# PREPAREDNESS OF HOSPITALS EMERGENCY DEPARTMENTS IN MALAYSIA FOR MANAGING ACUTE POISONING CASES

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**By**

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## DEDICATION

**I dedicate this work to my mother, my wife, my sons Ibrahim and Mohammed, my daughter Lamyaa and my sisters and brothers.**

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All praise and glory go to Allah, the Almighty who alone enabled me to accomplish this small objective successfully. I feel honored and privileged to glorify His name in the sincerest way throughout my doctorate and ask Him to accept my efforts. Peace be Upon His Prophet and His companions and all who follows him until the Day of the Judgment.

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| | |
|---|---|
| AACT | American Academy of Clinical Toxicology |
| AAPCC | American Association of Poison Control Centers |
| BB | Beta-Blocker drug |
| BUN | Blood Urea Nitrogen |
| C | Central region |
| CCB | Calcium Channel Blocker |
| CNS | Central Nervous System |
| CO | Carbon Monoxide |
| CPK | Creatine PhosphoKinase |
| CT SCAN | Computed Tomography |
| CVP | Central Venous Pressure |
| DH | District Hospital without specialist |
| DHS | District Hospital with Specialist |
| DIS | Drug Information Service |
| E | East region |
| E.M | East Malaysia (Sabah and Sarawak) |
| EAPCCT | European Association of Poisons Centers and Clinical Toxicologists |
| ECG | Electro-Cardio-Gram |
| ED | Emergency Department |
| EEG | Electroencephalography |
| F | Frequency |
| FBC | Full Blood Count |
| FFP | Fresh Frozen Plasma |

| | |
|---|---|
| GH | General Hospital |
| GIT | Gastro-Intestinal-Tract |
| GXM | Group and cross-match |
| I P P V | Invasive Positive Pressures Ventilators |
| ICU | Intensive Care Unit |
| IPCS | International Programme on Chemical Safety |
| MOH | Ministry Of Health |
| MRI | Magnetic Resonance Imaging |
| N | North region |
| n | number |
| N I P P V | Non- Invasive Positive Pressures Ventilators |
| NSAID | Non Steroidal Anti-Inflammatory Drug |
| OGDS | Oesophago – Gastro – Duodenoscopy |
| PC | Poison Center |
| S | South region |
| SD | Standard Deviation |
| T | Total |
| TCA | Tri-Cyclic-Antidepressant |
| TCP | Transcutaneous Cardiac Pacing |
| TDM | Therapeutic Drug Monitoring |
| UH | University Hospital |
| WADEM | World Association for Disaster and Emergency Medicine |
| WHO | World Health Organization |
| A&D | Accident and emergency department |

**KESEDIAAN JABATAN KECEMASAN HOSPITAL DI MALAYSIA DALAM MENGURUSKAN KES-KES KERACUNAN AKUT**

## ABSTRAK

Kajian ini dijalankan untuk meneliti tahap kesediaan jabatan kecemasan hospital di seluruh Malaysia dari sudut kemudahan penyiasatan dan pengurusan kes keracunan, kewujudan dan penggunaan garis panduan rawatan dan lain-lain sumber rujukan toksikologi, latihan kakitangan dan juga sejauhmana kemudahan rawatan esensial yang berada di luar jabatan kecemasan dapat dicapai.

Borang soal selidik semi-struktur yang di isi sendiri telah disahkan dan dihantar ke semua jabatan kecemasan hospital awam dan hospital universiti di Malaysia Ia terdiri daripada empat bahagian utama iaitu (a) data epidemiologi, (b) kemudahan mendapatkan kelengkapan diagnosis dan pemonitoran, (c) kemudahan rawatan yang terdapat di jabatan kecemasan dan (d) maklumat berhubung toksikologi serta latihan kepada kakitangan. Data terkumpul telah dianalisa menggunakan SPSS versi 16 secara analisis deskriptif dan perbandingan.

Tujuh puluh tujuh jabatan kecemasan hospital awam telah menjawab dan melengkapkan borang soal selidik yang dihantar (kadar respons 60.15%). Daripada jumlah ini, hanya enam puluh tujuh buah jabatan kecemasan termasuk dalam analisis yang dilakukan. Kajian ini mendapati parasetamol merupakan agen keracunan yang paling kerap dilaporkan, diikuti dengan patukan ular, sengatan lebah/tebuan dan *Clorox* (agen peluntur pakaian). Selain itu, organofosfat, parakuat dan minyak tanah juga sering dilaporkan.

Kemudahan asas yang diperlukan untuk mengenalpasti dan mengurus kes keracunan akut adalah didapati di jabatan kecemasan kebanyakan hospital termasuk hospital daerah. Ini termasuklah kemudahan penstabilan pesakit; lavaj gastrik dan

arang teraktif; kemudahan pemonitoran seperti pancaran sinar-X, ECG, oksimetri nadi dan ultrabunyi; siasatan makmal seperti paras glukos darah, elektrolit, kiraan darah penuh, urea nitrogen darah, pembekuan darah, kiraan leukosit, ujian fungsi hati, ujian fungsi ginjal, pemeriksaan penuh urin dan kebanyakan ubat esensial dan antidot.

Apabila terdapat perbezaan yang signifikan di antara hospital, jabatan kecemasan di hospital besar adalah yang terbaik diikuti dengan jabatan kecemasan di hospital daerah yang mempunyai pakar perubatan. Perbezaan ini termasuklah purata bilangan katil dan ambulans; kemudahan perkhidmatan khas; hemodialisis dan dialisis peritoneum; kemudahan bantuan pernafasan seperti ventilator mekanikal; siasatan makmal seperti keseimbangan asid-bes, methemoglobin, karboksihemoglobin, aktiviti kolinesteras, keosmolalan plasma; antidot seperti pralidoksim, N-asetilsistin, desferoksamina dan flumazenil; dan latihan berkaitan toksikologi.

Secara am, masih terdapat kurang dari 50% hospital yang membeli jenis latihan dan peratusan kakitangan yang dilatih. Walaubagaimanapun, kebanyakan jabatan kecemasan ada rancangan untuk dapatkan latihan. Buku teks diikuti dengan nasihat daripada rakan sekerja adalah sumber maklumat paling utama tentang pengurusan keracunan yang digunakan oleh kakitangan jabatan kecemasan. Pusat Racun merupakan sumber rujukan ketiga dan dirujuk oleh dua pertiga daripada jabatan kecemasan di seluruh Malaysia. Data yang diperolehi juga menunjukkan lebih daripada separuh jabatan kecemasan di seluruh Malaysia menggunakan protokol rawatan.

**PREPAREDNESS OF HOSPITALS EMERGENCY DEPARTMENTS IN MALAYSIA FOR MANAGING ACUTE POISONING CASES**

## ABSTRACT

This study was undertaken to examine the level of preparedness of accident and emergency departments across all regions in Malaysia with respect to poisoning investigational and management facilities, availability and use of treatment guidelines and other toxicological sources, training of staff and the extent by which essential treatment facilities outside the accident and emergency department are made accessible.

A self-administered semi-structured questionnaire was validated and sent to all government accident and emergency departments in Malaysia and university hospitals. to comprise of 4 main sections; (a) epidemiology data, (b) availability of diagnostic and monitoring equipments, (c) treatment facilities available at the accident and emergency department and (d) toxicological information and training of staff. Collected data was analysed in SPSS version 16 using descriptive and comparative analyses.

Seventy-seven accident and emergency departments of government hospitals answered and completed the questionnaire (response rate 60.15%). Of those, seventy six accident and emergency departments were included in the analysis. This study found that paracetamol was the most common toxic agents reported; followed by snake bite, bee/hornet sting, and Clorox. Beside these, organophosphate, paraquat and kerosene were also frequently reported.

Basic facilities required for poisoning identification and treatment were available in accident and emergency departments of most hospitals including district

hospitals. This include stabilization facilities (with some exceptions); gastric lavage and activated charcoal; monitoring facilities such as X-ray, ECG, pulse oximeter, and ultrasound; laboratory investigations such as blood glucose, electrolytes, full blood count (FBC), blood urea nitrogen, blood clotting, leukocyte count, liver function test, renal function test, and urine full examination; and most of the essential drugs and many of the antidotes.

When there were significant differences between hospitals, accident and emergency departments of general hospitals were the best followed by accident and emergency departments of district hospitals with specialists. This difference include the average number of beds and ambulances; the availability of special services; haemodialysis and peritoneal dialysis; breathing support facilities like mechanical ventilators; laboratory investigations such as acid-base balance, methaemoglobin, carboxyhaemoglobin, cholinesterase activity, and plasma osmolality; the antidotes such as pralidoxime, N-acetylcysteine, deferoxamine and flumazenil; and toxicology-related training.

Generally, less than 50% of the hospitals conduct training both in terms of the types of training provided and in terms of the proportion of staff trained. However, the majority of the accident and emergency departments have plans for training. Textbooks followed consultations with colleagues were the most important sources of information on poisoning management used by the staff. The poison center came at third place used by about two thirds of hospitals. Our data showed that more than half of accident and emergency departments throughout Malaysia were using treatment protocols.

# 1. INTRODUCTION

## 1.1: General concepts about poisoning

Poisoning is defined as an exposure to any substance, either natural or synthetic, which results in structural damage or functional disturbance to the body (Timbrell, 2002; Hodgson, 2004; Shiel and Stöppler, 2008; Eaton and Gilbert, 2008). Poisoning occurs when a toxic agent enters the body from any route (ingestion or inhalation). Poisoning can happen from many thing; natural (animal bites or sting, herbal), chemicals (pesticide and household), pharmaceuticals products or gases. Some poisonous substances can cause very mild symptoms such as irritation or nausea, while others can cause more serious symptoms and can sometimes is fatal such as respiratory arrest (Schonwald and Schonwald, 2001; Hodgson, 2004).The majority of poisoning exposures were acute cases (Bronstein et al., 2008).

## 1.2: Route of poisoning

Poisoning can result from ingestion, inhalation or contact on the skin or eyes. Poisoning by ingestion is the most common cause. A vast majority of poison exposures involved people who swallow a drug or chemical poison. A US study reported that 78% of poison exposures were oral ingestions (Hoppe-roberts et al, 2000). Data on poisoning fatalities from other US study showed that 75.4% were caused by ingestion. Inhalation, nasal and parenteral route of exposures showed very low proportions (9.5% and 4.7%, respectively; Bronstein et al., 2008). Srivastava et al. (2005) from India reported 88% for oral exposure and Paudyal (2005) from Nepal reported 100%. Balai-Mood (2004) from Iran and Goksu et al. (2002) from Turkey reported 79.7% and 78.8%, respectively. Another report from Turkey revealed a higher rate (84.51%; Tufekci et al., 2004).

In some developing countries natural sources exposures through skin contact such as bites and stings from venomous animals or insects represent the most common route of poisoning exposures. In Oman, for example, such exposures constitute 59.5% of all its poisoning cases, whereas poisoning by ingestions stood at only 38.5% (Hanssens et al, 2001). However, another data from Oman revealed the predominance of oral ingestion a similar to developed countries (Lall et al., 2003).

**1.3: Classification of poisoning exposures (types of poisoning)**

Poisoning can be classified according to various concepts; based on categories of the toxic agent, on the targeted organ or system, and based on the length of exposure into acute or chronic (Timbrell, 2002; Barile, 2003; Hodgson, 2004; Eaton and Gilbert, 2008). Poisoning is divided into several groups in relation to the types of toxic agents involved. These include drugs, natural, pesticide, household and industrial chemicals (Timbrell, 2002). Each one of these has some characteristics and distribution that differ from country to another. Drug overdose include many sub-groups that may vary according to whether they had occurred due to misuse or abuse. The drug misuse involve taking an overdose of a medicine such as antihypertensive, antipyretic, anti-diabetic or other medications either accidentally or suicidal, whereas, a drug abuse involve taking an agent that has no medicinal use like heroin, and amphetamines .Pesticides are categorized as rodenticides, insecticides, herbicides etc. and poisonings caused by these chemicals are more likely to happen in an agricultural scenario (Marrs and Ballantyne, 2004; costa, 2008).

Acute poisonings are characterized by sudden and severe exposure and rapid absorption of the substance (Eaton and Gilbert, 2008). Normally, in such a case, a

single large exposure is involved. Acute health effects from such exposure are often reversible (e.g. carbon monoxide or cyanide poisoning). On the other hand, chronic poisonings are characterized by prolonged or repeated exposures over a period which could be months or years (Eaton and Gilbert, 2008). Its symptoms may not be immediately apparent. Effects on the health due to chronic poisoning are usually irreversible.

### 1.4: Statistics of poisoning

Toxic exposures to drugs and chemicals are among the most common reasons for accident and emergency department's visits and hospital admissions in developed countries (Greene et al, 2005; Kristinsson et al., 2008). In 2005, poisoning continued to be the second leading cause of injury death in the United States (Fingerhut, 2008). In India, poisoning represented 1% of the total hospital admissions. The majority of these cases are young adults from the age group of 21–30 years, representing one-third of all cases, followed by those in the age group of 31–40 years (Singh and Unnikrishnan, 2006). In the United States, a substantial proportion of poisoning-related emergency admitted involved patients less than 5 years of age (Mccaig and Burt, 1999). Females between the ages of 5–19 had a significantly higher poisoning-related admitted than males in similar age group.

Poisoning incidences worldwide are increasing daily (Greene et al, 2005; Wananukul, 2007; Shin et al, 2004; van der Hoek and Konradsen, 2006). This is probably due to the increase in the availability of toxic agents, the changes in life style and socioeconomic factors (Singh and Unnikrishnan, 2006). Greene et al (2005) reported that the overall severity of poisoning in the UK has decreased over the past 10 years. Nevertheless, the number of poisoned patients admitted to accident and

emergency departments is on the upward trend, accounting for 5%–10% of the accident and emergency department workload. In Thailand, Wananukul et al. (2007) found that the number of poisoning inquiries referred to the poison center is increasing every year.

Poisoning incidents has a pattern of seasonal variation. Paudyal (2005) in Nepal reported more poisoning cases in summer months. In Bangladesh, the incidence of poisoning was highest in the summer and lowest in the spring (Rashid et al., 2007). Likewise in Turkey, majority of its poisoning cases and admissions to hospital were during the summer months (Güloğlu and Kara, 2005). Another report from Turkey confirmed that poisoning incidents in the country peaked during summer (Tufekci et al., 2004; Güloğlu and Kara, 2005; Baydin et al, 2005). In Iran, poisoning exposures are more likely to occur during both summer and spring (Balai-Mood, 2004). In these studies, the authors did not often any explanation on why poisoning occurs higher in summer.

### 1.5: Circumstance and factors associated with poisoning

Poisoning can be classified as accidental, intentional, and un-determined. According to Balai-Mood (2004) intentional exposures are "exposures resulting from the incorrect use of a substance for self harm or an effect rather than pursuit of a psychotropic effect". In the other hand, accidental exposures include all exposures that result from any passive, occupational or environmental contacts. These include all animal bites or stings and accidental plant intoxication, food poisonings and most pediatric exposures.

Intentional poisoning happens mostly in European countries and in some parts of South East Asia and the Western Pacific countries (Lapatto-Reiniluoto et al.,

1998; Shin et al., 2004; Burillo-Putzea et al.,2003; Staikowsky et al., 2004; Güloğlu and kara, 2004;Tufekci et al., 2004;Singh et al., 2004; Paudyal, 2005; Mcdowell et al., 2005; Güloğlu et al., 2005; ; Baydin et al, 2005; Singh and Unnikrishnan, 2006; Mert and Bilgin., 2006; van der Hoek and Konradsen 2006; Rafnsson et al., 2007; Wananukul et al 2007; Kristinsson et al., 2008; Lee et al., 2008). In contrast, the accidental poisoning is common in most Gulf States, North America and African countries (Ghaznawi et al, 1998; Mccaig et al., 1999; Hoppe-roberts et al., 2000; Tagwireyi et al, 2002; Akhtar et al, 2006; Tagwireyi et al, 2006; Bronstein et al., 2008; Malangu, 2008). In Zimbabwe, accidental poisoning (AP) and deliberate self-poisoning (DSP) made up similar proportions of hospital admissions (Tagwireyi et al, 2002). Another Zimbabwe data showed highest rate (almost two thirds) of accidental exposures (Tagwireyi et al, 2006). Accidental poisoning has been reported to be prevalent in South Africa (Malangu, 2008).

Mode of poisoning is more likely to be associated with type of toxic agent; demographic characteristics of patients such as age, gender, ethnicity, and religion; characteristics of area like urban/ rural; and the outcome of poisoning exposure (i.e. death or survival).

The most common agent used for intentional poisoning is differs from country to another. For example, in European countries, drugs such as paracetamol and antipsychotic are the most common agent whereas in the South East Asian countries it is pesticides (Hawton et al, 2000; Burillo-Putze et al. 2003; Dash, 2005; Unnikrishnan et al, 2005; Akbaba et al., 2007; Wananukul et al 2007). Chemicals and natural toxins too are commonly involved in accidental poisoning exposures (Tagwireyi et al., 2002). A household product such as kerosene is the most common

agent in accidental poisoning involving children (Paudyal, 2005; Akhtar, 2006; Malangu, 2008; Kohli et al, 2008).

In Turkey, self-poisoning is more apparent among singles than married persons (Güloğlu and kara, 2004; Güloğlu and kara, 2005). Another report from Turkey showed that intentional poisoning happens mostly in the homes (Tufekci et al., 2004). In Turkey too, Akbaba and associates found that suicide attempts by poisoning often result in death (Akbaba et al., 2007).

Intentional poisoning is documented as the least common among Muslims as Islam prohibits suicide and self-harm (Tsoi and Kok,, 1981; Hettiarachchi and Kodithuwakku, 1989; Fathelrahman et al, 2005). According to a study, suicide poisoning is more common among students from primary and high schools and less prevalent among university students (Shin et al, 2004). Van der Hoek and Konradsen (2005) found that the intentional poisoning incidences are higher among people with lesser education.

Intentional poisoning is also more common among the adolescents and the young adults aged 15 – 35 years old (Hanssens, 2001; Tagwireyi, 2002; Tufekci et al., 2004; Srivastava, 2005). Females are also more likely to be victims of intentional poisoning than male (Hanssens, 2001; Tagwireyi 2002; Güloğlu and kara, 2004; Tufekci et al., 2004; Malangu, 2008; Fathelrahman et al, 2008). However, some studies shows the equality between the two genders (Singh and Unnikrishnan, 2006; Shadnia et al.2007).

Accidental poisoning happens mostly among elderly people and children particularly who are aged less than 5 years (Mccaig et al., 1999; Tagwireyi, 2002; Paudyal, 2005; Akhtar et al., 2006; Tagwireyi et al, 2006; Wananukul et al 2007; Kristinsson et al, 2008; Assar et al, 2009).

The type of toxic agent involves influenced by availability, demographic characteristics of the poisoned victim, and presence of psychiatric history (Townsend et al, 2001, Fathelrahman et al, 2008).

### 1.6: Admission and mortality rate of poisoning

Poisoning exposures are significantly responsible for worldwide morbidity and mortality. Various factors contribute to the increase in the morbidity and mortality rates among poisoning cases such as type of poisoning substance, amount of toxic agent, availability of medical facilities and the latency time (Singh and Unnikrishnan, 2006). Poisoning-related admitted were more often recorded as urgent and patients normally require immediate attention (Mccaig and Burt, 1999).

According to a document on global pattern of injuries, poisoning cases represent 6% of all worldwide cases (Peden et al, 2002). In Spain a study revealed that poisoning accounted for 0.66% of all admission during the study period (Burillo-Putze et al., 2003). In Turkey, poisoning is responsible for around 1% to 2.4% of all admitted cases to accident and emergency departments (Tufekci et al., 2004; Akkose et al., 2005; Mert and Bilgin 2006; Akbaba et al. 2007).

In Malaysia, poisoning admissions to government healthcare institutions for the period of 1999-2001 was reportedly 21,714 cases (Rajasuriar et al, 2007). An Indian study reported that poisoning was responsible for 1% of the total hospital admission (Singh and Unnikrishnan, 2006). In Thailand, the average annual call to the Poison center was 6.0 per 100,000 populations (Wananukul et al., 2007). In Sri Lanka, Hoek (2006) found that the average incidence rate of acute poisoning was 318 per 100,000 (van der Hoek and Konradsen 2006).

In Iran, the annual incidence rate of poisoning was 3.9 per 1000 population (Balai-Mood 2004). In Oman poisoning was responsible for 18% of all admitted to the accident and emergency departments (Lall et al, 2003).

In Zimbabwe, poisoning accounted for 4.4 per 100 patients admitted to hospital and all poisoning cases were associated with complications (Tagwireyi, 2002).

Poisoning alone claims several hundred thousands of lives each year. The World Health Organization (WHO) Annual Report of 2000 stated that poisoning accounted for 315,000 fatalities worldwide, of which more than 94% were from low and middle-income countries. This number, however, represents only 2% of the total reported cases globally (Peden et al, 2002). In Southeast Asia alone, 2.2 deaths in every 100,000 people is caused by poisoning and accounts for one-quarter of all poisoning deaths worldwide (Peden et al, 2002).

A report from the United States revealed that death due to poisoning is ranked on the third place among all causes of deaths-induced injury (Fingerhut et al, 2008).

In Malaysia, fatality rate due to poisoning was 35.88 per 1,000 admissions (Rajasuriar et al, 2007). Poisoning cases in India accounted for annual mortality rate of 19.4/100000, which represented the highest rate of mortality of all admitted cases due to unnatural causes (Batra et al, 2003).

In Iran, the mortality rate due to poisoning exposures was 2.3 per 100000 of the population per year (Balai-Mood 2004). In another study from Iran, the mortality rate due to poisoning was reportedly 1.3% (Shadnia et al. 2007).

Table 1.1: Rate of poisoning admission worldwide

| Country | Admission Rate | Author | Year |
|---|---|---|---|
| Spain | 0.66% of A&D admission | Burillo-Putze et al. | 2003 |
| Iceland | 3.91 per 1000 population | Kristinsson et al | 2008 |
| Norway | 2 per 1000 of residence | Hovda et al. | 2007 |
| Turkey | 2.4% of hospital admission | Tufekci et al. | 2004 |
| | 0.97% of hospital admission | Mert and Bilgin | 2006 |
| | 1.57% of hospital admission per 5 year | Akkose et al. | 2005 |
| | 2.4% of hospital admission | Akbaba et al. | 2007 |
| | 0.7% of hospital admission | Goksu | 2002 |
| USA | 84 per 10000 A&D admission | McCaig and Burt | 1999 |
| Thailand | 6 per 100000 population poison center consultant | Wananukul et al., | 2007 |
| Nepal | 0.8% of hospital admission | Paudyal | 2005 |
| Sri Lanka | 318 per 100000 population | Van der Hoek and | 2006 |
| India | 68.12 per 100000 population | Batra et al | 2003 |
| | 1% of hospital admission | Singh and Unnikrishnan | 2006 |
| Malaysia | 0.2% of hospital admission per 9 year | AB Rahman | 2002 |
| | Indian 75.2 per 100000 Chinese 20.5 per 100000 | Fathelrahman et al | 2005 |
| Hong Kong | 113.5 per 100000 population | Chan | 1997 |
| Singapore | 1.7 per 1000 population | Ponampalam et al | 2009 |
| Taiwan | 4.2/1000 per A&D admission | Lee et al | 2008 |
| Iran | 3.9 per 1000 population | Balai-Mood | 2004 |
| Oman | 1.8 per 1000 per hospital | hanssens, et al. | 2001 |

### 1.7: Common poisoning agents

Poisoning varies in kind from region to region and from country to country. Pharmaceutical preparations are predominant in Europe, North America, Middle East and the most of the Western Pacific countries (Mccaig and Burt, 1999; Hanssens et al, 2001; Güloğlu and kara, 2004; Tufekci et al, 2004; Kotwica and Czerczak, 2007). The most common ingested agent is paracetamol, followed by sedatives and hypnotics and antidepressants mainly diazepam (Kelly et al, 2000; Hanssens, 2001; Tufekci et al, 2004; Srivastava, 2005; van der Hoek and Konradsen 2006). Pesticide poisoning is prevalent in Africa, South East Asia and some of the Western Pacific countries (van der Hoek and Konradsen 2006; Singh and Unnikrishnan, 2006; Wananukul et al 2007; Malangu*, 2008; Ramesha et al, 2009). The most common ingested agents in pesticide poisoning involves organophosphate, paraquat and carbamates (Tufekci et al, 2004; van der Hoek and Konradsen, 2005; van der Hoek and Konradsen 2006; Malangu*, 2008). Household product is predominant in childhood poisoning especially those aged less than 5 years old (Malangu, 2005). Kerosene and Clorox (bleaching agent) being the most common agents involved (Tagwireyi, 2002; van der Hoek and Konradsen 2006; Tagwireyi, 2006*; Assar et al, 2009). In Bangladesh, it has been revealed that kerosene was the most common toxic agent (Rashid et al., 2007). The natural poisoning, particularly snake bites, happens mostly in the Arabian Peninsula and Thailand. Although snakes are abundant in Australia, Malaysia and other countries, studies found that they were surprisingly not the most common cause of poisoning. In Thailand, however, snake bites especially neurotoxin type is the most common cause of poisoning (Wananukul et al., 2007).

A study conducted across Malaysia showed that the major poisoning admissions were due to drug mainly non-opioid analgesics, anti-pyretic and anti-

rheumatics (Rajasuriar et al., 2007). Among children, poisoning was most commonly caused by chemicals. In northern Malaysia, most poisoning incidents are linked to drugs (paracetamol & benzodiazepines) accounts for 62%; household products (e.g. Clorox) 26% and pesticides (Fathelrahman et al, 2005). A study conducted in the eastern part of Malaysia revealed that medicinal substances, pesticides and household were very common (AB Rahman, 2002). The most commonly ingested medical substances were paracetamol and salicylates. Poisoning involving children aged 13 and below was most frequently related to ingestion of kerosene. Insecticides, herbicides and rodenticides were also frequent causes of poisoning.

**1.8: The most common fatal toxic agent**

Some substances are highly toxic and can cause significant morbidities and mortalities. The patterns of these substances differ from country to another.

A review of European studies found that the most common toxic agents involved in deaths are pharmaceuticals. In Nordic countries, most poisoning deaths were due to drugs and medications (Andrew et al.2008). However, the sub groups of these are different from country to country (Andrew et al.2008). In Finland, alcohol is responsible for two-thirds of all fatal intoxications accounting for a death rate of 6.5 per 100,000 inhabitants. In Norway, narcotics showed the highest death rate representing 49% of all poisoning deaths. In the UK the most common drugs resulting in fatal overdoses are paracetamol, benzodiazepine and tricyclic antidepressants (Gunnell and Murray, 2004). ). In Iran however the most common causes of death were opioids (Shadnia et al. 2007).

A Turkish study done by Akbaba and associates however showed that pesticide contributed to high fatality than drugs (Akbaba et al., 2007).

In Sri Lanka, deaths from pesticide poisoning are also much higher than those caused by pharmaceutical products and other substances. (van der Hoek and Konradsen 2006). In Thailand, pesticide also contributed for the greater majority of poisoning fatalities **(**Wananukul et al.2007). In South East Asia, organophosphate is largely responsible for most poisoning-related deaths linked to pesticide (Singh and Unnikrishnan, 2006; van der Hoek and Konradsen 2006; Wananukul et al.2007). Chemical poisoning, mainly pesticide, is also the major cause of death in Malaysia (Rajasuriar et al, 2007). In India, organophosphates contributed largely to poisoning deaths (Singh and Unnikrishnan, 2006).

Table 1.2: The most commonly ingested pharmaceutical preparations worldwide

| Europe , USA and Medal East | Common Toxic agent (items) | Author | Year |
|---|---|---|---|
| UK | Pharmaceuticals (Paracetamol, BDZ) | Rafnsson | 2007 |
| Spin | Pharmaceuticals (BDZ, Alcohol) | Staikowsky et al. | 2004 |
| Norway | Pharmaceuticals (Paracetamol,BDZ,opioid, | Hovda et al. | 2007 |
| Finland | Pharmaceuticals (Alcohol) | Lapatto-Reiniluoto | 1998 |
| Iceland | Pharmaceuticals (no particular item) | Kristinsson | 2008 |
| Turkey | Pharmaceuticals (Psychotropic's, analgesic) | Mert and Bilgin | 2006 |
| | Pharmaceuticals (Analgesic especially | Goksu et al. | 2002 |
| | Pharmaceuticals (Psychotropic's) | Satar and Seydaoglu | 2005 |
| | Pharmaceuticals (Antidepressant ) | Tufekci et al. | 2004 |
| USA | Pharmaceuticals (no particular item) | McCaig and Burt | 1999 |
| Oman | Pharmaceuticals (Analgesic) | Hanssens, et al. | 2001 |
| | Pharmaceuticals (Analgesic) | Lall et al. | 2003 |
| Iran | Pharmaceuticals (Sedative-hypnotic ) | Balai-Mood | 2004 |
| | Pharmaceuticals (Sedative-hypnotic, Psychotropic's and analgesic) | Shadnia1 | 2007 |

Table 1.3: The most commonly ingested pesticide worldwide

| South East and African countries | Common Toxic agent (items) | Author | Year |
|---|---|---|---|
| India | Pesticide (Organophosphates) | Singh | 2005 |
| | Pesticide (Organophosphates) | Batra | 2003 |
| | Insecticide (Organophosphates) | Kiran | 2008 |
| | Pesticide (Organophosphates) | Singh, Unnikrishnan | 2006 |
| | Organophosphates | Ramesha et al | 2009 |
| Thailand | Natural (Neurotoxin snakes) | Wananukul et al. | 2007 |
| Sri Lanka | Pesticide (Organophosphates) | Van der Hoek and Konradsen | 2006 |
| Nepal | Pesticide (Organophosphates) | Paudyal | 2005 |
| Bangladesh | Household (Kerosene) | Rashid et al. | 2007 |
| South Africa | Pesticide (Organophosphates) | Malangu | 2008 |
| Zimbabwe | Pesticide (Organophosphates) | Tagwireyi | 2006 |

## 1.9: Hospitals' preparedness for the management of acute poisoning cases in accident and emergency departments

The accident and emergency departments of public hospitals are the department that receives urgent and critical acute injuries (Hladki et al, 2007; Doupe et al, 2008). However, occasionally, this department also receives mild cases of various clinical conditions. This increases the workload at the department and makes it always busy (lane et al, 2000; Derlet, 2002; Knapp et al, 2004; Doupe et al, 2008). As intended in any treatment, a patient's life can be saved if the patient is diagnosed properly and receives the appropriate treatment according to clinical guidelines at a reasonable time (i.e. treatment of patients diagnosed with paracetamol with the antidote N-acetylcystine within 8 hours) (Juckett and Hancox, 2002; Zimmerman, 2003; Gold et al, 2004; Daly et al, 2006; Betten et al, 2006; Singh and Unnikrishnan, 2006; Daly et al, 2008).

In poisoning cases, a wrong treatment (procedure) could lead to more harm and may complicate the situation further (e.g. inducing vomiting with emetic substance for patients poisoned by hydrocarbons could cause aspiration pneumonitis or providing oxygen to patients with paraquat intoxication could cause hasten and worsen pulmonary fibrosis) (Newstead, 1996; Worthley, 2002; Krenzelok, 2002; Singh and Unnikrishnan, 2006). Also, if a poisoning case receives an appropriate treatment but significantly late, the treatment would be ineffective as well (e.g. performing gastric lavage or providing single dose activated charcoal for patients after two hours) (Mokhlesi et al, 2003). To be able to provide effective management, healthcare personnel need to be knowledgeable and sufficiently trained.

Treatment of poisoning cases at the accident and emergency department begins with stabilizing the patient and protecting the vital signs starting by ABC [airway, breathing and circulation (Schonwald and Schonwald, 2001; Greene et al, 2005; Daly et al, 2006; Erickson et al, 2007; Leikin and Paloucek, 2008)]. This is followed by a decontamination procedure whereby any agent that causes or enhances the incidence of toxicity is removed using special techniques. For some patients providing specific treatment like an antidote or life-saving drug may be required (Schonwald and Schonwald, 2001; Betten et al, 2006; Leikin and Paloucek, 2008).

### 1.10: General management steps

#### 1.10.1: Stabilization

This refers to the resuscitation and stabilization of the patient by paying attention to attaining a conscious state, maintenance of an open airway, adequate ventilation and oxygenation (with exception of oxygen use in paraquat poisoning) and ensuring adequacy of the hemodynamic state (Schonwald and Schonwald, 2001;

Leikin and Paloucek, 2008; Boyle et al, 2009). This may sometimes require the use of specific antidotes in the very initial stages of management.

The vital signs of any patient admitted to the accident and emergency department with acute poisoning should be checked and protected (Larsen and Cummings, 1998; Schonwald and Schonwald, 2001; Erickson et al, 2007). Stabilization is initiated by checking the ABC (airway, breathing, circulation) (Larsen and Cummings, 1998; Daly et al, 2006). Airway must be checked to look for the presence of any foreign body that may block the airway passage. If found, the foreign body such as vomitus, food, tongue flaccid or broken dentures, laryngeal edema due to ingestion of a caustic acid or alkaline chemical substance must be removed (Olson et al, 1999; Schonwald and Schonwald, 2001; Kovacs and Law, 2008). Patients may be in two situations: conscious or unconscious. If patient is unconscious and there is no gage and cough reflex, then special techniques that are life-saving will be needed and must be made available and applied (Greene et al, 2005; Kovacs and Law, 2008). Examples of those special techniques involved include oro-pharyngeal or naso-pharyngeal airway with regular suctioning to remove any foreign bodies, endotracheal or nasotracheal intubation to enhance the movement of oxygen coming inside (Blanda and Gallo, 2003; Greene et al, 2005). The patient must also be positioned in a suitable position to optimize airway passage (Olson et al, 1999; Nolan et al, 2005; Kovacs and Law, 2008). In this situation, some useful techniques such as the head-tilt, chin-lift technique or the classical jaw thrust (Olson et al, 1999; Nolan et al, 2005; Kovacs and Law, 2008). In some cases, surgical intervention may be required to solve the problem (Schonwald and Schonwald, 2001; Blanda and Gallo, 2003; Kovacs and Law, 2008).

The next step of stabilization is breathing assessment and protection and failure to accurately do this is the second major cause of morbidity and mortality after acute poisonings. Treatment at this stage is not only to keep the patient breathing but also to correct the breathing movement if the patient has hyper or hypo ventilation due to many complications such as hypoxia, bronchospasm and respiratory arrest (Olson et al, 1999). In such situation, a patient may require provision of 100% oxygen. Mechanical ventilator is required to control and to adjust the amount of the provided oxygen. Assisting breathing manually with a bag-valve-mask device or bag-valve endotracheal- tube device could be done until the mechanical ventilator is ready for use.

The third step of stabilization is circulation assessment and protection. This step is not less important than airway and breathing and the failure to do so is also life-threatening. Many complications can affect blood circulation starting with any agent that may affect the heart such as a cardiotoxic agent (e.g. digoxin) that cause brady/tachycardia, arrhythmias or cardiac arrest; any toxic agent that can affect the arteries or veins by vasodilatation or vasoconstriction and blood loss (e.g. snake envenomation) (Gold et al, 2004; Greene et al, 2005). Circulation assessment requires checking the heart rate, blood pressure, and using ECG to monitor cardiac function (Olson et al, 1999; Greene et al, 2005; Vale and Bradberry, 2007). In most cases, treatment includes the provision of volume expander (e.g. crystalloids, colloids) (Olson et al, 1999; Greene et al, 2005).

CNS complication that affects the mental condition can cause undesirable outcome that is serious like seizure, coma and stupor and this may result from other complication like hypoxia, liver or renal damage severe hypotension, shock, and decrease in the oxygen concentration (Olson et al, 1999; Brubacher, 1999). Any

alteration in the respiratory system such as a reduction in the amount of oxygen entering the lungs may alter the mental status (Olson et al, 1999; Boyle et al, 2009). Additionally, any variation in body temperature (increase or decrease) can affect the mental status (Olson et al, 1999). Some lifesaving drugs work by solving CNS-related problems particularly coma. For example coma cocktail (i.e. dextrose, thiamine, and nalaxone) is commonly used to treat comatose patients (Olson et al, 1999; Schonwald and Schonwald, 2001; Mokhlesi et al, 2003; Bartlett, 2004; Diaz, 2006; Erickson et al, 2007; Hoffman et al, 2007). Anticonvulsant drugs are used for seizure and oxygen therapy is used in hypoxia (Schonwald and Schonwald, 2001; Erickson et al, 2007; Hoffman et al, 2007). To evaluate the consciousness of a poisoned patient, blood pressure; body temperature; breathing; renal function and few blood test like glucose, electrolytes, arterial blood gases should be assessed (Greene et al, 2005). EEG is used to check brain seizure activity (American College of Emergency Physicians, 2004).

The monitoring and investigation of cases with acute poisoning play essential role in detecting and confirming the type, the harmful effect of poisoning, to check the vital signs and to inform if victim needs further treatment (Larsen and Cummings, 1998; Watson, 2002). Radiological investigations are used to confirm some complication. For example x-ray is used to detect the aspiration, ingested drug packets, radiopaque poisoning and fibrosis due to paraquat (Im et al. 1991; Larsen and Cummings, 1998; Haywood and Karalliedde, 2000; Vale and Bradberry, 2007; Coulson and Thompson, 2008). Also CT scan is useful to detect fibrosis due to paraquat poisoning (Im et al. 1991).MRI is used to detect brain-related complications after poisoning (O'Donnell, 2000). Laboratory tests can also be used for monitoring and investigation (Watson, 2002). For example blood glucose test is used to measure

the hypoglycemic effect due to some toxic agent like salicylate and insulin, hematocrit is used to detect the bleeding and liver function test is used for detecting the abnormality of liver function (Flanagan, 2003). Moreover, some instruments are essential for monitoring and investigations of poisoning cases like pulse oximeter for measuring oxygen saturation and ECG for abnormality of heart (Brubacher, 1999; Wyatt, 2006; Vale and Bradberry, 2007).

### 1.10.2: Decreasing the concentration of the toxic substance

After stabilizing the patient's condition, the next vital step is to decrease the concentration of the toxic substance by decreasing the absorption or increasing the elimination (Walton, 1997; Aggarwal et al., 2000; Hoffman et al, 2007) (figure 1.1).

The absorption of the toxic agent is reduced through various decontamination techniques (Walton, 1997; Olson et al, 1999; Schonwald and Schonwald, 2001; Diaz, 2006; Erickson et al, 2007; Hoffman et al, 2007). This may be performed externally (surface) by removing a toxic substance from the skin, eye or lung of the patient or internally through gut/ gastric decontamination (Olson et al, 1999). There are several techniques that could be used for gastric decontamination such as the use of gastric lavage, single dose activated charcoal, cathartics, emetics, and whole bowel irrigation (Walton, 1997; Olson et al, 1999; Mokhlesi et al, 2003; Hoffman et al, 2007). Increasing the elimination of a toxic agent could be done through the use of multiple dose activated charcoals, diuretics, peritoneal dialysis, haemodialysis and haemoperfusion (Olson et al, 1999; Vale, 2003; Daly et al., 2006; Jones, 2006; vale, 2007).

Each of these methods requires certain conditions to achieve optimum result and has its own advantages and disadvantages (Olson et al, 1999; Vale, 2003; Greene

et al, 2005; vale, 2007). The selection of a particular technique to treat a poisoning case depends on the nature of poisoning, route of exposure, quantity of the toxic compound, severity of poisoning and the time gap between the exposure and presentation at the emergency room (Olson et al, 1999; Pietrzak et al, 1999; Zimmerman, 2003).

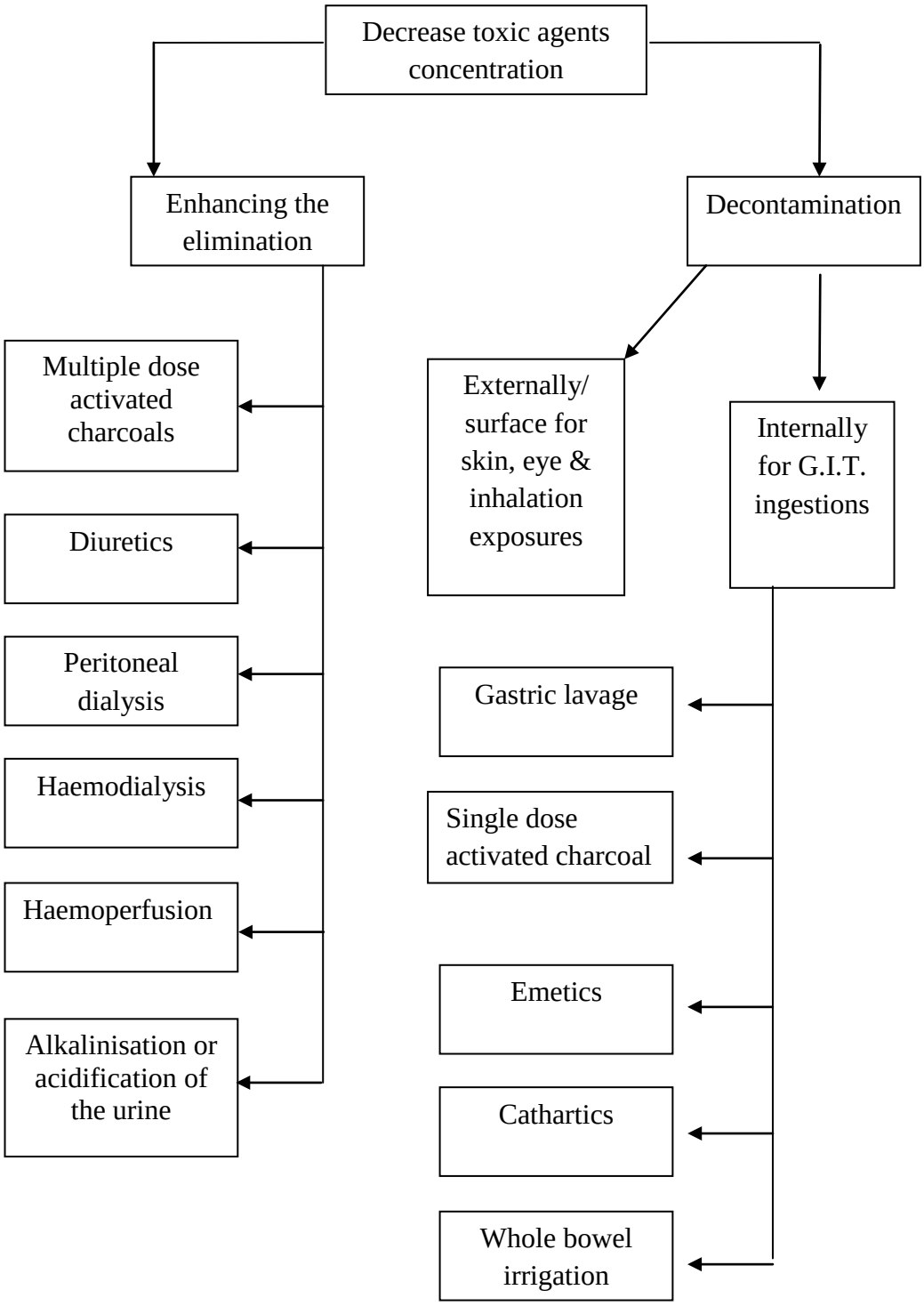


Figure 1.1: Various techniques used to decrease the concentration of the toxic substances

### 1.10.2.a: Decreasing the absorption of toxic substances

Gastric lavage

Gastric lavage is the most common technique used in the emergency departments to decrease the absorption of toxic substances (Olson et al, 1999; Lall et al, 2003; Tufekci et al., 2004; Jones, 2006; Ponampalam et al., 2009). Gastric lavage is performed by enforcing fluids like water or normal saline into the stomach using nasogastric or orogastric tube, washing the stomach contents and removing the fluid mixed with ingested substances passively by the force of gravity or actively by suction (Olson et al, 1999; Hackett, 2000; Worthley, 2002; Mokhlesi et al, 2003; Erickson et al, 2007). However, due to some limitations and the lack of evidence on its significant impact on final clinical outcomes clinical guidelines now recommend optimizing its use (Simpson and schuman, 2002; Greene et al, 2005; Mégarbane et al, 2006; Erickson et al, 2007; Leikin and Paloucek, 2008). Maximum effect can be attained if used early enough after poisoning has taken place, ideally within the first hour (Schonwald and Schonwald, 2001; Simpson et al, 2002; Greene et al, 2005; Heard, 2006; Erickson et al, 2007; Hoffman et al, 2007).

Activated charcoal

Activated charcoal is the second most common technique to decrease the absorption of toxic substances (Olson et al, 1999; Tufekci et al., 2004; Dines et al, 2007; Ponampalam et al., 2009). Activated charcoal given orally is very effective if used in the first hour of poisoning for a toxic substance that is adsorbed to its surface (Simpson et al, 2002; Mokhlesi et al, 2003; Greene et al, 2005; Heard, 2006; Mégarbane et al, 2006). Nevertheless, it can be used within two hours from the exposure in such poisoning like paracetamol (Dines et al, 2007). Certain substances

like charcoal, alcohol, metals and petroleum distillates are not well adsorbed by activated charcoal (Olson et al, 1999; Schonwald and Schonwald, 2001; Greene et al, 2005; Heard, 2006).

Whole bowel irrigation

Whole bowel irrigation can effectively decrease the absorption of poisoning substance (Greene et al, 2005; Olson et al, 1999). It is very useful to decrease the absorption of bulky substances and sustained released formulations (Krenzelok, 2002; Mokhlesi et al, 2003; Greene et al, 2005; Erickson et al, 2007; Hoffman et al, 2007; Dines et al, 2007; Coulson and Thompson, 2008). Whole bowel irrigation is performed using isotonic solution of poly ethylene glycol (Schonwald and Schonwald, 2001; Krenzelok, 2002; Mokhlesi et al, 2003; Greene et al, 2005; Hoffman et al, 2007).

Using emetics to induce vomiting

This method must be used with precautions because some poisoning is contraindicated to its use like hydrocarbon compound which can cause pneumonia if any amount of it enters inside the respiratory tract (aspiration) (Simpson et al, 2002; Mokhlesi et al, 2003). If the patient is unconsciousness vomiting can also induce pneumonia or close the air passages (Mokhlesi et al, 2003). Many documents reported that the disadvantages of using this technique are more than its merits (Heard, 2006; Greene et al, 2005; Erickson et al, 2007; Hoffman et al, 2007). In the US, syrup ipecac is commonly used in homes to induce vomiting after poisoning exposures. However, recent practices do not encourage its use (Greene et al, 2005). A classical technique to induce vomiting is pharyngeal stimulation.

Cathartics (purgatives)

Cathartics are not commonly practiced in hospital settings in poisoning treatment (Schonwald and Schonwald, 2001; Hoffman et al, 2007). However, they had been used classically to decrease the absorption of poisoning substance by inducing fast passage of gut contents through the rectum (Olson et al, 1999; Mokhlesi et al, 2003). Classic purgatives included sorbitol, magnesium citrate and magnesium sulphate. Cathartics are sometimes used with activated charcoals to reduce the risk of GIT obstruction and to decrease the absorption of some toxic agents such as salicylates (Krenzelok, 2002; Simpson et al, 2002; Mokhlesi et al, 2003; Greene et al, 2005; Erickson et al, 2007).

American Academy of Clinical Toxicology (AATC) and the European Association of Poisons Centers and Clinical Toxicologists (EAPCCT) issued Position Statement that says: "*Cathartic alone has no place in management of poisoned patient. No definite indication for use of cathartics and its routine use with activated charcoal is not endorsed. If it is used, it should be as a single dose*" (Simpson et al, 2002).

**1.10.2.b: Increasing the elimination of toxic substances:**

Multiple dose of activated charcoal

Multiple doses of activated charcoal are beneficial to decrease the amount of certain poisoning agents even several hours later after poisoning has taken place (Krenzelok, 2002). It works by interrupting enterohepatic or enteroenteric recirculation of the toxic substance (Olson et al, 1999; Krenzelok, 2002; Vale, 2003; Erickson et al, 2007; Hoffman et al, 2007).

Haemodialysis

In this technique, blood is pumped through a machine where toxic substances are separated from it by flowing passively passing a semipermeable membrane (Olson et al, 1999; De Pont, 2007). Haemodialysis is suitable for drugs with small size molecules; those are water soluble, those having low protein binding and low volume of distribution (Mokhlesi et al, 2003; Diaz, 2006; Erickson et al, 2007; De Pont, 2007). Haemodialysis is used as treatment of choice in severe poisoning in certain toxic agent like salicylate and alcohol (Vale, 2003; Jones, 2006; vale, 2007).

Haemoperfusion

This procedure is similar to haemodialysis in that blood is pumped outside the human body but through a column containing an adsorbent material such as charcoal or Amberlite resin (Olson et al, 1999; Mokhlesi et al, 2003; Vale, 2003; De Pont, 2007). This technique is less efficient than haemodialysis (vale, 2007).

Haemofiltration

Haemofiltration removes drug and toxin by transporting solutes through a highly porous membrane (Zimmerman, 2003; De Pont, 2007). Haemofiltration is suitable for substances with a large volume of distribution, slow intercompartmental transfer, or extensive tissue binding (Mokhlesi et al, 2003).

Peritoneal dialysis

This technique separates toxic substances from blood without pumping blood externally from human body. Using transscutaneous catheter, a dialysate fluid is infused inside peritoneal lumen and drained off (Olson et al, 1999; Shiel and