

Pattern of Pre-Hospital Treatment Received by Cases of Pesticide Poisoning

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ABSTRACT

Background: Prehospital treatment following acute pesticide poisoning is not optimal and mortality following such poisoning is high in Bangladesh.

Method: It was a prospective study in which pattern of pre-hospital treatment received and outcome of pesticide poisoned patient were studied at one adult medical unit of Dhaka Medical College Hospital from October 2005 to June 2006.

Results: The number of cases of pesticide poisoning were 60 (1.98%) of 3030 admitted patients. The mean age was 24.7±8.8 years. Most of them (40, 66.7%) were male. The incidence of poisoning was high among students (11, 18.3%) and housewives (10, 16.7%). The most common cause of poisoning was intentional (55, 91.7%). Familial disharmony was underlying cause in 27 (45%) patients. More than half of the patients (41, 68.3%) purchased the poison self. 25 (41.7%) patients got first contact with physician within 30 minutes of poisoning. In majority cases (45, 75%) first contact health care provider was government hospital. Only 22 (36.7%) patients received first aid before arrival to present hospital. Among them, 19 (31.7%) patients received induced vomiting by ingestion of tamarind water or lemon water or soap water or putting finger or other substances (cow dung, human excreta etc.) in mouth and 3 (15%) patients received home remedy like milk, raw egg etc. The overall mortality was 16.7%.

Conclusion: Measures should be taken to increase the awareness among general population regarding the first aid following pesticide poisoning.

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► *Implication for health policy/practice/research/medical education:* Measures should be taken to increase the awareness among general population regarding the first aid following pesticide poisoning.

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1. Introduction:

Pesticides particularly organophosphate compounds are commonly used as agricultural insecticides worldwide. Since agriculture is the main occupation in

Bangladesh, pesticides are widely and easily available in ordinary village grocery shops. Their easy availability makes them a popular method of self-harm particularly in the rural areas (1, 2). Many people consider suicide as an acceptable way of relieving their personal misery or of reducing the financial and emotional burden they cause their family.

Poisoning is an important preventable public health problem in developing countries like Bangladesh. The case fatality for self-poisoning in the developing world is commonly 10-20% but for particular pesticides, it may be as high as 50-70% (3). Although exact data is not available in Bangladesh, hospital-based studies suggest that it is the most common type of poisoning in Bangladesh with nearly half of the admissions to emergency with poisoning being due to organophosphate. In Bangladesh, a nationwide survey that was done in September 2002 in nine medical college hospitals showed total 380 cases of poisoning where pesticide was on top of the list (40%) (4). According to DGHS: Bangladesh Health Bulletin, 1999 poisoning is the 15th most common cause of morbidity (1997), the third most common cause of mortality (1997) and the second most common cause of mortality (1999) in Bangladesh (5).

Pesticide self-poisoning is a major clinical problem in many parts of the world (6), probably is already killing about 300,000 people every year (7, 8), while, most of the deaths occur in rural areas of the developing countries. Pesticide poisoning is also a problem in industrialized countries, where it may account for a significant proportion of deaths from self-poisoning that do occur (9, 10). Though, accidental poisoning can occur following exposure or inhalation, serious poisoning often follows suicidal ingestion (11). According to the World Health Organization (WHO) report every year, 1 million serious accidental and 2 million suicidal poisoning with insecticides occur worldwide, and of this approximately

200,000 die (12). The causes of the high case fatality are multifactorial but include the high toxicity of locally available poisons, difficulties in transporting patients across long distances to hospital, the paucity of health care workers compared with the large numbers of patients, and the lack of facilities, antidotes, and training for the management of pesticide-poisoned patients (3, 8).

The lay practice of giving a home remedy soon after ingestion, before bringing the poisoned person to hospital, is common in many parts of the world. First aid that is provided immediately after the poisoning may affect the outcome. It is necessary to develop awareness among the people about the first aid of pesticide poisoning and its outcome. The aim of this study is to know the pattern of pre-hospital treatment received by cases of pesticide poisoning and also outcome of pesticide poisoning cases.

2. Materials and Methods:

It was a prospective study, descriptive in nature, performed in one of the five adult medicine unit (Green Unit) of Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh. Over a period of nine months from October 2005 to June 2006, 60 patients with history of pesticide poisoning admitted in Green Unit of DMCH who fulfilled inclusion criteria at admission were enrolled in the study.

Inclusion criteria were: (i) History of pesticide use, (ii) Sign of pesticide poisoning and (iii) Informed consent from the patient or relatives.

The diagnosis was based on information taken either from the patient or from the patient's relative regarding the agent involved in the exposure. Diagnosis of any other causes of poisoning by deliberate self-harm using substances like sedatives, harpic, savlon etc. or patients admitted following suspected poisoning during travel using public transport or presence of any other organic cause of coma or who unwilling to give informed consent were not included in the study.

Detail history, thorough clinical examination were performed to elicit the cause of poisoning and to know information about pre-hospital treatment. Attempts made collection of the ingested pesticide samples. Patients were assessed on a daily basis until discharge from the hospital to see their outcome.

The patients were managed according to standard clinical protocols. Protocol was ethically reviewed and approved by the Ethical Review Committee of Dhaka Medical College, Bangladesh. All data were collected in an individual case record form. Before data collection, verbal or written informed consent was taken from the patients or their relatives. Data were analyzed using the SPSS 12.0. Data were presented as mean and percentage as applicable.

3. Results:

During the study period, total patients admitted in the study medical unit were 3030; 278 (9.17%) of them died. Out of total admitted cases, 581 (19.17%) were poisoning cases and total death due to poisoning were 25 (8.99%). During the study period, total pesticide poisoning cases were 60 (10.33%); 10 (16.7%) of them died.

Majority of the pesticide poisoning cases (46.7%) were between 21-30 years followed by 41.7% between 11-20 years and 6.6% between 31 to 40 years. Only 3 cases were above the age of 40 years. The mean age was 24.7 ± 8.8 years and the lowest and highest ages were 14 and 60 years respectively. Males were predominant than females, overall male:female ratio was 2:1. 50% of the patients were married. 36.7% patients were member of a farming family. Regarding occupation 18.3% were student, 16.7% housewife, 11.7% businessman, 40% were engaged with other occupations. 58.3% patients can read and write whereas 36.7% were illiterate. 80% of the patients were from rural areas.

Nearly half (45%) of the poisoning cases were resulted from familial disharmony,

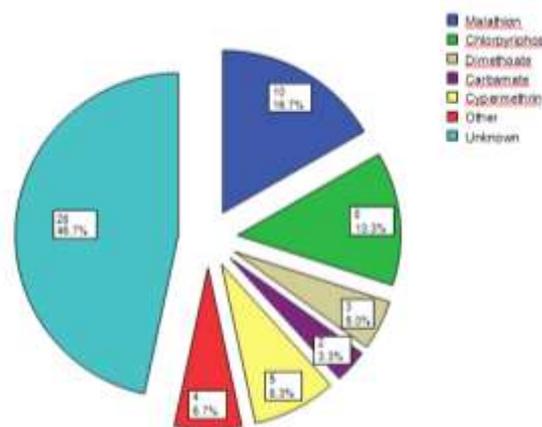


Fig. 1. Brand of poison used.

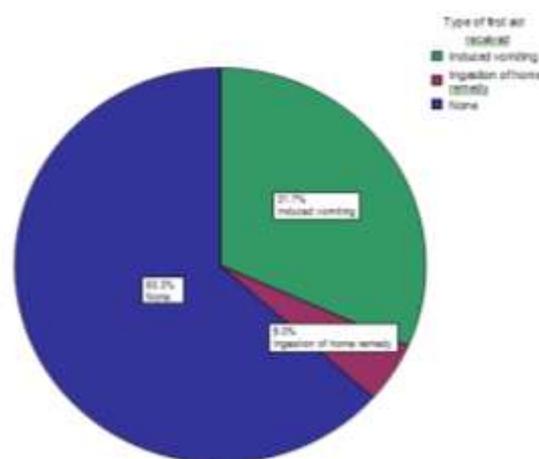


Fig. 2. Pattern of first aid received.

about 13.3% were resulted from reactive depression. In 15% cases the circumstances were unknown. 13.3% poisoning were due to some other causes, including: 8.3% originated from marriage related problem and 5% from financial problem.

Out of 32 patients from whom the specimen of poison could be recovered, 16.7% used malathion followed by 13.3% chlorpyrifos, 8.3% cypermethrin, 5% dimethoate, 3.3% carbamate and 6.7% used other brand of poison (Figure 1).

Majority of the poisoning (91.7%) was intentional, 5% was non-intentional and 3.3% was unknown. According to the source of procurement of poison, 68.3% patients purchased it self, 18.3% used leftover sample and 13.3% used poison from prior purchase for household use. Out

Table 1: Outcome of treatment.

	Number	%
Complete recovery	41	68.3
Recovery with complication	1	1.7
Absconded	8	13.3
Death	10	16.7

of 60 cases 7 (11.7%) had prior known psychiatric illness.

22 (36.7%) patients received some form of first aid before arrival to present hospital. Among the patients who received first aid before arrival to present hospital, 19 (31.7%) patients received induced vomiting by ingestion of tamarind water or lemon water or soap water or putting finger or other substances (cow dung, human excreta etc.) in the mouth and 3 (5%) patients received home remedy like milk, raw egg etc. immediately after ingestion of poison (Figure 2).

41.7% patients got first contact with physician within 30 minutes of poisoning, 33.3% cases got within 1 hour, 20% got in between 1 to 2 hours and the remaining more than 2 hours had contact with physician. Most of the patients (75%) received first contact health care from government hospital, 21.7% from private hospital, 1.7% from MBBS doctor and 1.7% from village doctor (quack).

In 57 cases atropine was given (3 were diagnosed at admission pesticide poisoning other than OPC). 35 (58.3%) patients required atropine from 1-150 ampoules, 9 (15%) patients required from 151-300, 4 (6.7%) patients required 301-450 and 8 (13.3%) patients required more than 600 ampoules. Only one patient required atropine from 451-600 ampoules. Pralidoxime was used in 40 cases (the other could not afford). Of them 17 (28.3%) used 1-20 ampoules, 14 (23.3%) used more than 80 ampoules, 3 (5%) used

21-40, 5 (8.3%) used 41-60 and only one patient given 61-80 ampoules.

11 patients developed intermediate syndrome and out of them five patients required respiratory support (two patients died without getting ventilatory support, two patients survived after getting ventilatory support and one patient died in ICU under ventilatory support due to cardiac arrhythmia). Among those who did not develop IMS, two patients required respiratory support but due to unavailability of bed in ICU, it could not be provided, therefore they died.

10 (20%) of the survived patients stayed at hospital for more than 7 days, while 33 (66%) stayed 4-7 days and the other stayed for 1-3 days.

More than half of the patients (41, 68.3%) recovered completely, 16.7% of the all patients died, 13.3% were absconded and only 1 (1.7%) patient was recovered with complication (developed dysphonia after extubation of IT tube) (Table 1).

Out of 10 cases 8 (80%) patients died due to acute cholinergic crisis, 1 (10%) patient from respiratory paralysis and the other (10%) from cardiac arrhythmia. 2 (20%) cases died in 1-6 hours, 2 (20%) others in 7-12 hours, 4 (40%) cases in 13-24 hours and 2 (20%) cases after 24 hours from admission.

10 patients used malathion, out of them six patients recovered completely, two patients died and two patients absconded. Eight patients used chlorpyrifos, three patients used dimethoate; all of them were recovered completely. Carbamate used by

Table 2: Association between brand of poison and outcome.

		Outcome		
		Complete recovery	Absconded	Death
	Malathion	6	2	2
	Chlorpyriphos	8	-	-
	Dimethoate	3	-	-
Brand of Position	Carbamate	1	-	1
	Cypermethrin	4	1	-
	Other	4	-	-
	Unknown	16	5	7

two patients, one patient recovered completely and the other died. Among the user of cypermethrin, four cases recovered completely and one case absconded. Than four cases that used other brand, all of them recovered completely. Among the unknown brand user (28), 16 patients recovered completely, five patients absconded and seven patients died (Table 2).

No significant difference was observed between cases who received first-aid and who did not received it in terms of treatment outcome ($P=0.923$) (Table 3).

4. Discussion:

Acute pesticide poisoning is a major clinical problem in developing countries like Bangladesh. The aim of the present study was to find out the pattern of pre hospital treatment received by cases of pesticide poisoning and also outcome of pesticide poisoning cases. We enrolled 60 diagnosed cases of pesticide poisoning who were admitted in one adult medical unit of Dhaka Medical College Hospital from October 2005 to June 2006. During this period, total 3030 patients were admitted in this medical unit and 581 cases of them have been found to be admitted following poisoning, that they are 19.17% of total admission. In total, 278 patients

died during this 9 months period which was about 9.17% of total admission. Among this death poisoning was responsible in 25 cases which were about 8.99% of total death and 4.30% of total poisoning cases. Among the poisoning deaths, 10 cases were due to pesticide poisoning which was about 40% of total poisoning death and 16.7% of pesticide poisoning death, which differ with other studies done in Bangladesh (13) and South India (14).

This study shows age ranging of most of the patients was between 21 to 30 years (46.7%). The mean age of the patients was 24.7 ± 8.8 years. Maximum incidence (88.4%) of pesticide poisoning occurred below the age of 30 years which indicates that pesticide poisoning is common among young people. These findings are close approximation with the finding of Ahmed *et al* (1995) (15) and Faiz *et al* (1998) (16). In our study, 40 (66.7%) were male and 20 (33.3%) were female, giving a male:female ratio of 2:1, which differs with the study of Khan *et al* (1985) (17) and Karki *et al* (2001) (18) but is similar to the studies carried out in CMCH (Karim *et al*, 1993) (19).

This study shows 30 (50%) patients were married and 30 (50%) patients were unmarried, which tells that pesticide

Table 3: Association between first-aid received and outcome of treatment.

		Outcome				P-value
		Complete recovery	Absconded	Death	Total	
Prior first aid received	Yes	17	2	3	22	0.923
	No	25	6	7	38	
Total		42	8	17	60	

poisoning is common in both groups. Besides, it shows a vast number of pesticide poisoning patients (24, 40%) were engaged in different occupations like rickshaw puller, taxi driver, carpenter, weaver, fishermen, garments worker, servant etc. The incidence of pesticide poisoning among the students was 11 (18.3%), the housewives 10 (16.7%), the businessmen 7 (11.7%), the laborer farmer 4 (6.7%), the land owner farmer 3 (5%) and the government employee 1 (1.7%). The high incidence among the students indicates they are emotionally vulnerable group and among the housewives indicates the possibility of familial instability as the underlying cause and it also tells that pesticide is easily available among the reach of these groups, these findings is similar with Karki *et al* (2001) (18).

Our study shows educational status among the poisoning cases is 35 (58.3%) patients can read and write whereas 22 (36.7%) patients were illiterate and 3 (5%) patients can read only. In this series, 48 (80%) patients came from rural area and 12 (20%) patients came from urban area which indicates that pesticide is a common household item in rural farming community.

Regarding circumstances of poisoning, familial disharmony was the underlying cause in 45% cases, reactive depression in 13.3% cases, marital problem in 8.3% cases, financial problem in 5% cases, the cause was unknown in 15% cases and

13.3% poisoning are due to some other causes like psychiatric illness etc.

This study shows in majority cases (91.7%), cause of poisoning was intentional, 5% was non-intentional and 3.3% was unknown. This data closely simulates with the findings which were described by Faiz *et al* (1998) (16) and Karki *et al* (2001) (18). Self-harm in particular self-poisoning is used for many reasons- to gain attention, express distress or to get revenge-not just for ending life (3, 20). M. Eddleston showed that many deaths from self-poisoning in Asia Pacific region occur in people who do not intend to die; they die because the poisons ingested are very toxic and patients are difficult to treat (3, 21).

Regarding source of procurement of poison more than half (68.3%) of the patients purchased it self, 18.3% used left over sample and 13.3% cases used poison which was purchased before for household use.

An attempt was made to identify the offending pesticide by requesting the accompanying person to bring the container left in the vicinity of the occurrence or by requesting the victim to bring a similar agent used for poisoning after recovery. In 53.3% cases, we could identify the used pesticide and 46.7% cases could not because the victims threw it in a pond or toilet or hide in other places after using the poison. Among the recovered specimen, 10 (16.7%) used

malathion, 8 (13.3%) chlorpyrifos, 5 (8.3%) cypermethrin, 3 (5%) dimethoate, 2 (3.3%) carbamate, 4 (6.7%) used other brand (diazinon, phenthoate and dichlorvos). Identification of the poison by chemical analysis is not routinely done for clinical use. Although this type of identification of poison not ideal, but is practical in a resource limited setting.

The study shows 38 (63.3%) patients were admitted in the hospital without getting any first aid. This poor pre-hospital management may contribute to the relatively high death rate. Developing awareness among the people at community level is necessary for improvement of first aid measures following poisoning. 88.3% of our patients were normal healthy population and 11.7% had prior known psychiatric illness. This finding suggests that pesticide poisoning is more common among normal population than population with mental disorders in Bangladesh. On the other hand poisoning by drugs is common in the west having prior mental illness (22).

In our study, 22 (36.7%) patients received first aid before arrival to present hospital. Regarding pattern of first aid, 19 (31.7%) patients received induced vomiting by ingestion of tamarind water or lemon water or soap water or putting finger or other substances (cow dung, human excreta etc.) in mouth and 3 (5%) patients received home remedy like milk, raw egg etc. immediately after ingestion of poison. The creation of awareness among the community for appropriate first aid is to be made.

Our patients had first contact with physician after a variable period of time following ingestion of the poison. 25 (41.7%) of all patients had first contact with physician within 30 minutes of poisoning, 20 (33.3%) cases had within 1 hour, 12 (20%) had in between 1 to 2 hours and rest 3 (5%) cases took more than 2 hours to have contact with physician.

Most of the patients (45, 75%) received first contact health care from government hospital, among others 13 (21.7%) from

private hospital, 1 (1.7%) from MBBS doctor and 1 (1.7%) from village doctor (quack). The high attendance in government hospital within short time interval of poisoning is encouraging.

Almost all the patients (59, 98.3%) received washing out the stomach (after ingestion of poison). In 20 (33.3 %) patients, gastric lavage was performed at the present hospital, 25 (41.7%) got it prior to the admission in the present hospital and 14 (23.3%) had it in both places.

We managed our patients by injection of atropine sulphate in almost all cases except those diagnosed at admission pesticide poisoning other than OPC (they were managed accordingly). Pralidoxime was used in those who could afford. The patients were atropinized according to newer treatment regimen (23). Atropinization was maintained for at least 5 days before withdrawal. The number of ampoules of atropine that used was variable and individualized. Among total 57 patients who were given atropine, 35 (58.3%) patients required atropine in between 1-150 ampoules, 9 (15%) required in between 151-300 ampoules, 4 (6.7%) required 301-450 ampoules, 1 (1.7%) required in between 451-600 ampoules and 8 (13.3%) required more than 600 ampoules. Pralidoxime was used in 40 (66.7%) cases as per WHO recommendation (24, 25). All of them got bolus dose but only 14 (23.3%) patients got maintenance dose. Others got maintenance dose incompletely (1 to 4 days) due to financial problem. Injection of diazepam was used in agitated patients. The availability of Pralidoxime in public hospitals needs to be considered. Optimum dose and duration of PAM may change in outcome of OP poisoning.

In our cases, 11 (18.3%) patients developed intermediate syndrome out of them 5 required respiratory support (2 died without getting ventilatory support, 2 survived after getting ventilatory support and 1 died in ICU under ventilatory support due to cardiac arrhythmia). Among those who did not develop IMS, 2 patients

required respiratory support but could not be provided due to unavailability of bed in ICU and died. Respiratory support by assisted respiration was not available in some cases which are the usual scenario in resource limited setting. Ways and means to provide such assistance is to be found out for such victims of pesticide poisoning. In our study, 10 (20%) of the survived patients stayed at hospital more than 7 days, while 33 (66%) patients stayed in between 4-7 days and the remaining 7 (14%) patients for 1-3 days.

Regarding outcome, 41 (68.3%) patients recovered completely and 10 (16.7%) patients died 8 (13.3%) were absconded and only 1 (1.7%) patient was recovered from the complication (developed dysphonia after extubation of IT tube). Our case fatality ratio is slightly lower than other earlier studies in Bangladesh (28) and South India (29). Among the fatal patients, two (20%) were died in 1 to 6 hours, the other two (20%) in 7 to 12 hours, four (40%) cases in 13 to 24 hours and two (20%) cases after 24 hours from admission. Most of the patients (80%) died within the first 24 hours of admission.

Our study shows that cause of death was acute cholinergic crisis in 8 (13.3%) cases, respiratory paralysis in 1 (1.7%) case and cardiac arrhythmia in 1 (1.7%) case.

5. Conclusion:

In agriculture-based-developing countries like Bangladesh, acute pesticide poisoning is a major health problem resulting in a high mortality and morbidity. Prompt recognition and early treatment is mandatory in acute poisoning in order to minimize the mortality from potentially lethal compounds. Awareness regarding pesticide poisoning prevention, immediate first aid measures and hospital admission following poisoning should be raised among general population via audio visual and broadcasting media. Though no significant difference was observed between cases who received first-aid and who did not in terms of outcome of treatment ($P=0.923$), further study on

larger group of patients is required as the study was a simple observational study done on small number of hospital admitted patients in Dhaka Medical College Hospital.

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References

1. Eddleston M, Karalliedde L, Buckley N, Fernando R, Hutchinson G, Isbister G. Pesticide poisoning in the developing world-a minimum pesticides list. *Lancet*. 2002;12:1163-67.
2. Murray D, Wesseling C, Keifer M, Corriols M, Henao S. Surveillance of pesticide related illness in the developing world: putting the data to work. *Int J Occup Environ Health*. 2002;8:243-48.
3. Eddleston M: Patterns and problems and deliberate self-poisoning in the developing world. *Q J Med*. 2000;93:715-731.
4. Bari MA. A programme to establish a Poison information centre in Bangladesh, Final Draft. 2003.
5. Bangladesh Health Bulletin. UMIS, Directorate General of Health Service, 1999.
6. Jeyaratnam J. Acute pesticide poisoning: a major global health problem. *World Health Statist Q*. 1990;43:139-144.
7. Eddleston M, Phillips MR. Self poisoning with pesticides. *BMJ*. 2004;328:42-44.
8. Buckley NA, Karalliedde L, Dawson A, Senanayake N, Eddleston M. Where is the evidence for the management of pesticide poisoning-is clinical toxicology fiddling while the developing world burns? *J Toxicol Clin Toxicol*. 2004;42:113-116.
9. Bruyndonckx RB, Meulemans AI, Sabbe MB, kumar AA, Delooz HH. Fatal intentional poisoning cases admitted to the University Hospitals of Leuven, Belgium, from 1993 to 1996. *Eur J Emerg Med*. 2002;9:238-243.

10. Langley R, Summer D. Pesticide mortality in the United States, 1979 - 1998. *Vet Hum Toxicol.* 2002;44:101-105.
11. Dutoit PW, Maller FO, Ventonder WM, Ungerer MJ. Experience with intensive care management of organophosphate insecticide poisoning. *S Afr Med J.* 1981;60:227-9.
12. WHO. Guidelines for poison control. WHO in collaboration with UNEP and ILO, Geneva. 1997;3-10.
13. Year Book of the Department of Medicine, Chittagong Medical College, Chittagong, Bangladesh. 2002.
14. Srinivas Rao CH, Venkateswarlu V, Surender T, Eddleston M, Buckley NA. Pesticide poisoning in South India: opportunities for prevention and improved medical management. *Tropical Med & Int Health.* 2005;10(6):581-588.
15. Ahmad R, Shah R, Amin MMM, Parveen S, Dey DK. Pattern and Mortality of poisoning in DMCH. *J Medical Teachers Federation.* 1995;1(1):10-12.
16. Faiz MA, Hasan M. Situation of poisoning in Bangladesh, Country report in SAARC meeting on poisoning, Colombo, 1998.
17. Khan NI, Sen N, Haque NA. Poisoning in a medical unit DMCH in 1983. *Bang Med J.* 1985;14(1):9-12.
18. Karki A. A clinicoepidemiological study of OPP at a rural based teaching hospital in eastern Nepal, *Tropical Doctor.* 2001;3:32-34.
19. Karim SA, Faiz MA, Nabi MN. Pattern of poisoning in CMCH. *JCMCTA.* 1993;4(3):10-14.
20. Maracek J. Culture gender and suicidal behaviour in Sri Lanka. *Suicide Life Threatening Behav.* 1998;28:69-81.
21. Philips MR, Yang G, Zhang Y, Wang L, Ji H, Zhou M. Risk factors for suicide in China: a national case control psychological autopsy study. *Lancet.* 2002; 360:1728-36.
22. Eddleston M, Phillips MR. Self poisoning with pesticides. *BMJ.* 2004;328:42-44.
23. Eddleston M, Dawson A, Karalliedde L, Dissananayake W, Hittarage A, Azhar S, Buckley NA. Early management after self-poisoning with an organophosphorus or carbamate pesticide – a treatment protocol for Junior Doctors. *Critical Care.* 2004;8(6):391-396.
24. Eyer P. The role of oximes in the management of organophosphorus pesticide poisoning. *Toxicol Rev.* 2003;22:165-190.
25. Johnson MK, Jacobsen D, Meredith TJ, Eyer P, Health AJW, Ligtenstein DA, Marrs TC, Szinicz L, Vale JA, Haines JA: Evaluation of antidotes for poisoning by organophosphorus pesticides. *Emerg Med (Fremantle).* 2000;12:22-37.