THE PRACTICE OF PARENTERAL NUTRITION IN MALAYSIAN HOSPITALS

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THE PRACTICE OF PARENTERAL NUTRITION IN MALAYSIAN HOSPITALS

by

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LIST OF ABBREVATIONS

The abbreviation	The Title
APTT	Activated partial thromboplastin time
A	Adult
ALB	Albumin
A/G	Albumin/globulin ratio
AA	Amino acids
ALT	Amino alanine transferase
ANOVA	Analysia of variance
ADU	Aseptic dispensing unit
AST	Aspartate amino transferase
ALP	Aspartate aminoransferase
BE	Base excess
HCO_3	Bicarbonate
BUN	Blood urea nitogen test
BW	Body wieght
£	British pound
Ca^{2+}	Calicium
CRB	Catheter related bacteremia
CRBSI	Catheter related blood stream infection
CVC	Centeral venous catheter
CPN	Central parenteral nutrition
Cl	Chloride
OTC	Drugs prescribed without physcicians
NEC	Enterocolitis
ECF	Extracellular fluid
GLB	Globulin
g/l	Gram/liter
Hb	Hemoglobin
HCB	Hospital compounded bags
HPN	Hospital parenteral nutrition
HUSM	Hospital Universiti Sains Malaysia
HUKM	Hospital University Kebangsaan Malaysia
INR	International normalized ratio
IFALD	Intestinal failure associated liver disease
ICF	Intracellular fluid
LFT	Liver function test
LCT	Long chain triglyceride
LBW	Low birth wieght
Mg^{2+}	Magnisium
MCT	Medium chian triglyceride
*u*mol/l	Micromol/liter
MMol/d	Milli mol/day

Ml	Milliliter
NG	Naso gastric
N	Neonate
NPCTON	Non protein calories to nitrogen
NBM	Nothing by mouth
NST	Nutrition support team
O_2 Sat.	Ogygen saturation
PN	Parenteral nutrition
PDA	Patent ductus arteriolus
P	Pediatric
pH	Hydrogen ion concentration
PICU	Pediatric intensive care unit
% O_2 Sat	Percent oxygen saturation
PCO_2 kPa	Peripheral arterial carbon dioxide content
PO_2 kPa	Peripheral arterial oxygen content
PICC	Peripheral intravenous catheter
PPN	Peripheral parenteral nutrition
PO_4^{3-}	Phosphate
Plt	Platelet
K^+	Potassium
Prem	Premature
PT	Prothrombin time
PPH	Pulau Pinang Hospital
RBS	Random blood sugar
RM	Ringgit Malaysian
SB	Separate bottles
Scr	Serium creatinine
Na^+	Sodium
SVC	Superior vena cava
TCB	Three compartment bags
TB	Total bilirubin
TBW	Total body water
TCO_2	Total carbon dioxide
TPN	Total parenteral nutrition
TP	Total protein
U/L	Unit/liter
USD	United state dollar
UMMC	University Malaya Medical Centre
WBC	White blood cells
Wt	Wieght

(The Clinican's Ultimate Reference)

PRAKTIS NUTRISI PARENTERAL DI HOSPITAL DI MALAYSIA

ABSTRAK

Nutrisi Parenteral (PN) telah diamalkan di Malaysia semenjak tahun 1986. Satu tinjauan terdiri daripada 41 soalan tentang perkhidmatan PN telah dijalankan untuk menilai amalan nutrisi parenteral di hospital di Malaysia. Keputusan daripada tinjauan itu menunjukkan perkhidmatan nutrisi parenteral diamalkan di sebanyak 17.3% hospital-hospital di Malaysia, 55.6% diamalkan di hospital tertier manakala 44.6% diamalkan di hospital sekunder. Purata bilangan sediaan nutrisi parenteral adalah sebanyak 10±11 sehari di hospital tertier dan 4±2 bagi hospital sekunder. Produk nutrisi parenteral disediakan oleh pegawai farmasi di 88.9% hospital manakala pembantu farmasi di 66.7% hospital. Pasukan bantuan nutrisi (NST) boleh didapati di 33.3% hospital manakala 88.9% mempunyai ahli farmasi yang bergiat didalam penyediaan sediaan PN dan 66.7% meggunakan borang piawai memantau pesakit.

Bahagian ke dua dari kajian ini merupakan kajian retrospektif terhadap dapatan, komplikasi, dan kos terhadap perkhidmatan PN. Kajian dijalankan di 4 hospital pendidikan, ia itu Hospital Pulau Pinang (PPH), Hospital Universiti Sains Malaysia (HUSM), Hospital Universiti Kebangsaan Malaysia (HUKM), dan Pusat Perubatan Universiti Malaya (UMMC). Sejumlah 890 kes PN dari tahun 2003 hingga 2005 dinilai. Dapatannya termasuk toleransi terhadap pemberian oral sebanyak 90.7%, 98.7%, 50.3%, dan 22% kes serta kematian sebanyak 5.7%, 1.3%, 7.2%, dan 15% kes. Diantara komplikasinya ialah sepsis sebanyak 6.7%, 0.7%, 0%, dan 0% kes, metabolik (asid base

tidak seimbang) sebanyak 6.7%, 6.2%, 0% dan 0.8% kes, komplikasi buah pinggang sebanyak 22.5%, 14.4%, 44.4%, dan 11.6% kes, komplikasi hati sebanyak 33.7%, 12.3%, 0%, dan 5.8% kes, elektrolit tidak seimbang sebanyak 27%, 56.2%, 55.6%, dan 81.8% kes masing-masing di PPH, HUSM, HUKM, dan UMMC. Komplikasi mekanikal hanya berlaku sebanyak 3.4% di PPH dan 0.5% di HUSM. Laluan administrasi adalah laluan sentral sebanyak 31.7%, 69.2%, 50.9%, 57.2% kes dan laluan periferi sebanyak 68.3%, 30.8%, 49.1%, dan 42.8% bagi semua kes di PPH, HUSM, HUKM, dan UMMC. Kos per hari bagi prematang kes adalah sebanyak (RM) 181±41, 99±46, 189±86 dan 73±16 manakala bagi kanak-kanak adalah sebanyak 223±126, 210±121, 242±109, dan 147±91, bagi dewasa adalah sebanyak 236±45, 398±103, 840±229, dan 406±112 di PPH, HUSM, HUKM, dan UMMC dimana perbezaan ketara adalah sebanyak (P=0.001). Kajian menunjukkan perkhidmatan PN ditawarkan terutamanya oleh hospital tertier dan sekunder. Kajian juga menyimpulkan kadar penglibatan pegawai farmasi dalam penyediaan PN adalah berbeza antara hospital. Kajian juga mendapati kadar komplikasi yang tinggi mungkin disebabkan oleh penggunaan sistem secara persendirian berbanding sistem piawai. Kos nutrisi parenteral juga meningkat seiring dengan peningkatan umur pesakit dan perbezaannya adalah ketara. Perbezaannya mungkin disebabkan peningkatan keperluan terhadap nutrisi terhadap umur.

Kata kunci : Nutrisi Parenteral, Praktis, Kos, Hasil, Komplikasi, Malaysia

THE PRACTICE OF PARENTERAL NUTRITION IN MALAYSIAN HOSPITALS

ABSTRACT

Parenteral Nutrition (PN) has been practiced in Malaysian hospitals, since 1986. A survey compised of 41 questions on PN practice was developed to evaluate the practice of PN in Malaysian hospitals. The results show that PN services is practiced in 17.3% of Malaysian hospitals. 55.6% were practiced in tertiary hopitals and 44.6% were practiced in secondary hospital. The average number of PN preparations per day was 10± 11 in tertiary hospital and 4 ± 2 in secondary hospitals. PN solution were prepared by pharmacist in 88.9% of hospitals and by Pharmacist assisstants in 66.7% of hospitals. Nutritional support team (NST) existed in 33.3% hospitals while 88.9% have pharmacists participating in PN compounding and 66.7% used standard Patient Monitoring Forms.

The second part of the study was a retrospective study on the outcome, complications and cost of PN services. The study was carried out at 4 teaching hospitals namely, Hospital Pulau Pinang (PPH), Hospital Universiti Sains Malaysia (HUSM), Hospital University Kebangsaan Malaysia (HUKM) and University Malaya Medical Centre (UMMC). A total of 890 PN cases from the years 2003 to 2005 were evaluated. The outcome included tolerating feeding 90.7%, 98.7%, 50.3% and 22%, Death 5.7%, 1.3%, 7.2% and 15%. Among the complication were sepsis 6.7%, 0.7%, 0% and 0%, metabolic (acid -base) 6.7% ,6.2%, 0% and .8%, renal complication were 22.5%, 14.4%, 44.4% and 11.6%, liver complication 33.7%, 12.3%, 0% and 5.8%, electrolyte

imbalances 27%, 56.2%, 55.6%, 81.8% PPH, HUSM, HUKM and UMMC respectively. Mechanical complication only occurred 3.4% in PPH and 0.5% in HUSM. The cost per day for premature cases was (RM) 181±41, 99±46, 189±86 and 73±16 while for pediatrics 233±126, 210±121, 242±109 and 147±91, for adults 236±45, 398±103, 840±229 and 406±112 at PPH, HUSM, HUKM and UMMC and the differences were significant (P=.001). The study concluded that the PN services were offered mainly by tertiary and secondary hospitals. The study also concluded that the the extend of pharmacist involvement in PN varies from hospital to another, the study also found that the high rate of complication could be due to the use of individualization system rather than the use of standard system. The cost of PN also increased with a patient's age and the differences were significant. The differences could be due to increasing nutritional requirements with age.

Keywords: Parenteral Nutrition, Practice, Cost, Outcome, Complication, Malaysia

Part 1 SURVEY OF TOTAL PARENTERAL NUTRITION PRACTICE IN MALAYSIAN HOSPITALS

1.1 INTRODUCTION AND LITERATURE REVIEW

1.1.1 Background

The history of intravenous infusion of fluids can be traced back to the sixteenth century. However, Dudrick and colleagues introduced the infusion of modern nutrients only 35 years ago when he successfully administered long-term PN to an infant. Since then parenteral nutrition has become an important adjunctive therapy in the management of patients unable to utilize the gastrointestinal tract (Dudrick *et.al.* 1969).

Parenteral nutrition formulation is a complex admixture of standard solutions containing nutrients. There are more than 40 different components including both macronutrients (carbohydrates, lipids, amino acids) and micronutrients (electrolytes, trace minerals and vitamins). These nutrients are mixed into a bag and infused simultaneously into the blood circulation through the peripheral or central vein. Parenteral nutrition may be partial in nature i.e. one that provids supplementary nutrients to that provide orally or enterally, or total (TPN, total parenteral nutrition or hyperalimentation) i.e. one that provides total energy and nutrient intakes for patients, (Maisonneuve *et.al* 2004). Parenteral nutrition is usually infused over 24 hours at a rate of 25 to 50 mL/h (Koss 2003).

Since parenteral nutrition involves a complex process, its provision usually involves a multidisciplinary team (Nutritional support teams, NST) consisting of doctors, nurses, nutritionists, pharmacists and other related health care providers. The nutrition support team evaluates the patient's metabolic needs, prescribes appropriate nutritional support, prepares nutritional admixture, administers the parenteral nutrition and monitors the patient (Harbans 1994) and (Ramanujam 1994). Generally serum levels of electrolytes should be checked daily, glucose levels must be checked at least three times per day to achieve euglycemia while calcium, magnesium and phosphorus should be cheked weekly. Parenteral nutrition improves wound healing, enhances immune system function, improves gastrointestinal structure and function and improves clinical outcomes through a reduction in complication rates and length of stay with accompanying cost savings (Shikora 2001).

Prior to early eighties, parenteral nutrition in Malaysia was provided conventially. Multiple nutritional solutions were hung over the patient's bed and administered by a multiple intravenous line. The indication for PN is mainly fluid therapy rather than as nutritional supplement (Bahari 1993). Parenteral nutrition in Malaysia was first started at the Kuantan General Hospital in 1986, followed by the Penang Hospital, Kuala Lumpur Hospital and Universiti Sains Malaysia Hospital (Bahari 1994), (Shamsuddin *et.al* 1994) and (Bahari *et.al* 1996).

The School of Pharmaceutical Sciences, Universiti Sains Malaysia being the only School of Pharmacy in Malaysia at that time contributed tremendously to the development of the parenteral nutrition programme. For instance, in 1985, the School

introduced a PN programme as a part of its final year curriculum, which was expanded to include a practice session in compounding PN in 1986 (Bahari, 1993). Table 1.1.1 shows total number of government hospitals providing PN Services (Bahari, 1993)

Table 1.1.1: Total number of government hospitals providing TPN Services

Year	Number of hospital initiating PN services	Cumulative no
1986	1	1
1987	3	4
1988	6	10
1989	4	14
1990	4	18

Adapted from MB Bahari 1993 with permission.

1.1.2 Practices of PN

Since it was introduced by Dudrick and his colleague parenteral nutritional therapy has been accepted as a mode of therapy in many medical areas such as surgery, pediatrics, gastroenterology and others (Dudrick *et.al* 1969). In fact standard PN guidelines have been developed to assist practitioners through out the world (A.S.P.E.N 1996) (Guideline on Pediatric, 2005) and (Pennington 1996). Studies on the effect of PN support showed that appropriate nutritional intervention has been shown to improve clinical outcomes and shorten length of stay as well as patients quality of life beside financial savings (Imad 2002) and (Bozzetti 2001). However, there is still a need to promote optimal nutrition care as a core component of patient management (Ravasco *et.al.* 2004) and (Guglielmi *et.al* 2003).

The role of pharmacists in the provision of PN services in Malaysian hospitals prior to 1986 has been very minimal. In fact, their main role was limited to the procurement and distribution of the nutritional solutions. In 1986 PN services were started in Kuantan, Penang and Kuala Lumpur hospitals and followed by HUSM in 1987. HUSM provided the PN services initially to the pediatric wards and later expanded the services to include adult wards especially to surgical patients. In order to improve the role of pharmacists, HUSM started an Aseptic Dispensing Unit (ADU) within the Pharmacy Department in 1991 to provide a centralized PN service. The pharmacists from the ADU worked together with physicians, nurses and dietitians as a team known as PN Team (Bahari 1993).

The data in 1993 showed that the mean PN preparation rate was 2.38 per day (634 preparations for 266 days, ranging from 1 to 7 preparations per day). Of those, only one preparation (0.16%) encountered complications. The average duration of PN for each patient was 8.8 days (ranging from 1 day to 32 days; n=62 patients). Fifteen (24.2%) of the patients were adults (Shamssudin *et.al* 2003).

The quality of PN services is evaluated based on their availability, the range of services offered, staff load, rate of complications, outcomes and costs. A survey in hospital pharmacists practices in France (F), Switzerland (CH), and Belgium (B) showed that NST were present in 32% to 45% of hospitals. Standard formulas were used in adult patients (F, 79%; CH, 86%; B, 86%), whereas approximately 50% of tailor-made PN bags were used for children. Most standard formulas were provided by industry as tailor-made formulas produced exclusively for hospital pharmacies. Quality controls were

mostly visual in 75% to 95% of hospitals surveyed (Maisonneuve *et.al*. 2004). Another study in Portugal showed that NST was reported in 34% of hospitals, 40% of which were teaching hospitals. The composition of NSTs included physicians, pharmacists, dietitians/nutritionists in 25% of all hospitals, physicians and dietitians/nutritionists (30%), physicians and pharmacists (5%) and dietitians/nutritionists only (16%), only 9% of NST covered the whole hospital population and 16% acted on a consultation basis. While 30% were only involved in purchasing nutrition products. Only 18% of the NSTs were involved in teaching/training (Ravasco *et.al*. 2004). A study in UK to determine the progress of PN practices since 1988 to 1992 showed that 32.5% of respondents had access to nutrition support teams, compared with 27% in 1988. Of these, 33% provided enteral nutrition and 53% parenteral nutrition. However, since 1988, the number of respondents using peripheral parenteral nutrition had doubled to 15% (James *et.al*. 1992). A study in Latin America showed that malnutrition was present in 50.2% of the patients. However, nutritional therapy was used only in 8.8% of these patients (6.3% enteral nutrition and 2.5% parenteral nutrition) (Correia and *et.al.* 2003). A study in the Von Hauner Children's Hospital at the University of Munich on the type of prescription showed that 68% used standard PN and 32% individualized PN. The standard PN were used more often in the pediatric intensive care unit with modifications of standard PN solutions performed in 54% of all cases. While, macronutrients and electrolytes contents were similar in both individual and standard PN solutions, calcium and phosphate intakes were lower in individual PN. Electrolyte imbalances occurred slightly more often in individualised PN than in standard PN (34% vs. 26%, respectively). (Krohn *et.al*. 2005). Another study evaluated the use of individualized PN prescriptions in neonates. It revealed that 20% of PN strictly followed the computer programmed

generated projections while 80% of PN prescriptions contained higher carbohydrate, sodium and phosphate content (Beecroft *et.al*. 1999). In another study (Villares *et.al.* 2002) found that the prescription was customized to each individual patient in 87% of the 48 centres. The centres used MCT and mixture of MCT/LCT for the fat and 50% of the centres using all-in-one mixtures. Most centers used inorganic phosphate (78%), daily vitamins and trace elements (65%), heparin (50%) and carnitine (27%). The study also found that only 40% of the centers indicated that the solution had to be used within 24 hours.

A study on the competency of physicians in prescribing parenteral nutrition support showed that the mean total score was 48.6±20.8. Total score differed according to the number of nutrition lectures attended during residency, specialty area and experience in prescribing parenteral nutrition (Vanek 1997). Another study involving dietitians in 1993 found that only 5% assumed total responsibility for the formulation of parenteral nutrition regimens. By 1995 this figure had risen to 14%. However, 83% of nutrition support dietitians wanted to increase their involvement in PN (Fisher *et.al* 1996). Results from a 1995 survey showed that 42% of dietitians felt that education at undergraduate level was inadequate, while 58% felt education at postgraduate level could be improved (Gilmour 1998).

A study in Swiss hospitals found that multi-disciplinary nutritional support teams were present in 52% of hospitals. 83% of adult PN used commercially prepared products in multicompartment bags. However, pediatric PN still used in house individualized admixtures because of the absence of commercial products. While 57% of home PN

were provided by hospital pharmacists (Pichard *et.al* 2001). A study into the effects of PN prescribing practice on patients by (Porcelli 2004) reported an average of 182 Very low birth weight (VLBW) infant admissions and involved the preparation 4810 parenteral nutrition orders per year. PN were prescribed by experienced neonatal nutrition staff in 5 centers of 8 centers surveyed, six centers with using paper parenteral nutrition order forms. All the centers provided some guidance such as recommended ordering dose range and self-reported medical mistakes such as incorrect parenteral nutrition additive dilutions and incorrect supplementation of parenteral nutrition additives.

Seres *et.al* (2003) in his survey found that there was no consistent method of prescribing PN. He noted that 45% of responders reported adverse events directly related to PN that required intervention. Of these events, 25% caused temporary or permanent harm, and 4.8% resulted in a near-death event or death. Another study by Schloreb *et.al*. (1998) showed the amounts of glucose given in PN were high (more than 4.48 mg/kg per minute) and produced a respiratory quotient greater than 1.0 in a standard PN formula of 4.25% amino acids, 15% dextrose, and 20% fat emulsion. Monitoring of fifty-three patients on PN found that nutritional requirements were reached in 67.6% of the patients within 2.9 ± 0.7 days. The mean duration of parenteral nutrition was 7.2 ± 6.6 days. Pain at the venipuncture site occurred in 17.1% of the cases, pain and fever in 20% and pain, hyperthermia and edema in 2.8%. No patient developed an abscess (Correia *et.al.* 2003).

Surveys to evaluate the current status of parenteral nutritional management in Malaysian hospital are crucial to offer a critical perspective of routine practices. In Malaysia, the practice of PN was introduced in the late 1980s and many the initiatives launched by tertiary and secondary hospitals to train health professionals have led to its widespread use. The current academic survey was undertaken in January 2007 in order to evaluate the practice of clinical nutrition in Malaysian hospitals, and identify those that might be receptive to teaching and training initiatives. The survey developed a set of questionnaires for the relevant hospitals (Appendix 1). Questions focused on various indicators concerning parenteral nutrition (PN): these included adult special sties type offered, (b) The no of pharmacists and pharmacist assistants, (c) Type of clinical services offered by the pharmacy department, (d) services in Malaysian hospitals, (e) services in Malaysian hospitals according to hospital type, (f) years of hospital service, (g) Ward with PN services, (h) Average number of preparation per day for adult and pediatric, (i) Places for the preparation of PN, (j) The practices of patient on PN, (k) Services of PN offered by pharmacists, (l) The addition of the component , (m) Information about compatibility, (n) Monitoring of quality control during compounding, (o) Product quality and improvement to its stability, (q) The use of commercially available standard product and (r) Components of the solutions.

1.1.3 Problem Statement

PN is an essential component of care for those who are unable to tolerate adequate oral or enteral feeding. However, it is not complications free due to the danger of

biochemical abnormalities, sepsis, thrombosis, extravasations, and death (Ahmed *et.al* 2004).

A prospective study carried in children with diarrhea of more than 14 days' duration (University of Malaya Medical Centre, Kuala Lumpur from 1 January 1996 to 31 December). Twenty-seven patients (14 boys and 13 girls) were studied. The result was nine cases required parenteral nutrition (Lee *et.al.* 1999).

The Straits Times of Malaysia (May 13, 1977-Editorial) estimated that there were about 200,000 squatters around the city of Kuala Lumpur. The size of this disadvantaged group of urban dwellers suggests that there may be many other urban children who are potentially vulnerable to the development of malnutrition (George *et.al* 1981).

Micronutrient malnutrition is a serious problem to the health and productivity of more than 2 billion people worldwide. Iron, Vitamin and Iodine were the major three micronutrient deficiencies elements (Hesham *et.al* 2003) and (Cheah 2006).

After more than a decade of PN introduction in Malaysia, there is no comprehensive report on the evaluation of PN practice. There is also no report about the extend of PN services offered, the total number of hospitals offering the service, the range of services offered, workload, manpower training and other related information to the provision of PN services in Malaysia. Such information is very important for policy makers as it serves as a guide for them to prepare policy related to the provision of PN services (Al-batani *et.al* 2006).

Literature also shows that the provision of PN services by pharmacists vary from hospital to another. As such, these variations need to be addressed and minimized so that a standard guideline for pharmacists involved in the provision of PN services can be formulated.

1.1.4 Rationale of the study

The information necessary to address the above problem is still not available. Although the PN service have been introduced for more than 20 years, the data on the number of hospitals offering the service, the extend of pharmacists involvement, the availability of standard solution and other related information are not available in a comprehensive manner: (Bahari 1999), (Shamsuddin *et.al* 1994), (Bahari 1998), (Bahari 1990), (Harbans1994) and (Ramanujam 1994).

This study will be able to provide information related to the extend of PN practice among Malaysian hospitals, the role of pharmacists and the scope of PN service. The study will also provide an evaluation of the types of cases commonly on PN, the types of solution of various PN services in the most established hospitals in Malaysia.

The data from the study will provide the information for the hospitals and policy makers for the planning and providing of PN services. In addition, the information related to the availability of PN services is also useful for the future planning of PN. Moreover, the geographical location of hospitals who offer PN service will allow physician to refer patients for PN more efficiently.

The information related to of PN solution used by the hospitals such as standard solutions, individualized solutions or premixed solutions is useful for the future planning of PN service. As the data can be used as guideline in selecting the type of service to offer and in selecting type of solutions to use.

This part of the study will highlight the PN services in Malaysian hospitals including the number of hospitals providing the services, the type and extend of clinical pharmacy services, the facilities available, the staff load, quality assurance, the availability of standard formula and computer programmed for PN calculations. The study will also look into the methods used by hospitals without PN services i.e. the use of ready made commercially available PN solution or purchase from other hospitals.

1.1.5 Objectives

The general objectives of the study is to:

1. explore PN practice in Malaysian hospitals.

The specific objectives of the study are to:

a. determine the extend of PN services offered by Malaysian hospitals.

b. determine the personnel involved in the provision of PN services.

c. determine the load of PN services

e. document the role of pharmacists in the provision of PN services

1.1.6 Justification of the study

The study provides information related to the provision of PN services in Malaysia. The information is very useful as in devising plans to the provision of PN services.

The result of the study is also useful to provide information in the development of protocol and procedures to improve the current PN practice. The result also provides insight information various PN practices in Malaysian hospitals. Remedial steps could be developed to improve the weakness of the current practice.

The justification of this study lie in the fact that there is not much information or knowledge about PN practices in Malaysia. The study was done to answer, enlighten, and evaluate the practice of PN in Malaysian hospitals. There is no informations about the types of clinical services offered by pharmacy department.

The study also justified because it will provide information about the number of hospitals offering PN service, the date PN services started in Malaysian hospitals, the extend of PN service and the load of PN service. The types of quality assurance carried out by the PN services such as aseptic techniques, frequency of microbial counts and maintenance of facilities in the clean room. The type of PN solutions used in the PN service such as standard formula or individualization for adults and Pediatrics. The personnel involved in the preparation of PN solution, the duration of PN service and the supply during the weekend and public holidays. The involvement of pharmacists in the estimation of PN requirement, PN monitoring and nutrition support team.

1.2 METHODOLOGY

1.2.1 Introduction

This part of study comprises a survey for the evaluation of PN practice in Malaysian hospitals. The survey was carried out among all hospitals in Peninsular Malaysia. A total of 100 hospitals were selected by stratified random selection according to the states in Malaysia. The list of hospitals was downloaded from website which includes public and private hospitals in peninsular Malaysia in the year of 2007.

1.2.2 Parenteral nutrition practice in Malaysian hospitals

The questionnaire of the PN practice in Malaysian hospitals was developed based on a study done by Shamsuddin (2003) in Malaysia and other surveys conducted on PN practices in hospital pharmacies in Switzerland, France, and Belgium by Maisonneuve *et.al* (2004). The content of the questionnaire was discussed with faculty and staff working in parenteral nutrition services. All the questions were designed to attain the objectives of this study. This section evaluated the practice of PN in Malaysia, based on the following aspects. Type of clinical services offered by the pharmacy department, the presence of PN services in Malaysian hospitals, the year the provision of PN services commenced in Malaysian hospitals, the provision of PN supplement to other wards, the preparations per day, the place of PN solutions prepared, the type and frequency of quality control processes such as prescription checks, calculation, microbial counts, particle counts and microbiological tests for final PN solutions. The use of standard formula and individualised prescriptions for adults and pediatrics. The evaluation also

looking into aspects of personnel involved in the preparation of PN, additional services such as 24 hour PN services, weekend and holiday services, the use of computer programs for PN calculation and checking the compatibility between drug-drug and drug-PN. The use of standard patient monitoring devices by pharmacists or the PN team and the use of commercially available PN solution or those ordered from other hospitals (Smith 1997) and (Passmore 2002).

1.2.3 Study design of survey of Practice PN in Malaysian Hospitals

The survey utilized a structured questionnaires (Appendix 1). A pretest was carried out to evaluate the validity using three voluntered pharmacist. The survey questionnaire was sent to the pharmacy director in each hospital. It was accompanied by a letter explaining the objectives of the study and a self address post-paid envelope. Responses were expected within a 30 days time frame.

1.2.4 Determination of the sample size.

The sample size was determined using to the following procedure: First, the total number of hospitals in Malaysia was determined as follow:

122 (Government) + 93 (Private) = 215 hospitals

Then the sample size was determined using the following equation formula.

$$n = \left[\frac{Z_{\alpha/2}}{E}\right]^2 P(1-P)$$

P =15:200= 0.075 (MOH Annual Report, 2002).

q = (1-p) = 0.925

n = sample size

Z = standard normal deviate usually 1.96

E= The degree of accuracy desired, usually set at 0.05.

Determination of sample size

$$n = \left[\frac{1.96}{.05}\right]^2 0.075\ (0.925)$$

= 100 hospitals were selected by stratified random selection method.

Table 1.2.2: The total number of hospitals in both government and private hospitals

Hospital	Governments	Private
Johor	11	14
Kedah	9	
Kelantan	9	8
Melaka	3	
Negeri sembilan	6	5
Pahang	8	
Perak	14	9
Perlis	1	
Pulau Pinang	6	14
Selangor	10	19
Sarawak	14	8
Sabah	22	2
Terengganu	6	
WP Kuala Lumpur	2	14
WP Putrajaya	1	
WP Labuan		
Total	122	93

Table 1.2.3: The total number of government and private Hospitals in participated in the study (100).

Hospital	Governments	Private
Johor	5	7
Kedah	4	
Kelantan	4	4
Melaka	1	
Negeri sembilan	3	2
Pahang	4	
Perak	7	4
Perlis	1	
Pulau Pinang	3	7
Selangor	5	9
Sarawak	7	4
Sabah	11	1
Terengganu	3	
WP Kuala Lumpur	1	7
WP Putrajaya	1	
Total	60	45

1.2.5 Subjects (hospitals)

In order to evaluate the parenteral nutrition practice in Malaysian hospitals, a survey was carried out among all hospitals including private and public hospitals in peninsular Malaysia. The list of hospitals according to geographical site was obtained from the Ministry of Health website which includes public and private hospitals in peninsular Malaysia.

1.2.5(a) Selection of hospitals

A total of 215 hospitals from public and private hospitals were listed in ministry of health website. Hundred (100) of hospitals were selected by stratified random selection according to the states in Malaysia.

1.2.5 (b) Inclusion criteria

All the government and private hospitals in Malaysia.

1.2.5 (c) Exclusion criteria

There were 29 small clinics were excluded from the study.

1.2.6 Data Analysis

The data was analyzed using SPSS version 11 and descriptive statistic was used as appropriate. Contingency tables were used for the following:

1. The classification of the hospitals.
2. PN services in Malaysian hospital.
3. Hospital size with relation to hospital type.
4. Availability of PN services according to class of hospital.
5. The Specialties type offered by the Malaysian's hospital.
6. Type of Clinical Pharmacy Services offered Pharmacy Department.
7. Clinical Pharmacy Services offered by Pharmacy Department according to hospital type.
8. Year of PN service started.
9. Ward with PN services.
10. Places for preparation of PN.
11. Parenteral Nutrition Services Offered by Pharmacy Department.

12. Pharmacist Involvement in Parenteral Nutrition Services.

13. Monitoring of quality control during PN compounding.

14. The use of commercially available standard product.

15. Type of recommendation by Pharmacist.

16. Components of solutions.

1.3 RESULTS AND DISCUSSION

1.3.1 Response rate

The response rate of the survey was 52% (52 out of 100 selected hospitals). This finding is comparable to other Malaysian health related studies using the questionnaires survey which is between 24.25% to 85% (Mohamad *et.al* 1997 and Marnoch *et al* 2002). The response rate from studies among doctors were lower (24.25%) than Pharmacists (52%) and nurses (85%). The differences could be due to the differenence in workload of each profession and time available. However, the finding on response rate was comparable to other studies on PN done outside Malaysia such as in Switzerland which was 55.6%, France 30.5%, and Belgium 24.5% (Maisonneuve *et.al.* 2004). A study in Portugal showed that the response rate was 44%, reaching (60%) in primary care (Ravasco *et.al.* 2004) while in the United Kingdom about 61.2% of questionnaires distributed were completed and returned (James 1992).

The study also showed that most of Malaysian pharmacists were aware about the PN services even though their hospital did not offer PN services.

1.3.2 Classification of hospitals

Table 1.3.4 shows the number of hospitals according the classification such as tertiary (15.4%), secondary (67.3%) and primary (17.3%) hospitals that responded to the questionnaires. The classification was based on the facilities, the level of training of medical staff, size and professionalism. The number of primary hospitals did not represent the actual number of primary hospitals selected for the study because most of them did not respond to the questionnaire. Another reason was the increase in the number of private hospitals in 2007. This is due to the compulsory registration of all private practitioners and hospitals in Malaysia which was implemented in 2007 (Chee 2007), (Association of private hospitals) and (Charles 2002).

Table 1.3.4: The classification of the hospitals

Hospitals	Hospital type	n %
Tertiary hospitals	teaching referral	8 (15.4)
Secondary hospitals	general district nucleus	35 (67.3)
Primary hospitals	private Public clinic HPN organization	9 (17.3)
Total		52(100)

1.3.3 PN services in Malaysian hospital

There were 9 (17.3%) Malaysian hospitals participated in the study offered PN service. Among the reasons for this low rate were:

1. The cost of setting PN services is very expensive and smaller hospitals do not have enough cases for PN and therefore it is not cost effective.
2. Small hospitals have the choice to purchase the PN solution from other hospitals.
3. The system that allows small hospital to transfer patients who require PN support to another hospitals with PN services.
4. Smaller hospitals have the choice to use ready made solution, which can be purchased from the pharmaceutical companies.

Studies from other countries showed that nutritional therapy was used in 8.8% of patients (6.3% enteral nutrition and 2.5% parenteral nutrition) in Latin America (Correia *et.al.* 2003) However, an other study showed that Standard PN solutions were prescribed in 68% of cases (Krohn *et.al* 2005).

Table 1.3.5: PN services in Malaysian hospital

	n (%)
PN service	9(17.3)
No PN service	43(82.7)
Total	52(100)

1.3.4 Hospital size

Table 1.3.6 shows the size of the hospitals that participated in the study. Majority of the hospitals (68.2%) had less than 250 beds and the relation between hospitals type and the hospital size was significant (P=0.024). All the primary hospitals had less than 250 beds and 68.6% of secondary hospitals also had less than 250 beds while 22.8% had between 250 to 500 beds. However, tertiary hospitals had more than 1000 beds. The study found that tertiary hospitals with 1000-1250 beds capacity have a higher number of pharmacist and pharmacist assistant. Therefore they could handle more preparation per day (Table 1.3.7). In addition, tertiary hospital also could offer wider types of pharmacy service (Raymond 2005) and (Starkweather 1970).

1. Tertiary hospitals had larger beds number than secondary and primary because they received referral patients from larger geographical areas. For example, the Penang hospital used to receive patients from other hospitals such as those from Perlis, Kedah and Perak.

2. Tertiary hospitals also had wider number of specialties.

3. Tertiary hospitals also cater to chronic and severe cases that required prolong hospital stay.

4. Tertiary hospitals had latest and sophisticated equipments such as MRI, etc.

Table 1.3.6: Hospital size in relation to hospital type.

	Less than 250 beds	250-500 beds	500-750 beds	750-1000 beds	1000-1250 beds	More than 1250 beds	Total
Hospital type							
Tertiary hospitals	2(25)	4(50)	0(0)	0(0)	1(12.5)	1(12.5)	8(15.4)
Secondary hospitals	24(68.6)	8(22.8)	2(5.7)	1(2.8)	0(0)	0(0)	35(67.3)
Primary hospitals	9(100)	0(0)	0(0)	0(0)	0(0)	0(0)	9(17.3)
Total	35(67)	12(23)	2(4)	1(2)	1(2)	1(2)	52(100)

1.3.5 Availability of PN services

Table 1.3.7: Availability of PN services.

Hospital type	Mean no of pharmacist	Mean no of assistant pharmacist	PN services	Total mean no of preparation/day for adult and pediatric
Tertiary hospitals	13±12	27±46	55.5 %	10±11
Secondary hospitals	5±6	9±6	44.4 %	4±2
Primary hospitals	1±1	4±3	0%	0

1.3.5 (a) PN services and mean of pharmacist and pharmacist assistant

Table 1.3.7 shows that PN is available in 55.5 % of tertiary, 44.4 % in secondary and 0% in primary hospitals. All primary hospitals did not have PN services because the hospitals did not manage complicated cases and patients that require PN service were referred to the either secondary or tertiary hospitals. Similarly not all secondary hospital

had PN services, as most small secondary hospital referred complicated cases to tertiary hospitals for further management.

The other reason was the load of pharmacist in the pharmacy department. The number of pharmacists was 13± 12, 5± 6, and 1±1 in tertiary, secondary and primary hospitals respectively. In addition the number of pharmacist assistant was 27± 46, 9 ± 6, and 4±3 in tertiary, secondary and primary hospitals respectively. The differences were significant (P=.001 and P= .021 respectively). Most tertiary hospitals had higher number of pharmacists and pharmacy assistants, and therefore could afford to offer a labor intensive service such as PN. This is supported by Krishnan *et.al* (2001) that showed higher number of pharmacist in tertiary hospitals was due to the load of the hospitals.

1.3.5 (b) Mean preparation per day

Table 1.3.7 shows the mean no of PN preparation per day were 10±11 and 4±2 in tertiary and secondary hospitals respectively. The relation between mean average no of preparation per day total and type of hospital was not significant P = 0.310.

The higher mean number of PN in tertiary hospitals could be due to the differences in

1. the number of patients
2. the type of specialties offered.
3. the facilities available
4. the number of trained staff.