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The nutritional management of burns Australian dietitians

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The Nutritional Management of Burns by Australian Dietitians.

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Abstract

This project focused on investigating the nutritional management of burn patients by Australian dietitians. A questionnaire was used to explore current practices in the nutritional assessment, support and the formulation of care plans for this dynamic group of patients. Twenty six (86.7 percent) of the thirty questionnaires were returned.

This study shows that there is great variation in the provision of nutritional support and management of burn patients. Australian dietitians are implementing early enteral feeding, particularly with patients who have burns in excess of 20 percent total body surface area. These patients are being fed within two to 48 hours of hospital admission. The enteral feeding route and the use of nasogastric feeding, when necessary, were preferred over parenteral nutrition support. Oral diets were prescribed for patients with less than 20 percent burn injury. These practices are in line with current recommendations described in the literature.

This project identified some areas of nutritional management contrary to current recommendations. The two most commonly used equations to estimate energy requirements for burn patients in Australia are the Harris-Benedict and the Schofield equations. These same equations are also used for non-burned patients, where many patients do not fit into the criteria from which these equations were derived. The Toronto equation was designed and validated specifically for burn patients, however it is not being used.

Serum albumin and body weight are the standard nutrition indicators used in Australian hospitals. These are known to be inaccurate when used with burn patients due to the provision of fluids and blood products. Comparatively, serum prealbumin is a better biochemical indicator of nutritional status, however, this indicator is used less frequently by dietitians.

Nutrient goals for macronutrients were in accordance with the literature. Protein contributed between 20 and 25 percent of the total energy, with 50 percent of energy from carbohydrate, and 30 percent from fat. Specific micronutrient requirements for burn patient have not been established. From this study vitamin C, zinc and multivitamin supplements were most often provided. Oral supplements were most often dairy foods and drinks.

Routine post discharge dietetic reviews were infrequently provided for burn patients. The main constraints were insufficient time and staffing. However, some departments provided a service based on referrals from the medical team.

There is a need to review current practices in estimating energy requirements and a need to evaluate the assessment and monitoring tools for burn patients in Australia. The management of burns is a specialised area of dietetics, where the dietitian plays a crucial role in patient management. Continuing education will ensure best nutrition practice is maintained for this dynamic group of patients.

CHAPTER 1

Introduction

Aggressive nutritional care is an important component in the total management for the burn patient. The post burn period is characterised by a hypermetabolic response as well as visceral protein loss. If the elevated nutritional requirements of the burn patient are not met, the patient becomes more susceptible to bacterial infections, and delayed wound healing can occur. The dietitian plays an active role in recommending and implementing aggressive nutritional support, in order to improve the survival of the patient with burn injury.

There are established recommendations for intensive nutritional management for the severely burned patient. However, controversies exist, leaving great variation in the way these patients are managed. Specifically, which equation to use in estimating their energy requirements, which feeding route to use for safe, effective and efficient delivery of nutrients, when to commence feeding, the nutritional goals for macro and micronutrients, and which nutritional indicators should be employed to monitor their progress. A comparison of current dietetic practice with the current literature will highlight areas which dietitians should review and evaluate in order to optimise the nutritional care, and improve the clinical outcomes for all burn patients.

CHAPTER 2

Literature Review

The hypermetabolic response that occurs after a thermal injury is greater than that observed during severe sepsis, or any other form of trauma (Deitch 1990a). The magnitude and duration of the hypermetabolic response parallels the severity of the burn injury, such that the metabolic rate reaches a maximum of twice the normal rate when the injury reaches 60 percent of the total body surface area (TBSA) (Deitch 1990a). During the post burn period, the burn patient remains in a catabolic state, hence the need for intensive nutritional support.

Just as the metabolic rate reflects the size of the burn injury, the extent of the injury plays a role in determining the nutritional needs of the patient. Burn injury can be classified according to the percent of body surface area that is affected (Clarke 1992). Diagrams that map the percentage of specific areas of the burned body surface, are depicted in Figure 2.1 (Clarke 1992:8). The patients' nutritional requirements increase proportionally with the size of the burn injury. Hence, dietitians can use this scheme to estimate the nutritional needs of burn patients, and plan appropriate support, by utilising a combination of the venous, oral or enteral tube feeding routes. The aim is to optimise the nutritional care plan, according to the patients' clinical condition, in order to achieve the best clinical outcome.

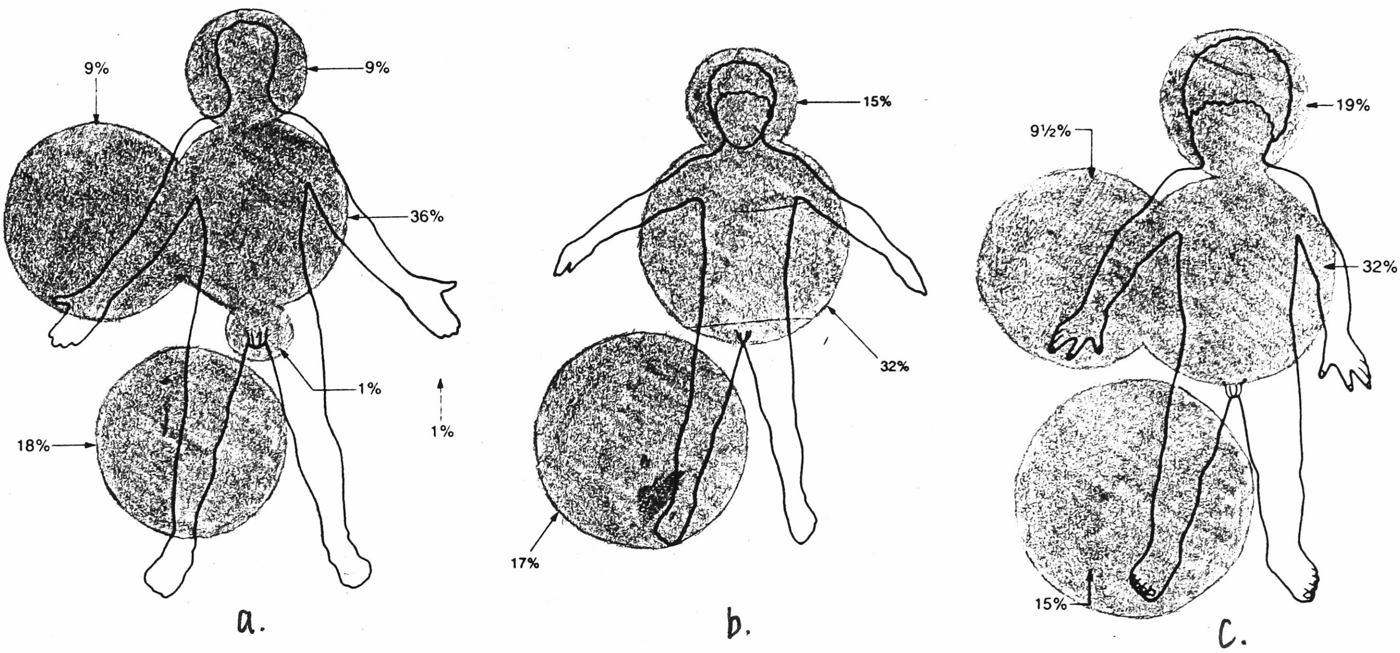

Figure 2.1: Estimation of the burn area: (a) Wallace rule of nine; (b) Lund and Browder modification of area in children of five to ten years of age; (c) Modification for children of up to four years of age (Clarke 1992:8).

Significant improvements in many facets of burn care over the last three decades has had an impact on burn patient outcome (Constable 1994; Muller and Herndon 1994). Refinement of nutritional support has been identified as one of the factors contributing to the reduced mortality, especially in the case of severe burns. However, there are few Australian burn studies reported in the literature. Importantly, this includes the area of nutritional management. Research in this area, will provide an insight into current nutritional management by Australian dietitians.

In the United States and Canada, Williamson (1989a, b) conducted a study regarding the "Nutritional care of burn patients at individual units" by dietitians. Part one of the questionnaire dealt primarily with the unit demographics, treatment methods and staffing, while part two focused on the actual nutrition care practices used at the various burn units. There were questions related to the formulae being used for estimating energy requirements, macronutrient and micronutient goals, the types of nutritional support being used, and the nutrition assessment and monitoring procedures.

More recently, Fakhry, Alexander, Smith, Meyer and Peterson (1995), also investigated "Regional and institutional variation in burn care" in the United States and Canada. This questionnaire focused on the medical aspects of burn care. However, the survey also covered the nutritional management using total parenteral nutrition support (TPN) and enteral tube feeding. Fakhry et al. (1995), found that enteral tube feedings were started on day one after burn injury, and TPN was not commonly used.

Both Williamson (1989a, b) and Fakhry et al. (1995) concluded that there was no standardisation between institutions in their approach to the nutritional management of burn patients. A certain degree of variation between patients is necessary, as this takes into account their individual condition. However, a protocol could be useful for providing guidelines and ensuring that the standards of practice for burned patients are maintained.

Lown (1991) investigated the "Use and efficacy of a nutrition protocol for patients in intensive care". The use of this protocol resulted in early initiation of enteral nutrition support. Importantly, the protocol used by Lown (1991), also became a vehicle for the examination of care provision and quality improvement of the service being provided to this group of patients. Areas for improvement identified by Lown (1991) included the consideration of intraoperative feeding, arranging for earlier replacement of dislodged feeding tubes, and reevaluation of the monitoring parameters being used. This process, of quality improvement can also be applied to the management of burn patients.

There is a relationship between optimal care and cost savings in the clinical setting. Garrel, Davignon and Lopez (1991), found that enteral feeding before the third day after the burn injury, reduced the length of hospital stay, and the cost of hospitalisation. Hence, these patients should receive aggressive nutrition intervention. Also, Weinsier, Heimburger, Samples, Dimick and Birch (1985), were able to demonstrate the positive impact of consultation and recommendation by a nutrition support team for patients with 20 to

50 percent burns. Patients who received consultations, lost less weight and were discharged earlier than those who did not.

2.1 Altered metabolism in burn patients

Energy expenditure typically increases 80-100 percent after major burns, compared to 50-60 percent after severe closed head injury, and 30-50 percent after multisystem trauma (Moore and Moore 1991). There is a need to supply adequate energy for body processes and wound repair.

The metabolic response to burn injury is biphasic. The initial *ebb phase* persists for 12 to 36 hours post injury (Lehmann 1993). During this phase, the patient experiences a diminished capacity for heat production, and a low cardiac output. In complete contrast with the later phase, the patient is hypometabolic, where total body oxygen demands are below normal levels (Tredget and Yu 1992). Traditionally, the treatment at this phase is focused on haemodynamic stabilisation of the patient.

The use of enteral feeding, remains controversial due to the common occurrence of ileus, which was thought to preclude the use of the gastrointestinal tract (McArdle, Palmason, Brown, Brown, Williams 1984). More recent research has demonstrated that enteric sepsis is common in burn patients. The condition is precipitated by the delay in nutrient administration which promotes bacterial translocation through the gut epithelial layer (Mochizuki, Trocki, Dominioni, Brackett, Joffe and Alexander 1984a; Chiarelli, Enzi, Casadei, Baggio, Valerio and Mazzoleni 1990; Epstein, Banducci and

Manders 1992). Consequently, it is necessary to implement early initiation of enteral nutritional support.

With fluid resuscitation complete, there is an elevation in cardiac output and energy expenditure (Tredget and Yu 1992). This phase, termed the *flow phase*, peaks three to four days following the injury (Lehmann 1993), and continues long after wound closure has occurred. The flow phase causes catabolism of lean body tissue, occurring particularly in severely burned patients.

Hormones such as cortisol, catecholamines, growth hormone and glucagon, along with other mediators, such as prostaglandins, cytokines and the complement system are activated by the injury (Lehmann 1993). Predominantly, their action accelerates energy expenditure, increasing the use of all major nutrients as energy substrates. Consequently, it is crucial to meet the patient's nutritional needs.

2.2 Energy requirements

The elevated energy requirement of the burn patient can be calculated from mathematical equations. The Curreri equation, the Harris-Benedict equation and the Schofield equation may all be used. However, there are problems in using these static equations. Several investigators have shown that these equations tend to overestimate energy requirements (Turner, Ireton, Hunt and Baxter 1985; Ireton, Turner, Hunt and Liepa 1986). In addition, the equations do not account for the changes that have occurred in the treatment and the management of burn patients over the last decades (Carlson, Cioffi, Mason, McManus and Pruitt 1992). In particular, the Curreri equation has no upper limit, and consequently, has a strong tendency towards overestimating requirements, especially in patients who have massive burns (Saffle, Medina, Raymond, Westenskow, Kravits and Warden 1985).

Carlson et al. (1992) compared measured resting energy expenditure (REE) by using indirect calorimetry in patients with burn injuries treated during 1972 and 1973, with measurements made in a similar group of burned patients treated during 1987 and 1989. Metabolic requirements were related to burn size in both patient populations, but there was a difference in the magnitude of energy expenditure between the two groups. The earlier data overestimated the energy requirements of the more recent group by 73 percent.

Like the Curreri equation, the Harris-Benedict and Schofield equations have limitations too. The Harris-Benedict equation, predicts basal metabolic rate (BMR) from body weight, height, age and sex. The Schofield equation uses weight, age and sex. Both equations were developed using normal, healthy individuals, free of chronic disease and stress (Elwyn, Kinney and Askanazi 1981). Despite the fact that many hospitalised patients do not meet these criteria, the equations are routinely used to estimate energy requirements. Additionally, predictive equations, by definition, are designed for population studies and are not meant for estimating the energy expenditure of individuals (Elwyn et al. 1981).

There are problems when predicting BMR using the Schofield equation. Subjects at the lower and upper ends of the age range are not mutually exclusive (Warwick 1989). In addition both the Harris-Benedict and Schofield equations may not be appropriate for individuals who fall well outside of the healthy weight range: those who are obese or malnourished. There is a normal range of variation for most healthy individuals which falls within about ten percent of the predicted values from these equations. The variation for weight stable individuals is much less, only one to four percent (cited in Warwick 1989). However, burned patients experience fluctuations in body weight as a consequence of their treatment. The endogenous fat reserves of an obese burned patient are not a readily available source of energy. Calculations of estimated energy requirements are complicated by excess weight. The use of reported body weight, in equations like the Harris-Benedict, would tend to overestimate needs. Conversely, if ideal weight was used in the same equation, the result would be an underestimation of REE (Gottschlich, Mayes, Khoury and Warden 1993). Loss of body weight is not desirable until wound healing has been achieved. So an aggressive approach to nutritional support, regardless of the patient's weight is recommended.

The Harris-Benedict and Schofield equations calculate basal energy requirements in the non-stressed state, an injury factor must be applied to arrive at a value for total energy expenditure. A factor of 1.2 may be applied to patients with mild hypermetabolism, 1.2 to 1.5 for multiple trauma or sepsis, and 1.5 to 2.0 for severe burns or multiple organ failure (Mainous and Deitch 1994). According to Mainous and Deitch (1994), burn patients rarely require more than twice their baseline needs. This is supported by several researchers (Bell, Molnar, Krasker and Burke 1986; Paulsen and Splett 1991; Hildreth, Herndon, Desai and Broemeling 1990). In hospitalised patients, over- and under-estimations of REE up to 30 percent have been found when using such equations (Elwyn et al. 1981).

Despite numerous findings supporting the inaccuracy of energy equations, Williamson (1989b) reported that dietitians in the United States and Canada were still using the Curreri equation to estimate the energy requirements of burn patients. Dietitians also commonly used the Harris-Benedict, with various modifications.

There is a newly devised and validated formula for calculating energy requirements of burn patients, the Toronto formula (Allard, Pichard, Hoshino, Stechison, Fareholm, Peters and Jeejeebhoy 1990). This formula takes into account the percentage of total body surface area burned, the expected basal energy expenditure (calculated by the Harris-Benedict equation), the body temperature ($^{\circ}C$), the number of post burn days, the number of surgical interventions for grafting and the thermogenic effect of feeding. Allard et al. (1990), found that the Toronto formula approximates closely to the measured prospective energy expenditure of burned patients. Royall, Fairholm, Peters, Jeejeebhoy and Allard (1994), also confirmed the accuracy of the Toronto formula in predicting REE in mechanically ventilated burn patients. This group also addressed the need for adding an *activity factor* to the formula, in consideration of activities experienced by the patient such as physiotherapy, dressing changes, position changes, agitation and family visits. These "activities" contributed to 27 percent of the overall energy expenditure, hence, an activity factor of 20 percent is considered appropriate. Unlike previous equations, this formula has the flexibility of being able to take into account the individual daily variation in energy requirements.

It is currently recommended that energy equations and formulae provide only a starting point for estimating the energy requirements for burn patients. Indirect calorimetry is considered the "gold standard" because it accounts for individual variability and changes in energy expenditure that occur during the course of treatment. Saffle, Larson and Sullivan (1990) recommend using indirect calorimetry for the detection of gross under- and over-feeding and for the determination of requirements for children and elderly patients, as standard equations are poor predictors of actual requirements for these groups. For burn patients, indirect calorimetry is also useful for detecting the decline in energy requirements in the recovery period. However, indirect calorimetry involves the use of specialised equipment, which is expensive and measurements can be time consuming, therefore it may not practical in the clinical setting.

2.3 Nutrition goals for macro and micronutrients

1. Protein

Protein losses are very high in the first three days post burn, decreasing gradually thereafter. A substantial increase in protein is critical in the diet for preservation of nitrogen balance. Despite this emphasis, the ideal amount of protein to be included in the diet of a burn patient is not clear (Dominioni, Trocki, Fang, Mochizuli, Ray, Ogle and Alexander 1985).

Alexander, McMillan, Stinnett, Ogle, Bozian, Fischer, Oakes, Morris and Krummel (1980), found that patients receiving 23 percent of their energy as protein, had fewer bacteremic days and a significantly lower mortality rate than those receiving 16.5 percent of their energy as protein. Waymack and Herndon (1992), recommended a range for protein of 20 to 25 percent of energy, which is supported by the earlier findings of Alexander et al. (1980) and Dominioni et al. (1985). Conversely, there is limited benefit for increasing protein intake above 30 percent of energy. Excess protein 'induces an apparent nitrogen retention, which is not paralleled by an increase in body weight nor by an early reversal of muscle tissue loss' (Dominioni et al. 1985:277-278).

2. Carbohydrates

Carbohydrates have been recommended as the principle energy source, as they contribute a protein sparing effect, and are more readily utilised than fat (Dominioni et al. 1985). However, there is a critical level because excessive carbohydrate is metabolised to fat, which causes an increase in oxygen consumption and carbon dioxide production. This places undue stress on the burn patients' respiratory system. Consequently, Ireton-Jones and Baxter (1991), and Waymack and Herndon (1992), recommend that 7mg/kg/minute, or 50 percent of total energy as carbohydrate be provided for burn patients.

3. Fat

Clinical and animal studies suggest that both the quantity of fat, and the fatty acid composition can significantly influence the metabolic, immunologic, and inflammatory responses associated with burn injury (Kremer, Bigauoette and Michalek 1985; Alexander, Saito, Ogle and Trocki 1986; Trocki, Heyd, Waymack and Alexander 1987). The fat content of many commercially available enteral diets for critically ill patients varies widely, but tends to reflect the high fat composition of normal diets, with usually over 35 percent of energy being supplied as fat (Mochizuki, Trocki, Dominioni, Brackett, Ray and Alexander 1984b). Many studies have questioned the use of high levels of fat, as excessive ingestion is associated with an increased incidence of diarrhoea and adverse effects on muscle mass, nitrogen balance and serum transferrin levels (Mochizuki et al. 1984b; Trocki et al. 1987; Gottschlich, Warden, Michel, Havens, Kopcha, Jenkins and Alexander 1988; Gottschlich, Jenkins, Warden, Baumer, Havens, Snook and Alexander 1990).

Mochizuki et al. (1984b) and Gottschlich et al. (1990), found an improvement in all nutrition indicators when fat provided less than 15 percent of total energy. This level is sufficient to prevent essential fatty acid deficiency (Alexander et al. 1986). In addition, Selleck, Wan, Gollaher, Babayan and Bistrian (1994:220) reported that 'the protein-sparing effects of lipids are optimal when they are provided in moderation'.

4. Micronutrients

Most vitamins, particularly vitamin A, C, E and B6 affect immune function. Thiamin, pyridoxine, vitamin C, folic acid and vitamin B12 are essential for protein synthesis and wound healing. Although there are no specific recommendations for each micronutrient for burn patients, it is generally agreed that supplementation is necessary (King and Goodwin 1984). When Gottschlich and Warden (1990) reviewed this issue, the team recommended that only vitamin C and vitamin A should be provided in levels above the recommended daily allowances. While definitive recommendations are tenuous, Waymack and Herndon (1992) suggest 500 mg of vitamin C, and 10000 international units of vitamin A in adults, and half of these amounts in children.

The short term benefits of wound healing versus the long term risks to organ function must be evaluated prior to routine diet supplementation. Over zealous supplementation of vitamin C can cause hyperoxalemia, with secondary worsening of renal function in patients with acute renal failure (Dylewski and Froman 1992). Further research is necessary to establish supplementation standards.

Trace elements also play an important role in wound healing and immune functions. Selmanpakoglu, Cetin, Sayal and Isimer (1994) advised routine supplementation of zinc and possibly selenium for burn patients. However, Klein, Herndon, Rutan, Miller and Alfrey (1990) and Selmanpakoglu et al. (1994) cautioned against over-supplementation of trace elements for burn patients with acute renal failure, as they are already receiving high levels of trace elements, such as aluminium, from blood products.

2.4 Nutrition assessment and monitoring

The disturbed metabolic functions of the burn patient, indicates the need for diligent nutrition assessment and monitoring of their response to nutrition therapy. However, the burn injury often makes assessment and monitoring difficult due to the multiple systems that are affected. As yet, a definitive test to evaluate the nutritional status of the burn patient is not available.

1. Anthropometry

Visceral protein, fat and skeletal muscle are the major tissues available to meet nutritional requirements during prolonged hypermetabolism. Body fat stores and skeletal muscle protein can be estimated by measuring the triceps skinfold thickness. These measures may be unreliable, as variations in technique make reproducing the exact site of measurement difficult. Henley (1989) admits that the use of such measures on a casual basis, by different staff, has limited value in the short term management of the burn patient. In contrast, mid arm muscle circumference is simple and reproducible, with little observer error (Henley 1989). An additional limitation related to both of these tools, is that the burn site may be distorted, particularly when the patient has extensive burns (Bell et al. 1985).

Body weight is probably the most frequently used indicator of nutritional status. Dietitians in Williamson's study (1989b) used body weight most often as an assessment tool for burn patients. However, the weight of the burn patient may be elevated 12 to 15 percent above their usual weight because of massive fluid resuscitation and the additional weight of dressings (Jensen, Long, Dudrick and Johnston 1985). Bell et al. (1986), reported that weight loss of greater than ten percent did not increase morbidity or death in burn patients. The team proposed that burn patients were probably able to tolerate greater weight loss because of an adequate provision of energy substrates, and hence, weight loss is probably related to lipid oxidation, rather than catabolism of muscle.

Serial weights can be used to monitor the patient's progress. Hydration status may also be monitored through body weight, as continual weight gain, along with a decreased energy intake, can be a sign of renal or cardiac dysfunction in burned patients (Bell and Wyatt 1986).

Additionally, Ireton-Jones, Turner and Baxter (1990), cautioned that weight gain in burn patients can be the result of over feeding, especially late in the recovery period, when patients are less likely to be active and their actual energy requirements are usually lower than predicted. Consequently, weight control and exercise should be encouraged as part of the discharge care plan.

2. Biochemical assessment

Visceral protein may be evaluated by serum albumin, transferrin and prealbumin. However, major fluid shifts, caused by the fluids provided during resuscitation and the multiple of blood products administered to the burn patient, can influence intravascular concentrations of proteins (Jensen et al. 1985).

Serum albumin, has a long half life of 20 days, and tends to be sensitive to hydration status. It is also depressed in patients with liver and renal disease (Brose 1990). Serum transferrin has a shorter half life of 8 days, and can also be affected by liver disease and blood transfusions (Henley 1989; Brose 1990). Jensen et al. (1985), found that low serum transferrin concentrations were significantly correlated with subsequent incidence of infectious complications in burn patients. Serum albumin did not possess the same predictive value, which may be due to the substantially longer half life. Despite this, twice as many dietitians in Williamson's study (1989 b), preferred serum albumin over transferrin.

Serum prealbumin is more sensitive to nutrition support than either serum albumin or transferrin. This protein has a shorter half life of 1.9 days and is not influenced by fluctuations in hydration status, or liver disease, to the same extent as other serum protein markers (Brose 1990). Whilst serum prealbumin may be elevated in patients with renal disease, Brose (1990:374) found that it is 'markedly more sensitive to refeeding than albumin'. Consequently, serum prealbumin is a better marker than serum albumin for burn patients.

Nitrogen balance reflects the synthesis and catabolism of protein, and so is valuable in assessing nutritional status. However, the measurement of nitrogen balance is problematic in burn patients. Data collection for calculating nitrogen balance are prone to error, even for the non-burn patient. In addition, there is a loss of non urea nitrogen from the burn wounds which is based on estimates (Bell and Wyatt 1986). Despite these limitations, nitrogen balance is still considered to be the "gold standard" for nutrition assessment in burn patients according Millner, Cioffi, Mason, Mcmanus and Pruitt (1993).

In the absence of injury, Urine Urea Nitrogen (UUN) accounts for 80 to 90 percent of the Total Urinary Nitrogen (TUN). In thermally injured patients, a correction factor of 25 percent (i.e. UUN x 1.25) is frequently used to estimate TUN from UUN (Milner et al. 1993). Certain adult burn studies have suggested that UUN does not accurately reflect TUN after burn injury, and TUN should be measured directly, rather than calculating from a formula (Konstantinides, Radmer, Becker, Herman, Warren, Solem, Williams and Cerra 1992). Milner et al. (1993) assessed the clinical practicality of using UUN and TUN measurements for nitrogen balance. Whilst the differences between the calculated TUN (from UUN), and direct TUN were statistically significant, this difference was too small to justify any alteration of the nutrition support regimen, and therefore, the difference in the result was considered 'clinically insignificant'. The accessibility, lower cost and validity of UUN makes it a better monitoring option for burn patients.
Overall, regardless of the nutritional indicator, initial and serial measures of the burned patient's nutritional status are imperative.

This is because there are limitations for each indicator. Hence, using a combination of nutrition indicators should overcome this problem and reflect the nutritional status of the patient.

2.5 Nutrition support systems

Providing there is no pre-existing malnutrition, and the patient is able to masticate and swallow, adult patients with burns covering less than 20 percent of the TBSA, and for children with less than 10 percent TBSA, a general hospital diet should meet their nutritional needs (Henley 1989). However, more often than not, there are other factors that affect the patients ability to consume foods adequately, and so each patient must be assessed individually. The patient may have a decreased appetite, or may be suffering nausea or vomiting, they may not be able to transfer food to their mouth due to burns to their hands or arms, and frequent surgical procedures may mean fasting prior to administration of the anaesthetic. These, together with the increased energy and protein needs of the burn patient, indicate a need for alternative modes of nutritional support, namely parenteral nutrition, or enteral tube feeding.

The known risks of catheter placement for total parenteral nutrition (TPN), pneumothorax, bleeding, increased risk of infection and sub-acute bacterial endocarditis are well documented. So too is the increased cost of TPN over enteral nutrition. Whilst parenteral nutrition may provide an effective route for nutrient administration in burn patients, this method has been associated with bacterial translocation more often than enteral administration of nutrients, and hence, an increased possibility of sepsis (Kudsk, Croce, Fabian, Minard, Tolley, Potret, Kuhl and Brown 1992).

At a time when weight loss of 30 percent was common in burn patients on a maximum oral diet (Muller and Herndon 1994), parenteral nutrition was thought to be useful, particularly in the early post burn period when achieving an adequate energy intake is difficult. In addition to providing nutrients, it was also thought to allow time for the resolution of post burn ileus. Despite this apparent concern with the functioning of the gastrointestinal tract, its role during severe stress, and in the prevention of sepsis, was largely ignored. The gastrointestinal tract was inappropriately perceived as a 'dormant organ' (Moore and Moore 1991).

From their research of TPN, Herndon, Stein, Rutan, Abston and Linares (1987) found that parenteral supplementation of oral intake provided no apparent beneficial effect on immune function, liver function or survival statistics. They discouraged the utilisation of TPN particularly in the early post burn period, after finding a significantly lower helper/suppressor T lymphocyte ratio in patients receiving parenteral nutrition. This has particular relevance to the immune function of the burn patient.

When this regimen was again tested in a controlled trial, mortality was much higher in patients who were intravenously supplemented, than those who were given the maximum amount of energy that could be tolerated enterally (Herndon, Barrow, Stein, Linares, Rutan, Rutan and Abston 1989). This finding is supported by Moore and Moore (1991), who found patients receiving early

TPN had a higher incidence of septic morbidity than those patients receiving early enteral nutrition. Herndon et al. (1989), concluded that the administration of intravenous supplementation, only serves to decrease the amount of enteral feeding that can be tolerated. They recommend that intravenous nutrition be restricted to patients whose enteral function has failed totally.

Increased intestinal permeability in burn patients is thought to be partly responsible for the bacterial translocation, a possible prelude to multiple organ failure following trauma (Deitch 1990b). The exact mechanisms by which thermal injury alters intestinal permeability is yet to be determined. Enteral feeding has been shown to increase gut mucosal blood flow, maintain the structural integrity of the mucosa, and suppress the rise in the level of the stress hormones (cortisol and glucagon) (Mochizuki et al. 1984a). Thus, enteral feeding, in complete contrast to TPN, has been found to assist in maintaining intestinal mucosal integrity, and diminishes the transfer of bacteria across the intestinal wall into the lymphovascular system. Furthermore, Inoue, Epstein, Alexander, Trocki, Jacobs and Gura (1989), demonstrated that a single bolus of tube feeding 12 hours following a thermal injury markedly decreased the translocation of *Candida albicans* in an animal model.

The timing of nutrient administration has also been found to be important in preventing intestinal atrophy. Gianotti, Alexander, Nelson, Fukushima, Pyles and Chalk (1994), found that by using enteral feeding during the early post trauma period in animals, they were able to prevent tissue hypoperfusion, the release of immunosuppressive mediators and catabolic hormones, resulting in improved clearance of translocating bacteria, as early as 24 hours. According to Gianotti et al. (1994), the beneficial effect of the early enteral feeding in reducing infection and septic complications, may be ascribed to two interacting mechanisms:

> a) a local effect due to the maintenance of the gut barrier function, limiting the passage of enteric organisms and endotoxin; and
> b) a systemic effect linked to augmentation of host defense and bacterial killing (Gianotti et al. 1994:271).

The post burn ileus was initially thought to contraindicate the use of enteral feedings for several days following burn injuries. Bell and Wyatt (1986) recommended that an enteral diet should not be commenced sooner than 48 to 72 hours, to ensure the resolution of the post-traumatic ileus. It is now known that the ileus is confined to the stomach and colon, and that the absorptive capacity and function of the small intestine generally returns within hours (Phillips and Olson 1993). It is suggested that even during gastric ileus, a feeding tube placed in the upper third of the small intestine makes enteral nutrition possible.

Some protocols have implied that the placement of a transpyloric feeding tube is mandatory for patients with moderate sized burns to promote early feeding (Lown 1991). McArdle et al. (1984), demonstrated safe and efficacious enteral feeding of patients within 48 hours of sustaining a burn injury of 40 to 70 percent TBSA. They found no significant complications with feeding into either the lower duodenum, or the upper jejunum, and achieved a positive nitrogen balance within ten days. The beneficial effects were also reflected in improved serum proteins, blood profile, and immunocompetence. A more recent study by Hansbrough and Hansbrough (1993), investigated the feasibility of very early enteral feeding via a nasogastric feeding tube, rather than a tube placed across the pylorus. These patients experienced less than ten percent weight loss during acute hospitalisation.

It is appropriate to note that nasogastric feeding was the preferred mode for 72 percent of dietitians responding to Williamson's questionnaire (1989b), while 26 percent preferred nasoduodenal feedings. One unit reported using jejunostomy feedings as a standard practice for burns greater than 50 percent TBSA (Williamson, 1989b).

There are many physiologic benefits which favour immediate enteral feeding in burn patients. The question of whether early enteral feeding diminishes the hypermetabolic response has been a focus of research, with a number of positive conclusions being made. The observation that enteral, but not parenteral feeding immediately after a burn injury markedly attenuates the hypermetabolic response has been supported by a number of studies (Mochizuki et al. 1984a; De Michele, Karlstad, Bistran, Istfan, Babayan and Blackburn 1985; Mc Donald, Sharp and Deitch 1991). Additionally, Chiarelli et al. (1990:1038) also found that early enteral feeding helps 'to prevent burn induced increase of catecholamine and glucagon secretion, leading to an improved control of the hypercatabolic state and an improved clinical course for burned patients'. Early enteral feeding also 'induces early stabilisation of biological membranes and encourages anabolic processes' (Sologub, Zaets, Tarasov, Mordkovitch and Yashin 1992 :249).

2.6 Pediatric patients

A pediatric burn patient has an increased need for energy for growth, development and tissue repair. Children are known to have a higher resting metabolic rate than adults, but their increase is smaller in response to a burn injury (Shaw and Lawson 1994). The extent of weight loss during the post burn period in children who are entering, or are at a phase of rapid brain and somatic growth, is not yet established (Childs, Hall, Davenport and Little 1990). Childs et al. (1990) hypothesised that weight loss at this stage, may mean a fall in trajectory growth. According to Solomon (1981), pediatric patients should continue to gain weight, as weight loss is a reflection of poor dietary management in children. Monitoring growth using percentile charts is necessary, noting weight and height for age, and ideal weight for height.

As with energy calculations from adult formula, the calculation of energy requirement for pediatric patients is problematic. A child's requirement cannot be assessed using adult formulae (Solomon 1981). Researchers have reported that burn hypermetabolism is lower in adult burn patients than previous estimates (Saffle et al. 1985; Ireton et al. 1986). It is possible that this is also true for pediatric burn patients.

Thomson, Bucolo, Quirk and Shepherd (1995) compared the use of equations such as the Schofield equation, the Harris-Benedict equation and the FAO/WHO/UNU equation, with measured values in healthy infants, and in those with cystic fibrosis. The team found that compared with measured values, predicted REE values varied markedly between the equations. The equations tended to overestimate REE in healthy infants, and underestimate REE in those with cystic fibrosis, except for the Harris-Benedict equation. The authors concluded that they could not rely on any of the predictive equations to give accurate estimates of REE for individual infants, particularly in disease states (Thomson et al. 1995). A child with cystic fibrosis is likely to have an increased energy requirement of 110 to 150 percent of the recommended dietary intake (RDI) (Daniels and Thompson 1990), which would be metabolically similar to a child with burns. Thus, similar conclusions regarding the energy equations can be made for children with burn injury.

Generally, equations developed specifically for children use a constant weight per kilogram, irrespective of the childs age (cited in Solomon 1981). This assumes that these children have the same energy needs. Solomon (1981) developed a formula for pediatric burn patients that provided daily basic energy and protein requirements, based on the age of non burned children from various literature. In addition, extra energy, 30 kcal/ percent burn surface area, and extra protein, 1.5 g/ percent burn surface area were prescribed (See Appendix 3). Like the adult energy equations, these formulae should only be used as a guideline. A fortnightly review of the burn area is necessary in order to adjust the nutritional care plan.

When pediatric patients are consistently unable to take 75 percent of their energy needs, O'Neil, Hutsler and Hildreth (1989) recommend overnight tube feeding. If a child is unable to tolerate enteral nutrition for more than two to three days, TPN is required. As with adults, early enteral feeding is possible. Engelhardt and Clarke (1994) were able to maintain admission weight in a case of a three year old burn patient who was fed into the duodenum for two weeks following the injury. Whilst there were difficulties in establishing the enteral feeding regimen, this did not prevent achievement of positive energy and protein balance.

2.7 Conclusion

Ultimately, with so much new research in the area of burns and nutritional support, there is a need to examine current practice of dietitians responsible for burn patients. This analysis of the literature has shown that there are benefits of aggressive nutritional support in terms of health outcome. Additionally, there are tremendous cost savings associated with early initiation of nutritional support combined with the expertise of a nutrition team.

CHAPTER 3

Method

Australian dietitians responsible for the mangement of burn patients were invited to participate in the study between July to October 1995. Each received a letter of invitation outlining the purpose of the study, a nutritional management of burns questionnaire and a pre- paid self addressed enveloped. Refer to Appendix 1 for the Nutritional Management of Burns questionnaire used in this study. The participants were given two months to return the completed questionnaire to the researcher. This method of data collection was also used by Williamson (1989a, b) and Fakhry et al. (1995) when they surveyed the nutritional management of burn patients in the United States and Canada.

Self-administered questionnaires have the advantage of ensuring standardisation of measurement, where all subjects are asked precisely the same questions. There is however, a problem of bias when participants do not return the survey. A response rate of 22 percent and 60 percent respectively were obtained from the aforementioned studies (Williamson 1989a, b; Fakhry et al. 1995). According to Dillman (1978), an average response rate for mailed surveys is 74 percent. However, for this specialised population, a slightly higher response rate of 77 percent could be expected (Dillman 1978).

Burn injury are classified according to the percentage of TBSA (Clarke 1992). The survey of burn patient management in the United States and Canada used two divisions, less than 20 percent TBSA, and greater than 20 percent TBSA (Williamson 1989b). Three divisions: less than 20 percent TBSA, 20 to 40 percent TBSA and greater than 50 percent TBSA, presents a clearer trend in the changes in nutritional requirements and the feeding route to be utilised. This classification system is not exhaustive and whilst it allows one to examine how the dietitian plans and implements nutritional management according to the severity of the burn injury, more precise categories would be suggested for future investigations. In this respect the researcher suggests three divisions: less than 20 percent TBSA, 20 to 50 percent TBSA and greater than 50 percent TBSA.

3.1 The sample population - definition and recruitment

Hospitals throughout Australia were selected on the basis that burn patient care is offered as a *medical service* (Australia's Major Hospitals Directory, 1994). There were however, a number of hospitals not included in the aforementioned reference which were eligible to participate in this study. Eligibility was clarified when the hospital was contacted by telephone prior to sending the questionnaire. This telephone contact also allowed the researcher to invite the dietitian to participate in the study. The final sample population included thirty hospitals from all States and Territories of Australia.

3.2 The survey

The questionnaire was developed after lengthy discussion with the supervising dietitian who specialises in burn patient care, and the academic supervisor. A draft questionnaire was prepared and piloted with seven dietitians at Concord Repatriation Hospital, Sydney. Although these dietitians were not currently specialising in burn patient management, most have had experience in the area. The questionnaire was presented on overheads for group discussion and the final draft was presented to the Chief Dietitian at Concord for evaluation. The group accepted the use of the three burn classifications to examine the nutritional requirements of burn patients. The University Statistical Service was also consulted to ensure that scoring categories would facilitate data analysis.

3.3 Research strategies - methods and procedures

A self addressed envelope was included with each questionnaire in an attempt to improve the response rate. Each envelope was coded so that hospitals which had not responded after three weeks were sent reminder letters. See Appendix 2 for the follow-up letter used in this study.

3.4 Ethical considerations

Approval to conduct this research was granted by the University of Wollongong Ethics Committee. All subjects were informed of the intent of the study, and were free not to participate. Return of the questionnaire was taken to be an indication of consent to participate. All information supplied remained confidential.

3.5 Data Analysis

Due to the nature of the data, a descriptive statistical analysis was performed. Data was entered into a spread sheet (Excel Microsoft version 4.0: Copyright 1985-1992). The Statistical Consulting Service at the University of Wollongong was consulted.

CHAPTER 4

Results

Of the 30 questionnaires sent to dietitians, four were not returned. Of the 26 that were returned, three questionnaires were incomplete. This is a response rate of 86.7 percent and a participation rate of 76.7 percent. As the sample size for this study is small, participants were not excluded if they returned a questionnaire with some missing data, as each item in the questionnaire was interpreted independently. The researcher was not able to contact all participants prior to sending the questionnaire, hence there were three participants (10 percent) who received a questionnaire and were no longer managing burn patients.

4.1 Demographics

All but one hospital had over 100 beds. Most (52.1 percent) had between 200 and 500 beds. Eight (34.8 percent) of the participating hospitals had more than 500 beds. Twenty one (91.3 percent) are dietetic training facilities.

Ten of the participating hospitals treated adults only (43.5 percent). Nine hospitals treated both adults and pediatric patients (39.1 percent) and four hospitals treated pediatric patients (17.4 percent). Table 4.1 presents the numbers of in-patients with burns admitted to the hospitals each year.

Table 4.1. Number of burn patients admitted to the responding hospitals (n = 23).

Burn Patients per year	Frequency of responses	Percent of responses
< 20	7	30.4
20 - 50	3	13.0
51 - 100	4	17.4
> 100	9	39.1

Participants were asked to indicate the dietetic staff time allocated for the burn service. The mean was seven hours per week. Seven (30.4 percent) dietitians stated that they provide service on a referral basis. Dietitians have been working in the area of burn services ranging from four months to 30 years, with a mean of four years.

Seven (30.4 percent) of the participants surveyed required a referral from a doctor to assess a burn patient's nutritional status. Most often, a nutritional care plan would be implemented within two to 48 hours of hospital admission. Two hospitals (8.7 percent) reported that a delay may occur with patients who have burns to greater than 50 percent of the total body surface area (TBSA), as they are resuscitated in intensive care, and consequently, may not be in the care of the dietetic department within the 48 hour period. One dietitian highlighted that a nutrition care plan would be implemented within 24 hours for all burn classification levels.

4.2 Energy requirements

All the dietitians use equations to calculate the estimated energy requirements of their patients. Five equations are used for adult burn patients, with the Schofield and Harris-Benedict equations being used most often. Dietitians use six different equations for pediatric burn patients, with the Solomon equation being used most often. Table 4.2 presents the formulae used to estimate energy requirements for both adult and pediatric patients.

Table 4.2. Formulae used by dietitians to estimate energy requirements for adult (n = 19) and pediatric patients (n = 13). See Appendix 3 for equations.

Ranking	Frequency of responses	Percent of responses
ADULTS		
1. Schofield equation	10	43.5
2. Harris-Benedict	10	43.5
3. Curreri equation	4	17.4
4. Harris-Benedict (MODIFIED)	3	13.0
5. Own equation	1	4.3
PEDIATRICS		
1. Solomon equation	2	25
2. Curreri	1	8.3
Schofield	1	8.3
Harris-Benedict	1	8.3
DAA Handbook	1	8.3
Own equation	1	8.3
** No response	6	46.2

* Percentages totalling more than 100 indicate multiple responses accepted.

Eight (34.8 percent) of the dietitians used more than one energy equation. Most often, participants reported this was to provide a range for estimating energy requirements, rather than a single figure. Two respondents commented that the use of two equations was necessary in order to provide an upper and lower limit to monitor their nutrition care plan. Table 4.3 presents the injury factor used for each level of burn injury.

Table 4.3. Injury factor and percent TBSA burn (n = 23).

Percent burn	Injury factor	Number of responses	No response
< 20 %	1.3	15	4
	1.5	4	
20 - 40 %	1.5	16	5
	1.7	1	
	2	1	
> 50 %	1.5	2	5
	2	15	
	> 2	1	

** Two participants noted that their response to this question was inappropriate since the Solomon equation does not utilise an injury factor.

Dietitians were asked which body weight is used to estimate a patient's energy requirements. The majority of the dietitians answering this question used the patient's reported weight as their choice for both adult and pediatric patients. Ideal weight was used by seven hospitals (36.8 percent) for adults, and by five hospitals (38.5 percent) for pediatric patients. Admission weight was used by three hospitals (15.8 percent) for adults and by five hospitals (38.5 percent) for pediatric patients. Table 4.4 presents this data, including variations preferred by dietitians not included in the questionnaire.

Table 4.4. Preferred measure of body weight for adult (n = 19) and pediatric patients (n = 13).

Preferred Weight	Frequency of responses	Percent of responses
ADULTS		
1. Patients reported weight	11	57.9
2. Ideal weight	7	36.8
3. Admission weight	3	15.8
4. Ideal weight + 10 %	1	5.3
PEDIATRICS		
1. Patients reported weight	8	61.5
2. Admission weight	5	38.5
3. Ideal weight	3	23.1
4. Ideal weight in relation to height	1	7.7

* Percentages totalling more than 100 indicate multiple responses accepted.

4.3 Nutrition goals for macro and micronutrients

Dietitians were asked to state their goals for macronutrients as a percentage of the total energy to be provided for adult and pediatric patients at three burn classifications (less than 20 percent TBSA, 20 to 40 percent TBSA and greater than 50 percent TBSA).

Twelve (52 percent) dietitians described the nutrition goals as a percentage of total energy. Hence, the average was used to determine the mean for each macronutrient. In the case of protein, five (21.7 percent) dietitians stated that they used grams per kilogram body weight, rather than a percentage of the total energy. Consequently, in order to interpret the data, both the mean percentage, and the mean number of grams of protein are reported in Table 4.5 for adults, and Table 4.6 for pediatric patients. It should be noted that five participants did not attempt to record macronutrient goals for adults, and five participants did not record any goals for pediatric patients.

Table 4.5. Goals for macronutrients for adult patients presented as averaged total response (n = 19).

Percent burn	PROTEIN	FAT	CARBOHYDRATE
< 20 %	17.0% (1.6 g/kg)	30.3%	52.8%
20 - 40 %	20.2% (2.2 g/kg)	32.5%	49.8%
> 50 %	23.9% (2.4 g/kg)	32.5%	46.9%

* Percentages for protein, carbohydrate and fat do not add to 100 as these are averages.

Table 4.6. Goals for macronutrients for pediatric patients presented as averaged total response (n = 7).

Percent burn	PROTEIN	FAT	CARBOHYDRATE
< 20 %	21.3% (3.6 g/kg)	33.8%	48.8%
20 - 40 %	23.3% (3.6 g/kg)	32.5%	47.5%
> 50 %	28.1% (3.6 g/kg)	31.3%	47.5%

* Percentages for protein, carbohydrate and fat do not add to 100 as these are averages.

Sixteen dietitians (73.9 percent) reported that the hospital provided burn patients with micronutrient supplements. Both adults and pediatric patients were most commonly given zinc, vitamin C and a multivitamin. Vitamin A was less likely to be provided as a single supplement, but, as one participant commented, this vitamin would be present in the multivitamin supplement. Three dietitians (13 percent) reported that supplementation was not routine.

4.4 Nutrition support systems

The question about feeding route was divided into three parts; namely, less than 48 hours, 48 to 72 hours, and greater than 72 hours. Each question was further divided into the three levels of burn classification as previously outlined. Nasogastric feeding was used less than 48 hours following hospital admission most often for burns over 50 percent TBSA.

Comparatively, five burn services (21.7 percent) used nasogastric feeding for burns less than 20 percent TBSA, whereas 15 burn services (65.2 percent) used this form of nutritional support for burns greater than 50 percent TBSA. This trend is indicative of the variation in the nutritional management of burns over 20 percent TBSA, compared with burns less than 20 percent TBSA, whereby the oral route is utilised if at all possible. The use of the oral route for burns less than 20 percent TBSA, and the use of nasogastric enteral feeding for burns over 20 percent TBSA was also observed at 48 to 72 hours, and again after 72 hours.

Nasoduodenal feedings are used by one burn service for burns greater than 50 percent TBSA in the time period from 48 hours onwards. Similarly, the nasojejunal route is used by three burn services for burns greater than 50 percent TBSA.

Peripheral parenteral nutrition was used routinely by one service for all burns within the first 48 hours of admission. TPN was used more often than the peripheral route, mostly for burns over 50 percent TBSA, and to a lesser extent, for burns 20 to 40 percent TBSA.

The oral route was utilised by 20 burn services (87.0 percent) with less than 20 percent burns. Oral feeding of burns greater than 20 percent TBSA increased gradually as time progressed. Oral diets are often supplemented with a number of high energy, high protein foods or fluids. Twenty two different foods or fluids were listed as being used to supplement the diets of burn patients. Table 4.7 lists the variety of supplements.

Table 4.7. High energy, high protein supplements (n = 23).

Ranking	Number of responses	Percent of responses
Milk shakes	17	73.9
Milk	17	73.9
Ice-cream	17	73.9
Yoghurt	16	69.6
Cheese	13	56.5
Glucose polymer	12	52.2
Sustagen Hospital formula	11	47.8
Skim milk powder	9	39.1
Protein powder	8	34.9
Ensure plus HN	4	17.4
Fortisip	4	17.4
Sustagen Gold Plus	3	13.0
Cream	3	13.0
Custard	2	8.7
Sandwiches	2	8.7
Nuts	2	8.7
Ensure	2	8.7
Fruche	2	8.7
Eggflip	1	4.3
Extra Fat	1	4.3
Cooked breakfast	1	4.3
Biscuits	1	4.3
Kangaroo meat	1	4.3

* Percentages totalling more than 100 indicate multiple responses accepted.

4.5 Enteral tube feeding

Dietitians were asked to list the tube feeding formula used regularly for burn patients. Table 4.8 depicts the thirteen formulae that were listed for adults, and Table 4.9 displays the ten formulae listed for pediatric patients. Overall, Traumacal was the most often used enteral feeding formula.

Table 4.8. Enteral tube feeding formula used by dietitians for adult burn patients (n = 19).

Formula	Cals/ml	Number of responses
Traumacal	1.5	5
Sustagen Gold Plus	1.5	4
Ultracal	1	4
Isocal	1	2
Ensure Plus	1.5	2
Two cal HN	2	2
Deliver 2.0	2	1
Osmolite	1	1
Ensure Plus HN	1.5	1
Isocal HN	1	1
Jevity	1	1
Osmolite HN	1	1
Nepro (burn patients in renal failure)	2	1

* Four participants did not provide a response.

Table 4.9. Enteral tube feeding formula used by dietitians for pediatric burn patients (n = 13).

Formula	Number of responses
Modified infant formula (1.25 conc.)	3
Ultracal	3
Jevity	2
Isocal	2
Sustagen Gold Plus	2
Traumacal (over 10 years)	2
Ensure 1.2 - 1.5 conc.	1
Osmolite (children)	1
Deliver 2.0	1
Ensure Plus	1

* Three participants did not provide a response.

Tube feeding was most often commenced within two to 48 hours of hospital admission for all burn classifications, indicating that early enteral feeding is prevalent. Often tube feeding of burns less than 20 percent TBSA was delayed until after 48 hours. One unit commenced tube feeding in under two hours for burns over 20 percent TBSA. This hospital admits around 200 burn patients per year.

Fifteen (65.2 percent) dietitians do not have a specific tube feeding regimen for burn patients. For those who do have a specific regimen for burn patients (21.7 percent), the variation accounted for regular theatre visits, recommendations for supplements of zinc, vitamin A and vitamin C, increased fluid, and is specialised for critically ill patients, that is, tube feeding is always commenced using continuous feeds via a feeding pump. Only one unit commented that they routinely initiate tube feeding within 24 hours of admission for all burn patients.

Dietitians were asked how often enteral tube feeding is used with burn patients. Thirteen dietitians (56.5 percent), said that enteral tube feeding is used with less than 50 percent of patients that have burns to less than 20 percent of the body surface area. Fifty to 100 percent of patients with burns covering 20 to 40 percent of their body were tube fed according to nine (39.1 percent) of the dietitians in this study. Twelve (52.2 percent) always tube feed patients with burns over 50 percent TBSA burn. This response emphasises that patients with larger burns are being enterally tube fed most often, an aspect that will be discussed in the next chapter.

4.6 Nutrition assessment and monitoring

This section comprised two questions relating to nutritional indicators used for assessing and monitoring during the first month of care and subsequently.

Of all the indicators listed, weight, serum albumin, serum creatinine and blood sugar levels (BSL's) are most frequently used. In the first month of care, weight is measured weekly, and serum creatinine and BSL's daily. Six dietitians (26.0 percent) monitor serum albumin daily, six (26.0 percent) monitor twice weekly and six (26.0 percent) monitor weekly. Skin fold thickness and mid arm muscle circumference are used by two burn services (8.7 percent). Six dietitians (26.0 percent) use serum transferrin and four (17.4 percent) use serum prealbumin during the first month, despite being known as a more sensitive nutrition indicator for burn patient management. Six dietitians (26.0 percent) utilised urinary nitrogen.

Indicators not included in the questionnaire list, such as protein, haemoglobin and serum zinc were listed as additional indicators. Only one dietitian (4.3 percent) routinely monitors these indicators. Oral intake is measured twice weekly by one dietitian. Likewise, arm muscle area and arm fat area is measured by only one dietitian (4.3 percent) on a weekly basis for both the first, and subsequent months of care.

During the second month of care, fewer nutritional indicators are measured. Body weight remained the most frequently used nutritional indicator, with thirteen dietitians (56.5 percent) weighing burn patients on a weekly basis. In the subsequent months of hospitalisation, 18 dietitians (78.3 percent) monitor serum albumin, 14 dietitians (60.9 percent) monitored serum creatinine and 12 dietitians (52.2 percent) monitor BSL's.

Seven dietitians (53.8 percent) working with pediatric burn patients use percentile charts during in the first month of care. During the subsequent month(s) the use of percentile charts decreased to five (38.5 percent). Some dietitians commented that these charts are used only for department records for long term follow up of pediatric patients.

4.7 Post discharge nutrition reviews

Eighteen dietitians (78.3 percent) do not routinely review burn patients post discharge. Dietitians commented that staffing constraints (16.7 percent) and inadequate time (22.2 percent), are limitations for providing a routine out-patient burn service. In addition, dietitians (44.4 percent) considered this unnecessary, as patients are generally fully recovered at discharge. Only one dietitian (4.3 percent) reported that post discharge nutrition services are routinely provided for this group of patients. Five burn services (27.8 percent) report that follow-up appointments are made on a referral basis, by a medical officer or surgeon as appropriate. As patients are most often referred for undesirable weight gain following discharge from hospital, body weight and percentile charts are the most commonly used assessment tools.

CHAPTER 5

Discussion

The purpose of this research was to investigate the current nutritional management of burn patients by Australian dietitians using a questionnaire. Williamson (1989a, b) and Fakhry et al. (1995), have previously investigated the nutritional management of burn patients in the United States and Canada using the same method.

As in Williamson's study (1989a, b), the survey population comprised of dietitians working in hospitals where a burn service is provided. Hospitals were identified using Australia's Major Hospital Directory (1994). This resource did not provide an exhaustive list of all the hospitals eligible to participate. Also, it identified some hospitals as providing a burn service when the dietitian reported that burn patients were routinely transferred to larger centres. This would indicate that the dietitian was not involved in the immediate care of the patient.

The response to this study exceeded response rates for both of the studies conducted in the United States and Canada (Williamson 1989a, b; Fakhry et al. 1995). By the due date, 63 percent of the questionnaires had been returned. A follow-up letter encouraged subjects to respond. This further increased the response rate to 86.7 percent. While using the same survey techniques, Williamson

(1989a, b) and Fakhry et al. (1995) achieved a response rate of 22 percent and 60 percent respectively.

5.1 Demographics

Since most of the hospitals surveyed have between 200 and 500 beds, it is apparent that a burns service is most often associated with larger hospitals, more often in a metropolitan than a rural area. The majority of the hospitals were described as dietetic training facilities, hence dietetic students in training are being exposed to the nutritional care of critically ill patients. Whether the wide range in the number of burn patients admitted to these hospitals was associated with the size of the hospital, that is, the total bed numbers, was not addressed in this study.

The clinical experience of dietitians working with burn patients ranged from four months to thirty years. This study shows that dietitians are working an average of four years in the area of nutritional management for burn patients. Williamson (1989a) has commented that dietitians working in the area of burns management also provide a service for other hospitalised patients. Consequently, the significance of clinical experience in solely managing burn patients would not be relevant.

The amount of time dietitians work in the burn service also varied. Dietitians responsible for major burn services are likely to have a specific length of time allotted for providing nutritional care for these patients. Conversely, dietitians in hospitals where the treatment of burn injuries is more infrequent would not have the same opportunity to develop their skills. Ultimately, both the experience of the dietitian, and the time set aside for working in the area of burns would be expected to impact on the quality of service provided to this group of patients. However, this study did not address this issue, and consequently, this is a question for future research.

Seven units (30.4 percent) require a physician referral prior to dietetic assessment. It is assumed that most dietetic departments would be notified of a burn patient admission by the clinical unit, or the ward directly. The necessity for a physician referral may have implications for the nutritional management of the patient. It is possible that the early involvement of a dietitian depends on the physician's knowledge and attitude towards aggressive nutritional support. It may be that the dietitian can assess a patient sooner if a referral from a physician is not required, or, if an open referral applies to the whole burn care team. Alternatively, the dietitian may not be considered an essential part of the medical team in the resuscitation phase. It would be interesting in future research to examine a possible relationship between the timing of the referral, and the implementation of the nutrition care plan. Early referrals may significantly influence patient outcome and the duration of care, as does the early introduction of enteral feeding (McArdle et al. 1984; Chiarelli et al. 1990; Moore and Moore 1991; Garrel et al. 1991). The dietitian is able to assess the patient and provide expert advice on the appropriate feeding plan to meet the patients nutritional requirements.

5.2 Energy requirements

All dietitians used equations to estimate their patients' energy requirements, despite the controversy over which equation most accurately predicts the energy requirements for burn patients. The problem lies partially with the static nature of the equations, while the actual metabolic response to burn injury is dynamic. A crescendo - decrescendo pattern follows the injury, while many equations do not account for these variations in metabolic rate. The three major equations used by Australian dietitians were the Harris-Benedict equation, the Schofield equation, and to a lesser extent, the Curreri equation. Both the Harris-Benedict and Schofield equations were devised from data collected from healthy adult populations. It is possible that the preference for these equations, over the Curreri equation, indicates that dietitians are aware of the Curreri equation's potential to overestimate energy requirements. Alternatively, it may suggest that burn patients are being treated similar to other hospitalised patients.

In order to account for the stress caused by the burn injury, an appropriate injury factor is to be used with the Harris-Benedict and Schofield equations. Most often with burns of less than 20 percent TBSA, an injury factor of 1.3 was used by dietitians. With 20 to 40 percent burns, 1.5 was used, and with burns greater than 50 percent TBSA, a factor of two was used most frequently. These practices are consistent with the current recommendations (Hildreth et al. 1990; Paulsen and Splett 1991; Mainous and Deitch 1994). One dietitian used an injury factor greater than two for burns greater than 50 percent TBSA which may be inappropriate, as over feeding can lead to hepatic steatosis (Turner et al. 1985; Ireton et al. 1986; Saffle et al. 1990).

None of the dietitians mentioned the use of the new Toronto formula designed specifically for burn patients. This equation was reported by Allard et al. (1990) as the most accurate equation in estimating energy requirements when compared with measured energy expenditure. Whilst this equation is complex, and requires more variables than the Harris-Benedict or Schofield equations, it has the benefit of being able to take into account the daily energy fluctuations experienced by the burn patient. From this study, it cannot be established why dietitians did not use this equation. It may be that this equation is not well known to dietitians, as it was developed very recently and to this point, has not been extensively used in the literature.

The energy needs of pediatric patients in Australia are most frequently estimated using the Solomon equation (1981). The Solomon equation uses age, weight and percentage burn surface area to guide the practitioner in determining the energy requirements of the pediatric burn patient. There are no research studies that assess the accuracy of this equation. Solomon (1981) commented that there are some advantages to estimating energy needs based on the normal surface area of a child rather than weight alone. However, surface area depends on both weight and height measures. According to Solomon (1981), height in a young burned child can be imprecise, and weight is affected by hydration status and other factors associated with the total management of the patient. It is important to emphasise that this equation should be used only as a guide to estimate energy requirements, and these requirements should be reviewed and adjusted fortnightly, taking into account wound healing.

Eight dietitians (34.8 percent) use more than one equation to estimate energy requirements. Seventy-five percent of dietitians reported that this was to provide a range of estimated needs. Williamson (1989b) commented that by using more than one equation, dietitians are able to establish a range, rather than an absolute value in estimating the energy needs for burn patients. This practice allows safe limits for intake goals to be established, and allows for fluctuations in food intake.

While Australian dietitians prefer to use the patient's reported weight in calculations, American and Canadian dietitians often used body weight upon hospital admission. Consequently, Williamson (1989b:193) commented that 'if the patient had already received multiple litres of resuscitation fluid, using admittance weight could explain why a burn patient's energy needs might be overestimated'. The patient's usual or reported weight is the most appropriate choice when the patient is of a healthy weight.

5.3 Nutrition goals for macro and micronutrients

Nutrition goals for burn patients are inconsistent in the literature. However, it is important to note that Australian dietitians provided similar nutrient goals to their United States and Canadian counterparts (Williamson 1989b).

The average goal for energy supplied as protein for burn patients was within the recommended range of 20 to 25 percent for adults with burns greater than 20 percent TBSA. For burns less than 20 percent TBSA, respondents in this study, and in Williamson's (1989b), provided an average of 17 percent of energy as protein. A greater percentage of energy was contributed from protein in proportion to the size of the burn injury. Regardless of the extent of the injury, the goal for fat was always greater than 30 percent of the total energy, despite lower levels being suggested as beneficial in the literature (Mochizuki et al. 1984b; Gottschlich et al. 1990; Selleck et al. 1994). The goal for carbohydrate contribution was similar to Williamson's findings (1989b), that is, close to 50 percent of the total energy.

The nutrition goals for pediatric patients were similar in some respects to those for adult patients. However, there was a greater contribution from protein for burns greater than 50 percent TBSA. The provision of fat, as with adult patients, exceeded 30 percent of the total energy. Carbohydrates make up 50 percent of the total energy.

The provision of macronutrients is most probably a result of the practicalities associated with having to provide such high energy diets to burn patients, whilst also being related to commercial feed composition. With considerably elevated energy needs, burn patients may have problems consuming adequate energy from a diet containing 30 percent fat, let alone a diet containing even lower levels. Additionally, most commercially prepared tube feeds provide well over 30 percent of energy as fat (Mochizuki et al. 1984b).

Most dietitians (57.9 percent) provided their burned patients with vitamin and/or mineral supplements. These supplements consisted of zinc, vitamin C or a multivitamin. There are no established benefits for specific micronutrient supplements for burn patients. Despite this, the practice of routine supplementation for burn patients is accepted in current literature (Bell and Wyatt 1986; Ireton-Jones and Baxter 1991). Since the dose of each supplement was not covered in this questionnaire, it is unknown how significantly each micronutrient contributes to the patient's overall intake. This would be an area for future research, as supplementation without an apparent benefit to the patient is not justified. In addition, over-supplementation of vitamin C and trace elements, particularly aluminium, can exacerbate renal failure in susceptible patients (Klein et al. 1990; Dylewski and Froman 1992; Selmanpakoglu et al. 1994).

5.4 Nutrition assessment and monitoring

Some indicators of nutritional status have been shown to be more accurate than others. The distortion of results for burn patients is due to the nature of the medical treatments and surgical procedures. Consequently, the importance of serial measurements to monitor changes in the patient's clinical condition is imperative.

Body weight does not reflect true body composition, it is merely a sum of all body components. Consequently, body weight is a weak nutritional indicator for burn patients (Henley 1989). The actual body weight of a burn patient can be overestimated, due to oedema or dressings used to cover wounds. Alternatively, it may be underestimated, particularly if the patient has received multiple escharectomies (Bell and Wyatt 1986). Serial measures of body weight enhance the usefulness of this assessment tool. Henley (1989), suggests twice weekly weighing without dressings to minimise error. Only three dietitians (14.3 percent) used twice weekly weighings. Body weight was most commonly measured weekly, this may be due to the difficulties associated with weighing patients with severe burns as they may be immobile.

Anthropometric indicators may provide a more precise measure of nutritional status. However, Jensen et al. (1985) aptly pointed out the futility of skin fold and muscle circumference measures after conducting a study of burn patients where 92 percent had burns on their arms, precluding all such measures. Ultimately, the use of triceps skin fold and mid arm muscle circumference measures possess limitations for routine use (Henley 1989). The limited use of these tools is confirmed by the results of this study where two dietitians (8.7 percent) use mid arm muscle circumference and skin fold thickness respectively. Bell and Wyatt (1986) believe that arm anthropometry may be used effectively if the upper body is spared from burn injury. Although, it should be remembered that donor sites, used for skin grafts, will also preclude such measurements (Henley 1989).

Serum albumin and transferrin are used for many hospitalised patients. Again distortion of the measurements occurs with fluid shifts and protein loss, and is further exacerbated when the burn patient receives multiple transfusions. According to Bell and Wyatt (1986), primary excisional therapy and grafting will reduce the number of transfusions, and therefore, monitoring of serum albumin and transferrin may be useful. As in Williamson's study (1989b), body weight and serum albumin were the most commonly used nutritional indicators in Australia for monitoring a patients progress.

Alternatives such as serum prealbumin, respond to nutritional support faster than either serum albumin or transferrin (Brose 1990), however, very few burn units (n = 4) are using this test. This test has proven to be useful for burn patients primarily because it is not influenced by hydration status. Additionally, it is more sensitive to nutritional status. The reason dietitians are not using this test is unclear from this study. Future research should investigate the criteria for selecting nutrition indicators for assessing and monitoring the nutritional status of the burn patient. It is possible that the use of serum albumin over serum prealbumin is cost related.

Nitrogen balance studies may be an inexpensive means of evaluating nutritional support regimens (Konstantinides et al. 1992). However, there are significant nitrogen losses via the open wound in burn patients. Urine urinary nitrogen (UUN) was found to be a satisfactory indicator of total urinary nitrogen (TUN) (Milner et al. 1993). In addition, UUN is less expensive to perform. However, the estimation of TUN is very much dependent on the accuracy of the UUN measures. Despite research into the use of nitrogen balance studies, and the opinion that it is the "gold standard" for monitoring protein status (Milner et al. 1993), few burn services utilise this nutrition indicator (n = 7). As with all monitoring tools, regular assessment is necessary. Lehmann (1993) suggests that nitrogen balance be conducted at weekly intervals, and compared to the initial baseline measure, in order to monitor the nutritional status of the patient.

Whilst oral intake has not been included in the list of nutrition indicators, only one dietitian considered this as a monitoring tool for an effective care plan. The unpopularity of using this tool has been noted in Williamson's study (1989b), where it was reported that dietitians are not using this method of monitoring nutritional care. There are advantages of monitoring nutritional intake, especially for burn patients, who often must undergo several surgical procedures which interrupt enteral nutrition support. This method is also useful to assess if adequate fluid is being provided. Food intake charts can be completed by nursing staff, menu monitors or nutrition technicians. It would be useful if further research could address why dietitians are not using this method of assessment.

5.5 Nutrition support systems

It is not surprising that Australian dietitians emphasised the use of an oral diet for burns less than 20 percent TBSA. For all those patients with greater than 20 percent burns, a combination of enteral tube feeding and an oral diet was recommended. The nasogastric route was found to be the most common enteral nutrition route. Additionally, this study shows that enteral tube feeding, rather than parenteral nutrition was preferred by dietitians. Williamson (1989 a, b) and Fakhry et al. (1995), reported this same observation.

Nasoduodenal and nasojejunal tube feedings are used much less frequently than nasogastric feeding. This is probably due to the need for surgical placement of the feeding tube, and the need to repeat the procedure if the tube becomes dislodged. There is also a need for radiographic confirmation of tube placement. The nasoduodenal and nasojejunal route may be utilised if nasogastric feeding is poorly tolerated. The use of the gastrointestinal tract in preserving mucosal integrity and immunological functioning is imperative (Deitch 1990; Epstein et al. 1990; Tredget and Yu 1992; Gianotti et al. 1994). This means that the nasoduodenal and nasojejunal routes should be utilised in preference to parenteral nutrition for patients with burns.

Lown (1991) recommended transpyloric feedings for patients with even moderate burns. Gastric ileus is believed to be limited to the stomach and colon, hence transpyloric feeding is possible even during gastric ileus (Phillips and Olson 1993). More recently, the importance of placing tubes past the pylorus as a standard procedure has been moderated by the increasing emphasis on early initiation of enteral nutrition support. Hansbrough and Hansbrough (1993) found that in a study of very early enteral feeding, they were able to utilise the nasogastric route. This research is supported by current practice in Australia, where the early initiation of nasogastric feeding is the most frequently used route of nutrient administration for all burns over 20 percent TBSA.

Foods which are high in energy and high in protein are used to supplement a burn patients' oral intake. The use of oral food supplements must take into account the patients preferences, as well as providing variety. Dairy foods rated highly, suggesting patients' may tolerate these familiar foods in preference to commercial supplements, despite the associated increased labour costs and shorter shelf life of these supplements. This finding is similar to Williamson (1989b).

There was also a variety of tube feeding products. In this study, Traumacal was most often selected for use with burn patients. Thirty percent of burn services used this formula. Traumacal is a high nitrogen formulation and was developed for highly stressed patients. Traumacal contains 40 percent of its total energy as fat, and is typical of the commercial feeds available. According to research, this level of fat may be excessive (Gottschlich et al. 1988). In this study, the reason for using a particular kind of enteral feeding formula for burn patients has not been addressed. Consequently, it is not appropriate to recommend a specific formulation for this group of patients. It is also important to consider that what is occurring on an individual patient basis, could not be assessed by a survey. Hence, no one tube feeding formula will be considered to be ideal for burn patients.

Fakhry et al. (1995) found that tube feedings were started on day one by less than 30 percent of centres. This survey of Australian dietitians, found that tube feeding was most often commenced within two to 48 hours following hospital admission. Ultimately, this indicates that early initiation of tube feeding is occurring in

Australian burn centres. Patients who have burns that exceed 20 percent TBSA are more likely to be candidates for tube feeding. This is reinforced by the fact that 12 (52 percent) of the dietitians recorded that patients with burns over 50 percent TBSA are always tube fed.

Specific tube feeding regimens for burn patients were generally not used by dietitians. Perhaps this is related to the dynamic nutritional requirements of burn patients who require personalised feeding plans. There is a need to optimise all feeding time available to burn patients, as frequent surgical procedures require periods of fasting. Consequently, it is vital to ensure early tube placement, and to replace the feeding tube should it become dislodged in order to maximise the delivery of the feeding formula. For patients on an oral diet, mid-meal supplements should be available on patient request. Consideration of intraoperative feeding for burn patients has been considered in the United States (Lown 1991). Advancements in the management of critical care patients may see the same trend in Australia in the future.

5.6 Post discharge nutrition services

Most dietetic departments did not routinely provide nutrition review appointments for burn patients after their hospital discharge. Many dietitians (44.4 percent) considered review appointments unnecessary, as patients should be able to consume a nutritionally adequate diet upon discharge. Post discharge, patients are seen on a referral basis. The primary dietary concern is that whilst the patient remains in hospital, although their dietary intake is stable and adequate, the synthesis of somatic protein is likely to be retarded due to general inactivity. As a consequence, there are reports of burn patients becoming centrally fat towards the end of the hospitalisation period, which may be exacerbated post discharge (Muller et al. 1994). To prevent this problem, the dietitian should provide appropriate education for the burn patient focusing on the need for a nutritionally balanced diet to prevent excessive weight gain, with an emphasis on the importance of regular exercise.

CHAPTER 6

Conclusion

This study examined a number of issues in the nutritional management of burn patients. Firstly, there is a great variation in the overall nutritional management for the burn patient, which was also noted by both Williamson (1989b) and Fakhry et al. (1995). Variation arises from the clinical experience of the dietitian, the length of time allocated for providing nutritional care for burn patient, and the need for medical referrals.

Secondly, there is a need to examine and evaluate the equations used for estimating energy requirements and the nutrition indicators for assessing and monitoring nutritional status. The use of the Harris-Benedict and Schofield equations should be reviewed in light of the availability of a more recently validated equation designed specifically for burn patients, namely the Toronto equation. The use of serum albumin and body weight are used by dietitians here, and in the United States and Canada as the key indicators of nutritional status. For burn patients, these indicators should be interpreted according to the clinical condition of the patient. Serial measures should be used in order to monitor the patient's nutritional status. Additionally, serum prealbumin should be considered, as it reflects the nutritional status of burn patients more accurately than both serum albumin and transferrin (Brose 1990).

Thirdly, there is need to promote the role of the dietitian to all health professionals. The role of nutritional support in improving patient outcome has been commended as one major factor in influencing the survival of many patients with severe burn injury. In this respect, the dietitian has a major role in contributing expertise in assessing and in providing nutrition care plans for this group of patients. Ideally, feeding should be initiated as early as possible after hospital admission. Early enteral nutrition support has played a significant role in burn survival. Dietitians need to be proactive in promoting and implementing nutritional care plans, in order to enhance patient recovery and to achieve more positive patient outcomes.

CHAPTER 7

Limitations of the study

7.1 Validity and reliability of the survey

It is necessary to note that this questionnaire is intended to establish baseline data of the nutritional management of burn patients. Whilst the reliability and validity of the questionnaire is relevant, this study is qualitative rather than quantitative. Normally, a test - retest reliability would have been performed prior to finalising the questionnaire had the sample size been larger. However, the validity of the questionnaire was tested using a pilot group of seven dietitians at Concord Repatriation Hospital, some of whom had previous experience with burn patients. It is interesting to note that the questionnaire used by Williamson (1989a, b) did not discuss reliability.

Burn classifications were described using percentages to define the extent of the burn injury. This is in accordance with the conventions for burn patient management according to Clarke (1992). The nutritional requirements increase proportionally with the size of the burn. Therefore, ranges such as less than 20 percent, 20-40 percent and greater than 50 percent were used to classify the severity of injury. This classification was to provide distinct categories to examine how the dietitian plans and implements nutritional management according to the severity of the burn injury. Certainly the nutritional requirements of each patient classification as prescribed here, cannot be compartmentalised, and the needs of each patient must be individualised. For future investigations, the researcher suggests three divisions: less than 20 percent TBSA, 20 to 50 percent TBSA and greater than 50 percent TBSA. We would not expect more than twice the BEE to be provided for burns greater than 50 percent TBSA (Bell et al. 1986; Hildreth et al. 1990; Paulesen and Splett, 1991; Mainous and Deitch 1994).

7.2 The use of Australia's Hospital Directory to establish a burns service data base

There are limitations in using Australia's Major Hospital Directory (1994), to establish which hospitals provide a burn service. This directory stated that a number of hospitals (n = 3) provided a burn service, when, according to the dietitian, burn patients were always transferred to another hospital. It may be that dietitians do not have the opportunity to participate in the immediate care of these patients. Additionally, a large teaching hospital, known particularly for its expertise in the area of burn care and burn research, was not listed in this edition as providing a burn service.

It is possible that errors may have been made in the 1994 edition of this directory. The origin of such errors may be with the individual hospital, or in the data collation phase. It is also possible that a significant period of time elapses from the time of data collection to the publishing of the directory. Consequently, errors may be a result of changes in the variety of clinical services being provided. For future research in this area, it is suggested that the most recent edition of this resource be consulted. In addition, telephone contact should be made to all hospitals prior to sending the questionnaires to ensure that the only the specified population is reached. There were a small number of dietitians who were sent questionnaires in this study before telephone contact could be made. Consequently, three surveys were returned, but were not completed.

CHAPTER 8

Future Recommendations

There have been few Australian studies evaluating the nutritional management of burn patients. Results from this study will be particular to Australian current practice, hence reducing the need for generalisations from overseas studies. Whilst the design of this study allowed for broad areas to be examined, a number of specific areas of interest areas have been highlighted. These should be addressed by investigations in the future in order to provide a greater understanding of the nutritional management for these patients.

These areas include: the relationship between the timing of the doctors referral and the initiation of nutritional care, since early nutrition has positive health and cost benefits; and the dietitians' clinical experience, as this may influence how the burn patients are managed.

There are limitations associated with almost all assessment and monitoring tools available, especially when used with burn patients. This has been stressed as an area for future research. Examining the criteria for selecting nutrition indicators has been suggested in order to evaluate which tool will be most efficient in terms of cost and effectiveness. Monitoring actual food and fluid intake were used very infrequently by dietitians. The effectiveness of using this method for evaluating nutritional care plans deserves further investigation.

Precise guidelines for micronutrients have not yet been established for burn patients. Routine supplementation can be hazardous and costly. There is a need to gather information on the specific amounts that are being supplemented for both adult and pediatric burn patients.

If trends in research are any indication, the next decade will probably reveal a further specialisation of feeding substrate's for specific conditions pertinent to burn injury, such as wound healing, sepsis, pulmonary failure and pediatrics. Hence, a more specialised and diversified range of nutritional supports will be applied to this single group of patients in future years.

Whilst this project focused on a small, specialised area of nutritional management in a critical care setting, it stimulated the interest of dietitians involved. Burns is one example of an area where dietitians have increasingly become an indispensable part of the clinical team. As with all areas of dietetics, technological developments and new research, means that continuing education is essential to improve work practices and outcomes.

References

Alexander, J.W., Macmillan, B.G., Stinnett, J.D., Ogle, C.K., Bozian, R.C., Fischer, J.E., Oakes, J.B., Morris, M.J. and Krummel, R. (1980). Beneficial effects of Aggressive Protein feeding in Severely burned Children. Annals of Surgery, Vol.192 (4): 505 - 517.

Alexander, J.W., Saito, H., Ogle, C.K. and Trocki, O. (1986). The importance of lipid type in the diet after burn injury. Annals of surgery, Vol. 204 (1): 1 - 8.

Allard, J.P., Pichard, C., Hoshino, E, Stechison, S., Fareholm, L., Peters, W.J. and Jeejeebhoy, K.N. (1990). Validation of a new formula for calculating the Energy Requirements of burn patients. J. of Parenteral and Enteral Nutrition, Vol. 14 (2): 115 - 118.

ATA Marketing Pty. Ltd. (Pub.) (1994). Australia's Major Hospitals Directory. 2nd Ed. [PO BOX 1640 North Sydney, 2059. Ph: 02 9661158].

Bell, S.J., Molnar, J.A., Krasker, W.S. and Burke, J.F. (1985). Prediction of total urinary nitrogen from urea nitrogen for burned patients. J. of the American Dietetic Association, Vol. 85 (9): 1100 - 1103.

Bell, S.J. and Wyatt, J. (1986). Nutrition guidelines for burned patients. J. of the American Dietetic Association, Vol. 86 (5): 648 - 653.

Brose, L. (1990). Prealbumin as a marker of nutritional Status. J. of Burn Care Rehabilitation. Vol. 11 (4): 372 - 375.

Carlson, D.E., Cioffi, W.G., Mason, A.D., Mc Manus, W.F. and Pruitt, B.A. (1992). Resting energy expenditure in patients with Thermal Injury. Surgery, Gynecology and Obstetrics. Vol. 174: 270 - 276.

Chiarelli, A., Enzi, G., Casadei, A., Baggio, B., Valerio, A. and Mazzoleni, F. (1990). Very early nutrition supplementation in burned patients. American J. Clinical Nutrition. 51: 1035 - 1039.

Childs, C., Hall, T., Davenport, P.J. and Little, R.A. (1990). Dietary intake and changes in body weight in burned children. Burns. Vol. 16 (6): 418 - 422.

Clarke, J.A. (1992). Classification of burns. A Colour Atlas of Burn Injury. Chapman and Hall, London. pp. 8.

Constable, J.D. (1994). The state of burn care: past, present and future. Burns. Vol. 20 (4): 316 - 324.

Daniels, L. and Thompson, S. (1994). Cystic Fibrosis In Hawker, J. (ed.). Handbook No. 6 : Principles of Nutritional Management of Clinical Disorders. Pub. DAA., Canberra, ACT. pp. 47-55.

Deitch, E.A. (1990a). The management of burns. The New England J. of Med., Vol. 323 (18): 1249 - 1253.

Deitch, E.A. (1990b). Intestinal permeability is increased in burn patients shortly after injury. Surgery, Vol. 107 (4): 411 - 416.

De Michele, S.D., Karlstad, M.D., Bistran, B.R., Istfan, N., Babayan, V.K. and Blackburn, G.L. (1985). Enteral nutrition with structured lipid: effect on protein metabolism in thermal injury. American J. Clinical Nutrition, 50: 1295 - 1302.

Dillman, D.A. (1978). Chapter One: The total design method (TDM): A new approach to mail and telephone surveys. Mail and Telephone surveys: The total design method. John Wiley and Sons, USA, pp. 1 - 38.

Dominioni, L., Trocki, O., Fang, C.-H., Mochizuki, H., Ray, M.B., Ogle, C.K. and Alexander, J. W. (1985). Enteral feeding in burn Hypermetabolism: Nutritional and Metabolic effects of different levels of calorie and protein intake. J. of Parenteral and Enteral Nutrition, Vol. 9 (3): 269 - 279.

Dylewski, D.F., Froman, D.M. (1992). Vitamin C supplementation in the patients with Burns and Renal Failure. J. of Burn Care Rehabilitation, Vol. 13 (3): 378 - 380.

Elwyn, D.H., Kinney, J.M. and Askanazi, J. (1981). Energy expenditure in surgical patients. Surgical Clinics of North America, Vol. 61 (3): 545 - 556.

Engelhardt, V.J. and Clark, S.M. (1994). Early enteral feeding of a Severely burned Pediatric patient. J. of Burn Care Rehabilitation, Vol. 15 (3): 293 - 297.

Epstein, M.D., Banducci, D.R. and Manders, E.K. (1992). The role of the Gastrointestinal tract in the development of Burn sepsis. Plastic and Reconstructive Surgery, Vol. 90 (3): 524 - 531.

Fakhry, S.M., Alexander, J., Smith, D., Meyer, A.A. and Peterson , H.D. (1995). Regional and Institutional Variation in Burn Care. J. of Burn Care Rehabilitation, Vol. 16 (1): 86 - 90.

Garrel, D.R., Davignon, I. and Lopez, D. (1991). Length of care in patients with Severe burns with or without Early Enteral Nutritional support: A retrospective study. J. of Burn Care Rehabilitation, Vol. 12 (1): 85 - 90.

Gianotti, L., Alexander, J.W., Nelson, J.L., Fukushima, R., Piles, T. and Chalk, C.L. (1994). Role of early enteral feeding and acute starvation on postburn bacterial translocation and host defense: Prospective, randomised trials. Critical Care Medicine, Vol. 22 (2): 265 - 272.

Gottschlich, M.M, Jenkins, M.J., Warden, G.D., Baumer, T., Havens, P., Snook, J.T. and Alexander, J.W. (1990). Differential effects of three Enteral Dietary regimens on selected outcome variables in Burn Patients. J. of Parenteral and Enteral Nutrition, Vol. 14 (3): 225 - 236.

Gottschlich, M.M., Mayes, T., Khoury, J.C. and Warden, G.D. (1993). Significance of Obesity on nutritional, immunologic, hormonal, and clinical outcome parameters in burns. J. of the American Dietetic Association, Vol. 93 (11): 1261- 1268.

Gottschlich, M.M, and Warden, G.D. (1990). Vitamin supplementation in the Patient with Burns. J. of Burn Care Rehabilitation, Vol. 11 (3): 275 - 279.

Gottschlich, M.M, Warden, G.D., Michel, M., Havens, P., Kopcha, R., Jenkins, M. and Alexander,J.W. (1988). Diarrhoea in Tube - Fed Burn Patients: Incidence, Etiology, Nutritional Impact, and Prevention. J. of Parenteral and Enteral Nutrition, Vol. 12 (4): 338 - 345.

Hansbrough, W.B. and Hansbrough, J.F. (1993). Success of immediate intragastric feeding of patients with burns. J. of Burn Care Rehabilitation, Vol. 14 (5): 512 - 516.

Herndon, D.N., Barrow, R.E., Stein, M.D., Linares, H., Rutan, T.C., Rutan, R. and Abston, S.(1989). Increased Mortality with Intravenous Supplemental feeding in severely burned patients. J. of Burn Care Rehabilitation, Vol. 10 (4): 309 - 313.

Herndon, D.N., Stein, M.D., Rutan, T.C., Abston, S. and Linares, H. (1987). Failure of TPN Supplementation to improve Liver Function, Immunity, and Mortality in Thermally Injured Patients. The J. of Trauma, Vol. 27 (2): 195 - 204.

Henley, M. (1989). Feed that Burn. Burns, Vol. 15 (6): 351 - 361.

Hildreth, M.A., Herndon, D.N., Desai, M.H. and Briemeling, L.D. (1990). Current treatmnet reduces calories required to maintain weight in pediatric patients. J. of Burn Care Rehabilitation, Vol. 11 (5): 405 - 409.

Inoue, S., Epstein, M.D., Alexander, J.W., Trocki, O., Jacobs, P. and Gura, P. (1989). Prevention of Yeast translocation across the Gut by a single enteral feeding after Burn Injury. J. of Parenteral and Enteral Nutrition, Vol. 13 (6): 565 - 571.

Ireton, C.S., Turner, W.W., Hunt, J.L. and Liepa, G.U. (1986). Evaluation of energy expenditures in burn patients. J. of the American Dietetic Association, Vol. 86 (3): 331 - 333.

Ireton - Jones, C. and Baxter, C.R. (1991). Nutrition for Adult Burn Patients: A review. Nutrition in Clinical Practice, Vol. 6 (1): 3 - 7.

Ireton - Jones, C., Turner, W.T. and Baxter, C.R. (1990). Nutritional Considerations in Recovered Patients with Burns. J. of Burn Care Rehabilitation, Vol. 11(6): 581 - 582.

Jensen, T.G., Long, J.M., Dudrick, S.J. and Johnston, D.A. (1985). Nutritional assessment of postburn complications. J. of the American Dietetic Association, Vol. 85 (1): 68 - 72.

King, N.K. and Goodwin, C.W. (1984). The use of vitamin supplements for burned patients: a national survey. J. of the American Dietetic Association, Vol. 84 (8): 923 - 925.

Klein, G.L., Herndon, D.N., Rutan, T.C., Miller, N.L. and Alfrey, A.C. (1990). Elevated serum Aluminium levels in severely burned patients who are receiving large quantities of Albumin. J. of Burn Care Rehabilitation, Vol. 6 : 526 - 530.

Konstantinides, F.N., Radmer, W.J., Becker, W.K., Herman, V.K., Warren, W.E., Solem, L.D., Williams, J.B. and Cerra, F.B. (1992). Inaccuracy of Nitrogen balance determinations in thermal injury with calculated total Urinary Nitrogen. J. of Burn Care Rehabilitation, Vol. 13 (2): 254 - 260.

Kremer, J.M., Bigauoette, J. and Michalek, A.V. (1985). Effects of manipulation of dietary fatty acids on clinical manifestations of rheumatoid arthritis. Lancet, No. 1: 184 - 187.

Kudsk, K.A., Croce, M.A., Fabian, T.C., Minard, G., Tolley, E.A., Poret, A., Kuhl, M.R. and Brown, R.O. (1992). Enteral versus Parenteral feeding: effects on sepsis morbidity after blunt and penetrating abdominal trauma. Annals of Surgery, Vol. 215 (5): 503 - 513.

Lehmann, S. (1993). Nutritional Support in the Hypermetabolic Patient. Critical Care Nursing Clinics of North America, Vol. 5 (1): 97 - 103.

Lown, D. (1991). Use and efficacy of a Nutrition Protocol for patients with Burns in Intensive care. J. of Burn Care Rehabilitation, Vol. 12 (4): 371 - 376.

Mainous, M.R. and Deitch, E.A. (1994). Nutrition and Infection. Surgical Clinics of North America, Vol. 74 (3): 659 - 676.

Mc Ardle, A.H., Palmason, C., Brown, R.A., Brown, H.C. and Williams, H.B. (1984). Early Enteral Feeding of Patients with Major Burns: Prevention of Catabolism. Annals of Plastic Surgery, Vol. 13 (5): 396 - 401.

Mc Donald, W.S., Sharp, C.W. and Deitch, E.A. (1991). Immediate Enteral Feeding in Burn Patients is safe and effective. Ann. Surgery, Feb. Vol. 213 (2): 177 - 183.

Milner, E.A., Cioffi, W.G., Mason, A.D., Mcmanus, W.F. and Pruitt, B.A. (1993). Accuracy of Urinary Nitrogen for predicting Total Urinary Nitrogen in Thermally injured patients. J. of Parenteral and Enteral Nutrition, Vol. 17 (5): 414 - 416.

Mochizuki, H., Trocki, O., Dominoni, L., Brackett, K.A., Joffe, S.N. and Alexander, J.W. (1984a). Mechanism of prevention of postburn Hypermetabolism and Catabolism by Early Enteral Feeding. Annals of Surgery, Vol. 200 (3): 297 - 308.

Mochizuki, H., Trocki, O., Dominoni, L., Brackett, K.A., Ray, M.B. and Alexander, J.W. (1984b). Optimal Lipid content for enteral diets following thermal injury. J. of Parenteral and Enteral Nutrition, Vol. 8 (6): 638 - 646.

Moore, E.E. and Moore, F.A. (1991). Immediate Enteral Nutrition Following Multisystem Trauma: A Decade perspective. J. Am. College of Nutrition. Vol 10 (6): 633 - 648.

Muller, M.J. and Herndon, D.N. (1994). The Challenge of Burns. The Lancet. Vol. 343: 216 - 220.

O'Neil, C.E., Hutsler, D. and Hildreth, M.A. (1989). Basic Nutritional guidelines for Pediatric Burn Patients. J. of Burn Care Rehabilitation. Vol. 10 (3): 278 -283.

Paulsen, L.M. and Splett, P.L. (1991). Summary document of Nutrition intervention in Acute illness: burns and surgery. Supplement to the J. of the American Dietetic Association. Vol. 91: S15 - S17.

Phillips, M.C. and Olson, L.R. (1993). The immunologic role of the Gastrointestinal tract. Critical Care Clinics of North America. Vol. 5 (1): 107 - 120.

Royall, D., Fairholm, L., Peters, W.J., Jeejeebhoy, K.N. and Allard, J.P. (1994). Continuous measurement of energy expenditure in ventilated burn patients: An analysis. Critical Care Medicine. Vol. 22 (3): 399 - 406.

Saffle, J.R., Larson, C.M. and Sullivan, J. (1990). A randomised trial of Indirect calorimetry- based feedings in Thermal injury. The J. of Trauma. Vol. 30 (7): 776 - 783.

Saffle, J.R., Medina, E., Raymond, J., Westenskow, D., Kravitz, M., and Warden, G.D. (1985). The use of Indirect Calorimetry in the Nutritional Management of Burned Patients. The J. of Trauma. Vol. 25 (1): 32 - 39.

Selleck, K.J., Wan, J, M-F., Gollaher, C.J., Babayan V.K. and Bistrian, B.R. (1994). Effect of low and high amounts of a structured lipid containing fish oil on protein metabolism in enterally fed burned rats. American J. Clinical Nutrition. Vol. 60 : 216 - 222.

Selmanpakoglu, A.N., Cetin, C., Sayal, A. and Isimer, A. (1994). Trace element (Al, Se, Zn, Cu) levels in serum, urine and tissues of burn patients. Burns. Vol. 20 (2): 99 - 103.

Shaw, V. and Lawson, M. (1994). Chapter 25: Burns. Clinical Pediatric Dietetics. Blackwell Scientific Publications, Oxford. pp 304 - 308.

Sologub, V.K., Zaets, T.L., Tarasov, A.V., Mordkovitch, M.R. and Yashin A. Yu. (1992). Enteral hyperalimentation of burned patents: the possibility of correcting metabolic disorders by the early administration of prolonged high calorie evenly distributed tube feeds. Burns. Vol. 18 (3): 245- 249.

Solomon, J.R. (1981). Nutrition in the Severely Burned Child. Progress in Paediatric Surgery. Vol. 14 : 63 - 79.

Thomson, M.A., Bucolo, S., Quirk, P. and Shepherd, R.W. (1995). Measured versus predicted resting energy expenditure in infants: a need for reappraisal. J. of Pediatrics. 126 (1): 21 - 7.

Tredget, E.E. and Yu, Y.M. (1992). The Metabolic effects of thermal injury. World J. of Surgery. Vol. 16: 68 - 79.

Trocki, O., Heyd, T.J., Waymack, P.J., and Alexander, J.W. (1987). Effects of fish oil on Postburn Metabolism and Immunity. J. of Parenteral and Enteral Nutrition. Vol. 11 (6): 521 - 528.

Turner, W.W., Ireton, C.S., Hunt, J.L. and Baxter, C.R. (1985). Predicting Energy Expenditures in Burned Patients. The J. of Trauma. Vol. 25 (1): 11 - 16.

Warwick, P.M. (1989). Predicting food energy requirements from estimates of energy expenditure. Australian J. Nutrition and Dietetics. Vol. 46 (Suppl.): S3 - S28.

Waymack, J.P. and Herndon, D.N. (1992). Nutritional Support of the Burned Patient. World J. of Surgery. Vol. 16 (1): 80 - 86.

Weinsier, R.L., Heimburger, D.C., Samples, C.M., Dimick, A.R. and Birch, R. (1985). Cost containment: a contribution of aggressive nutritional support in burn patients. J. of Burn Care Rehabilitation. Vol. 6 (5): 436 - 441.

Williamson, J. (1989a). Actual Burn Nutrition Care Practices: A National Survey (Part I). J. of Burn Care Rehabilitation, Vol. 10 (1): 100-106.

Williamson, J. (1989b). Actual Burn Nutrition Care Practices: A National Survey (Part II). J. of Burn Care Rehabilitation, Vol. 10 (2): 185-194.

APPENDICES

APPENDIX 1

Cover Letter

Dear Dietitian,

My name is Sara Grafenauer. As part of my MSc degree at the University of Wollongong, I will be conducting a study reviewing the current practices of Australian Dietitians involved in the care of Burns patients. I will be supported by my field supervisor Kitty Hoh, a Senior Dietitian in the Burns Unit at Concord Hospital, Sydney, and academically, by Professor Ross Harris, the Head of the Public Health and Nutrition Department at Wollongong University.

I would like to take this opportunity invite you to participate in this study. A questionnaire will be utilised to assess current nutritional management of burns patients. Whilst completing the questionnaire, please feel free to add additional information you feel is pertinent to this area of burns management. **If you have an existing protocol for the management of burns, it would be appreciated if could you attach this with the questionnaire.**

Approval to conduct this research has been granted by the University of Wollongong Ethics Committee. It should be noted that the Ethics committee requires evidence of informed consent. In this case, the return of the completed questionnaire will be taken as evidence of your willingness to participate in this study. It is not necessary for you to include your name, or the name of the hospital on the questionnaire. A coded number is being used for mailing purposes, and so that hospitals participating in the study, can be sent a copy of the results upon request.

Be assured, all information is strictly confidential. If you have any further questions regarding the questionnaire, or the research project, please feel free to contact me on 042-672542. Alternatively, my Field Supervisor, Kitty Hoh may be contacted during work hours at Concord Hospital on 02-7366328.

For enquires regarding the conduct of this research, please contact the Secretary of the University of Wollongong Human Research Ethics Committee on 042-213079. Thank you for you time and co-operation.

Yours sincerely,

S.J. Grafenauer.
MSc (Nutrition and Dietetics) Student
University of Wollongong.

Kitty Hoh
Dietitian

The Nutritional Management of Burns.

Please indicate the most correct answer by providing a tick in the box or, a written response in the space on this sheet. Thank you.

1. Demographics:

1.1 How many beds does your hospital have?

☐ <100 ☐ 100-200 ☐ 200-500 ☐ > 500

1.2 Is this a dietetic training facility?

☐ Yes ☐ No

1.3 Does your patient population consist of:

☐ Adults only? ☐ Paediatrics only? ☐ Both Adults & Pediatrics?

1.4 How many inpatients with burns does your hospital admit per year?

☐ < 20 ☐ 20 - 50 ☐ 51 - 100 ☐ > 100

1.5 How many hours of dietetic staffing time is allocated to the burn service? __________ hours per week.

1.6 How long have you been working as a dietitian in the area of burns?

____

1.7 Do you require a Doctor's referral to assess the burns patients' nutritional status?

☐ Yes ☐ No

1.8 Following admission, when would you begin to implement a nutrition care plan with a patient that has <20%, 20 to 40% and > 50% total body surface area (TBSA) burns?

Please place ticks in the appropriate columns:

Burn size:	< 2 hours	2 - 48 hours	>48 hours
< 20% TBSA			
20 - 40% TBSA			
>50% TBSA			

2. Nutrition Assessment:

For the following question you may tick more than one box:

2.1 What formula(e) do you use to calculate energy needs of adult and pediatric patients with burns?
(See also attached appendix for formulae definitions)

	Curreri Equation	Harris Benedict Equation	Modified Harris Benedict	Other? Please specify:
Adults				
Pediatrics				

2.2 Do you use more than one formulae when estimating energy needs?
☐ Yes (go to 2.3) ☐ No (go to 2.4)

2.3 If yes, what is your reason for doing this?
☐ To assess the accuracy of the formulae
☐ To provide a range or estimating energy requirements
☐ As a standard practice
☐ Other reason, please specify________________________________

2.4 What injury factor do you use for patients with <20%, 20 - 40 % and >50% TBSA burns?

	Injury Factor			
Burn size:	1.3	1.5	2	>2
< 20% TBSA				
20 - 40% TBSA				
>50% TBSA				

2.5 Which weight is being used to calculate energy needs?
ADULTS: ☐ Usual weight (per pt.) PAEDIATRIC: ☐ Usual weight
☐ Admission weight ☐ Admission weight
☐ Ideal weight ☐ Ideal weight for 50th percentile for age

3. Nutrients:

3.1 What are your goals for Macronutrients in the diet?
Please provide answers as a percentage of total energy.

PATIENTS:	Burn size:	Protein	Fat	Carbohydrate
ADULTS	< 20% TBSA			
	20 - 40% TBSA			
	>50% TBSA			
PAEDIATRICS	< 20% TBSA			
	20 - 40% TBSA			
	>50% TBSA			

3.2 What oral supplements do you routinely used in your hospital for adults and children with burns?

	Zinc	Vitamin C	Vitamin A	Multivitamin	Other? Please specify:
Adults					
Pediatrics					

4. Feeding:

In the following question you may tick more than one box:

4.1 Which feed route is used most often <48 hours following the patients admission to the hospital?

ENTERAL ROUTE						TPN	
Burn size:	NG	ND	NJ	Oral diet	Other? Please specify	Central line	Peripheral line
<20% TBSA							
20 - 40% TBSA							
>50% TBSA							

4.2 Which feed route is used most often 48 - 72 hours following the patients admission to the hospital?

ENTERAL ROUTE						TPN	
Burn size:	NG	ND	NJ	Oral diet	Other? Please specify	Central line	Peripheral line
<20% TBSA							
20 - 40% TBSA							
>50% TBSA							

4.3 Which feed route is used most often >48 hours following the patients admission to the hospital?

ENTERAL ROUTE						TPN	
Burn size:	NG	ND	NJ	Oral diet	Other? Please specify	Central line	Peripheral line
<20% TBSA							
20 - 40% TBSA							
>50% TBSA							

4.4 Please provide examples of the oral supplements being provided to burns patients.

☐ Glucose Polymer ☐ Protein powder ☐ Skim milk powder
☐ Commercial Supplements (please specify)____________________
____

☐ Milkshakes ☐ Milk ☐ Cream ☐ Ice cream
☐ Nuts ☐ Cheese ☐ Yoghurt
☐ Others (please specify)______________________________________

5. Enteral Feeding:

5.1 Which enteral tube feeding formula do you use regularly for burn patients? Please specify:____

5.2 Following admission, when does the burns patient commence enteral tube feeding ?

Burn size:	< 2 hours	2 - 48 hours	>48 hours
< 20% TBSA			
20 - 40% TBSA			
>50% TBSA			

5.3 Do you have a specific tube feeding regimen for burns patients?
☐ Yes (go to 5.4) ☐ No (go to 5.5)

5.4 If yes, how does this differ from the regimen for other patients?
____
____
____
____

5.5 How often is enteral feeding being used with burns patients with < 20% burns, 20 - 40% burns and > 50% burns?

Burn size:	Never	In < 50% of patients	In > 50 % of patients	In 100 % of patients
< 20% TBSA				
20 - 40% TBSA				
>50% TBSA				

6. Monitoring:

6.1 What nutrition assessment indicators are being used ***during*** the first month of care? **Please tick in the columns to indicate the frequency of measurement.**

	Daily	2x Weekly	Weekly	Fortnightly	Monthly
Weight					
Percentile growth charts					
Skinfold thickness					
Midarm muscle circumference					
Serum Albumin					
Serum Transferrin					
Pre Albumin					
Serum Creatinine					
Urinary Nitrogen					
Blood sugar levels					
Others?					

6.2 What nutrition assessment parameters are being used ***after*** the first month of care?

	Daily	2x Weekly	Weekly	Fortnightly	Monthly
Weight					
Percentile growth charts					
Skinfold thickness					
Midarm muscle circumference					
Serum Albumin					
Serum Transferrin					
Pre Albumin					
Serum Creatinine					
Urinary Nitrogen					
Blood sugar levels					
Others?					

7. Follow - up:

7.1 Are burns patients routinely followed - up on discharge?
☐ Yes (go to 7.3) ☐ No (go to 7.2)

7.2 Why don't you routinely follow - up burns patients on discharge?

____

7.3 If you do follow - up patients, what nutrition assessment indicators are being used?

☐ Weight ☐ Percentile growth charts
☐ Skinfold thickness ☐ Mid arm muscle circumference
☐ Others? Please specify ______________________

Thankyou for your participation in this questionnaire.

Please Note: A stamped envelope is enclosed for your convenience.

**** Appendix of formulae ****

Curreri Formula:
kcal/ day adults = (25 x preresusitation weight in kg)+(40 x %TBSA burn)
kcal/ day children = (60 x preresusitation weight in kg)+(35 x %TBSA burn)

Harris Benedict Equation:
BEE for men = 278 + (57.5xW)+(20.9xH)-(28.3xA)kJ/day
BEE for women = 2741 + (40xW)+(7.7xH)-(19.6xA)kJ/day
Energy requirement = BEE x activity factor x injury factor

Modified Harris Benedict:
Harris Benedict x 1.5 or 2.

APPENDIX 2

Reminder letter

Dear

Just a reminder to encourage you to complete and return the questionnaire about the Nutritional Management of Burns patients.

It is very important that completed surveys are obtained from all areas of Australia so as to gain a complete insight into the nutritional management of these patients. **In order to be included in this research, please return the questionnaire as soon as possible.**

If you have further questions, or you have lost your survey, please contact me on (042) 672542. Thank you.

Sincerely,

Sara Grafenauer,
Student Dietitian.

APPENDIX 3

Energy Equations.

3.1 Curreri Equation

kcal/day adults =(25 x preresusitation weight in kg)+(40 x %TBSA burn)

kcal/day children =(60 x preresusitation weight in kg)+(35 x %TBSA burn)

3.2 Harris - Benedict Equation

BEE for men = 278 + (57.5xW)+(20.9xH)-(28.3xA)kJ/day

BEE for women = 2741 + (40xW)+(7.7xH)-(19.6xA)kJ/day

Energy requirement = BEE x activity factor x injury factor

3.3 Modified Harris - Benedict Equation

Harris Benedict x 1.5 or 2.

3.4 Schofield Equation (cited in Warwick 1989).

	Age (years)	Equation
Males	10 - 18	(0.074 x wt) + 2.754 = BMR
	18 - 30	(0.063 x wt) + 2.896
	30 - 60	(0.048 x wt) + 3.653
	over 60	(0.049 x wt) + 2.459
Females	10 - 18	(0.056 x wt) + 2.898
	18 - 30	(0.062 x wt) + 2.036
	30 - 60	(0.034 x wt) + 3.538
	over 60	(0.038 x wt) + 2.755

3.5 Toronto formula (Allard et al. 1990).

EBEE (men) = 66.47 + (13.75 x W) + (5.0 x H) - (6.76 x A)

EBEE (women) = 655.1 + (9.56 x W) + (1.85 x H) - (4.68 x A)

TF = -4 343 + (10.5 x % TBSA) + (0.23 x CI) + (0.84 X EBEE) +

(114 x Temp (C)) - (4.5 x PBD)

KEY:

W = usual body weight in kg's; **H** = height in centimeters; **A** = age in years. **% TBSA** = percent of the total burn surface area estimated on admission and corrected where amputation was performed; **CI** = the number of calories received by the patient in the previous 24 hours, including all dextrose infusions, parenteral and enteral feedings; **Temp.** = average hourly rectal temperature for the previous 24 hours expressed in degrees Celsius; **PBD** = the number of postburn days.

3.6 Solomon equation (1981: cited in Shaw and Lawson 1994)

Age	Energy kcal/day (kJ / day)	Protein (g/day)
0 - 1 year Up to 9 kg	Normal requirement + 15 kcal (63kJ) x percentage burn	Normal requirement + 0.75g x percentage burn
1 -3 years 10 - 13 kg	Normal requirement + 20 kcal (84 kJ) x percentage burn	Normal requirement + 1.0 g x percentage burn
3 + years Up to 9 kg	Normal requirement + 30 kcal (125kJ) x percentage burn	Normal requirement + 1.5g x percentage burn

APPENDIX 4

Tables and Figures of survey results

Table 1. Bed numbers of surveyed hospitals (n = 23).

Bed numbers	Frequency of responses	Percent of responses
< 100	1	4.3
100 - 200	2	8.7
200 - 500	12	52.2
>500	8	34.8

Table 2. Hospitals surveyed divided by patient type (n = 23).

Patient Type	Frequency of responses	Percent of responses
Adults	10	43.5
Pediatrics	4	17.4
Adults and Pediatrics	9	39.1

Table 3. Time delay in implementation of a nutrition care plan (n = 23).

Burn Classification	Frequency of response			
	<2 hours	2-48 hours	> 48 hours	NR
<20 % TBSA	11 47.85%	14 60.9%	5 21.7%	3 13.0%
20 to 40 % TBSA	1 4.3%	17 73.9%	0 0	5 21.7%
>50 % TBSA	2 8.7%	13 56.5%	2 8.7%	6 26.1%

* NR = no response

Table 4. Reasons given for utilising more than one energy formula for calculations (n = 8).

Ranking	Frequency of responses	Percent of responses
* To provide a range for estimating requirements.....	6	75
* To assess the accuracy of the formula........	2	25
* As a standard practice....	0	0
* Curreri equation overestimates...	1	12.5
* To account for individual needs...	1	12.5
* To check for mistakes in calculations.......	1	12.5

* Percentages totalling more than 100 indicate multiple responses accepted.

Table 5 a. Frequency of individual supplements routinely provided to adult patients (n = 19).

Ranking	Frequency of responses	Percent of responses
Zinc	8	42.1
Vitamin C	7	36.8
Vitamin A	2	10.5
Multivitamin	8	42.1
Iron	2	10.5
No routine supplementation	3	15.8
No Response	5	26.3

* Percentages totalling more than 100 indicate multiple responses accepted.

Table 5 b. Frequency of individual supplements routinely provided to pediatric patients (n = 13).

Ranking	Frequency of responses	Percent of responses
Zinc	7	53.8
Vitamin C	7	53.8
Vitamin A	1	7.9
Multivitamin	8	61.5
Iron	4	30.8
No routine supplementation	0	0
No Response	4	30.8

* Percentages totalling more than 100 indicate multiple responses accepted.

Table 6 a. Type and frequency of feeding route utilised for patients within 48 hours of admission.

Feeding route	Frequency of responses for each burn classification:		
	<20%	20 - 40%	>50%
ENTERAL ROUTE:			
Nasogastric	5	14	15
Nasoduodenal	0	0	0
Nasojejunal	0	0	3
Oral	20	14	5
PARENTERAL NUTRITION:			
Central route	0	4	7
Peripheral route	1	1	1
No response	3	4	6

* Multiple responses accepted.

Table 6 b. Type and frequency of feeding route utilised for patients within 48 to 72 hours of admission (n = 23).

Feeding route	Frequency of responses for each burn classification:		
	<20%	20 - 40%	>50%
ENTERAL ROUTE:			
Nasogastric	7	14	16
Nasoduodenal	0	0	1
Nasojejunal	0	0	1
Oral	20	15	10
PARENTERAL NUTRITION:			
Central route	0	3	9
Peripheral route	0	0	0
No response	3	5	6

* Multiple responses accepted.

Table 6 c. Type and frequency of feeding route utilised for patients after 72 hours of admission (n = 23).

Feeding route	Frequency of responses for each burn classification:		
	<20%	20 - 40%	>50%
ENTERAL ROUTE:			
Nasogastric	6	14	15
Nasoduodenal	0	0	1
Nasojejunal	0	1	1
Oral	19	16	12
PARENTERAL NUTRITION:			
Central route	0	2	7
Peripheral route	0	0	0
No response	3	4	5

* Multiple responses accepted.

Table 7. Time delay in the initiation of enteral tube feeding: a) < 20% TBSA burn; b) 20 - 40% TBSA burn; c) >50% TBSA burn (n = 23).

Burn classification	Frequency of responses:			
	< 2 hours	2-48 hours	>48 hours	NR
<20%	0	8	5	10
	0	34.8%	21.7%	43.5%
20 - 40 %	1	12	0	10
	4.3%	52.2%	0	43.5%
> 50%	1	15	1	6
	4.3%	65.2%	4.3%	26.1%

Table 8. Differences in tube feeding regimen for burns patients (n = 5).

Ranking	Frequency of responses	Percent of responses
* Always continuous feeds.....	2	25
* Commence enteral tube feeding within 24 hours after admission.....	1	12.5
* Considers theatre visits....	1	12.5
* Considers need for supplements e.g. Zinc, Vit. A and C.....	1	12.5
* Feed type.....	1	12.5
* Specific starting regimen for burns unit....	1	12.5

* Percentages totalling more than 100 indicate multiple responses accepted.

Table 9. Frequency of enteral tube feeding in burns patients: a) < 20% TBSA burn; b) 20 - 40% TBSA burn; c) >50% TBSA burn (n = 23).

Burn classification	Frequency of responses:				
	Never	In <50% of patients	In >50% of patients	100% of patients	NR
< 20 %	5 21.7%	13 56.5%	1 4.3%	0 0	4 17.4%
20 - 40%	0 0	3 13.0%	9 39.1%	4 17.4%	6 26.1%
>50%	0 0	0 0	4 17.4%	12 52.2%	7 30.4%

* NR = no response

Table 10. Frequency of use of nutrition indicators during the first month of care.

Indicator	Frequency of response:					
	1	2	3	4	5	6
*** Body Weight**	**5**	**3**	**13**	**0**	**0**	**0**
* Percentile charts	1	1	2	2	0	0
* Skin fold thickness	0	0	1	0	1	0
* Mid Arm Muscle Circumference	0	0	1	1	0	0
*** Serum Albumin**	**6**	**6**	**6**	**0**	**0**	**0**
* Serum Transferrin	0	0	3	2	0	0
* Pre Albumin	0	0	1	1	0	2
*** Creatinine**	**1**	**2**	**9**	**2**	**0**	**0**
* Urinary Nitrogen	0	0	3	1	0	1
*** Blood sugar levels**	**2**	**4**	**5**	**1**	**0**	**0**
* Protein	0	2	0	0	0	0
* Hb	1	1	0	0	0	0
* Oral intake	0	1	0	0	0	0
* Serum Zinc	0	0	0	0	0	0
* Arm Muscle Area	0	0	1	0	0	0
* Arm Fat Area	0	0	1	0	0	0

KEY: (1) Daily; (2) 2x Weekly; (3) Weekly; (4) Fortnightly; (5) Monthly; (6) On request.

Table 11. Frequency of use of nutrition indicators after the first month of care.

Indicator	Frequency of response:					
	1	2	3	4	5	6
*** Body Weight**	**1**	**3**	**13**	**0**	**0**	**0**
* Percentile charts	0	1	2	2	2	0
* Skin fold thickness	0	0	1	0	1	0
* Mid Arm Muscle Circumference	0	0	1	1	0	0
*** Serum Albumin**	**0**	**6**	**7**	**5**	**0**	**0**
* Serum Transferrin	0	0	3	2	0	0
* Pre Albumin	0	0	1	1	0	2
*** Creatinine**	**1**	**2**	**9**	**2**	**0**	**0**
* Urinary Nitrogen	0	0	3	1	0	1
*** Blood sugar levels**	**2**	**4**	**5**	**1**	**0**	**0**
* Protein	0	0	0	0	0	0
* Hb	0	0	0	0	0	0
* Oral intake	0	1	0	0	0	0
* Serum Zinc	0	0	1	0	0	0
* Arm Muscle Area	0	0	1	0	0	0
* Arm Fat Area	0	0	1	0	0	0

KEY: (1) Daily; (2) 2x Weekly; (3) Weekly; (4) Fortnightly; (5) Monthly; (6) On request.

Table 12. Reasons given for not routinely following up burns patients (n = 18).

Ranking	Frequency of responses	Percent of responses
* Do not treat patients with significant burns.....	4	22.2
* Inadequate time....	4	22.2
* Appointments on referral basis only....	5	27.8
* Patients are discharged to remote communities....	2	11.1
* Not necessary....	8	44.4
* insufficient funding....	1	5.6
* staffing constraints....	3	16.7
* seen by dietitian in rehabilitation ward or larger hospital....	2	11.1

* Percentages totalling more than 100 indicate multiple responses accepted.

Table 13. Frequency of use of nutrition indicators used at post discharge appointments (n = 10)

Ranking	Frequency of responses	Percent of responses
* Body Weight	9	90
* Percentile charts	6	60
* Skin fold thickness	1	10
* Mid arm muscle circumference	1	10
* Serum Albumin	2	20
* Serum Protein	1	10
* Diet Diary	1	10
* Arm Muscle Area	1	10
* Arm Fat Area	1	10

* Percentages totalling more than 100 indicate multiple responses accepted.