospheric Environment*, 244(3), pp.117918. https://doi.org/10.1016/j.atmosenv.2020.117918

FERNANDO, R., 2002. 'The National Poisons Information Centre in Sri Lanka: The First Ten Years'. *Journal of Toxicology: Clinical Toxicology*, 40(5), pp. 551–555. https://doi.org/10.1081/CLT-120014644

GALVAO, T.F., SILVA, E.N., SILVA, M.T., BRONSTEIN, A.C. and PEREIRA, M.G. 2012., Economic evaluation of poison centres: A systematic review. *International Journal of Technology Assessment in Health Care,* 28(2), pp. 86-92. https://doi.org/10.1017/S0266462312000116

Geneva: World Health Organization. Available under CC BY-NC-SA 3.0 IGO licence.

GHANE, T., BEHMANESH, Y. and KHAZAEI, F., 2015. Annual Report of Recorded Phone Calls to Iran's Drug and Poison Information Centres (2014-2015). *Asia Pacific Journal of Medical Toxicology*, 4(3), pp. 97–101. https://research-ebsco-com.ejournals.um.edu.mt/linkprocessor/plink?id=5bab584e-3beb-3d39-93c7-132856a727b6

GHANE, T., SABERI, S. and DAVOODABADI, M., 2013. Descriptive analysis of recorded phone calls to Iran drug and poison information centres during 2011-2012. *Asia Pacific Journal of Medical Toxicology*, *2*(2), pp.48-51. https://doi.org/10.22038/apjmt.2013.859

GHANNOUM, M. and ROBERTS, D.M., 2023. Management of poisonings and intoxications. *Clinical Journal of the American Society of Nephrology*, 18(9), pp.1210-1221. *DOI:* 10.2215/CJN.0000000000000057

GIORDANO, F., PENNISI, L., FIDENTE, R.M., SPAGNOLO, D., MANCINELLI, R., LEPORE, A. and DEAISCI, R., 2021. The National Institute of health and the Italian poison centres network: results of a collaborative study for the surveillance of exposures to chemicals. Annali di Igiene: Medicina Preventiva e di Comunità, 10.

GLOBAL BURDEN OF DISEASE COLLABORATIVE NETWORK, 2020. *Global burden of disease study 2019 (GBD 2019) results*. Seattle, United States: Institute for Health Metrics and Evaluation (IHME). Available at: http://ghdx.healthdata.org/gbd-results-tool [Accessed on 15/04/25].

GRAVES, J. M., DILLEY, J. A., TERPAK, L., BROOKS-RUSSELL, A., WHITEHILL, J. M., KLEIN, T. A. and LIEBELT, E., 2021. Kratom exposures among older adults reported to U.S. poison centres, 2014-2019. *Journal of the American Geriatrics Society*, 69(8), pp.2176–2184. https://doi.org/10.1111/jgs.17326

GRECH, A., MUSCAT, R., BLESS, R., CAMILLERI, J., TONNA LOWELL, S., VELLA, S., ARPA, S., ATTARD, A., ATTARD, F., BALZAN, M. and BORG, M., 2004. 2004 Natio nal report to the EMCDDA: Malta–New developments, trends and in-depth information on selected issues. https://hydi.um.edu.mt/permalink/356MALT_INST/8ph8sn/alma994042958403956

GUMMIN, D.D., MOWRY, J.B., BEUHLER, M.C., SPYKER, D.A., BROOKS, D.E., DIB ERT, K.W., RIVERS, L.J., PHAM, N.P. and RYAN, M.L., 2020. 2019 Annual report of the American Association of poison control centers' National Poison Data System (NPDS): 37t h annual report. *Clinical toxicology*, *58*(12), pp.1360-1541.

GUMMIN, D.D., MOWRY, J.B., BEUHLER, M.C., SPYKER, D.A., BRONSTEIN, A.C., RIVERS, L.J., PHAM, N.P. and WEBER, J., 2021. 2020 annual report of the American ass ociation of poison control centers' national poison data system (NPDS): 38th annual report . *Clinical toxicology*, *59*(12), pp.1282-1501.

GUMMIN, D.D., MOWRY, J.B., BEUHLER, M.C., SPYKER, D.A., RIVERS, L.J., FELD MAN, R., BROWN, K., NATHANIEL, P.P., BRONSTEIN, A.C. and WEBER, J.A., 2022. 2021 annual report of the National Poison Data System©(NPDS) from America's poison ce nters: 39th annual report. *Clinical toxicology*, *60*(12), pp.1381-1643.

GUMMIN, D.D., MOWRY, J.B., BEUHLER, M.C., SPYKER, D.A., RIVERS, L.J., FELD MAN, R., BROWN, K., PHAM, N.P., BRONSTEIN, A.C. and DESLAURIERS, C., 2023. 2022 Annual report of the national poison data system®(NPDS) from America's Poison Ce nters®: 40th annual report. *Clinical Toxicology*, *61*(10), pp.717-939.

GUMMIN, D.D., MOWRY, J.B., BEUHLER, M.C., SPYKER, D.A., RIVERS, L.J., FELDMAN, R., BROWN, K., PHAM, N.P., BRONSTEIN, A.C. and DESLAURIERS, C., 2024. 2023 Annual report of the National Poison Data System® (NPDS) from America's Poison Centres®: 41st annual report. *Clinical Toxicology*, 62(12), pp.793-1027. https://doi.org/10.1080/15563650.2024.2412423

GUSSOW, L., 2015. 'My child ate poop!'—How one poison centre established its social media presence. *Clinical Toxicology*, 53(5), pp.419-420. https://doi.org/10.3109/15563650.2015.1014909

GUYER, B. and MAVOR, A., 2005. Forging a poison prevention and control system: report of an Institute of Medicine committee. *Academic Paediatrics*, 5(4), pp.197.

HAHN, A., 2011. The public health role of Poison Centres-Signals from human cases, examples of collaboration between Poisons Centres and Public Health Authorities. *Journal of Medical Toxicology,* 10(4), 107–111 https://doi.org/10.1007/s13181-013-0363-2

HAHN, A., 2020. Poison control centres. In: *Information Resources in Toxicology*. Academic Press, pp.875-885. https://doi.org/10.1016/B978-0-12-813724-6.00078-5

HAN, E., HWANG, H., YU, G., KO, D.R., KONG, T., YOU, J.S., CHOA, M. and CHUNG, S.P., 2021. Systematic review for economic benefit of poison control centre. *Journal of the Korean society of clinical toxicology*, *19*(1), pp.1-7. DOI: https://doi.org/10.22537/jksct.2021.19.1.1

HARGREAVES, S., RUSTAGE, K., NELLUMS, L.B., MC ALPINE, A., POCOCK, N., DEVAKUMAR, D., ALDRIDGE, R.W., ABUBAKAR, I., KRISTENSEN, K.L., HIMMELS, J.W. and FRIEDLAND, J.S., 2019. Occupational health outcomes among international migrant workers: a systematic review and meta-analysis. *The Lancet Global Health*, *7*(7), pp.872-882. http://dx.doi.org/1c0.1016/ S2214-109X(19)30204-9

HITTI, E, EL ZAHRAN, T, HAMADE, H, KADDOURA, R, MNEIMNEH, Z, MORGAN, B.W. and KAZZI, Z., 2020. 'Toxicological exposures reported to a telephonic consultation service at a tertiary care hospital in Lebanon', *Clinical Toxicology*, 58(9), pp. 886–892.

HONDEBRINK, L., NUGTEREN-VAN LONKHUYZEN, J.J., HUNAULT, C.C., VAN DEN BERG, J., VAN DER GOUWE, D. and VAN RIEL, A.J., 2020. New psychoactive substances (NPS) in the Netherlands: occurrence in forensic drug samples, consumer drug samples and poisons centre exposures between 2013 and 2017. *Addiction*, 115(4), pp.716-725. https://doi.org/10.1111/add.14868

HOOIJMAN, M.F., MARTINEZ-DE LA TORRE, A., WEILER, S. and BURDEN, A.M., 2022. Opioid sales and opioid-related poisonings in Switzerland: A descriptive population-based time-series analysis. *The Lancet Regional Health - Europe*, 1(20), 100437. https://doi.org/10.1016/j. lanepe.2022.100437

HOPPE-ROBERTS, J.M., LLOYD, L.M. and CHYKA, P.A., 2000. Poisoning mortality in the United States: comparison of national mortality statistics and poison control centre reports. *Annals of emergency medicine*, *35*(5), pp.440-448. https://doi.org/10.1067/mem.2000.105932

HUYNH, A., CAIRNS, R., BROWN, J.A., JAN, S., ROBINSON, J., LYNCH, A.M., WYLIE, C., BUCKLEY, N.A. and DAWSON, A.H., 2020. Health care cost savings from Australian Poisons Information Centre advice for low-risk exposure calls: SNAPSHOT 2. *Clinical Toxicology*, *58*(7), pp.752-757. https://doi.org/10.1080/15563650.2019.1686513

HUYNH, A., CAIRNS, R., BROWN, J.A., LYNCH, A.M., ROBINSON, J., WYLIE, C., BUCKLEY, N.A. and DAWSON, A.H., 2018. Patterns of poisoning exposure at different ages: the 2015 annual report of the Australian Poisons Information Centres. *Medical journal of Australia*, *209*(2), pp.74-79. https://www.mja.com.au/podcasts

INTERNATIONAL LABOUR ORGANIZATION, 2024. *Occupational Safety and Health. World Statistic*. Available at: https://www.ilo.org/moscow/areas-of-work/occupational-safety-and-health/WCMS_249278/lang–en/index.htm [Accessed on the 20/04/25].

ISLAM, T., KNOECKEL, R., WYLIE, C. and ISOARDI, K., 2022. Plant poisonings in Australia: a retrospective series of calls to the Queensland Poisons Information Centre. *Clinical Toxicology*, *61*(1), pp.72–76. https://doi.org/10.1080/15563650.2022.2133727

JOARDER, M., DEAN, D., HARRIS, K. and ISOARDI, K.Z., 2022. Ambulance referrals to an Australian Poisons Information Centre: a retrospective series. *Clinical Toxicology*, *60*(12), pp.1345-1349. doi: 10.1080/15563650.2022.2131567.

JOHNSON, A. R., TAK, C. R., ANDERSON, K., DAHL, B., SMITH, C. and CROUCH, B. I., 2020. Poison-related visits in a paediatric emergency department: A retrospective analysis of patients who bypass poison control centres. *The American Journal of Emergency Medicine, 38*(8), pp.1554-1559. https://doi.org/10.1016/j.ajem.2019.158418

JOLLANT, F., BLANC-BRISSET, I., CELLIER, M., AMBAR AKKAOUI, M., TRAN, V.C., HAMEL, J.F., PIOT, M.A., NOURREDINE, M., NISSE, P., FRENCH POISON CENTRE CONTROL RESEARCH GROUP and HAWTON, K., 2022. Temporal trends in calls for suicide attempts to poison control centres in France during the COVID-19 pandemic: a nationwide study. *European Journal of Epidemiology*, *37*(9), pp.901-913.

KADER, A., HERMANNS-CLAUSEN, M., VAN RIEL, A., FABER, K. and HONDEBRINK, L., 2025. Advancing toxicovigilance of recreational drugs, including new psychoactive substances, by using data from four European poison centres. *Clinical Toxicology*, *63*(1), pp.23-31.

KENDRICK, D., SMITH, S., SUTTON, A., WATSON, M., COUPLAND, C., MULVANEY, C. and MASON-JONES, A., 2008. Effect of education and safety equipment on poisoning-prevention practices and poisoning: systematic review, meta-analysis and meta-regression. *Archives of disease in childhood*, *93*(7), pp.599-608. https://doi.org/10.1136/adc.2007.133686

KHAREL, R., GHIMIRE, R., SHARMA, R., MALEKU, K., ALUISIOl, A.R. and KAZZI, Z., 2024. Establishment of the first Institution-Based Poison Information Centre in Nepal

through a multilateral international partnership. *Global Health: Science and Practice*, *12*(5), pp. 1-8. https://doi.org/10.9745/GHSP-D-24-00142

KHOJA, N., ALTAMIMI, A., MOHAMED, A., ALAWI, L., ALMULHIM, K. and PLEVIN, R. 2024. Prevalence and characteristics of poisoning calls/cases in Saudi Arabia: a single-center experience from a tertiary care hospital. *Toxicology Communications*, *8*(1). https://doi.org/10.1080/24734306.2024.2442859

KIM, J.M., SON, K., YUM, S.G. and AHN, S., 2020. Analysing the risk of safety accidents: The relative risks of migrant workers in construction industry. *Sustainability*, *12*(13), pp.5430. https://doi.org/10.3390/su12135430

KING, C., ANDERSON, M., AGARWAL, A., FAKIS, A., PARRY, C. M., LYNN, R. M., HAWCUTT, D. B., and STARKEY, E. S. 2025. Severe accidental poisonings in children: a British Paediatric Surveillance Unit nationwide prospective study. *Archives of Disease in Childhood*, 110(8), 597–602. https://doi.org/10.1136/archdischild-2024-328196

KINGSLEY, T.A., DIEUDONNE, A. and JACQUES, Y., 2017. Evaluating the necessity of a poison control centre in Cameroon: The knowledge and perception of health care professionals in the Laquintinie hospital and the Bonassama district hospital in Douala. *Journal of Clinical Toxicology*, *7*(6), pp.367-380. doi: 10.4172/2161-0495.1000367

KOH, Q.X., WISE, S., RAUBENHEIMER, J.E., DEBONO, D., ROBERTS, D.M. and CARLAND, J.E., 2024. Unintentional poisoning in older Australians: a retrospective audit of New South Wales Poisons Information Centre data. *Clinical Toxicology*, 62(10), pp.625-635. https://doi.org/10.1080/15563650.2024.2398766

KOSKELA, L.O., RAATINIEMI, L.V. and LIISANANTTI, J.H., 2020. How does socioeconomic status affect the incidence of hospital-treated poisonings? A retrospective

study. *European journal of public health*, *30*(3), pp.568-572. https://doi.org/10.1093/eurpub/ckz179

KOULI, M., Al HOURI, H. N., JOMAA, S., ISSA, A., ARROUK, D. M. N., ALHOURI, A., ALMHANNI, G. and WARDEH, R., 2022. Epidemiology of poisoning in Syria (1999 through 2020). *Clinical Toxicology*, *61*(2), pp.116–122. https://doi.org/10.1080/15563650.2022.2156882

KRENZELOK, E.P., REYNOLDS, K.M., DART, R.C. and GREEN, J.L., 2014. A model to improve the accuracy of US Poison Centre data collection. *Clinical Toxicology*, *52*(8), pp.889-896. doi.org/10.3109/15563650.2014.953169

KUBICKA, M., POLANSKA, P., GRUSZKA, M. and ZAKROCKA, M., 2025. Analysis of poisoning with OTC drugs for suicidal purposes among children and adolescents in Poland in the period 2012-2023: Paracetamol as the most frequently used substance in intentional poisonings. *Journal of Education, Health and Sport*, *78*, pp.57622-57622. https://doi.org/10.12775/JEHS.2025.78.57622

KUMPULA, E.K., PATERSON, D.A. and POMERLEAU, A.C., 2023. A retrospective analysis of therapeutic drug exposures in New Zealand National Poisons Centre data 2018–2020. *Australian and New Zealand journal of public health*, *47*(2), p.100027.

KUMPULA, E.K., SHIEFFELBIEN, L.M. and POMERLEAU, A.C., 2021. Enquiries to the New Zealand National Poisons Centre in 2018. *Emergency Medicine Australasia*, *33*(1), pp.45-51.https://doi.org/10.1111/1742-6723.13563

LECOT, J., CELLIER, M., COURTOIS, A., VODOVAR, D., LE ROUX, G., LANDREAU, A., LABADIE, M., BRUNEAU, C. and DESCATHA, A., 2023. Cyclopeptide mushroom

poisoning: A retrospective series of 204 patients. *Basic & clinical pharmacology and toxicology*, *132*(6), pp.528-537. https://doi.org/10.1111/bcpt.13858

LEONARD, J.B., MCFADDEN, C., FEEMSTER, A.A. and KLEIN-SCHWARTZ, W., 2020. Analysis of iatrogenic and in-hospital medication errors reported to United States poison centres: a retrospective observational study. *Drugs & Therapy Perspectives*, *36*(5), pp.190-201. https://doi.org/10.1007/s40267-020-00723-z

LEVINE, M., FLORES, J., SEABURY, S.A., SANKO, S. and ECKSTEIN, M., 2017. Impact of the use of regional poison control centres in an urban EMS dispatch system. Journal of Medical Toxicology, 13(1), pp.47-51. doi: https://doi.org/10.1007/s13181-016-0586-0

LI, H., DODD-BUTERA, T., BEAMAN, M.L., PRITTY, M.B., HEITRITTER, T.E. and CLARK, R.F., 2021. Trends in childhood poison exposures and fatalities: a retrospective secondary data analysis of the 2009–2019 US National Poison Data System annual reports. *Paediatric reports*, *13*(4), pp.613-623. https://doi.org/10.3390/pediatric13040073

LIAKONI, E., BERGER, F., KLUKOWSKA-RÖTZLER, J., KUPFERSCHMIDT, H., HASCHKE, M. and EXADAKTYLOS, A.K., 2019. Characteristics of emergency department presentations requiring consultation of the national Poisons Information Centre. *Swiss medical weekly*, *149*(5152), pp.20164-20164. https://doi.org/10.4414/smw.2019.20164

LIM, M.S., MOLENAAR, A., BRENNAN, L., REID, M. and MCCAFFREY, T., 2022. Young adults' use of different social media platforms for health information: Insights from web-based conversations. *Journal of medical Internet research*, *24*(1), pp.23656. doi: 10.2196/23656

LINDHOUT, P., SWUSTE, P., TEUNISSEN, T. and ALE, B. 2012. Safety in multilingual work settings: Reviewing a neglected subject in European Union policymaking. *European Journal of Language Policy*, 4(2), 137–170. https://doi.org/10.3828/ejlp.2012.10

LO VECCHIO, F., CURRY, S., WASZOLEK, K., KLEMENS, J., HOVSETH, K. and GLOGAN, D., 2008. Poison control centres decrease emergency healthcare utilisation costs. *Journal of medical toxicology: official journal of the American College of Medical Toxicology*, *4*(4), pp.221–224. https://doi.org/10.1007/BF03161204

LUCKOCK, U., HARNETT, J. and CAIRNS, R., 2021. Vitamin and mineral supplement exposures: cases reported to Australia's largest Poisons Information Centre, 2014–2015 to 2018–2019. *The British Journal of Nutrition,* 126(12), pp.1788-1793. https://doi.org/10.1017/S0007114521000647

MAKALINAO, I.R. and AWANG, R., 2005. Poison control centres in developing countries and Asia's need for toxicology education. *Toxicology and Applied Pharmacology*, 207(2), pp.716-721. https://doi.org/10.1016/j.taap.2005.04.033

MALTA, G., ALBANO, G.D., LAVANCO, G., BRANCATO, A., CANNIZZARO, C., ARGO, A., CONTORNO, S., PLESCIA, F. and ZERBO, S., 2025. Acute cannabis intoxication among the paediatric population. *Frontiers in Toxicology*, *7*, pp.1558721. DOI: 10.3389/ftox.2025.1558721

MAMO, K., 2024. Drug related emergency calls in the EU, A regional and Malta focus. Drug_related_emergencies_in_the_EU_A_regional_and_Malta_focus-libre.pdf. Accessed on 20/08/25.

MARANO, M., ROSSI, F., RAVÀ, L., KHALIL RAMLA, M., PISANI, M., BOTTARI, G., GENUINI, L., ZAMPINI, G., NUNZIATA, J., REALE, A., BARBIERI, M. A., CELEANI,

F., DI NARDO, M., CECCHETTI, C., STOPPA, F., VILLANI, A., RAPONI, M., LIVADIOTTI, S., and PONTRELLI, G. 2021. Acute toxic exposures in children: analysis of a three-year registry managed by a paediatric poison control centre in Italy. *Italian Journal of Paediatrics*, *47*(1), pp. 125. https://doi.org/10.1186/s13052-021-01071-y

MARSHALL, R.D., BAILEY, J., LIN, A., SHERIDAN, D.C., HENDRICKSON, R.G., HUGHES, A. and HOROWITZ, B.Z., 2024. Impact of social media "challenges" on poison centre case volume for intentional ingestions among school-aged children: an observational study. *Clinical Toxicology*, *62*(3), pp.183-189. https://doi.org/10.1080/15563650.2024.2331064

MARTINEZ-DE LA TORRE, A., WEILER, S., BRAM, D. S., ALLEMANN, S. S., KUPFERSCHMIDT, H., and BURDEN, A. M., 2020. national poison centre calls before vs after availability of high-dose acetaminophen (paracetamol) tablets in Switzerland. *Journal of the American Medicine Association network open*, *3*(10), pp.2890-2897. https://doi.org/10.1001/jamanetworkopen.2020.22897

MCDONALD, J., 2014. Handbook of Biological Statistics (3rd ed.). Sparky House Publishing, Baltimore, Maryland. Available from: http://www.biostathandbook.com/ [Accessed 04/06/25]

MESGARPOUR, B., FARIDFAR, S., REZAEI, M., ABDOLLAHIASL, A., SHADNIA, S., MAHDAVINEJAD, A. and ABDOLLAHI, M., 2024. Age-and gender-specific acute poisoning with drugs and medications affecting nervous system. *BMC pharmacology and toxicology*, *25*(1), pp.37. https://doi.org/10.1186/s40360-024-00759-1

MILELLA, M.S., PETRACCIA, L., PIRELLI, F., FOTI, G., SAPIO, M., BERARDI, R., CAPRIOLOI, D., PUGLIESE, F., and VIVINO, G., 2024. Self-harm by single- and multi-

agent medication poisoning in a retrospective analysis of a Poison Control Centre database from January 2018 to December 2022. *Pharmacoepidemiology Drug Safety,* 33(2), pp.5770-5767. doi:10.1002/pds.5767

MILLARD, Y.C., SLAUGHTER, R.J., SHIEFFELBIEN, L.M. and SCHEP, L.J., 2014. Poisoning following exposure to chemicals stored in mislabelled or unlabelled containers: a recipe for potential disaster. *NZ Medical Journal*, *127*(1403), pp.17-23. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2014/vol-127-no-1403/6312

MOTTLA, M.E., BOWLER, M.E. and ASGARY, R., 2023. Epidemiology, risk factors, and strategies to prevent and manage poisonings due to pharmaceuticals in children in low income and low-middle income countries: A systematic review. *Journal of global health*, *13*, pp.04173. doi: 10.7189/jogh.13.04173

MOWRY, J.B., 2023. Forty years of National Poison Data System Annual Reports. *Clinical Toxicology*, *61*(10), pp.713-716. https://doi.org/10.1080/15563650.2023.2286200

MULLINS, M.E., 2025. Epidemiology of acetaminophen toxicity. In *Acetaminophen Toxicity* (pp. 455-465). Academic Press.

MURALIDHARAN, H., VENKATESAN, A., VENATI, R., DHANASEKARAN, I.D., SUTHAHAR, T., AHMED, A., SALHOTRA, A., NAIR, B.B., KRISHNAN, M. and RAJANANDH, M.G., 2022. Barriers of healthcare professionals in utilising the service of drugs and poison information Centre: A cross-sectional study. *Exploratory research in clinical and social pharmacy*, *6*, p.100142. doi: 10.1016/j.rcsop.2022.100142

NASCIMENTO, T., SANTOS, T., RATO, F. and DE SOUSA-COELHO, A. L., 2023. Characterization of Potential Intoxications with Medicines in a Regional

Setting. *Pharmaceuticals (Basel, Switzerland)*, 16(2), pp.308-312. https://doi.org/10.3390/ph16020308

NEUMAN, G., MILLER-BARMAK, A., KHOURY, L., GIVON, L., SALAMEH, M., LEVDOV-AVITAL, I., MOED, T. and BENTUR, Y., 2022. Adherence of caregivers of children to advice provided by a National Poison Information Centre. *Clinical Toxicology*, 60(10), pp.1139-1144. https://doi.org/10.1080/15563650.2022.2109484

NICHOLLS, E., 2022. *Determining potential cost savings associated with avoided medical utilisation due to National Poisons Centre self-management of suspected poisonings, and identifying factors associated with awareness and utilisation of the service*. Doctoral dissertation, University of Otago. https://hdl.handle.net/10523/12692

NATIONAL POISONS INFORMATION SERVICE, 2024. *National Poisons Information Service Report 2023 to 2024*. London: UK Health Security Agency. Available at: [NPIS - Annual Reports] [Accessed: 06/07/25].

NITESCU, G.V., GRAMA, A., TURCU, T., STRATULA, A., DRAGOMIRESCU, A., PANA, E.S., BACONI, D. L., CRACIUN, M.D. and CORIOLAN, E.U., 2024. Epidemiology and Clinical Characteristics of Acute Plant Exposure in Patients Aged between 0 and 18 Years—A Six-Year Retrospective Study. *Children,* 11(3), pp.271-276. https://doi.org/10.3390/children11030271

NIŻNIK, Ł., TOPOROWSKA-KAZMIERAK, J., JABLONSKA, K., GLAB, N., STACH, S., FLOREK, J., SOWINSKA, M., ADAMCZYYK, A. and JUROWSKI, K., 2024. Toxicovigilance 2.0 - modern approaches for the hazard identification and risk assessment of toxicants in human beings: A review. *Toxicology*, 503, pp.153-158. https://doi.org/10.1016/j.tox.2024.153755

NATIONAL STATISTICS OFFICE MALTA, 2024. *World Population Day: 11 July 2024*. Available at: https://nso.gov.mt/world-population-day-11-july-2024/ [Accessed on the 30/03/25].

ODER, M. and POLD, K., 2013. Estonian experience on establishment of a modern national poison information centre: one-year profile of phone calls in 2012. *Asia Pacific Journal of Medical Toxicology*, *2*(2), pp.42-47. https://doi.org/10.22038/apjmt.2013.858

PACINI, A., TSUTAOKA, B., LAI, L. and DURRANI, T. S., 2023. Unintentional paediatric exposures to household cleaning products: a cross-sectional analysis of the National Poison Data System (2000-2015). *Journal of occupational medicine and toxicology (London, England)*, *18*(1), pp.16. https://doi.org/10.1186/s12995-023-00384-4

PANDEY, M., KAMRUL, R., MICHAELS, C. R. and MCCARRON, M., 2022. Identifying Barriers to Healthcare Access for New Immigrants: A Qualitative Study in Regina, Saskatchewan, Canada. *Journal of Immigrant and Minority Health*, *24*(1), p.p188–198. https://doi.org/10.1007/s10903-021-01262-z

PAREKH, U. and GUPTA, S., 2019. Epidemio-toxicological profile of poisoning cases-A five-year retrospective study. *Journal of forensic and legal medicine*, *65*, pp.124-132. https://doi.org/10.1016/j.jflm.2019.05.013

PER PEREIRA, M., 2023.*Poisoning related admissions to the Intensive Therapy Unit at the general teaching hospital in Malta*. University of Malta. https://www.um.edu.mt/library/oar/handle/123456789/125637

PERSSON, H.E., SJÖBERG, G.K., HAINES, J.A. and DE GARBINO, J.P., 1998. Poisoning severity score. Grading of acute poisoning. *Journal of Toxicology: Clinical Toxicology*, *36*(3), pp.205-213.

PETIT-FRERE, P. and MILTENBERGER, R.G., 2021. Evaluating a modified behavioral skills training procedure for teaching poison prevention skills to children with autism. *Journal of applied behavior analysis*, *54*(2), pp.783-792.

PESHIN, S.S. and GUPTA, Y.K., 2018. Poisoning due to household products: A ten-year retrospective analysis of telephone calls to the National Poisons Information Centre, All India Institute of Medical Sciences, New Delhi, India. *Journal of forensic and legal medicine*, *58*, pp.205-211. https://doi.org/10.1016/j.jflm.2018.07.005

PIETERSE, D., HOARE, J., LOUW, K.A., BREET, E., HENRY, M., LEWIS, I. and BANTJES, J., 2020. Methods of deliberate self-harm in a tertiary hospital in South Africa. *South African journal of psychiatry*, *26*, p.1399.

POMERLEAU, A.C., GEE, P., BEASLEY, D.M.G. and KUMPULA, E.K., 2023. Specialist medical toxicologist consultations provided by the New Zealand National Poisons Centre, 2018–2020. *The New Zealand Medical Journal (Online)*, *136*(1569), pp.60-71. https://journal.nzma.org.nz/

POMERLEAU, A.C., MILLER, M.A., BORRON, S.W., HUGHES, A., JANG, D.H., SPYKER, D.A., WAHL, M. and CARLTON, F.B., 2014. On the role of poison centres in radiation emergency preparedness and response activities: findings of the "Radiation Emergencies Public Health Roundtable" (Atlanta, GA—August 2012). *Journal of Medical Toxicology*, 10(1), pp.107-111. https://doi.org/10.1007/s13181-013-0363-2

PUCCI, M., SINGH JUTLEY, G., LOOMS, J. and FORD, L., 2024. N-desethyl isotonitazene detected in polydrug users admitted to hospital in Birmingham, United

Kingdom. *Clinical Toxicology*, *62*(1), pp.19–25. https://doi.org/10.1080/15563650.2024.2309321

PUJO, J. M., SIMON, Y., GUY ROGER, L. N., SIGNATE, B., MUTICY, R., FREMERY, A., BURIN, A., BERTRAND, D. T., IBTISSEM, B. A., HOUCKE, S., NASRI, A., RESIERI, D., and KALLEL, H., 2024. Clinical and Epidemiological Characteristics of Severe Acute Adult Poisonings in French Amazonia: Urgent Need for a Toxicovigilance Monitoring Framework. *Toxics, 12*(3), pp.200. https://doi.org/10.3390/toxics12030200

RAJABALI, F., WONG, A., COWLE, S., WOOTTON, R., FUSELLI, P. AND PIKE, I., 2024. 250 Estimating the Canadian costs of poisonings and the cost effectiveness of poison centres. A54-A55.

RHALEM, N., AGHANDOUS, R., CHAOUI, H., ELOUFIR, R., BADRANE, N., WINDY, M., HARDOUZ, H., OUAMMI, L., SOULAYMANI, A. and SOULAYMANI-BENCHEIKH, R., 2013. Role of the poison control centre of Morocco in the improvement of public health. *Asia Pacific Journal of Medical Toxicology*, *2*(3), pp.82-86. https://doi.org/10.22038/apjmt.2013.1667

RODGERS, G.B., FRANKLIN, R.L. and MIDGETT, J.D., 2012. Unintentional paediatric ingestion poisonings and the role of imitative behaviour. *Injury prevention*, *18*(2), pp.103-108. https://doi.org/10.1136/injuryprev-2011-040008

SALEM, W., ALZOUBI, K.H., HAMMAD, H., BANI YOUNES, A., ALWAFI, H., ALQUDAH, A., ABU-GHARBIEH, E. and BUSTANJI, Y., 2024. Epidemiology, clinical characteristics, and associated cost of acute poisoning: a retrospective study. *Journal of Pharmaceutical Policy and Practice*, 17(1). https://doi.org/10.1080/20523211.2024.2325513

SAM, K.G., KONDABOLU, K., PATI, D., KAMATH, A., KUMAR, G.P. and RAO, P.G., 2009. Poisoning severity score, APACHE II and GCS: effective clinical indices for estimating severity and predicting outcome of acute organophosphorus and carbamate poisoning. *Journal of forensic and legal medicine*, *16*(5), pp.239-247. https://doi-org.ejournals.um.edu.mt/10.1016/j.jflm.2008.12.004

SAMI, F., BERG, S., MANADAN, A.M. and MYCYK, M.B., 2024. Acetaminophen overdose: analysis of 2018 US nationwide emergency database. *International Emergency Medicine,* 19, pp.1727–1732. https://doi-org.ejournals.um.edu.mt/10.1007/s11739-024-03555-1

SCHEIN, R., WILSON, K. and KEELAN, J.E., 2011. *Literature review on effectiveness of the use of social media: a report for peel public health*. Peel Public Health. *URL: http://www. peelregion. ca/health/resources/pdf/socialmedia. pdf [accessed 2013-09-23]*

SCHÜCK, S., ROUSTAMAL, A., GEDIK, A., VOILLOT, P., FOULQUIÉ, P., PENFORNIS, C. and JOB, B., 2021. Assessing patient perceptions and experiences of paracetamol in France: infodemiology study using social media data mining. *Journal of Medical Internet Research*, *23*(7), pp.25049. https://doi.org/10.2196/25049

SCHURTER, D., RAUBER-LÜTHY, C., JAHNS, M., HABERKERN, M., KUPFERSCHMIDT, H., EXADAKTYLOS, A., ERIKSSON, U. and CESCHI, A., 2014. Factors that trigger emergency physicians to contact a poison centre: findings from a Swiss study, *Postgraduate Medical Journal*, 90(1061), pp.139–143, https://doi.org/10.1136/postgradmedj-2013-132242

SCHWARZ, E.S., KOPEC, K.T., WIEGAND, T.J., WAX, P.M. and BRENT, J., 2017. Should we be using the poisoning severity score? *Journal of medical toxicology*, *13*(2), pp.135-145. https://doi.org/10.1007/s13181-017-0609-5

SHARMA, L., PRAKASH, A. and MEDHI, B., 2024. Ensuring medication and patient safety for better quality healthcare. *Indian Journal of Pharmacology*, *56*(6), pp.375-378.

SHANKAR, J., LAI, D., CHEN, S.P., TURIN, T.C. JOSEPH, S. and MI, E., 2022. Highly educated immigrant workers' perspectives of occupational health and safety and work conditions that challenge work safety. *International journal of environmental research and public health*, *19*(14), pp.8757. https://doi.org/10.3390/ijerph19148757

SHI, Y. and LIANG, D., 2020. The association between recreational cannabis commercialization and cannabis exposure was reported to the US National Poison Data System. *Addiction*, 115(10), pp.1890-1899. https://doi.org/10.1111/add.15019

SIMONE, K. E. and SPILLER, H. A., 2010. Poison centre surveillance data: the good, the bad and … the flu', *Clinical Toxicology*, 48(5), pp.415–417. doi: 10.3109/15563650.2010.495349.

STEVENS, A., HAMEL, J.F., TOURE, A., HADJADJ, S. and BOELS, D., 2019. Metformin overdose: a serious iatrogenic complication—Western France Poison Control Centre data analysis. *Basic & clinical pharmacology & toxicology*, *125*(5), pp.466-473. https://doi.org/10.1111/bcpt.13273

STOCKINGS, E., HALL, W.D., LYNSKEY, M., MORLEY, K.I., REAVLEY, N., STRANG, J., PATTON, G. and DEGENHARDT, L., 2016. Prevention, early intervention, harm reduction, and treatment of substance use in young people. *The Lancet Psychiatry*, *3*(3), pp.280-296. http://dx.doi.org/10.1016/ S2215-0366(15)00363-6

SUTTER, M.E., BRONSTEIN, A.C., HEARD, S.E., BARTHOLD, C.L., LANDO, J., LEWIS, L.S. and SCHIER, J.G., 2010. The role of clinical toxicologists and poison control

centres in public health. *American journal of preventive medicine*, *38*(6), pp.658-662. https://doi.org/10.1016/j.amepre.2010.02.010

SZYDLOWSKA, A., 2025. Poisoning and overdose at a glance. *British Journal of Nursing*, *34*(3), pp.140-144.

SHOIB, S., PATEL, V., KHAN, S., ARMIYA'U, A.Y.U., SAEED, F., SWED, S., DAS, S. and CHANDRADASA, M., 2022. Over-the-counter drug use in suicidal/self-harm behaviour: Scoping review. *Health science reports*, *5*(3), pp.662.

SCHICCHI, A., RUVITUSO, I., PETROLINI, V. M., FERRARI, I., DI PIETRO, S., LONATI, D., RODA, E., VALLI, A., MALOVINI, A. L., PERLINI, S., LOCATELLI, C. A., and SALINARO, F. 2025. Epidemiology of suicides attempt by self-poisoning: the Pavia Emergency-Toxicologic Network experience before and after the COVID-19 pandemic years. *Internal and Emergency Medicine*. https://doi.org/10.1007/s11739-025-04040-z

WAX, P.M., CULBRETH, R.E., BRENT, J., HANTSCH, C., MIKHAILOV, T., BRUNDAGE, N. and ALDY, K., 2025. Medical toxicology consultations and mortality among patients with poisonings in the PICU. *JAMA Network Open*, *8*(2), pp.246213-2462139.

TANGIISURAN, B., JIVA, M., ARIFF, A. M., ABDUL RANI, N. A., MISAN, A., RASHID, S. M., MAJID, M. I. A., and DAWSON, A. H., 2018. Evaluation of types of poisoning exposure calls managed by the Malaysia National Poison Centre (2006-2015): A retrospective review. *British Medical Journal open*, *8*(12), pp.41-48. https://doi.org/10.1136/bmjopen-2018-024162

TANTI, A., CAMILLERI, M., BONANNO, P.V. and BORG, J.J., 2013. Medication errors through a national pharmacovigilance database approach: a study for Malta. *International journal of risk and safety in medicine*, *25*(1), pp.17-27.

TANTI, A., MICALLEF, B., SERRACINO-INGLOTT, A. and BORG, J.J., 2017. A review of the National pharmacovigilance system in Malta–implementing and operating a pharmacovigilance management system. *Expert Opinion on Drug Safety*, *16*(1), pp.65-76.

THOONEN, I.M., RIETJENS, S.J., VAN VELZEN, A.G., DE LANGE, D.W. and KOPPEN, A., 2024. Risk factors for deliberate self-poisoning among children and adolescents in The Netherlands. *Clinical Toxicology*, *62*(1), pp.39-45.

TORRENTS, R., REYNOARD, J., GLAIZAL, M., SCHMITT, C., FABECK, K.V., BOULAMERY, A., DE HARO, L. and SIMON, N., 2023. Deliberate self-poisoning with plants in southeastern France, a poison centre 20-year report. *Toxins*, *15*(12), pp.671. https://doi.org/10.3390/toxins15120671

TURCU, T.A., LESCAIE, A., GRAMA, A.R., STRATULAt, A.C., VINCENCE, A.I., GRIGORAS, L.M., JITAREANU, C., BABEU, A.M., GAFENCU, M., CRACIUN, M.D. and CHIVU, C.D., 2024. Patterns and Emerging Trends in Acute Poisoning with Substances of Abuse Used for Recreational Purposes in Adolescents: a six-year multicentre study. *Life*, *14*(8), pp.1033. doi: 10.3390/life14081033

TYRRELL, E.G., KENDRICK, D., SAYAL, K. and ORTON, E., 2018. Poisoning substances taken by young people: a population-based cohort study. *British journal of general practice, 68*(675), pp. 703–710. https://doi.org/10.3399/bjgp18X698897

TYRRELL, E.G., ORTON, E., TATA, L.J. and KENDRICK, D., 2024. Patterns and trends of medicinal poisoning substances: a population-based cohort study of injuries in 0–11-year-

old children from 1998–2018. *Archives of public health*, *82*(1), pp.50. https://doi.org/10.1186/s13690-024-01268-7

UNODC, 2022. World Drug Report 2022. [online]. Available at: https://www.unodc.org/unodc/en/data-and-analysis/world-drug-report2022.html [Accessed 20 August 2025].

VASSEUR, P., SINNO-TELLIER, S., ROUSSELET, J., LANGRAND, J., ROQUES, A., BLOCH, J., and LABADIE, M., 2021. Human exposure to larvae of processionary moths in France: study of symptomatic cases registered by the French poison control centres between 2012 and =2019. *Clinical Toxicology*, *60*(2), pp.231–238. https://doi.org/10.1080/15563650.2021.1919694

VEALE, D., WIUM, C. and MULLER, G., 2012. Toxicovigilance II: A survey of the spectrum of acute poisoning and current practices in the initial management of poisoning cases admitted to South African hospitals. *South African Medical Journal, 103*(5), pp.298-303. doi:10.7196/SAMJ.6648

VINCENT, F., THOMPSON, J., GRAY, L., BRADBERRY, S., SANDILANDS, E., THANACOODY, R. and TUTHILL, D., (2024). Medication errors involving intravenous paracetamol in children: experience from enquiries to the National Poisons Information Service. *Archives of disease in childhood*, *109*(7), 582–585. https://doi.org/10.1136/archdischild-2023-326460

VODOVAR, D., LANGRAND, J., CARÉ, W., TOURNOUD, C., EVRARD, M., DRIDI, I., MÉGARBANE, B. and LABORDE-CASTEROT, H., 2023. Short message service as a tool for mass follow-up of patients requesting a poison centre: a retrospective comparative

study in France. *Clinical Toxicology*, 61(11), pp.982-989. https://doi.org/10.1080/15563650.2023.2276032

VO, K. and SMOLLIN, C. (2015). Online social networking and US poison control centres: Facebook as a means of information distribution. *Clinical toxicology (Philadelphia, Pa.)*, *53*(5), 466–469. https://doi.org/10.3109/15563650.2015.1014906

VOS, T., LIM, S.S., ABBAFATI, C., ABBAS, K.M., ABBASI, M., ABBASIFARD, M., ABBASI-KANGEVARI, M., ABBASTABAR, H., ABD-ALLAH, F., ABDELALIM, A. and ABDOLLAHI, M., 2020. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*, 396(10258), pp.1204-1222. doi: 10.1016/S0140-6736(20)30925-9

WARING, W.S., PALMER, S.R. and BATEMAN, D.N., 2007. Alerting and surveillance using poisons information systems (ASPIS): outcomes from an international working group. *Clinical Toxicology*, 45(5), pp.543-548. https://doi.org/10.1080/15563650701365842

WATT, A., CAPARROTTA, T., BRADBERRY, S., GRAY, L., THANACOODY, R., JACKSON, G. and SANDILANDS, E.A., 2025. Poisoning in adolescents in the UK: a review of enquiries to the National Poisons Information Service. *Archives of Disease in Childhood*, 110, pp.687-692 doi: https://doi.org/10.1136/archdischild-2024-327405

WEISBROD, V. and PROVENZANI, A., 2025. Liver transplants from paracetamol overdose: is it time to rethink OTC availability? *European Journal of Hospital Pharmacy*, *32*(4), pp.297-298. https://doi.org/10.1136/ejhpharm-2024-004434

WHITEHILL, J.M., DILLEY, J.A., BROOKS-RUSSELL, A., TERPAK, L. and GRAVES, J.M., 2021. Edible cannabis exposures among children: 2017-2019. Paediatrics, 147(4). https://doi.org/10.1542/peds.2020-019893

WHO REGIONAL OFFICE FOR EUROPE, 2023. Poison centres as essential unit for poisoning prevention and sound chemicals management. Technical summary. Copenhagen: WHO Regional Office for Europe. Licence: CC BY-NC-SA 3.0 IGO. https://www.who.int/initiatives/medication-without-harm. [Accessed on 08/05/25]

WIJNANDS, A., THIELMAN, M., HUNAULT, C., KOPPEN, A., DE LANGE, D. and RIETJENS, S., 2024. Significant increase in the number of occupational exposures reported to the Dutch Poisons Information Centre (2016–2022): the importance of poison centre data in health surveillance. Clinical Toxicology, 62(6), pp.396–403. https://doi.org/10.1080/15563650.2024.2370303

WIJNANDS, A.P., KOPPEN, A., DE VRIES, I., DE LANGE, D.W. and RIETJENS, S.J., 2025. Poison centre surveillance of occupational incidents with hazardous materials (2016–2023): insights for risk mitigation and incident preparedness. International Journal of Environmental Research and Public Health, 22(2), pp.158. https://doi.org/10.3390/ijerph22020158

WILLIAMS, H., BATEMAN, D.N., THOMAS, S.H., THOMPSON, J.P., SCOTT, R.A. and VALE, J.A., 2012. Exposure to liquid detergent capsules: a study undertaken by the UK National Poisons Information Service. *Clinical Toxicology*, *50*(8), pp.776-780.

WOOD, D.M., HILL, S.L., THOMAS, S.H.L. and DARGAN, P.I., 2014. Using poisons information service data to assess the acute harms associated with novel psychoactive substances. Drug Test Analysis, 6, pp.850-860. https://doi.org/10.1002/dta.1671

WORLD HEALTH ORGANIZATION (2020) *Guidelines for establishing a poison centre*. Geneva: World Health Organization. Available at: 9789240009523-eng.pdf (Accessed: 10/06/25).

YEHYA, A., ALBALS, D., ISSA, R. and FAWADLEH, A., 2020. Retrospective assessment of acute poisoning incidents by pharmaceutical agents in Jordan: Data from Pharmacy One™ Poison Call Centre, 2014 to 2018—Part II. Pharmacology Research & Perspectives, 8(2), pp.1-8. https://doi.org/10.1002/prp2.583

YIP, P.S., CAINE, E., YOUSUF, S., CHANG, S.S., WU, K.C.C. and CHEN, Y.Y., 2012. Means restriction for suicide prevention. The Lancet, 379(9834), pp.2393-2399. https://doi.org/10.1016/S0140-6736(12)60521-2

ZUVEKAS, A., LEIFER, J.C., ROSENBAUM, E. and HUGHES, R., 1997. Linking primary care centers and hospitals. *The Journal of Ambulatory Care Management*, *20*(1), pp.65-76.

Appendix 1: Approval from the Director General for healthcare services Malta and Data Controller for the MNPC

Ms Lara Bonnici

Practice Nurse

Dear Ms Bonnici, On the basis of the documentation you submitted, you have been cleared to proceed with your Masters study in M.Sc in Pharmatoxicology with the Faculty of Medicine and Surgery at the University of Malta, on the premise that all data will be provided to you already anonymised by the selected intermediary who works within the Unit. Kindly note the below clarifications: This clearance does not cover ethical approval. This clearance does not allow you to communicate with data subject. The identity of data subjects cannot be divulged to anyone by your intermediary not even to academic staff. Data Subject demographics being shared need to be kept to a minimum to minimise data subject identification. This clearance is valid for your report to be included with your dissertation only and not in medical journals or elsewhere. For any additional approvals resubmit request through this office. This clearance doesn't cover access to medical records or Health Information Systems. What was declared during this clearance process is what you will abide to. Your submitted documentation and declarations must remain unchanged. You must abide with all the articles of the GDPR (EU) 2016 / 679 throughout the data collection process and thereafter. You are requested to submit a copy of your findings to this office at the end of your study. This clearance covers your research to be carried out only at the Malta National Poison Centre.

Regards, Mr Clarence Pace

Director General Health Services &

Data Controller National Poisons Centre

Appendix 2: Ethical approval from the Medical School Faculty Research and Ethics Committee (FREC), University of Malta

L-Università ta' Malta

Faculty of
Medicine & Surgery

University of Malta
Msida MSD 2080, Malta

Tel: +356 2340 1879/1891/1167
umms@um.edu.mt

www.um.edu.mt/ms

Ref No: MED-2024-00078

30 September 2024

Ms Lara Marie Bonnici
2, Alley No.2,
Tower Road,
Mosta, Malta.

With reference to your application submitted to the Faculty Research Ethics Committee in connection with your research entitled:

Analysis of the calls made to the Malta National Poisons Centre

The Faculty Research Ethics Committee is granting ethical approval for the above-mentioned application.

Professor Anthony Serracino Inglott
Chair
Faculty Research Ethics Committee

Appendix 3: Data intermediary approval

I, Robert Chircop, hereby declare my intent to serve as research intermediary, specifically to gather secondary data on behalf of Ms. Lara Marie Bonnici.

As a third-party data intermediary, I understand the paramount importance of safeguarding the confidentiality and privacy of patient information. My primary responsibility will be that of gathering and processing secondary patient data from the patient information database at the Malta National Poisons Centre for research purposes. It is incumbent upon me to ensure that this data is handled with the utmost care and in compliance with all relevant data protection regulations, including General Data Protection Regulation (GDPR).

To maintain anonymity and protect sensitive patient information, I will employ rigorous coding techniques during the data processing stage. Specifically, I will assign unique identifiers to each patient record, replacing any personally identifiable information (such as names, addresses, and identification numbers) with these identifiers. Additionally, I will aggregate and anonymize demographic data to further mitigate the risk of re-identification.

Furthermore, access to the patient data will be strictly limited to authorized personnel who require it for analysis purposes only. Stringent security measures, including encryption and access controls, will be implemented to prevent unauthorized access or disclosure of the data.

I am committed to upholding the highest standards of data privacy and security throughout the entire data handling process. By adhering to these principles, I aim to ensure that patient confidentiality is maintained while enabling valuable insights to be gleaned from the data for research and analytical purposes.

I hereby confirm that the information provided in this declaration accurately reflects my understanding of the role as third party data intermediary for this research.

Signature: _____

Date: 6/5/2024

Dr. Robert Chircop

Consultant Emergency Physician & Clinical Toxicologist

Emergency Department, Mater Dei Hospital

Malta National Poisons Centre

robert.a.chircop@gov.mt

Appendix 4: Number of unique agents identified

1. AA battery (chewed on)
2. Acetone
3. Acetylsalicylic acid
4. Aciclovir
5. Alprazolam
6. Aluminium oxide
7. Amikacin
8. Amioderone
9. Amitriptyline
10. Amlodipine
11. Anastrozole
12. Anionic surfactant (cleaner)
13. Anoxic agent (Unknown agent)
14. Antimicrobial agent (unknown brand)
15. Argon
16. Aripiprazole
17. Artificial sweetener (BBQ flavour)
18. Arum pictum (plant)
19. Atenolol
20. Atomoxetine
21. Atorvastatin
22. Augmentin
23. Azithromycin
24. Baygon spray (insecticide)
25. Benakor (Veterinary Rx)
26. Bendroflumethiazide
27. Benzyl salicylate
28. Betadine (containing povidone iodine)
29. Betahistine
30. Biotin
31. Biperiden hydrochloride
32. Biro Ink
33. Bitagliptin
34. Bleach (WC cleaner unknown brand)
35. Bold laundry pods
36. Bromadiolone (rat poison block)
37. Bromazepam
38. Brown recluse spider venom
39. Bumetanide
40. Butane/Isobutane/Propane propellant
41. Caffeine
42. Calcium (IV)
43. Camphor
44. Cannabis–THC
45. Caprylyl glucoside
46. Capsaicin 0.075%
47. Carbamazapine
48. Carbimazole

49. Carbon monoxide
50. Castor beans (masticated)
51. Cefixime
52. Cefuroxamine
53. Cetirizine hydrochloride
54. Cetomacrogol
55. Chewy Vits Kids Multi Vit Advance
56. ChewyVits Immune Support Kids
57. China berry flower
58. Chlorhexidine
59. Chlorine fumes
60. Chlorpromazine hydrochloride
61. Chlorpyrifos (Pesticide)
62. Citric Acid
63. Citronella oil
64. Clavulanic acid
65. Cleaning agent (unknown brand)
66. Clomifene citrate
67. Clonazepam
68. Clonidine hydrochloride
69. Clorox (disinfecting bleach)
70. Co-amoxiclav
71. Cocaine (Crack)
72. Cocaine powder
73. Codeine phosphate
74. Crayons (Crayola)
75. Dabigatran
76. Dash detergent
77. Deanxit (Flupentixol + Melitracen)
78. Degreaser
79. Deltrinate (insecticide)
80. Dentaid Xeros
81. Desloratadine
82. Dettol household antiseptic liquid
83. Dettol spray (mildew spray)
84. Dextromethorphan
85. Diazepam
86. Dichloromethane
87. Diclofenac sodium
88. Digoxin
89. Dimenhydrinate
90. Dimethylsulfoxide (DMSO)
91. Dimeticon
92. Diphenhydramine
93. Dipyridamole
94. Disulfiram (Antabuse)
95. Domperidone
96. Donepezil hydrochloride
97. Doxazosin mesilate
98. Drotaverine hydrochloride

99. Duloxetine
100. EMLA cream (lidocaine + prilocaine)
101. Empagliflozin
102. Escitalopram
103. Ethylene glycol
104. Eucalyptus oil
105. Eye makeup remover water-based
106. Fairy Platinum all-in-one dishwasher tablet
107. Ferric ammonium citrate
108. Ferric chloride
109. Ferric sodium EDTA
110. Ferrous fumarate
111. Finasteride
112. Flax seed oil
113. Fluoxetine
114. Flupentixol decanoate
115. Fluvoxamine
116. Folic acid
117. Folidi supplement (Vit D and Calcium)
118. Formic acid
119. Freons (air-condition coolant)
120. Gabapentin
121. Gastrografin
122. GHB (Gamma-hydroxybutyrate)
123. Gliclazide,
124. Glyceryl trinitrate
125. Guaifenesin
126. Haliborange Softies Omega 3
127. Haloperidol
128. Hedelix syrup (ivy extract)
129. Heroin
130. Hornet sting
131. Hydrocarbon (fuel)
132. Hydrochloric acid
133. Hydrocortisone butyrate
134. Hydrogen peroxide
135. Hydrogen sulphide
136. Hydroxyzine
137. Ibuprofen
138. Illicit substance (unspecified)
139. Imipramine
140. Intestinal tablets (Veterinary Rx)
141. Isopropyl alcohol
142. Isosorbide mononitrate
143. Ivabradine
144. Ketamine
145. Ketoconazole (topical antifungal cream)
146. Lamotrigine
147. Lampant oil
148. Lead

149. Lecithin
150. Levetiracetam
151. Levothyroxine sodium
152. Lidocaine hydrochloride
153. Liquid paraffin
154. Liquid plant food containing NPK
155. Lithium
156. Lorazepam
157. Magnesium citrate
158. Magnesium hydroxide
159. Mapei cleaner and bleach
160. MDMA
161. Mebeverine
162. Mecoprop (Herbicide)
163. Medofed Compound
164. Mefloquine hydrochloride
165. Melatonin
166. Meloxicam (NSAID)
167. Mercaptopurine
168. Mercury beads (elemental)
169. Metformin hydrochloride
170. Methadone
171. Methanol
172. Methocarbamol
173. Methotrexate
174. Methyl salicylates
175. Methylamine
176. Methylchloroisothiazolinone
177. Methylisothiazolinone
178. Methylphenidate hydrochloride
179. Mexazolam
180. Mianserin
181. Minoxidil
182. Mirtazapine
183. Morphine
184. Multivitamin supplements (Containing: VitA, B1, B2, B3…)
185. Mupirocin
186. Nail polish
187. Naphtha (gasoline)
188. Naproxene
189. Neem oil
190. Neno Baby Cologne
191. Niacinamide
192. Nicotine (cigarette bud)
193. Nicotine from vape fluid
194. Nitrofurantoin
195. Nitrogen
196. Nurofen
197. Nystatin (Antifungal)
198. Ocratoxin (via contaminated figs)

199. Olanzapine
200. Omeprazole
201. Opioid (unknown)
202. Oxalic acid
203. Oxymetazoline (nasal decongestant)
204. Oxymethalone (steroid)
205. Paint dust/fragments containing lead
206. Paint thinner
207. Pancreatin
208. Panthenol
209. Paracetamol
210. Paroxetine
211. Peg-180
212. Perindopril
213. Phenergan
214. Phenobarbital
215. Phenytoin sodium
216. Picoline dye
217. Pimobendan (Veterinary Rx)
218. Play-Doh
219. Polyvinylpyrrolidone (PVP)
220. Potassium permanganate
221. Prednisolone acetate
222. Pregabalin
223. Procyclidine
224. Propan-2-ol
225. Propranolol hydrochloride
226. Propylene glycol
227. Pseudoephedrine
228. Quetiapine
229. Ranitidine
230. Rapidet cleaning solution (Tetrasodium EDTA + NaOH + isopropanol)
231. Rat poison
232. Ricin (plant)
233. Risperidone,
234. Rivaroxaban
235. Rosuvastatin
236. S400 descaler
237. Salt (from pre-workout drink)
238. Sanitol
239. Sedoxil
240. Sertraline
241. Shampoo (unknown brand)
242. Silica gel
243. Simmethicone (foaming agent)
244. Simvastatin
245. Sodium benzoate
246. Sodium bicarbonate
247. Sodium bisulphate
248. Sodium carbonate

249. Sodium hydroxide
250. Sodium hypochlorite (unknown brand)
251. Sodium lauryl sulfate
252. Sodium peroxide
253. Sodium valproate
254. Solpadine (Codeine + Paracetamol)
255. Spironolactone
256. Stress ball
257. Sucrose
258. Sulphuric acid
259. Sulpiride
260. Synthetic cannabis (including gummies, cookies and chocolate)
261. Synthetic cannabis (CC9)
262. Taurine (pre-work out)
263. Tetraacetylethylenediamine (TAED)
264. TH1 Vitamin
265. Thiocolchicoside
266. Thyroxine
267. Toluene
268. Tramadol hydrochloride
269. Trazodone
270. Trifluoperazine
271. Trihexyphenidyl hydrochloride
272. Triprolidine
273. Turpentine (in Vicks VapoRub)
274. TUSI (pink cocaine + Ketamin mix)
275. Unknown analgesics
276. Unknown DOA
277. Unknown flower
278. Unknown Rx
279. Valsartan
280. Venlafaxine
281. Vetmedin (Pimobendan) (Veterinary Rx)
282. Vicks Vaporub
283. Vit D (Colecalciferol)
284. Vit E (tocopherol derivatives)
285. Vitamin A
286. Vitamin B
287. Vitamin E
288. W5 disgorgante gel
289. Warfarin
290. Weaver fish sting
291. White board marker
292. Wild mushroom (unknown species)
293. Window cleaner (2-methyl-2H-isothiazol-3-one)
294. Xylene
295. Yellow soft paraffin
296. Yellow-tinged water (unknown agent)
297. Zolpidem
298. Zonisamide