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Poisoning: An Indian Toxicological Scenario in Need of Poison Information Centers

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Abstract

Nowadays, there is a diversity of products and chemicals, with their widespread use on an organism. It provide a benefit or comfort them, leading the population to rigorous exposure to poisons. Poisons are any harmful substance that impact biological functions in the organisms, whether action dependent on dose or not. In addition, another term relatively used is "Toxin." They are those substances, capable of interacting with biological molecules contracting a disease or disturbing homeostatic balance in the body of an organism. Due to the increasing incidences of poisoning cases, major steps are to be taken by the authorities to establish the Poison Information Center (PIC) and Poison Control Center (PCC) which could be helpful in decreasing the insult due to lack of knowledge and overall emergencies of hospitalization due to poisoning. PCCs were established with the mission of providing helpful information and tracking the national incidence of poisoning, to have the most extensive databank on overdose and poisoning. Each year number of articles is published providing poisoning-related epidemiology. This review deals with highlighting the overall benefit achieved by the world by establishing PIC and Indian scenario in the immediate need of a large number of PICs.

Keywords: Antidotes, Indian Scenario, Morbidity, Mortality, Poison, Poison Information Center, Toxicology

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1. Introduction

"All substances are poisons; there is no such thing as a nonpoison" - .[1] The term "poison" is defined as any substance if absorbed in sufficient quantity by an organism causes disturbances usually by molecular scale activity or by a chemical reaction. Toxicology is the science that deals with the study of adverse effects of chemical or physical agent produced in the living organism under specific exposure conditions.[2] Poison Information Center (PIC) is a specialized unit helpful in providing information about early diagnosis, treatment, prevention and poison management according to the enquirer's need, thus helpful in reducing treatment costs due to poisoning and preventing unnecessary hospitalization. It aims in reducing morbidity and mortality due to poisoning.[3] Poison Information (PI) is "specialized area of drug information which includes information about the toxic effects of chemicals and pesticides, hazardous material spills, household products, overdose of therapeutic medicines, plants including mushrooms, animal toxins from the bites of snakes, spiders and other venomous creatures and stings."[4]

2. Historical Background

Earlier it was difficult and hard to manage poisoning cases coming in the Emergency Department, due to lack of information about the various poisons and about the poisoning issues. Keeping in view, in the year 1994, at All India Institute of Medical Sciences AIIMS], New Delhi, first PIC was established, then at National Institute of Occupational Health, Ahmedabad, then at Government General Hospital, Chennai afterward at Amrita Institute

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of Medical Sciences and Research, Cochin. Only, these four centers were earlier recognized by the World Health Organization (WHO) in India.[4]

2.1 World Scenario in Accordance with the World Health Organization Statistics and Current Status

Poisoning has been a global health issue all around the world to which according to the WHO in the year 2002 estimated about 350,000 deaths worldwide from unintentional poisoning. Dates back to the year 2000 the unintentional poisoning was the ninth leading cause of deaths worldwide. Majority of deaths in young adults within the age group of 15–29 years due to unintentional poisoning and about millions of death due to suicide to which majority was due to ingestion of chemicals. According to WHOs report in the year 2004, there were 346,000 deaths worldwide out of which 91% deaths were reported in low- and middle-income countries. Pesticides are very frequently used in developed countries due to which the number of deaths globally in those countries is low as compared to developing countries. Snakebite has also been found to be a major challenge to cope with in case of medical emergencies to which 2.5 million people are envenomed yearly and an estimated 125,000 deaths globally.[3]

3. Indian Scenario

To an estimate, about seven hundred people die every day globally, and the majority is from the developing countries due to much of the agricultural land, farmers, and workers working in those fields are much more in contact to those fatal poisons used as pesticides and herbicides. In India, the National Poisons Information Centre (NPIC) was established in the Department of Pharmacology at the AIIMS, New Delhi. The center provides toxicological information and advice on the management of poisoned patients adapted to the level of the enquirer. The basis of this service is the databases on poisoning, drug reactions, and also the continuous and systematic collection of data from the library. This information service is available round the clock. The PIC has the training responsibility extending to medical and other health professionals and community. Further, NPIC is a participant of INTOX project of IPCS/WHO, receiving regular yearly training on the use of INTOX database.[5]

Poisoning is the fourth common cause of mortality in India resulting in deaths of five to six persons per lakh every year. Factors' resulting behind poisoning includes easy access to poisons, socioeconomic status of a person, regional beliefs, and cultural influences, whereas poison has also been used for murder, suicide, execution, and pest control.[6] In a study conducted in Tamil Nadu by Maharani and Vijayakumari reports about the need for the establishment of PIC in India studying the pattern and type of enquiries pertaining to poisoning cases as shown in Figure 1. They studied retrospectively for the poisoning cases and concluded the benefit of PIC for the benefit of common people in getting timely diagnosis and treatment.[7]

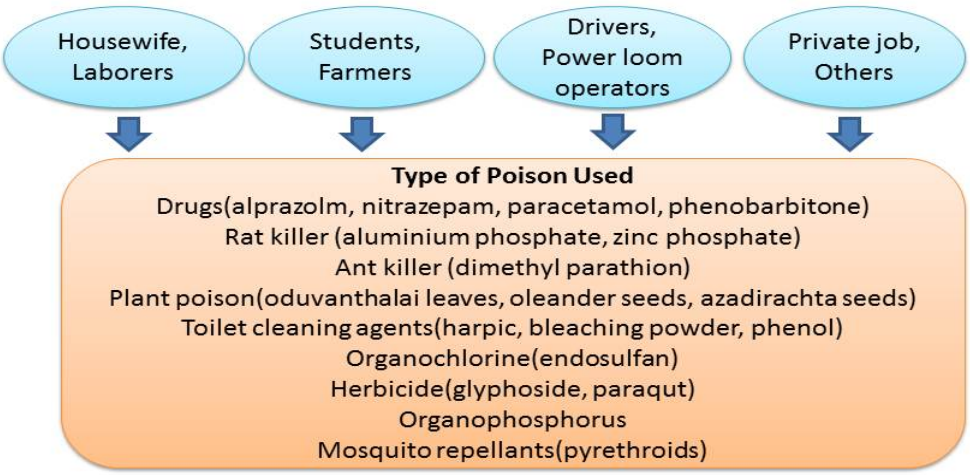


Figure 1. Depicts variation in origin and use of poison depending on availability which makes it difficult to treat (diagnose and treatment) the patient.[7]

4. India's Scenario as a Developing Country

Intake of poisons is the most common method to commit suicides. Pesticide poisoning is an important cause of morbidity and mortality in many countries of the world. Developing countries estimate about 95% of fatal pesticide poisonings, many of which are stated in Asia-Pacific region.[8]To an estimate, around 800,000 people have died due to pesticide in developing countries since green revolution. Nearly, 20,000 people die every year in developing countries due to pesticide consumption.[9]

The worldwide scenario tells us about the cause of mortalities accordingly to the difference between the developed and the developing countries. Due to the recent advancements in the agricultural field, modern technologies, and medical pharmacology lead to the vast change in scenario globally leading to the trend difference between the acute poisoning cases in developing and developed countries. In developed countries, majority of deaths to acute poisonings is due to the ingestion of prescribed medicines and household chemicals whereas, in developing countries in spite of their tremendous contribution in increased food production and pest control have been the most common vital offenders. Well to a known scenario India comes in the list of the developing countries, so the major cause of mortality is to the factor that relates to the ease of availability, overall use, negligence of adequate or appropriate use of protective equipment leading to gross exposure, and increased mortality rates due to pesticides. It is reported that in India, occasional crop failures however the use of high-tech agricultural methods, often results to dejected farmers committing suicides using same pesticides, which they use to purchase for better crop yield.[10]

5. Indian Toxicological Scenario

In April 2006, Ramesh Menon won The Ramnath Goenka Excellence in Journalism Award for Environmental Reporting, for his articles on pesticide poisoning in Punjab.[9] Mortality rates due to poisoning vary from 1% to 2% in developed countries than that of 15–30 % in developing countries like India making it the fourth common cause of deaths in India.[11] Developed countries have a better reporting system as compared to developing countries thus making a mass reduction in the poisoning cases. The critical care units in developed countries have better resources for poison management as in accordance to developing countries. They have better PIC and resources to cope with poison cases with advanced reporting centers. In India, it is under reported or either the people are unaware of a reporting system.

6. World Health Organization Intervention and Measures

WHO started "The International Programme for Chemical Safety" in which it stated various guidelines for the prevention and control of poisoning as INTOX project in 2014 which includes various material and training manual for PI technicians. Recently, poisoning has not been included in the Geneva health report as a major problem due to the current changing trend scenario worldwide and with the establishment of major Poison Control Centers (PCCs) and PICs globally. Pediatric poisoning has also been causing a mass increase in morbidity and mortality rate and has been a major problem globally and a major challenge in emergency conditions at a hospital. It is due to the mouthing tendencies of children that they are easily prone to poisoning. WHO started various programs and centers for the prevention of morbidity and mortality due to poisoning cases globally. For the prevention and consultation, various PCCs and PICs were established. The first PCC was established in Chicago in 1953 under the poison control program after a study was conducted which stated that the major accidental deaths in children are due to poisoning. PIC is also an important component of poison control program which plays a vital role in poisoning management. PICs acts as a consultation services in cases of emergencies letting a helping hand in the management of poisoning cases. NPIC was the first establishment in India at the Department of Pharmacology, AIIMS, New Delhi in 1995.[6,12] PCCs established with a motto of improvising and prevention of fatalities due to poisonings. Developing countries commonly do not provide services like these. In hospitals, communication establishment between clinicians and toxicologists with the availability of antidotes are helpful in reducing morbidity and mortality rates worldwide.[13]

7. Indian Scenario of Poison Information Center

Various cases and queries have been reported by various hospitals in different states which are having better

PIresources and center or either majorly by the forensics department established at a hospital. Such as, a total of 348 PI queries were reported at an established PIC at the Department of Clinical Pharmacy, JSS College of Pharmacy to which was found that majority came from doctors and health care professionals (75.5%) management related queries were up to 34.5%. The patient care related queries were 74.1%, and a total of 62.9% queries were reported immediately.[14]

The assessment as shown in Figure 2 provides layout and provides results from the study as provided, which was conducted to answer origin and pattern of queries and in which it was found that majority of queries were received from doctors, health care facility, and related to better patient care. Most of the queries were related to intentional poisoning and common poisoning agents like pesticides followed by medicines and household products. The study concludes that the PI services are better utilized by doctors and health care professionals to assisted in the management of poisoning cases.[14]

An article published by Brett *et al.* in March 2014 in Australia, mentioned the use of PIC highlighting poisoning cases related to one drug clenbuterol. He gave reference of PIC receiving 11,000 calls every year with most of the calls from health care providers; this number shows the awareness regarding PIC, intended benefits and faith eventually developed on the PIC to treat poisoning cases.[15] Likewise, earlier also an article published by Ponampalam and Anantharaman in Singapore med. Journal in 2003, highlighted and presented the need of PIC. A questionnaire survey designed and interviewed by them for the importance of the establishment of PIC. In that study, 93.3% replied in favor of PIC as it could help practitioners for quick and easy access to solve any immediate poisoning query, which could lead to negative consequences if not diagnosed and treated well and that too in stipulated time period related to poison absorbed or ingested.[16]

A retrospective study at NPIC at AIIMS for 3 years showed that 2720 calls were received by the center regarding queries related to poisoning and poison management within a period of 3 years. To which poisoning in children a total number of 995 cases were reported within the age limit of 1–18 years. Males outnumbered females in which 628 were males, and 367 were females. Accidental was the most common mode of poisoning in which it was seen

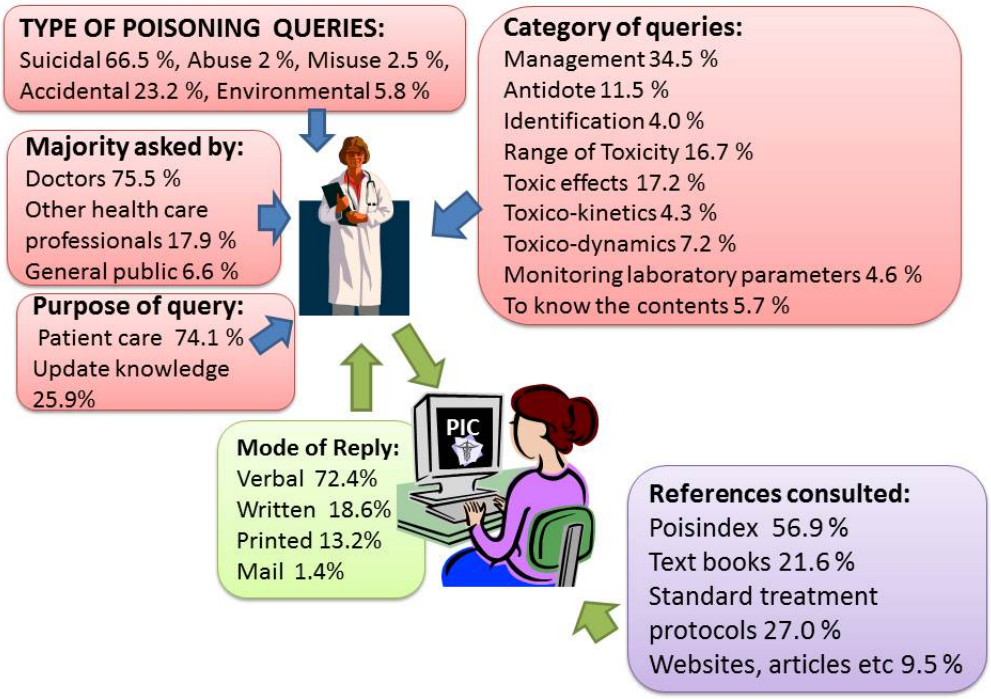


Figure 2. This figure displays origin and pattern of queries for the poison information center, according to a study conducted showing percentage share with major portion asked by doctors and health care professionals to ensure better patient care.[14]

that various household products were the most common reason for poisoning.[12]

PIC is expected to provide an information service to medical practitioners for the identification of chemical substances, safety, toxicity, hygiene, first aid, and treatment of acute poisoning cases. To maintain and research on queries and improvise and form policies for the establishment of computerized databases having information on chemical composition, toxicity, and treatment of acute poisoning cases and collecting information about new common products causing or potential poison. More importantly, to gather and provide information about all patients who are treated in poisoning units and toxicological departments and circulate the important procured information in the form of posters, brochures, etc., to prevent acute poisonings.[17] WHO runs an International Programme on Chemical Safety - INTOX project in the US, as an annual report published giving benefits and usage details gained from the PIC.[18-21]

Indian National Science Academy in 2011 published a position paper "Hazardous Metals and Mineral Pollution in India" marking various sources of heavy metal and their toxicity. It shows that Gujarat, Andhra Pradesh, and Maharashtra contribute a total of 80% of waste in India. This data shows chances of toxicity due to extensive use and need of PIC in these places to provide easy information on preventive and curative measures.[22]

8. Highlights on Studies Reported on Poisoning Cases

"Profile of poisoning in children and adolescents at a North Indian Tertiary Care Centre." A paper published in 2011 having a retrospective study of 3 years from 2008 to 2011. A total of 117 patients were reported, and the majority of patients (60.68%) were within 1–6 years. The male to female ratio was 1.4:1 and a majority of cases came from the rural areas. Insecticides were the major common cause of mortality. About 97.2% of cases within 1–6 years of age group were accidental. 12–18 years group majority of cases were due to suicidal cases.[6] This study shows that the majority of cases came from a rural area where literacy level is low, and even little information might be very useful, and the establishment of PIC could provide easy access to preventive and general information on poisoning avoiding major consequences. Some of our PICs are performing well in some states to which the retrospective study was done based on the WHO guidelines to which 210 queries were received by the center and about which 80% were reported back, and the services were rated back as excellent in accordance to the guidelines.[13] According to "aluminum phosphide fatalities: A 24 years experiences" an experience-based research conducted at PGIMER, Chandigarh revealed that acute poisoning contributed 12.6% of total unnatural fatalities and out of which 20% in the year of 1982–1986 increased to 73% in 1994–1998 and decreased to 49% of total acute poisoning fatalities in 2002–2006. This decrease may be due to the increased education quality and awareness about poisonings and poisons in recent years with the help of involvement of PICs and the information and help provided by them.[10]

Another study in the state of Tamil Nadu's JJM Medical College, Davangere shows that in the year of 2007–2008 a total of 228 cases of poisoning were reported in that hospital with a male:female ratio of about 2.3:1 to which 30.7% of cases were between the age group of 21 and 30 years and 21.1% cases were between the age group of 31 and 40 years. About 151 cases were married, and 76 cases were unmarried. One hundred and thirty-four cases were from the rural areas were as 93 were from urban areas. Organophosphate was the most common poisoning source used as an agrochemical by farmers. About 149 cases were due to the result of organophosphates. Mortality was seen in many patients but if immediate care provided to the patient by first aid information from PIC.[8] Same with the another case reported in the state of Karnataka according to the study held at the Vijaynagar Institute of Medical Sciences, Bellary with a title "assessment of poisonings at a tertiary care hospital" out of one hundred study subjects 48 were males and 52 were females. 21–30 years age group was more prominent as a fatality among males as compared to females. The most common type of poisoning was organophosphate poisoning.[23]

9. Trend of Suicidal Deaths by Poisoning

According to the "trends of suicides in north eastern rural Haryana: A retrospective study" held at M.M Institute of Medical Sciences and Research Mullana, Ambala showed that crop failure, inability to repay loans due to high rates of interests have led about 25,000 farmers in India to commit suicide since 1990 as shown by official figures and where

very less number of emergency health care providers or with not so much experience of handling toxicological patient exists, there nearby PIC services could be a lifesaving drug.[24] A 1-year study showed that a total of 2039 cases of deaths were reported out of which 208 were due to poisoning to which male:female ratio was found to be 1.36:1.[25] According to the journal of forensic medicine science and law a 5 year study at Loni, Ahmednagar, Maharashtra, showed that the suicidal deaths by poisonings were 37.97%. The incidence of suicidal deaths for Indian population is 10.84%, and the most common cause of death is poisoning.[26] A paper published in 2011 showed the poisoning patterns in Khammam region of Andhra Pradesh showed that organophosphate poisoning was most common having a percentage of 74.10%. The common scenario was suicidal (93.43%), the male:female ratio was 6.07:1, the male percentage was found to be 85.85%, and the female percentage was found to be 14.14%.[27] It was shown by a paper quoted as "pattern of poisoning admission in the medical intensive care unit of a tertiary care hospital" in 2014 that the prevalence of poisoning in the Mangalore area in Karnataka was as 35.49 cases per 1000 hospitalizations. Majority were from age group between 25 and 44 years of age and case of suicidal poisoning (85%).[28]

These large number of suicidal deaths can be controlled where attendant reaches the site in time if they know and aware about PIC services to call them and get to know about immediate care depending on situations.[23,27]

10. Mortality due to Poisoning: Showing Need of Poison Information Center for Immediate Care

"Pesticide poisoning in South India – opportunities for prevention and improved medical management" a paper published in 2005 published that India records yearly more than a thousand poisoning cases every year. A reviewed data on patients from 1997 to 2002 showed that a total of 8040 patients were admitted with a case fatality ratio of 22.06%, <30 years of age were 57% and 96% of them have intentionally poisoned themselves. According to n annual number of deaths in china alone around the world is 1,75,000 per year.[11] An another 5 years study held at a South Indian Medical College, Maharashtra, shows that 90% of the fatal poisonings occur in developing countries and is a leading cause of emergency hospitalization around the world.[29] An epidemiological retrospective study held from 2003 to 2006 at Pravara Hospital, Loni showed that a total of 428 patients were treated for organophosphate poisoning, and a majority of patients were males. Dimethoate was the most commonly used substance as poison. It is the most common cause of mortality in rural India. In developing countries, rate of mortality due to poisoning is 1–2 % but in India, it varies from 15 to 30%.[30] A retrospective study held at Rajindra Hospital and Government Medical College showed that a major poisoning include 20 cases 28.16% of aluminum phosphide, 18 cases 25.35% of organophosphate poisonings, 10 (14.8%) cases of zinc phosphide, and 8 cases of organochlorine poisoning. The mortality rate of the hospital was 9.85%.[31] There was about a total of 595 deaths due to poisoning from 1994 to 2003 as reported by the department of forensic medicine and toxicology established at the Government Medical College and Hospital, Chandigarh. It reports that 1–1.5 million people every year are hospitalized due to poisoning to which 50,000 die annually.[32] A farmer committed suicide made the current headlines at Moga village in Punjab by consuming a poisonous substance due to depression over not able to pay his debts taken from various quarters. It also made headlines that a survey conducted by three state universities from 2000 to 2010 has put the count up to 6,926. Majority of 3,954 were farmers, and 2,972 were landless land laborers. Around 10,000 farmers and farm laborers have committed suicide in Punjab since 2000. Debt was the main reason for deaths in 70% of cases.[33] All these cases highlight diversity in poisoning cases with respect to an agent used as a poison. These differences make it difficult for a general practitioner or immediate attendant available to recognize or provide urgent care or support, respectively. This is where they approach the services of PIC for better patient care or in some cases to update their knowledge.[14,27,28]

11. Poisoning Scenario in Other Countries

A study conducted in Bangladesh as it is also a part of developing countries and is also majorly an agriculture based country showed that a total of 1035 cases were reported in Delhi during a period of 1983–1996 showed

the increased use of agrochemicals. Five hundred and fifty-nine cases were involved from Rohtak showed that aluminum phosphide poisoning was the most common reason for fatality due to poisonings.[34] As we move internationally to a developed country like morocco according to a literature review "role of PIC of morocco in improvement of public health" it was found that MPCC received about 4,01,148 from the year 1980 to 2011 majorly involved reports about scorpion stings and a minor portion received about poisoning were due to agrochemicals and pharmaceuticals. We can find a large difference between developed and developing countries. In the case of a fully functional PI and control center, it was found out that the mortality rate in morocco reduced from 1.54% to 0.22%.[35] The recent studies and research in the field of therapeutics have been found to be efficient in the management of many diseased conditions which include nanoparticles as an efficient drug delivery system, but recent studies show the adverse/toxic effects of these nanoparticles giving birth to a new field of study of toxicology known as nanotoxicology. A recently published literature "Gerber *et al*., 201" showed that the toxic effect of the gold's nanoparticles can be multisided and can be hard to predict thus should be kept in consideration so as to reduce potential hazards to humans.[36]

12. Antidote Variations Supporting Need of Poison Information Center

Poisoning cases are difficult to diagnose due to a number of poisons and common symptoms produced by a number of poisons. There is a full class of snakes, arthropods, and other insects whose treatment depends on correct identification of causative poison. This much data is hard to acquire by any attending physician with perfection. Due to this reason, the establishment of PIC becomes a prime need for early treatment of poisoning. In addition, India with a wide variation of climate, species, and geographical area provide favorable conditions for many poisonous species of plants and animals to happily co-exist making vulnerable for poisons and hence poisoning cases. Well to a conclusion antidotes and antivenins have played a major role in the management of poisoning but if timely provided with an accurate knowledge of poison to which morbid condition of the patient has occurred. Only 5% of the antidotes are available worldwide for the known poisons. This is where services of PIC came into play as toxicology is the subject not so much widely experienced due to difference or availability of a large number of chemicals or agents which can be used as a poison or cause poisoning depending on its characteristics.[19]

13. Conclusion

Availability of so many poisons and their antidotes with some common symptoms associated with them makes it difficult to treat and diagnose poisoning cases. This problem can be easily rectified by the establishment of PIC. Related poison fatalities mentioned above yearly had caused drastic effects on Indian morbidity and mortality index in recent years. Antidotes are helpful in the management of poisoning morbidities and thus reducing mortality rates but, if timely provided with an accurate knowledge of concerned poison to which the morbidity has occurred. Above scenario provides us with a concluding point that there is an emergence of the intense need for the establishment of PIC. It can be a key step in reducing the poisoning fatalities in Indian scenario, as India comes under the category of developing countries and data supporting the need for an establishment of PICs in the developing country as presented above. PIC plays the key roles in providing information, assessment and control of poisoning fatalities worldwide.

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