Proceedings of the Nutrition Society

Abstracts of Communications

A joint meeting of the Clinical Nutrition and Metabolism Group of the Nutrition Society, and the British Association for Parenteral and Enteral Nutrition was held at Norbreck Castle Hotel and Conference Centre, Blackpool on 2–4 December 1997, when the following papers were presented.

All abstracts are prepared as camera-ready material by the authors.

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Energy economy following liver transplantation. By ROSEMARY A. RICHARDSON[1], ISOBEL DAVIDSON[1], ALISON HINDS[1], ALISTAIR McGILCHRIST[2] AND JAMES O. GARDEN[2], [1]*Department of Dietetics and Nutrition, Queen Margaret College, Clerwood Terrace, EH12 8TS and the* [2]*Scottish Liver Transplant Unit, The Royal Infirmary, Edinburgh, EH9 3YW.*

Following liver transplantation (LTx), complications such as hyperlipidaemia, hypertension and obesity are common (Stegall *et al*, 1995). Audit results from our own unit have shown that (n = 22) after LTx there is a progressive and significant weight gain which exceeds pre illness weight by an average of 6 kg (12 %). In the present study we have investigated possible mechanisms involved in this weight gain in relation to energy expenditure. Resting energy expenditure (REE) and postprandial energy expenditure after ingestion of a test meal (15 kJ/kg, 60% carbohydrate, 30% fat, 10% protein) were measured in liver transplant recipients and in a control group.

Using indirect calorimetry (Datex, Deltatrac, Finland) energy expenditure was measured at baseline (REE) and the integrated thermogenic response (ITR) from measurements taken at 20, 45, 90 and 120 min after the meal was calculated. Control subjects (mean age 50.5 SD 2.8years, M:F=4:9) were studied on a single occasion, liver transplant recipients were studied at 3 months (mean age 52.5 SD 2.8 years; M:F=4:5) and 9 months (mean age 56.6 SD 1.3 years; M:F=3:6) following discharge for LTx. All subjects were measured for height and weighed. Body cell mass (BCM) was estimated by multi-frequency bioelectrical impedance analysis (MFBIA, 5 and 200 kHz). Patients with prolonged periods of rejection or sepsis were excluded.

	Controls (n = 14)		Patients 3 months Post LTx (n = 9)		Patients 9 months Post LTx (n = 9)	
	Mean	SEM	Mean	SEM	Mean	SEM
REE/kg kJ/day	80.2	2.10	80.6	4.11	75.6	2.10
REE/BCM kJ/day	243.2	4.66	245.7	11.0	223*	16.0
ITR (AUC)	8683	956	8538	401	7645*	457

*Significantly different compared with control values, P<0.05, unpaired t test.

Results show that when compared with controls REE and the ITR to the meal in transplanted patients were significantly lower at 9 months post transplant. At 3 months post-transplant energy expenditure was similar to that of controls in the resting and postprandial states.

These findings indicate that at 3 months post LTx energy metabolism is normalized. By 9 months post LTx energy metabolism is significantly suppressed. This is a factor which would contribute to the weight gain seen in these patients and attempts at weight reduction following LTx may be hampered by this adaptive mechanism of energy conservation. This mechanism requires further investigation but may be related to the underfeeding/refeeding phenomenon recently described by Dulloo *et al* (1997).

Dulloo A G, Jacquet J, Girardier L (1997). *American Journal of Clinical Nutrition* **65**: 717-723.

Stegall M D, Everson G, Schroter G, Bilir B, Karrer F & Kam I (1995). *Transplantation* **60**: 1057-1060.

We gratefully acknowledge the financial support of Nutricia Ltd.

An evaluation of protein energy supplementation in medically ill admissions to a geriatric unit. By JAN M. POTTER[1], MARGARET A. ROBERTS[1], JOHN J. REILLY[2], and JOHN H. MCCOLL[3]. [1]*Department of Medicine for the Elderly, Victoria Infirmary NHS Trust ,Glasgow G41 3DX and Departments of* [2]*Human Nutrition and* [3]*Statistics, University of Glasgow G12 8QQ*

Undernutrition is common in hospital admissions, especially in the elderly (McWhirter & Pennington 1994; Potter *et al* 1995). Further nutritional depletion is likely during inpatient stay (Klipstein-Grobusch *et al* 1995). A recent meta-analysis of randomized trials of nutritional supplementation concluded that supplementation may be associated with benefits in weight change and mortality, but these conclusions were restricted by methodological limitations of some of the studies (Potter & Langhorne, 1996). Here we report a prospective randomized controlled trial of oral protein energy supplements given to patients admitted from home to a Department of Medicine for the Elderly. Anthropometric assessment was undertaken on admission, and patients were categorized into three groups: Group 1 BMI <5th centile; group 2 BMI>5th <25th centile; group 3 BMI >25th <75th centile. Consenting patients (*n* 381) were randomized into treatment and control groups within each category. The treatment group were given 120 ml of a sip feed supplement (6.3 kJ/ml and 62.5 g protein/l) three times daily (2259 kJ, 22.5 g protein/d), prescribed on the drug cardex. Energy balance was assessed using weighed dietary records and predicted BMR.

Supplementation was associated with a significant reduction in mortality, and improvement in functional status (Barthel score) in group 1 patients (table). Improvements in weight change were observed in all three groups (table), and this was a consequence of improvements in energy balance. Supplementation did not suppress voluntary food energy intake.

	Group1		Group 2		Group 3	
	Treatment	Control	Treatment	Control	Treatment	Control
Improved Barthel *n* (%)	17* (68)	11 (39)	57 (70)	51 (72)	28 (65)	38 (66)
Intercurrent sepsis *n* (%)	3 (16)	4 (20)	7 (13)	8 (14)	7 (24)	8 (18)
Mortality, *n* (%)	5** (15)	14 (35)	8 (8.9)	13 (15)	8* (13)	6 (9)
Median Length of stay	17	17.5	18.5	16.5	13.5	21
(range)	(4-100)	(2-76)	(3-141)	(3-62)	(3-62)	(2-69)
Mean Wt Change (kg)	+1.5**(SD2.4)	-0.8 (SD 2.2)	+0.7 (SD2.0)	+0.1 (SD 2.3)	+1.0**(SD 2.1)	-0.7 (SD3.0)

Values were significantly different from those for controls: *P <0.05, ** P <0.01

Protein energy supplementation in elderly patients admitted acutely from home led to clinical and functional improvement, with a significant reduction in mortality in the most poorly nourished group. This form of supplementation was well tolerated by patients and did not suppress food intake.

Klipstein-Grobusch K. , Reilly, J. J., Potter, J. M. , Edwards, C. A. & Roberts, M. A. (1995). *British Journal of Nutrition* **73**: 323-334.

McWhirter, J. P & Pennington, C. R. (1994). *British Medical Journal* **308**:945-949.

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Potter, J. M., Klipstein, K., Reilly, J. J. & Roberts, M. A. (1995). *Age and Ageing* **24**:131-136.

This study was funded by the Scottish Office Home and Health Department.

Manganese intake and parenteral-nutrition-associated cholestasis in the preterm infant. By LORRAINE FOSKETT, HELEN MARTIN and JOHN W. L. PUNTIS, *The Children's Centre, Clarendon Wing, The General Infirmary at Leeds, Belmont Grove, Leeds, LS2 9NS*

Parenteral-nutrition-associated cholestasis (PNAC) is a common complication of intravenous nutrition with multifactorial aetiology. In its most severe form it can progress to cirrhosis and liver failure. Risk factors include duration of parenteral nutrition (PN), failure to tolerate enteral nutrition, sepsis, and disturbed enterohepatic circulation of bile salts; toxic components of PN fluids may also contribute. Mn is an essential trace element provided with PN solutions. Mn is predominantly excreted in the bile and is known to accumulate in patients with liver disease who are being parenterally fed. Mn has also been shown to be hepatotoxic in an animal model, and can cause central nervous system damage in human subjects. Whether or not hepatotoxicity from Mn intake is a primary cause of PNAC (Fell *et al.* 1996) or Mn accumulation is a secondary phenomenon occuring once other factors have initiated liver injury is uncertain. This issue has been examined in surgical newborn (median gestational age 35 weeks) by investigating the incidence of PNAC before and after a change in trace element formulation resulted in a 50-fold reduction in Mn intake, when no difference was found (Beath *et al.* 1996). We have focused on small, preterm infants since prematurity is one of the major risk factors for PNAC such that a primary hepatotoxic effect of high Mn intake would be more likely to become apparent in this group. Case notes of infants without primary hepato-biliary disease who received PN for more than 2 weeks over a 2-year period on a regional neonatal intensive care unit were examined retrospectively. PNAC was defined as a conjugated plasma bilirubin >30 μmol/l after a minimum of 2 weeks PN. Forty-seven patients were identified; sixteen had been given Ped-El (Pharmacia) as their trace element supplement supplying 54.8 μgMn/kg per day (high Mn group), and thirty-two had been given Peditrace (Pharmacia & Upjohn) supplying 1 μgMn/kg per day (low Mn group). The median gestational age of the study population was 29 (range 23 - 41) weeks; birth weight 1.5 (range 0.56 - 3.63) kg; age at commencement of PN 7 (range 1 - 42) d; duration of PN 33 (range 14 - 181) d. There were no significant differences in these variables between the high and low Mn intake groups. Five high Mn intake and five low Mn intake patients developed PNAC. Although the proportion of infants developing PNAC was higher in the high Mn intake group, this was not statistically significant ($P< 0.2$; X^2). These findings in a group at high risk of PNAC suggest that Mn intake is not a major determinant of this complication of parenteral nutrition.

Beath, S.V., Gopalan, S. & Booth, I.W. (1996). *Lancet* **347**, 1773 - 1774.
Fell, J.M.E., Reynolds, A.P., Meadows, N., Khan, K., Long, S.G., Quaghebeur, G., Taylor, W.J., & Milla, P.J. (1996). *Lancet* **347**, 1218 - 1221.

A recipe for improving the nutritional intake in elderly hospital patients. By ARLENE D. STEPHEN, CHARLOTTE L. BEIGG, EDITH T. ELLIOT, IAN A. MACDONALD and SIMON P. ALLISON, *Departments of Dietetics and Nutrition, Medicine, Physiology and Pharmacology, Queens Medical Centre, Nottingham NG7 2UH*

In a previous study of food wastage in our elderly patients we showed a food wastage rate of 42%, resulting in an average energy intake at lunch and supper of 3200 kJ. Assuming an intake of 2520 kJ from breakfast and snacks, the total daily intake was 5720 kJ, only 75% of that recommended (Department of Health 1995). A patient questionnaire revealed that 42% of patients on elderly wards found that the portion sizes of main meals were too large. In an attempt to improve energy intake and reduce food wastage an intervention study was conducted to compare standard hospital food with energy dense fortified foods in which the portion size had been reduced by approximately 20%.

Patients on an elderly ward were studied for four menu cycles (56 days). Patients were randomly allocated to receive normal (N) or reduced portion fortified (F) food at lunch and supper meals on alternate menu cycles, both menus contained the same food choices. Intake from breakfast and snacks was estimated from ward records. As described previously (Stephen *et al.* 1997) waste food was weighed for the ward as a whole and for each individual patient. The weight of food wasted and the average intake for the whole ward (n 28) and for individual patients (n 15) was calculated, allowing comparison of intakes with the previous study and of the N and F menus using patients as their own controls.

	Standard menu (N)	Fortified menu (F)
Weight of food provided (kg)	463	385
Weight of wasted food (kg)	158	106
Average intake (whole ward study)		
Total energy (kJ)	3480	4620
Total protein (g)	33.8	35.0
Average intake (individual study)		
Total energy (kJ)	3530	4775
Total protein (g)	35.2	35.6

These results show that when comparing the F menu with the N menu the absolute weight of wasted food was reduced by one third and that the average energy intake from lunch and supper was increased from 3480 to 4620 kJ. Adding an estimate of 2520 kJ from breakfast and snacks, as in the previous study, this would give an average daily intakes of 6000 kJ (N) and 7140 kJ (F) which represents 79%(N) and 94%(F) of the recommended intake. Using patients as their own controls it has been possible to increase their intake at lunch and supper by 35% from 3530 kJ(N) to 4775 kJ (F) ($P<0.001$). The challenge faced by hospital catering is to provide meals which are appropriate to meet the nutritional needs of each patient group whilst keeping costs to a minimum. Our study has shown that this is feesable with the provision of fortified foods.

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Patients' nutritional status influences their use of health care resources. By J. EDINGTON[1], S.J. COLES[1] and C.N. MARTYN[2]. [1]*Abbott Laboratories Ltd, Maidenhead, SL6 4XE;* [2]*MRC Environmental Epidemiology Unit, Southampton University, SO16 6YD*

The aim of this study was to investigate how nutritional status affects use of health care resources by patients with chronic respiratory, neurological and gastrointestinal disease. The General Practice Research Database, currently maintained by the UK Office of National Statistics, contains information on patients registered with more than 500 National Health Service general practices. We used this database to measure rates of consultation, prescription of drugs and hospital admissions in patients with chronic disease according to their BMI (weight (kg) / height^2(m)). Data for nearly 30 000 person-years of follow up were available.

On average, rates of consultation, prescription of drugs and hospital admissions were higher in women than in men and in older people than in younger. Independently of these trends, there were relations between these rates and BMI. As can be seen in the table, consultation and prescription rates were lowest among patients whose BMI was between 20 and 25 and increased in patients who were leaner or fatter ($P < 0.001$). During the period of follow up, the BMI of 137 patients increased from below 20 to above 20. This increase was associated with decreasing consultation and prescription rates. By contrast, in 135 patients whose BMI decreased to below 20, consultation and prescription rates rose. Hospital admission rates were significantly higher in patients whose BMI was below 20 ($P < 0.01$).

Nutritional status seems to exert a significant influence on use of health care resources by patients with chronic disease.

	BMI group			
	15 to <20	20 to <25	25 to <30	≥30
GP consultations*	106	100	103	118
Prescriptions*	109	100	106	121
Hospital admissions*	125	100	102	96

* Rates, standardized for age and sex, are given relative to BMI group 20-24 kg/m^2

An audit of nutrition risk assessment on admission to a teaching hospital. By EMMA BOOTH, *Dietetic Department, Hope Hospital, Salford, M6 8HD.*

The case for assessing nutrition risk on admission to hospital is now well recognized (Lennard-Jones 1992; McWhirter & Pennington,1994). Salford Royal Hospitals NHS Trust launched a nutrition risk assessment tool (nutrition risk score) for Trust-wide use in September 1995. This was adapted from the nutrition risk assessment tool developed by Helen Reilly at the Birmingham Heartlands Hospital (Reilly *et al.* 1995). Nutrition support information packs, the nutrition risk score and supporting education were given to a named nutrition link nurse on each ward Trust-wide. An audit of the use of the nutrition risk score was undertaken in April 1996 to April 1997 with the following findings of uptake and barriers to use.

In two separate four week data collection periods (May and December 1996) it was found that 31% and then 36% of nursing notes of new patients admitted to hospital contained a nutrition risk score Of these assessments only one third were complete (13% and 16% respectively). Barriers to use of the nutrtition risk score were investigated and the 38% of questionnaires which were returned were analysed with the following results. Height was expressed by 60% of respondents as a barrier, weight measurement by 48%, lack of information from the patient by 46% and from the carers by 41%. Time was stated by 35% of respondents as a barrier to completing the nutrition risk score, as was too much paperwork by 24%, and that the assessment tool was felt to be inappropriate by 11%.

The poor uptake of the nutrition risk score and the barriers to its use have become a focus of a quality development team within the Trust. This multi-disciplinary team is now investigating alternative methods of assessing nutrition risk, addressing catering issues, developing nutrition protocols and collaborating with all staff concerned with the nutritional care of patients. Further audits will continue to evaluate service developments.

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Referrals to the nutritional support team (NST). Effective use of resources? By JOY DAVIS and VANESSA MARVIN, *NST, Royal Surrey County Hospital, Guildford, GU2 5XX.*

Parenteral nutrition (PN) is used for pre- and post-operative nutritional support, and for other rarer indications e.g. hyperemesis gravidarum. A previous local audit in 1993 had shown that of ninety patients referred to the NST, 63% were fed for less than 7d, and a large number (10%) developed line-related sepsis, thereby limiting positive outcomes. Improved aseptic technique and written criteria for referral to the NST were developed. It seemed timely to re-examine the profiles and crude outcomes of PN referrals. An audit of NST activity for 1996 was undertaken, to examine the diagnoses of 132 referrals, the reasons for referral, for stopping PN and the duration.

Diagnosis			Reasons for PN referral		
Upper GI cancer	24	18%	Poor postoperative recovery	30	23%
Bowel cancer	19	15%	Planned postoperative	27	21%
Other cancer	13	10%	Obstruction	24	18%
Pancreatitis	8	6%	Gut rest ± malabsorption	22	17%
IBD ulcerative colitis	8	6%	Dysphagia	12	9%
IBD Crohn's disease	7	5%	Fistula	7	5%
IBD toxic megacolon	2	2%	Planned preoperative	2	1.5%
Other	45	34%	Other	2	1.5%

Reasons for stopping PN			
Eating some (500 to 1000 Calories)	52	39%	includes 2 nasogastric & 2 gastrostomy
Adequate oral intake	21	16%	
Not started PN	14	10.5%	includes 2 who died
Died	16	12%	13 of whom had cancer
Line problem, not sepsis (e.g. dislodged)	11	8%	
Encouraged to eat (oral intake less than 500 Calories)	9	7%	
Line related pyrexia	6	4.5%	

Fourteen patients referred for NST assessment did not commence PN; the team recommended either enteral feeding options or that the patient needed stabilizing biochemically. Fifty-six patients had a primary diagnosis of cancer and seventeen inflammatory bowel disease (IBD), see Table. Other referrals included patients with perforation, obstruction and pancreatic disease. The most common reason for referral was poor postoperative recovery, indicating lack of initial progress after surgery. PN was unplanned in these. Rates for line-related pyrexia were lower than previously at 4.5%. Most patients (39%) stopped PN because they were taking some oral nutrition, though not considered adequate by the NST, (see Table). Patients receive PN for longer periods on average compared with 3 years ago.

Sixteen patients died in hospital during the treatment episode. All others were followed up for 6 months and twenty-eight had died (24%). Of these, fifteen were from cancer diagnosis groups accounting for 54% of 'late' deaths. We agree with others (Souba, 1997), that the appropriateness of PN in this group needs to be addressed, including consideration of quality of life issues (Nitenberg *et al.* 1995).

Nitenberg, G., Nicolas, C. & Garban, F. (1995). *Medical Nutrition* **31**, 139-147.
Souba, W. W. (1997). *New England Journal of Medicine* **336**, 41-48.

Compliance of orthopaedic patients with post-operative nutritional supplementation. By R. LAWSON, M.K. DOSHI, L.E. INGOE, J.M. COLLIGAN, J.R. BARTON and I. COBDEN, *University of Newcastle Regional School of Medicine, North Tyneside General Hospital, North Shields, Tyne and Wear NE29 8NH*

Previous studies have shown that nutritional supplementation in geriatric and orthopaedic patients has reduced complication rates and length of stay (Delmi *et al.* 1990; Larsson *et al.* 1990). We have studied the nutritional and clinical outcome of adult orthopaedic patients given routine supplementation post-operatively, irrespective of age or nutritional status. Difficulties with patient acceptance of oral nutritional supplements were anticipated; thus, as part of this larger study, patient compliance with the intended supplementation was assessed.

Consenting patients were prescribed two milk or juice-based oral supplements (i.e. 400 or 500 ml respectively) per day of their hospital stay according to preference, in addition to their usual hospital diet. Patients were given an explanatory leaflet regarding the supplements with supporting information given in detail by the dietitian. Supplements were issued on drug rounds by nurses and recorded on the drug charts. Patients and staff recorded the proportion of each drink consumed. Patients could choose to change from one type of drink to another or to discontinue the drinks completely at any time.

Of a total of 187 patients in the larger study, eighty-four were prescribed supplements. Of these, twenty-seven were male and fifty-seven were female aged 40-88 years (mean age 72 years). Seventeen were admitted as emergencies and sixty-seven for elective surgery. Mean length of stay was 14.4 (range 5-101)d, median 9 d. Supplements were taken for a mean of 6.7 d. Defining 100% compliance as the taking of the full intended number of supplements for the duration of their hospital stay, the following results were found; 80-100% compliance was not achieved by any of the patients, 61-80% compliance was achieved by four patients, 41-60% compliance by nine patients, 21-40% by twenty-two patients, 1-20% compliance by thirty-two patients and seventeen patients were unable to comply at any level. Median percentage compliance was 14.9%. Thirty-seven patients changed from milk to juice-based drinks. Eight patients stopped supplements without trying the alternative. Reasons for stopping supplements included nausea and dislike of taste.

This work shows that prescription of routine nutritional supplementation is associated with low levels of patient compliance. The contributing factors to this should be further studied and measurement of compliance should be an integral part of any future work.

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Use of immediate post-operative tunnelled jejunal feeding and subsequent nutritional status in patients undergoing oesophago gastrectomy (Oes). By E.L. RUSHBY and T.C.B. DEHN, *Department of Dietetics and Department of Surgery, Royal Berkshire Hospital, London Road, Reading, RG1 5AN*

The use of post operative tunnelled jejunal feeding in patients undergoing Oes. was investigated to evaluate the success of feeding and to monitor subsequent nutritional status of patients. Fresenius tunnelled jejunal feeding tubes were inserted at surgery. Nutritional requirements were calculated; feeding commenced post-operatively until restoration of adequate oral intake. Nutritional requirements were calculated 1 month post-operation and compared with intake from 24 h dietary recall.Weight and anthropometric measurements (AM) (triceps skinfold thickness (TST), mid-arm muscle circumference (MAMC)) were recorded pre-operation, on discharge, at 1 month post-operation and periodically thereafter.

Twenty patients (15M: 5F) underwent Oes. Jejunostomy feeding commenced within 48 h in 90% and continued for 9 (range 3-20) d. Major tube complications occurred in one patient and minor tube complications in one patient. There were no deaths. Major morbidity occurred in four patients. Two patients died of metastases and two had recurrence.

Following Oes, median weight change was 0 (range -9.4 to +5.5) kg on discharge and -1.6 (range -7.3 to +5.9) kg between discharge and 1 month. Nutritional requirements were met by 47% of patients at 1 month. Of fifteen patients followed up to 4 months, 77% patients had maintained ($\pm$ 2 kg) or gained weight. Median weight changes were +0.9 (range -3.1 to + 3.6) kg. Subsequent measurements indicate weight maintenance in approximately 90% patients without recurring disease.

AM taken in sixteen patients showed reduction in MAMC and TST at 1 month of 69% and 50% respectively: of eleven patients with subsequent AM, 45% and 100% showed maintenance/improvement in MAMC and TST respectively.

Tunnelled jejunostomy feeding is effective after Oes, ability to meet nutritional requirements is reflected in recorded weight changes.

Preliminary report of the efficacy of nasogastric feeding in allogeneic adult bone marrow transplant patients. By MICHELLE YOUNG, JULIA STANFORD, DEBBIE J. WALKER and GARY S. FROST. *Department of Nutrition and Dietetics, Hammersmith Hospital, London W12 0HS*

Parenteral nutrition (PN) has traditionally been used as the route of nutritional support in bone marrow transplantation (BMT). This has arisen from the assumptions that nasogastric tubes (NG) would be poorly tolerated due to mucositis. In addition it was commonly thought that the conditioning therapies and possible graft v. host disease therapy would reduce the absorptive capacity of the gut to such an extent that enteral feeds would not be absorbed. Gastrointestinal symptoms have been shown to be variable (Stanford *et al.* unpublished data). Recent work suggests positive benefits in maintaining gut nutrition (Alexander 1990).

We report the preliminary results of a randomized trial of PN v. NG feeding in allogeneic BMT, a subgroup of BMT patients who experience severe side-effects. All patients were made aware of the study in their initial outpatients appointment. Consent was obtained on admission to the ward prior to transplantation. Twenty patients were randomized 10 to NG and 10 to PN. Feeding was initiated when the patients had lost 10% of their admission body weight or had not met their nutritional requirements for 3 d. Nutritional requirements were determined (Schofield, 1985; and Elia, 1990). The NG group received an isotonic, whole protein, 4.18KJ/ml feed (Osmolite, Abbott Laboratories) and the PN was made up on site in the hospital pharmacy.

Of those randomized to the NG group, 5 dislodged the tube by vomiting within 24 hours and refused to have the tube repassed. These patients were withdrawn from the trial although their progress continued to be monitored (results not shown). The results are presented as the median and range shown in the Table.

	Nasogastric		Parenteral Nutrition	
	Median	Range	Median	Range
Number of patients	5		10	
Duration of feeding (d)	48.5	38-65	63	43-91
Number of days fed	15.7*	7-22	26*	14-46
Weight at start of feeding (kg)	83.1	57.1-97	74	62-93
Weight at end of feeding (kg)	83.5	57.7-97	73	62-94
Change in body weight (%)	0.5	- 0.3-1.05	0.9	- 1.1-4.5
Episodes of pyrexia (n.)	0.5*	0-2	2.3*	0 - 6

* significant difference between mode of feeding

It is important to note that NG withdrawal was not due to intolerance to the feed. The conditioning therapy was responsible for the vomiting which led to the tubes being dislodged. Although the groups were not large enough for complete statistical comparison there are interesting trends in the NG group such as decrease in duration of feeding (P=0.05 Mann-Witney U test), reduced episodes of pyrexia and decreased hospital stay all of which warrant further research. This study provides preliminary evidence that NG feeding is as effective as PN support.

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Elia, M. (1990). *Medicine Internationa,*, **82**, 3392-3396.
Schofield W.N. (1985). *Human Nutrition Clinical Nutrition,* **44**, 1-19.
Stanford, J.M., Frost, G. and Barrett, J. unpublished data.

One thousand weeks of home parenteral nutrition at a district general hospital. By RUPERT A.J. RANSFORD and BARRY J.M. JONES, *Department of Gastroenterology, Russells Hall Hospital, Dudley West Midlands DY1 2HQ*

Home parenteral nutrition (HPN) has become widely accepted in the treatment of intestinal failure, but has been largely restricted to a few referral centres in the UK (ESPEN Home Artificial Working Group). We report here our first 1000 patient weeks of HPN based upon our district general hospital (DGH) with a catchment area of 350 000.

Over 8 years (1989-97) eleven patients aged 18-74 years with intestinal failure due to Crohn's disease (n 4), small bowel infarction (n 3), radiation enteritis (n 2) and carcinomatosis (n 1), received HPN, including three from outside our catchment area, for a total of 1011 weeks (mean 94, range 10-332 weeks). Only one patient became dependent on district nurses for HPN administration due to blindness, three were partially dependent on relatives and the remainder were fully independent. Quality of life, reflected by functional activity, was excellent for eight patients, two travelling abroad with their HPN. Three (27%) patients are currently on HPN and three (27%) have been successfully returned to independent oral nutrition. Five (46%) have died from carcinomatosis (n 1), aortic thrombosis (n 1) or postoperative complications (n 3) for procedures related to their underlying disease.

Complications for ten patients were three line infections (1 in 3.4 years), three line fractures (1 in 3.4 years) and one line occlusion (1 in 13.5 years) with an overall line complication rate of 1 in 1.93 years. Excluded from this data is one patient with multiple complications who would markedly skew the results (aged 69 years, fed for 332 weeks with sixteen line infections largely due to poor nasal hygiene habits and one subclavian vein thrombosis).

Metabolic complications included glutamine induced hypernatraemia (n 1), metabolic bone disease (n 2) and vitamin A deficient night blindness (n 1).

Our nutrition team has not to date included a specified nutrition nurse, but all patients are now based on one specialist gastroenterology ward. Although our complication rates exceed those of larger referral centres (Johnston & Pennington,1993) our data demonstrate that HPN can be practised at DGH level with long-term survival and good quality of life provided sufficient resources are available, although better results could be achieved by appointment of a nutrition nurse to our nutrition team.

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Johnston,DA. & Pennington,CR.(1993). Scottish Medical Journal **38**,110-111.

Percutaneous endoscopic gastrostomy (PEG) feeding: too little too late? By CATRIONA GENTLEMAN, *Nutrition and Dietetic Services, Dewsbury Health Care NHS Trust, Dewsbury WF13 4HS*

During the summer of 1996, numerous cases of infected PEG sites were brought to the attention of the dietitians. It appeared that the rate of infection was rising. This was based on anecdotal evidence, so a 12-month retrospective review of all PEG tubes placed was carried out by completing a proforma, using information gained from case notes. A total of forty-two cases were included.

The overall aim of the review was to establish the extent of PEG site infection, with the results providing baseline figures to compare with future audit findings. Along with the conclusions drawn from them, the results would aid in the development of any guidelines and protocols found to be necessary following completion of the review.

The results, however, showed that less than half the patients were reported as having a PEG site infection and that there was no significant increase in the numbers being reported following the transfer of PEG placements to a new day surgery unit in February 1996. Most of the microbiology reports showed stoma colonization by normal skin or gut flora. Two of the other patients had pre-existing infections.

The most important finding of the review related to patient mortality post-PEG insertion. Not only did 54.8% of patients die post-insertion (during October 1995-September 1996), the mean mortality rate was less than 1 month, with a median and mode of 9 and 6 d respectively. There are many possible reasons for this. Owing to their disease state, a patient may have been an inappropriate candidate for a PEG. The PEG should perhaps have been placed earlier in treatment. Was the patient already too malnourished and would an earlier referral to a dietitian for nutritional support advice have made a difference?

The results raise serious issues surrounding patient selection for PEG feeding. However, the diagnosis, prognosis and causes of death need to be investigated further before a firm conclusion can be drawn.

Nutritional supplementation: How much do people drink? By HILARY J. PEAKE, SUZANNE EVANS, ALISON CHAMBERS, CAROLINE RICHES and GARY FROST, *Department of Nutrition and Dietetics, Hammersmith Hospital, London, W12 0HS*

We have previously demonstrated that writing nutritional supplements onto the medical drug chart increases delivery to the patients from 45% (using an *ad hoc* method of prescription) to 69% (Frost *et al.*1995).

We report the results of an audit of supplement consumption on six wards including general medical, surgical and care of the elderly. The audit assessed the volume of supplements (sip feeds) consumed against the amount prescribed. Supplement prescription was calculated by the dietitian, taking into account nutritional requirements and patient tolerance. Nurses on each of the wards were asked not to discard any of the supplements given to a patient over the audit period. An individual poster was displayed at each patient's bedside to reinforce this. The volume of supplement given to the patient and volume not drunk were measured in the morning and afternoon of each of the study days. The accuracy of this was checked against the amount of supplements delivered to the ward at the beginning and the amount remaining at the end of each day. The results are shown in the Table.

Ward	No. of patients days	Prescribed volume		Percentage volume consumed	
		Average (ml)	Average volume consumed (%)	12.00 hours	16.00 hours
Medicine	15	400	39	71	29
Surgery	24	558	51	58	42
Elderly	39	335	52	42	58
Mean	26	431	47	52	48

This audit shows that although 98 % of the supplements reached the ward, on average only 47% of the prescribed volume was consumed. The volumes consumed was similar to those reported in a recent study that demonstrated a positive effect of nutritional supplements on patients nutritional status and the incidence of complications (Keele *et al.* 1997).

Although there was no difference in the average percentage volume consumption according to type of ward, it is interesting to note the marked difference between wards. Percentage volume consumption varied between 16% and 65% when the two medical wards were compared.

The average overall volume consumption according to the time of day was similar between different wards. Examining the individual ward consumption in more detail, two wards (one surgical and one medical) showed improved percentage volume consumption before lunch, e.g. 86% (surgical ward) and 100% (medical ward) consumed before 12.00 hours. This may be related to ward differences in the number of permanent/trained staff working on various shifts.

This audit highlights the complex issues surrounding the poor consumption of nutritional supplements. The reasons for this low supplement consumption are multi-factorial. It may be partly explained by the failure to deliver the supplement to the patients, despite documentation on the drug charts; over prescription of the volume of supplements recommended by the dietitian and supplement palatability.

It is vital to identify pertinent factors which affect supplement consumption on particular wards to maximize consumption. To achieve this goal there is a need for dietitians, nursing staff and patients to work more closely together.

Frost, G., Master, K., Stanford, J., Kelly, M., Jones, R. Macqueen,C., Lowfthouse, A., Youde, L., Hassan, U. & King, C. (1995). *Penlines*, **6,** 3.

Keele, A.M., Bray, M.J., Emery, P.W. Duncan, H.D. & Silk, D.B.A. (1997). *Gut,*, **40,** 393-399.

Pilot study of a percutaneous endoscopic gastrostomy clinic for stroke patients. By ANDREW HANRAHAN, ALISON HAWKINS, JUDITH HYAM, DAMIAN JENKINSON and RENEE WRIGHT, *Stroke Unit, Royal Bournemouth & Christchurch Hospitals NHS Trust, Bournemouth BH7 7DW*

There has been a significant increase in the number of stroke patients with persistent dysphagia who are fed via a percutaneous endoscopic gastrostomy (PEG) as opposed to a nasogastric tube, mainly because of the suggestion that the former provides more effective nutritional support with less interruption of feeding (Park *et al.* 1992; Norton *et al.* 1996). In our Trust, the average number of patients discharged home with a PEG *in situ* has risen in recent years from about five to twenty five per year. The continuing care for this group of patients discharged into the community was fragmented and so we set up a pilot Gastrostomy Clinic where patients were reviewed at each appointment by a speech and language therapist, a dietitian, a nurse and a consultant physician. The PEG Clinic is held every 2 months as part of an existing General Medicine outpatient clinic. At the first three clinics, a total of eight patients were seen. The mean time from discharge to PEG Clinic appointment was 18 weeks (*n* 8, range 3.4 - 34 weeks). The mean time from insertion of PEG to first clinic appointment was 23 weeks (*n* 7, range 6.6 - 37.6 weeks).

Assessment of these eight patients at their first clinic appointment revealed that since discharge, there had been a weight gain in two patients, weight loss in four and no change in weight in two patients. The average BMI was 22 (range 18 – 26)kg/m^2. There had been an improvement in swallowing of solids in five patients (see Table) with an overall trend towards a normal consistency oral diet. There was a similar improvement in the swallowing of oral fluids in four patients. Examination of the PEG tube site revealed a localized infection in two patients and swabs were taken for microscopy and culture.

Oral diet	At discharge (no. patients)	At PEG Clinic (no.patients)
Nil by mouth	2	1
Puree diet	4	1
Minced diet	2	1
Chopped diet	0	4
Normal diet	0	1
TOTAL	8	8

On the basis of the assessment by the multidisciplinary team, the PEG tubes were removed from two patients, a replacement PEG tube was requested for one further patient, videofluoroscopy was requested in two patients, the staff of nursing homes were advised regarding any changes in diet for all of the patients and the General Practitioners of two patients were contacted regarding PEG site infections and recommended antibiotics based on the culture and sensitivity results from the swabs.

This small pilot study suggests that a multidisciplinary PEG Clinic facilitates regular monitoring of the swallowing in stroke patients, their nutritional status and also local complications relating to the PEG tube site. Perhaps most importantly, a clinic allows close supervision of a return to oral intake whenever possible and the earliest removal of the PEG tube, factors which in themselves have significant emotive and financial implications (Raha & Woodhouse, 1993). We are in the process of undertaking a larger prospective study of the clinic.

Norton, B., Homer-Ward M., Donnelly, M.T., Long, R.G. & Holmes, G.K.T. (1996). *British Medical Journal* **312:**13-16.

Park, R.H., Allison, M.C., Lang, J., Spence,E., Morris, A.J., Danesh, B.J., Russell, R.I, & Mills, P.R.(1992). *British Medical Journal* **304:**1406-1409

Raha, S.K. & Woodhouse,K.W. (1993). *Age and Ageing* **22,** 313-315

Providing fortified meals and between-meal snacks significantly increases energy intake of hospital patients. By MURIEL J. GALL[1], GEORGE K. GRIMBLE[2], NIGEL J. REEVE[2] and SUE J. THOMAS[3], [1]*Department of Nutrition and Dietetics, Queen Mary's University Hospital, Roehampton SW15 5PN,* [2]*Roehampton Institute London, West Hill, London SW15 3SN*, [3]*Putney Hospital, Putney, London SW15 1HW*

Although low nutrient intakes have been documented in hospital patients (Rana *et al.* 1992), it is unclear whether this is an inevitable result of anorexia arising from illness or is caused by inappropriate presentation of hospital food. We therefore wished to know if voluntary food intake could be increased by use of food fortification and snacks. Intakes and deficits of protein and energy were measured for 3 d in a control group of eighty-two consecutive admissions (twenty-seven male and fifty-four female) who ate freely from the standard hospital menu provided on medical, elderly care and orthopaedic wards. Subsequently, an intervention group of sixty-two different patients on the same wards (twenty-two male and forty female), were offered additional food items which provided an additional 22.2 g protein/d and 4057 kJ/d. This comprised a choice of snack with mid-afternoon and bedtime drinks, whilst 50 ml double cream (with dessert) and fortified soup were offered at lunch and supper. Deficits of protein and energy were obtained by subtracting actual intake from estimated requirements, which were calculated using previously described formulas (Schofield, 1985; Elia, 1990). The Table summarizes intake and balance in the two groups.

	Control group (*n* 81)		Intervention group (*n* 62)	
	Mean	SE	Mean	SE
Energy deficit (kJ/d)	-1432	256	-29***	269
Energy intake (kJ/d)	5897	260	6930**	273
Protein deficit (g/d)	-22.8	2.9	-17.8	3.2
Protein intake (g/d)	51.2	2.1	55.4	2.5

Mean values were significantly different from control: **$P<0.01$, ***$P<0.001$ (independent t test).

Fortification significantly increased energy intake in those groups with the lowest energy intake and largest energy deficits, that is male and female orthopaedic, female medical and female elderly patients (84% of total). The increases in energy intake were 21.3, 21.4, 23 and 19.6% respectively. Energy intake in male medical patients (*n* 10, 16% of total) increased by only 8.6%, sufficient to achieve positive energy balance. Only 18% of the patients had a large energy deficit which was not affected by supplementation. The increased energy and protein intakes represented 25.6% and 22.5% respectively of the supplements given.

These findings demonstrate that for these groups of hospital patients, current catering provision does not meet their requirements. The standard hospital menu designed to meet requirements, may not be in a form which can be easily taken by people who are unwell. We have shown that simply fortifying food and providing snacks was sufficient to increase voluntary intake and bring 82% of patients from deficit into overall energy balance. However, despite its efficacy, "wastage" of the supplements was high. It may not have been necessary to fortify the diet to the level of 4057 kJ/d, as the majority of patients achieved energy balance with much lower intakes of the supplements. We therefore suggest, paradoxically, that smaller, fortified portion sizes, offered more frequently may be more effective in achieving the nutritional requirements of these groups of patients than the current provision of food in hospital. Further studies need to examine the optimum, cost-effective combination of additional foods.

Elia, M. (1990). *Medicine International*, **82**, 3392-3396
Rana, S.K., Bray, J., Menzies-Gow, N., Payne-James, J.J. & Silk, D.B.A. (1992) *Clinical Nutrition* **11**, 337-334.
Schofield, W.N. (1985). *Human Nutrition Clinical Nutrition* **44**, 1-19.

Nutrient deficiencies during home enteral feeding. By C. Baldwin, C.J. Shaw, O. Dewit and M. Elia, *Dunn Clinical Nutrition Centre, HIlls Road, Cambridge CB2 2DH*

The British Artificial Nutrition Survey (BANS) has found that the majority of patients receiving home enteral tube feeding (HETF) either do not eat or their oral intake contributes little to the overall nutrient intake. Therefore the composition and quantity of feed administered is a major determinant of nutrient status in these patients. Additionally, the increased dietary requirements associated with specific clinical conditions have also been linked to at least some of the nutrient deficiencies that have found to occur during HETF e.g. Na, K, Mg, Cu, Se, thiamin, vitamin C and vitamin D.

The nutrient requirements of patients on HETF have been largely based on the recommended dietary allowances (RDA) or reference nutrient intake (UK) for normal subjects. However, these vary considerably between countries e.g. fourfold difference for vitamin D in the elderly (The Netherlands/Japan cf. UK), two-fold difference for vitamin C for adults (Canada & Germany cf. UK) and a 50 % difference for thiamin in adults (UK cf. Germany). This variability creates difficulties for companies who market the same feeds in different countries. The European Community has produced its own RDA's but individual countries may relate more to their own RDA's, causing potential legislative difficulties.

The RDA's which are intended for normal subjects may not be appropriate for specific groups of patients e.g. in those with persistent diarrhoea or loss of intestinal effluents when there may be increased requirements for Na, K Mg, and Zn; and in those with inflammatory disease there may be increased requirements for some B vitamins, vitamin C, and vitamin A (analogous to the increased recommended intake of vitamins for intravenous nutrition).

The variability in RDA's between countries and the need to cater for different types of patients has led to marketing of feeds with variable micronutrient composition. For example, for the same amount of energy, commercial feeds vary 4-5 fold in their content of vitamin C, folic acid, and biotin, 3-fold in their content of vitamin E, and 2-fold in their content of vitamin D.

Assessment of micronutrient status in patients on long-term HETF using the same methods as used in a Department of Health national survey, suggest the presence of frequent borderline or inadequate circulating concentrations of vitamin D, thiamin, carotenoids and to some extent vitamin C. Factors contributing to these results are multiple: absence of nutrients in feeds (carotenoids); inadequate intake of vitamin D in certain feeds relative to the RDA (10 µg for vitamin D for those > 65 y in the UK); low energy intake (up to 40% of patients on HETF reviewed in a survey in East Anglia are unable to walk); increased requirements associated with inflammatory disease (about 40% of patients in a survey in Cambridge had an elevated C-reactive protein); theoretical possibility that nutrients are lost during storage and administration.

The Scientific Committee for Food (European Community) has produced a preliminary document that proposes an upper limit to the nutrient content of enteral feeds. Many of the current commercial feeds exceed these limits, and MAFF is considering the implications of legislative issues by taking into account both the risks of deficiency and toxicity.

Appetite and food intake during Artificial Nutrition. By REBECCA J. STRATTON[1], R. JAMES STUBBS[2] and MARINOS ELIA[1], [1]*MRC Dunn Clinical Nutrition Centre, Hills Road, Cambridge CB2 2DH,* [2]*Rowett Research Institute, Greenburn Road, Aberdeen AB2 9SB*

The 1996 British Artificial Nutritional Survey (BANS) reported that approximately 13% of hospital patients received some form of Artificial Nutrition (including supplements), and that at any one time more patients received tube feeding at home than in hospital. Despite the increasing use of Artificial Nutrition (AN) there is a remarkable lack of information about its effects on appetite and voluntary food intake.

Appetite sensations and symptoms during Home Artificial Nutrition are common. In a stable group of patients receiving home parenteral nutrition (PN), we found 87% had a desire to eat, 67% experienced hunger, and 33% of all patients were distressed by hunger. A few patients chewed and spat out food in an attempt to relieve their symptoms. Temporal tracking of appetite during waking hours, in people solely fed intravenously overnight, revealed a variety of hunger profiles which were markedly different from normal subjects. Some patients had little or no hunger throughout the day, that was uninfluenced by stopping PN after an overnight feeding period (these patients typically had an acute phase protein response). Others showed a gradual increase in hunger during the day, which declined after the start of PN. Although hunger and desire to eat usually changed in the same direction, some patients experienced a strong desire to eat, chew and taste food in the absence of hunger. In similar studies, in mentally alert and well orientated adult patients receiving long-term home enteral tube feeding in Cambridge, we found that 83% had a desire to eat, 50% experienced hunger and a third of all patients were distressed by hunger.

The extent to which AN suppresses voluntary food intake and appetite is of obvious clinical importance, but the literature is unclear on this point, partly because of the effect of confounding variables (e.g. disease, drug therapy, mobility), and partly because of differences in study design. There have only been a few controlled clinical studies, and these suggest that overnight tube feeding suppresses oral energy intake by less than 20%. Anecdotal reports suggest that AN may even stimulate food intake in some malnourished patients. Our studies in normal subjects suggest there is less than 10% suppression of oral energy intake and no significant suppression of diurnal hunger during a 3 day period of tube feeding, irrespective of whether the feed (6.9 MJ/d) is administered nocturnally or continuously over 24 h. A more prolonged period of nocturnal tube feeding (6 days) appears to reduce food intake further. Continuous diurnal and bolus feeding reduced spontaneous food intake by 15-20% over 3 days and by 30% on the third day of bolus feeding.

Three conclusions can be drawn from the above: 1) In metabolically stable patients receiving long-term enteral or parenteral nutrition distressing appetite sensations are common; 2) A number of clinical studies, and experimental studies in normal subjects, suggest that AN suppresses voluntary food intake by 0-30%; 3) Further investigations are needed to assess the effects of the duration, timing and mode of delivery of AN.

Occluding material present in central venous and haemodialysis catheters. By GITANJALI S. PRASAD[1], ROBIN LEDGER[1], JOHN W.L. PUNTIS[2] and PATRICK A. BALL[1],. [1]*School of Pharmacy, University of Otago, PO Box 913, Dunedin, New Zealand and* [2]*Clarendon Wing, The General Infirmary at Leeds, Belmont Grove, Leeds LS2 9NS*

A common problem associated with venous access devices is occlusion. Although it is widely believed that clotting is involved, and papers have reported recovery of patency in occluded catheters using thrombolytic agents, the nature of the occluding material has not been characterized. The aim of the present study was to examine and attempt to characterize the occluding material.

Occluding material was removed by dissection from haemodialysis catheters (*n* 7) and central venous catheters (*n* 9). The central venous catheters had been used for parenteral nutrition. The material removed was examined by light microscopy, scanning electron microscopy (SEM) and microprobing. Samples were homogenized and separated by differential centrifugation. The resulting pellets and supernatant liquid were freeze-dried. The freeze-dried extracts were also examined microscopically. Fractionated extracts were assayed for total protein then hydrolysed and subjected to amino acid analysis. Lipid-like material found in the lines used for parenteral nutrition was examined by TLC.

In all cases the occluding material contained at least 65% protein. The microscopic appearance was that of fibrin, but the amino acid profiles suggested that significant amounts of other proteins were also present. SEM on some samples showed the presence of particulate contamination. Microprobe analysis showed only traces of heavy elements in these particles, suggesting they may be plastics. SEM also showed irregularities in the internal surfaces of some catheter samples. TLC of the lipid material suggested that the lipid-like material was a mixture of endogenous and exogenous fat.

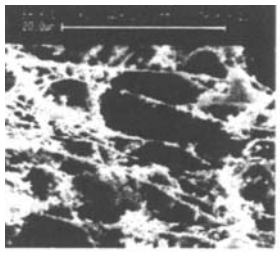


Fig. 1. Organised clot in occluding material

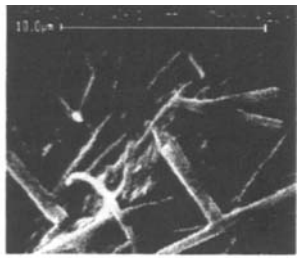


Fig. 2. Particulate material in occluding plug

Study of blocked catheters is difficult because of the complex nature of the occluding material and the very small amounts of sample for examination. The present study identified organized clot in the occluding material of all the haemodialysis catheters, and in the majority of the central venous catheters. Occlusion, which is a random and unpredictable event, is occurring as a result of triggering of the clotting pathway within the catheter. All components of the clotting cascade must be present in these lines, which raises the question; what is the trigger ?

Our evidence suggests that particulate contamination from the parenteral fluids or irregularities of the internal wall of the catheter could provide a trigger that leads to occlusion.

Treatment of central venous catheter (CVC) sepsis in young children receiving long-term parenteral nutrition. By SHANNON PAGE, GILL ABEL, MARK D. STRINGER and JOHN W. L. PUNTIS, *The Children's Centre, Clarendon Wing, The General Infirmary at Leeds, Belmont Grove, Leeds, LS2 9NS*

Central venous catheter-related sepsis (CRS) is an important complication of parenteral nutrition (PN) and presents the nutritional care team with the dilemma of catheter removal resulting in the loss of venous access, or antibiotic treatment and possible clinical deterioration. When CRS is suspected in our long-term PN patients, blood is taken for culture, and vancomycin and gentamicin given via the CVC which continues to be used for PN. We define CRS as fever with positive blood culture when there is no apparent focus of infection. The CVC is considered to have been sterilized if there are no signs of sepsis, and blood culture remains negative, for 2 weeks after stopping antibiotic treatment. A retrospective review of clinical records was undertaken to assess the pattern of infecting organisms and the effectiveness of this policy in seventeen children who received PN for more than 2 months.

Indications for PN were short bowel syndrome resulting from congenital gastrointestinal anomalies (*n* 9) or necrotising enterocolitis (*n* 4); idiopathic protracted diarrhoea (*n* 2), and liver disease associated with failure to thrive (*n* 2). The median age at commencement of PN was 1 week (range 1 d - 2 years). Types of CVC used included single lumen Broviac (*n* 47), neonatal 0.6 mm percutaneous (*n* 14), double-lumen Hickman (*n* 3), and totally implantable devices (*n* 2). There were seventy-six episodes of CRS, representing one episode per seventy-nine catheter days, with equal numbers of Gram positive and negative isolates; fifty-two were associated with a single organism and twenty-four with multiple organisms. Yeasts were grown on five occasions, treatment with the CVC *in situ* being attempted for one of these, with successful result. Coagulase negative staphylococci accounted for only 16% of CRS and were no more common than *Enterococcus faecalis* or *Klebsiella pneumoniae*. Of infected CVC 70% were sterilized (median treatment 10 d), 71% of these by the first line antibiotic regimen. Multiple organ failure caused death in one child with CRS in whom antibiotic treatment was delayed. We conclude that in this group of patients: (1) CRS is common; (2) it is possible to clear CRS in two-thirds of cases whilst continuing to use the CVC for administering both PN and antibiotics; (3) vancomycin and gentamicin is an effective first line therapy; (4) coagulase negative staphylococcus is a relatively uncommon cause of CRS; (5) antibiotic treatment should be commenced promptly, at the time that CRS is first suspected.

Investigation of particulate contamination in total parenteral nutrition admixtures in a clinical setting. By JEREMY C. FOX, ROBIN LEDGER and PATRICK A. BALL, *School of Pharmacy, University of Otago, PO Box 913, Dunedin, New Zealand*

There are many reports in the literature of particulate contamination in parenteral solutions from containers, administration equipment and contamination during handling. In 1994 the United States Food and Drug Administration recommended that all parenteral nutrition should be administered through in-line filters to protect the patient from the risk of precipitation in unstable admixtures. When considering implementation of this recommendation, clinical staff asked for information on what particulate contamination was present in the admixtures used in Dunedin hospital. The aim of the present study was to collect samples from patient-ready administration systems at ward level and to count and characterize the particulate contamination, which the patient would have received.

The parenteral nutrition admixtures had been pre-mixed by a national admixing centre in Auckland, with final additions being made, and administration sets fitted, by the Dunedin hospital aseptic pharmaceuticals unit. When a parenteral nutrition admixture was to be administered the ward was visited. Prior to connection to the patient, two samples, one of 30 mL and a second of 100 mL were collected from the line into a sterile, screw-top container which had been previously prepared by washing with ultra-clean water and solvents. Particle counts were obtained by filtration and observation under a light microscope using the method of Wilkins (Puntis et.al., 1992). Samples were filtered onto a 0.8 μm analytical membrane (Millipore) and viewed under x100 magnification using an eyepiece graticule G10 (BS3260). The particles were characterised using scanning electron microscopy (SEM) and X-ray diffraction (EDX) equipment at the Centre for Surface Analysis, University of Queensland, Australia. This technique enabled the chemical composition of the particles to be determined. Samples were taken from twenty total parenteral nutrition administration sets and the particle counts are shown in the Table.

		Particles per 1 mL solution (*n* 20)							
Particle size range (μm)		>40	40-28	28-20	20-14	14-10	10-7	7-5	5-2
1st 30 mL of admixture,	Mean	0.06	0.51	0.55	0.51	0.44	0.61	0.74	3.47
	SD	0.45	0.32	0.39	0.43	0.31	0.24	0.73	1.24
2nd 100 mL of admixture	Mean	0.15	0.09	0.15	0.14	0.15	0.20	0.22	0.90
	SD	0.09	0.07	0.14	0.10	0.07	0.11	0.12	0.41
Total	Mean	0.21	0.60	0.70	0.65	0.59	0.81	0.96	4.37

The SEM/EDX showed many of the particles found were composed of Si, Na, and Al suggesting that they were glass. Others contained Mg, Si and O and were presumed to be talc. Many other particles showed no heavy elements were present using EDX, so were presumably organic in nature.

This is the first study looking at admixtures on the ward immediately before use. Although methods differ, these results are similar to those found in previous studies (DiPaolo, 1990; Puntis, 1992; Foroni, 1993). These findings show that there is still considerable particulate contamination present in parenteral nutrition admixtures, and support the use of in-line filtration.

Di Paolo, E.R., Hirschi, B, & Pannatier, A. (1990). *Pharmaceutische Weekblad Scientific Edition* **12**,190-195.

Foroni, L.A., Rochat, M.H., Touiller, P. & Calop, J.Y. (1993). *Journal of Parenteral Science and Technology* **47**,311-314.

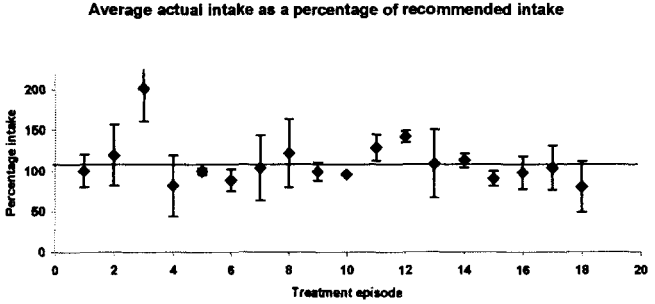
Puntis, J.W.L., Wilkins, K.M., Ball, P.A., Rushton, D.I., & Booth, I.W. (1992). *Archives of Disease in Childhood* **67**,1475-1477.

Adult parenteral nutrition: does one size fit all ? By DIANA L. BOOTH[1], PATRICK A. BALL[1,2] and JOHN L. McCALL[3], [1]*Pharmacy Department, Dunedin Hospital, 201 Great King Street,* [2]*School of Pharmacy and* [3]*Department of Surgery, University of Otago, PO Box 913, Dunedin, New Zealand*

Since 1993, standardized, premixed total parenteral nutrition (PN) admixtures have been used at Dunedin Hospital in place of individualized formulations. It was noted that prescriptions were rarely adjusted for weight, age or clinical status of the patient, leading to concern that inadequate or excessive nutrition may be administered to some patients. Other studies on the use of standardized formulations have focused on cost saving implications and state that the mean energy intake in a sample population is adequate (Genoni et al. 1994). The aim of the present study was to examine the PN administered to patients in this hospital in terms of the individual's 'ideal' requirements.

With ethical approval, surgical consultants were approached and asked for consent to include their patients in the study. The junior medical staff prescribing the nutrition were to be unaware of the study. Over a 6-month period, all adult patients prescribed PN were studied. Records were kept of the nutrition prescribed, and of all nutritional intake by all routes, including all carbohydrates received with fluid therapy and medications. The 'ideal' intake was calculated by an agreed protocol based upon guidelines produced by ASPEN (1993) and BAPEN (Pennington, 1996).

Fifteen patients received 18 treatment episodes in a total of 152 line-days of therapy (some patients received more than one treatment episode). Complete data was available for 113 line-days. The prescribed intake was significantly greater ($P<0.05$, t test) than both the recommended and actual energy intakes. In seven treatment episodes (39%) the energy intake infused was not within 20% of the ideal intake. Those patients whose energy requirements differed most from that supplied by the standard formulation were the most likely to be fed inappropriately.



Many patients in the study received an inappropriate energy intake, including both overfeeding and underfeeding. Whilst standard formulations provide an efficient and cost effective means of supplying PN, their use should not preclude determination of the patient's ideal requirements and appropriate adjustment of the quantity administered.

Genoni, M., De Loenzi, D., Bogen, M., & Muller, W. (1994). *Infusionstherapie und Transfusionsmedizin*, 21,304-309.

ASPEN Board of Directors, (1993). *Journal of Parenteral and Enteral Nutrition*, 17,1SA-51SA

Pennington, C.R. (editor) (1996). *Current Perspectives on Parenteral Nutrition in Adults*, 1st ed. Biddenden: ADM & Co Ltd.

Should all-in-one parenteral nutrition mixtures be pre-incubated before testing for sterility? By JOY WYATT[1], ANDREW R. BARNES[2] and EMMA M. GRAHAM-CLARKE[2], [1]*Pharmacy Department, Selly Oak Hospital B29 6JD,* [2]*Pharmacy Department, City Hospital, Birmingham B18 7QH*

City Hospital parenteral nutrition aseptic unit has been compounding 3 litre all-in-one parenteral nutrition (PN) bags since 1985. As part of its quality assurance programme, all unused bags are sterility tested, as recommended by Lee (1995). Any contamination of the mixture during preparation would most probably arise from either the aseptic staff or the environment and this is most likely to involve only a low level of organisms. The survival of organisms in PN and other parenteral products depends on the species and the composition of the fluid (Duffett-Smith & Allwood, 1979; Garcia-Caballero *et al.*1985; Scott *et al.* 1985; Lawrence *et al.* 1988). Also, because of the emulsion nature of lipid-containing PN mixtures, it is only feasible to perform sterility testing on a relatively small proportion of a 3 litre bag. There is, therefore, the possibility of a sterility test producing a false negative result. The behaviour of a range of micro-organisms was studied after inoculation into a commonly used PN mixture: 10^2 colony forming units (cfu) of either *Pseudomonas aeruginosa* (NCTC 6749), *Staphylococcus aureus* (NCTC 4103), *Escherichia coli* (ATCC 11229) or *Candida albicans* (clinical isolate W8718) were separately inoculated into 3 litre EVA Kabibags containing Pharmacia Regimen 5 without vitamins (2515 ml, 1440 mOsmol/l). The bags were stored at ambient laboratory temperature and viable counts performed on 0.5 ml samples taken from the additive port at intervals up to 22 d. In addition, a review was undertaken of organisms identified during routine settle plate environmental monitoring performed in three local hospital aseptic manufacturing units.

	Log cfu/ml					
Time (d)	0	1	6	7	21	22
Staphylococcus aureus	1.95	2.43	4.16			6.77
Escherichia coli	1.95	2.13	4.72			7.44
Pseudomonas aeruginosa	2.32	2.26	1.30	1.42	<0.30	
Candida albicans	1.83	3.42		7.91		7.78

The Table shows that all of the organisms tested were able to multiply in the mixture except *Pseudomonas aeruginosa*, which was not detectable by 21 d. Of the 134 environmental isolates identified from finger dabs or finger swabs, Gram-positive cocci comprised 57%, aerobic sporing bacilli 33%, fungi 8% and yeast 1%. From the seventy seven settle plate results, the proportions were 46, 38, 15 and 1% respectively.

Pre-incubation of PN mixtures prior to sterility testing may be desirable to optimize the likelihood of detecting contamination, depending on the likely contaminants and the constitution of the product. As Gram positive cocci, which would include *Staphylococcus epidermidis* from skin of staff, and aerobic sporing bacilli are commonly found in the manufacturing environment, study of the survival of these organisms would be especially valuable.

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Increased renal arginine turnover after lipopolysaccharide (LPS) treatment in the rat. By MARCELLA M. HALLEMEESCH, DAVID C.P. COBBEN, NICOLAAS E.P. DEUTZ and PETER B. SOETERS, *Department of Surgery, Maastricht University, The Netherlands*

The amino acid arginine plays a role in various metabolic routes; including the synthesis of proteins, urea, creatine and nitric oxide. Thus, arginine and its metabolites are at the centre of metabolic routes in several organs. Also, the production of arginine is a multiple organ event. In the healthy condition, the kidney has been demonstrated to be the main site of endogenous arginine synthesis, predominantly from gut-derived citrulline. After endotoxin challenge, intestinal citrulline production is decreased. The objective of the present study therefore was to determine renal arginine metabolism after LPS treatment. Therefore, LPS (2 mg/kg body weight (BW)) was administered subcutaneously (s.c.) to male Wistar rats (± 250 g BW) at t=0 and 12 h; the rats also received fluid supportive therapy (saline, 10 ml/100 g BW s.c.). Control animals did not receive LPS. At t=20 h, the right jugular and renal vein and the abdominal aorta were cannulated. A primed continuous infusion of L-[2,3-^{3}H]-arginine was given via the jugular vein. Kidney blood flow was measured using the *para*-aminohippuric acid indicator dilution technique. Samples of renal venous and aortic blood were collected. Plasma and kidney free amino acid concentrations and specific activity were determined using HPLC. Three compartment modelling, in which the intracellular specific activity was used as the precursor pool, was used to calculate renal arginine turnover.

	Control		LPS	
	Mean	SE	Mean	SE
Blood flow (ml/100 g BW per min)	2.4	0.7	2.6	0.5
Cit net balance (nmol/ 100 g BW per min)	-72	17	-45	17
Arg net balance (nmol/ 100 g BW per min)	31	12	53	12
Arg production (nmol/ 100 g BW per min)	203	47	380*	72
Arg disposal (nmol/ 100 g BW per min)	222	48	443*	72

* Significantly different from control, $P<0.05$ (Student's t test).

At t=20 h, renal blood flow was unchanged. Renal citrulline uptake tended to decrease ($P=0.11$). Net arginine production however, was unchanged. However, the ratio of net citrulline uptake: net arginine production increased from approximately 50% to approximately 100%. Also, both intracellular production and disposal of arginine were significantly increased, reflecting increased arginine turnover. Interestingly, increased disposal and production of arginine were related to increased inward and outward arginine transport and reduced metabolic shunting (results not shown).

In conclusion, this study shows that renal arginine turnover is increased after LPS treatment, with no apparent increase in net arginine balance.

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Glutamine utilization and oxidation by the rat oesophagus and duodenum. By L. JAMES, M.ELIA, P.G. LUNN, *Dunn Nutritional Laboratory, Downham's Lane, Milton Road, Cambridge CB4 1XJ*

We have reported that glutaminase (EC 3.5.1.2) activity is weak in both the human and rat oesophagus but strong in the small intestine (James *et al*, 1995). The purpose of the present study was to develop an *in vitro* system for measuring glutamine utilization and oxidation and total gaseous exchange in rat oesophageal and duodenal tissue, so that two hypotheses could be tested: (a) the contribution of glutamine to oxidative metabolism is low in the oesophagus and high in the small intestine, and (b) glutamine utilization and oxidation is not suppressed by other fuels.

Relative utilization of nutrients by tissue samples was assessed using radiolabelled substrates, followed by quantifying labelled CO_2 as the end-product of respiration. Briefly, tissue slices weighing 30-40 mg were incubated in Krebs-Henseleit medium with added substrates. Metabolites were measured by standard enzymic techniques. O_2 consumption was measured polarographically in conjunction with CO_2 production. NaOH (1.5mmol/l) was used for trapping CO_2, then total CO_2 determined by titration. ^{14}C from the oxidation of labelled substrates was assessed by liquid scintillation counting. O_2 consumption occurred at a constant rate over 30 min. CO_2 production also occurred at a constant rate, and was similar in the duodenum as in the oesophagus, e.g. 0.59 (sd 0.14) v. 0.48 (sd 0.13) µmol/min per g wet weight respectively when all the substrates were included in the incubation medium..

	DUODENUM				OESOPHAGUS			
	% CO_2 from glutamine		Glutamine utilization*		% CO_2 from glutamine		Glutamine utilization*	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Glutamine (2 mmol/l)	42	14	-0.49	0.09	8	4	-0.14	0.05
Glutamine (2 mmol/l) + glucose (4 mmol/l)	43	6	-0.59	15	9	2	-0.14	0.12
Glutamine + Glucose (4 mmol/l) + lactate (1 mmol/l) + BOH (2mmol/l) + AcAc (1 mmol/l) + Oleate (2 mmol/l)	39	13	-0.70	0.09	7	3	-0.18	0.14

BOH β-hydroxybutyrate; AcAc acetoacetate

* Rates of utilization of glutamine are expressed in µmol/min/per g wet weight.

However, glutamine utilization by the duodenum was found to be 2-3-fold higher than by the oesophagus, and the contribution of glutamine oxidation to CO_2 production in the duodenum (about 40%) was 4-6-fold than in the oesophagus. The contribution of glutamine oxidation to CO_2 production was not inhibited in the presence of glucose or a mixture of glucose, lactate, ketone bodies and oleate (Table). Only about 10% of the glutamine utilized was oxidized. The majority of the glutamine C utilized by the duodenum was converted to glutamate (about 60-70%).

The results suggest that: (a) both glutamine utilization and oxidation are considerably greater in the duodenum than in the oesophagus; (b) only a small proportion of the glutamine utilized is oxidized by oesophageal and duodenal tissue; and (c) glutamine is a preferred fuel by the duodenum, not only because it was found to contribute to about 40% of its oxidative metabolism but also because this oxidation failed to be suppressed in the presence of a mixture of other fuels. The data indicate that different parts of the GI trace may vary widely in their response to glutamine administration.

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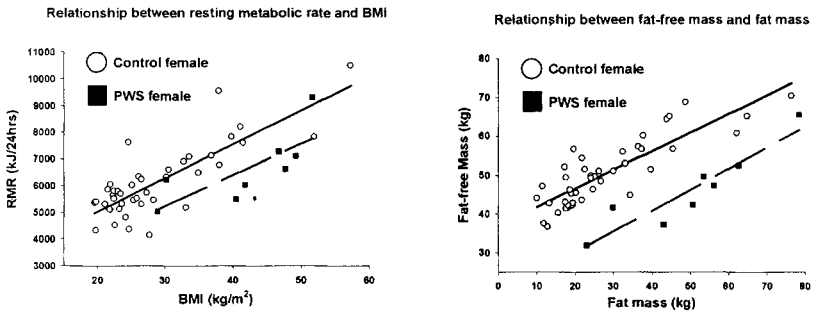
Resting metabolic rate is reduced in Prader-Willi syndrome as a result of altered body composition. By AUDREY E. BRYNES [1], ANTHONY P. GOLDSTONE [2], E. LOUISE THOMAS [3], JIMMY D. BELL [3], ANTHONY HOLLAND [4], STEPHEN R. BLOOM [2] and GARY FROST [1], *Department of [1]Dietetics, [2]Endocrine Unit, [3]Robert Steiner MRI Unit, Imperial College School of Medicine, Hammersmith Hospital, London, W12 0NN; [4]Department of Psychiatry, University of Cambridge, CB2 2AH.*

Prader-Willi syndrome (PWS) is a genetic disorder characterized by life-threatening obesity, hyperphagia, mental retardation, behavioural problems and short stature. Measured resting metabolic rate (RMR) is 20-50% lower than expected using predictive equations correcting for height, body weight and age. However the interpretation of these results is difficult because of the abnormal body composition in PWS. We therefore compared RMR in PWS and healthy female subjects using detailed body composition measurements and multiple regression analysis.

Subjects underwent indirect calorimetry (Deltatrak II, Datex) and body composition analysis (fat mass (FM) and fat-free mass (FFM)) using whole-body magnetic resonance imaging (MRI Picker 1.0T HPQ system, T1-weighted SE, 10 mm slices every 10-30 mm). Subject details are given as means ± SEM:

	Age (years)	Weight (kg)	Height (m)	BMI (kg/m^2)	MRI % Body Fat	FFM (kg)	FM (kg)	FM:FFM Ratio
Lean	31	65.6	1.66	23.7	29.1	46.1	19.5	0.42
(*n* 28)	± 1	±1.7	±0.01	±0.46	±0.8	±0.9	±0.9	±0.02
Obese	36	104.9*	1.65	38.5*	42.8*	59.3*	45.5*	0.76*
(*n* 14)	± 3	± 5.1	± 0.01	± 2.1	± 1.3	± 1.9	± 3.6	± 0.04
PWS	25†	95.7*	1.50*†	42.1*	50.8*†	46.1†	49.6*	1.06*†
(*n* 8)	± 2	± 9.7	± 0.03	± 3.0	± 2.0	± 3.7	± 6.3	± 0.07

Mean values were significantly different from those for: lean subjects, * $P<0.05$; obese subjects † $P<0.05$, (ANOVA with post-hoc Tukey test or Kruskal-Wallis ANOVA on ranks with post-hoc Dunn's method).

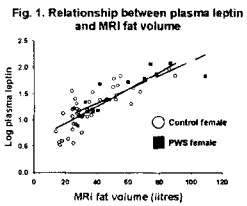


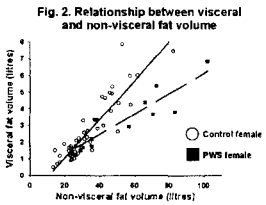
Linear regression analysis showed that RMR correlated with BMI in both control and PWS subjects (control: r 0.81, $P<0.001$; PWS: r 0.76, $P<0.05$). However PWS subjects had lower RMR relative to BMI when compared to controls ($P<0.005$). Body composition analysis revealed that PWS subjects had a lower FFM relative to FM when compared to controls ($P<0.001$). To correct for body composition differences, multiple linear regression analysis was performed using RMR as the dependent variable and age, FFM, FM and diagnosis as independent variables. RMR remained lower in PWS when regressed with age together FM ($P<0.001$), but was higher when regressed with age and FFM ($P<0.001$). However regression with age, FFM and FM together revealed no effect of PWS ($P=0.6$). This indicates that the reduction in RMR seen in PWS is explained by altered FFM and FM, rather than being due to differences in energy expenditure at the tissue level. Reduced lean tissue with increased fat deposition in PWS is the underlying defect affecting RMR.

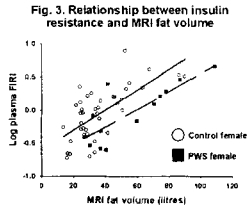
Plasma leptin, insulin resistance, lipids and body fat distribution in lean and obese healthy and Prader-Willi syndrome subjects. By A.P. GOLDSTONE [1], E.L. THOMAS [2], A.E. BRYNES [3], J.D. BELL [2], G. FROST [3], A. HOLLAND [4], M.A. GHATEI [1] and S.R. BLOOM, [1] *[1]ICSM Endocrine Unit, [2]Robert Steiner MRI Unit, [3]Department of Dietetics, Hammersmith Hospital, London W12 0NN; [4]Department of Psychiatry, University of Cambridge CB2 2AH*

Body fat content and distribution, particularly visceral obesity, have adverse effects on glucose tolerance and lipids. Leptin, an adipocyte hormone, acts in the hypothalamus to reduce food intake. Plasma leptin increases with total body fat and has greater gene expression in subcutaneous than visceral fat depots. Prader-Willi syndrome (PWS) is a genetic disorder characterised by life-threatening obesity, hypogonadism and short stature. The extreme hyperphagia and obesity mirrors that seen in leptin deficiency in animals and man, and genetic leptin resistance in animals (Montague *et al.* 1997). The cause of obesity in PWS is unknown. The metabolic consequences of obesity may also be different in PWS (Schuster *et al* 1996). We therefore examined whether leptin levels and obesity-related phenotypes are altered in PWS compared with controls, when correcting for confounding variables.

Forty-six healthy (age 18-56 years, BMI 19.6-51.9 kg/m^2) and thirteen PWS female adults (age 20-38 years, BMI 23.6-51.6 kg/m^2) were venesected after an overnight fast. Plasma was assayed for leptin, glucose, insulin and lipids. Since BMI is a poor predictor of body fat content in PWS, whole body magnetic resonance imaging (MRI, Picker 1.0T HPQ system, T1-weighted SE, 10 mm slices every 30 mm) was used to determine body content and distribution (non-visceral and visceral). Results were analysed by multiple linear regression using age, MRI fat volumes and PWS status as dependent variables.







Log plasma leptin levels correlated (r^2 0.68) with MRI fat volume ($P<0.001$) (Fig. 1). Log plasma leptin correlated with non-visceral fat volume ($P<0.005$) but not visceral fat volume ($P=0.3$). There was no difference in the correlation between log leptin and MRI fat volume between controls and PWS, with or without correction for age and fat distribution ($P=0.9$) (Fig. 1). PWS was associated with reduced amounts of visceral fat, even when corrected for age ($P<0.001$) (Fig. 2). Log plasma FIRI (a marker of insulin resistance=fasting insulin x glucose/25) correlated with MRI fat volume (r^2 0.68, $P<0.001$) (Fig.3). PWS was associated with lower insulin resistance ($P<0.001$), even when corrected for age and fat distribution. Log plasma triacylglycerol (TG) was positively and HDL:LDL ratio inversely correlated with MRI fat volume (r^2 0.53, r^2 0.5, both $P<0.001$). PWS was associated with reduced TG levels ($P<0.01$) but this was normalised once corrected for body fat distribution. There was no effect of PWS on HDL:LDL ratio, with or without correction for age and body fat distribution.

There is no evidence for leptin deficiency as a cause for obesity in PWS. The extreme hyperphagia in PWS may be due to leptin resistance or other hypothalamic defects. PWS patients have increased fat content at a young age with reduced visceral:non-visceral fat ratios. Even when correcting for these findings, there is reduced insulin resistance in PWS. The role of other factors, such as hepatic insulin extraction, growth hormone deficiency and hypothalamic needs further examination.

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Changes in body composition following liver transplantation. By ISOBEL DAVIDSON[1], ROSEMARY A. RICHARDSON[1], AMANDA MAYTUM[1], ALISON HINDS[1], ALISTAIR McGILCHRIST[2] AND JAMES O. GARDEN[2], *[1]Department of Dietetics and Nutrition, Queen Margaret College, Clerwood Terrace, EH12 8TS and the [2]Scottish Liver Transplant Unit, The Royal Infirmary, Edinburgh, EH9 3YW.*

Weight gain is common following liver transplantation (LTx) and evidence suggests that this exceeds recipients pre illness weight (PIW; Palmer *et al*, 1991). This increase in body mass cannot be attributed to pharmacological regimens (Johnson *et al*, 1993) but could contribute to long term morbidity and mortality. The composition of this weight gain has not been investigated in this patient population.

The present study was undertaken to evaluate the weight change and its composition occurring after LTx. We examined retrospectively weight status at 6, 9 12 and 24 months post-transplant (group A) and assessed prospectively body composition prior to and at 3, 6 and 9 months post LTx (group B). Patients with prolonged periods of sepsis were (<3 months) were excluded. Group A comprised twenty-two patients (M:F = 10.12; mean age 51 SD 1.8 years) where weight history was reviewed. Group B comprised six patients (M:F=2:4; mean age 55 SD 1.1 years). In this group, weight, triceps skinfold thickness (TSF) and arm muscle circumference (AMC) were measured. Multifrequency bioelectrical impedance analysis (MFBIA) at 5 and 200 kH was performed. Data were analysed by t test for paired comparisons.

Results from group A showed a significant increase in body mass by 6 months (70.1 SE 2.99 kg, $p<0.05$) compared with PIW. This period of weight gain continued until the end of the study. At 9 months weight was 72.5 (SE 3.12) kg ($P<0.01$), at 12 months 74.1 (SE 3.14) ($P<0.001$), at 24 months 76.0 (SE 3.65) ($P<0.0001$). At 2 years after LTx patients weighed 6kg (12%) more than their PIW.

Group B	At transplant		3 months		6 months		9 months	
	mean	SEM	mean	SEM	mean	SEM	mean	SEM
BMI	23.8	1.58	25	1.32	25.6	1.6	26.6*	1.8
TSF (%)	72.0	7.34	80	10.65	99	8.54	108**	8.35
AMC (%)	95	4.25	103	5.04	101	6.06	102	4.79
Fat mass (kg)	21.9	2.84	23.8	1.64	27.2**	2.86	27.4**	2.92

Mean values were significantly different from those at transplant*P<0.05, **P<0.01

Results from group B show a significant increase in body mass at 6 months after LTx. In addition results from arm anthropometry and MFBIA indicate that this weight gain is reflected in fat mass not lean body mass. There was no significant change in markers of lean body mass. This study illustrates that weight gain in post LTx patients is a consistent and continued feature which exceeds patients' PIW. This weight gain comprises changes in fat not lean body mass. It is evident that further investigations in the areas of nutrient intake and metabolism are required to elucidate the mechanisms of this disturbing and potentially life threatening change in body morphology.

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We gratefully acknowledge the financial support of Nutricia Ltd.

Use of specific lipid formulation in food preparations can regulate appetite. By LARS LINDMARK[1] and ANNELI SVENSSON[2], *[1] Scotia LipidTeknik, Box 6686, Stockholm, Sweden and [2] Bates Sweden, Box 1043, Helsingborg, Sweden*

Dysregulation of food intake is considered an important part of an unhealthy dietary behaviour pattern. All major nutrients, protein, carbohydrates and fat affect eating behaviour. Earlier studies have demonstrated that fat can regulate appetite and satiety. However, limited information is available using actual food products. A specific lipid formulation, containing chromatographically fractionated vegetable oil triacylglycerols in emulsified form (IB-emulsion), has been developed. This emulsion is stable and suitable for incorporation in various food products. A fruit-yoghurt with a 30 g/kg fat content was produced using the IB-emulsion. The fruit yoghurt was packed in 200 g plastic jars (each one portion). Two pilot studies were performed. One study (Expt 1) was double-blind randomized and compared IB-fruit yoghurt with normal dairy fat fruit yoghurt in thirty-six subjects (females and males) eating identical amounts of yoghurt (same fat content and energy content). Satiety was measured using a visual analogue 100 mm scale (VAS). The second pilot study (Expt 2) was an open field study in twenty-three volunteers (females) eating a self-selected light lunch (total energy 1400 - 1500 kJ) daily for 1 week. The following week the subjects instead ate one portion of IB fruit yoghurt for lunch. Subjects were also allowed to eat one or two slices of plain hard bread (total energy 950 - 1000 kJ, including IB fruit yoghurt). Satiety was measured using the VAS scale after each meal. The IB fruit yoghurt was well received judging by taste, texture and general satisfaction.

Time (min)	0		30		60		120		180		240	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Expt 1												
IB-yoghurt (800 kJ)	24.4	2.6	75.6	3.1	68.5	2.8	56.1	3.3	46.1	3.7	38.5*	4.2
Normal yoghurt (800 kJ)	22.7	2.2	70.1	2.7	69.3	2.7	54.9	3.0	39.3	3.5	26.0	3.2
Expt 2												
IB-yoghurt (1000 kJ)	14.8	2.1	89.9	1.1	81.5	1.5	66.0	2.4	43.4	3.0		
Light lunch (1500 kJ)	15.5	1.9	88.9	1.4	79.7	1.9	63.5	2.3	41.4	2.6		

Mean value was significantly different from that for normal yoghurt, * $p< 0.025$ (t test)

Expt 1 shows that IB fruit-yoghurt led to a clearly higher satiety at 4 h after intake. The effect was also evident at 3 h, but this was not signficant. Expt 2 shows that an IB fruit yoghurt lunch is equal or slightly better than a light lunch in producing satiety. The difference between Expt 1 and Expt 2 could be that only females were studied in Expt 2.

In conclusion the results suggest that the IB-emulsion is more effective in producing satiety than dairy fat. The use of IB-emulsion could thus be valuable and helpful to formulate fat-modified normal food products with an improved satiety effect and used to promote more healthy dietary habits and to regulate appetite.

Changes in weight, albumin and C-reactive protein in advanced pancreatic cancer. By MATTHEW D. BARBER, JAMES A. ROSS and KENNETH C.H. FEARON, *University Department of Surgery, Royal Infirmary of Edinburgh, Edinburgh EH3 9YW*

Weight-loss and the acute phase protein response (APPR) have been associated with poor survival in advanced pancreatic cancer, however, little information is available on changes in these factors over time. The present study examined changes in weight, C-reactive protein (CRP), serum albumin and Karnofsky performance status (KPS) (as a measure of functional ability) in twenty-five patients with advanced pancreatic cancer given supportive symptomatic treatment only. Patients were assessed at approximately monthly intervals on a total of seventy occasions allowing assessment of changes over thirty-seven intervals of 28 d. All assessments were made at least 3 weeks after surgery or bile duct stenting. Thirteen patients were seen on two occasions between 3 and 8 weeks after diagnosis and nine patients were seen on two occasions within 8 weeks of death allowing comparison of changes in weight, CRP, albumin and performance status at these times.

			UICC stage			Change over 28 d			
	Number of intervals	Age (years)	2	3	4	Weight (kg)	CRP (mg/l)	Albumin (g/l)	KPS
All patients	37	64	10	4	11	-2.3	+15	-1	-4
(*n* 25)		(29-76)				(-4.5--0.6)	(0-+48)	(-3-+1)	(-19-0)
Patients at diagnosis	13	70	4	2	7	-2.5	0	-1	0
		(51-76)				(-4.6--1.1)	(0-28)	(-3-+2)	(-4-0)
Patients near death	9	55	2	3	4	-5.6 *	+69 *	-5	-20*
		(29-76)				(-7.2--2.6)	(39-128)	(-7-0)	(-42--16)

Values shown are median (interquartile range) except for age where values shown are median (range).

UICC, Union Internationale Contre le Cancre.
* Significant difference between patients close to death and close to diagnosis ($P<0.05$, Mann-Whitney U test).

The Table shows overall changes for all patients and changes within 8 weeks of diagnosis and within 8 weeks of death. Rate of rise in CRP level and fall in weight and KPS were significantly greater close to death compared with shortly after diagnosis. Only 13% of patients had an elevated CRP level close to diagnosis compared with 100% of those close to death.

Changes in CRP were significantly negatively associated with changes in weight (r -0.41, P=0.016). This association may be due to the APPR causing a direct drain on amino acid stores resulting in loss of lean body mass. Alternatively the association between APPR and weight loss may reflect other pro-inflammatory cytokine mediated catabolic events. There was no significant association between changes in CRP and changes in albumin (r -0.31, P =0.059) or between changes in weight and changes in albumin (r 0.17, P =0.31). A greater change in weight was associated with a lower value of KPS (r 0.5, P=0.0034).

We have previously suggested a constant decline in weight with time in this group of patients (Wigmore *et al.* 1997) whereas the current data suggest an accelerating pattern of weight loss (and parallel increase in the rate of rise in CRP) close to death. Weight loss also appears to contribute to deterioration in functional ability.

These data further implicate the APPR in contributing to the progressive weight loss seen in patients with advanced pancreatic cancer and may also provide a benchmark with which to compare the effects of interventions in these patients.

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Does the presence of a nasogastric tube adversely affect distal colonic motor activity and contribute to the pathogenesis of enteral feeding-related diarrhoea? By HAMISH D. DUNCAN, SIMON J. COLE, TIMOTHY E. BOWLING and DAVID B.A. SILK, *Department of Gastroenterology and Nutrition, Central Middlesex Hospital NHS Trust, London NW10 7NS*

Up to 25% of patients receiving enteral tube feeding develop diarrhoea, the pathogenesis of which remains unclear. Our recent studies have shown that continuous nasogastric enteral tube feeding is associated with abnormal colonic motor activity (Bowling *et al.* 1993*a*) and an ascending colonic secretory response (Bowling *et al.* 1993*b*). We have previously reported that bolus nasogastric tube feeding of 250 ml or more of enteral diet causes diarrhoea associated with suppression of distal colonic motor activity (Duncan *et al.* 1996*a*), but when a bolus of an identical enteral diet is drunk, diarrhoea does not develop (Duncan *et al.* 1996*b*). We were concerned that the physical presence of the nasogastric tube may be an important factor in the development of the abnormal colonic motor activity response and resulting diarrhoea associated with enteral tube feeding.

The aim of the present study was to investigate whether the presence of a nasogastric tube was a contributing factor in adversely affecting distal colonic motor activity and development of diarrhoea.

Intraluminal pressure recordings in the unprepared distal colon were studied in six healthy volunteers using an established water perfusion technique. Continuous recordings were made for 8 h; 3 h before and 5 h following the administration of a polymeric diet. A nasogastric tube was inserted in subjects in groups 2 and 3. Subjects in group 1 drank 250 ml of feed over 15 min every 2 h for two instillations (70 kJ/min, 105 mg N/min). Subjects in group 2 were bolus fed, via a nasogastric tube, an identical enteral feed of 250 ml over 15 min every 2 h for two instillations (70 kJ/min, 105 mg N/min). Subjects in group 3 drank 250 ml of an identical enteral feed over 15 min every 2 h for two instillations (70 kJ/min, 105 mg N/min) with a nasogastric tube *in situ*. The pressure records were analysed in 30 min epochs for the study segment (sum of four channels) activity index (AI, area under the curve: mmHg/min) by fully automated computer analysis.

None of the six subjects in group 1 developed diarrhoea, nausea or bloating. There was no significant difference in the AI before (AI 3376 (SE 209) mmHg/min) or after drinking the polymeric enteral feed (AI 3363 (SE 210), P = 0.48). In group 2 however, all six subjects developed diarrhoea. The fasting AI (2957 (SE 227)) fell significantly with bolus tube feeding (2505 (SE 72), P < 0.05) associated with subjects developing diarrhoea. None of the six subjects in group 3 developed diarrhoea, nausea or bloating. There was no significant difference in the AI before (AI 3368 (SE 122) mmHg/min) or after drinking the polymeric enteral feed (AI 3161 (SE 128), P = 0.14).

Drinking boluses of a standard polymeric enteral diet does not suppress colonic motor activity even with a nasogastric tube *in situ*. Bolus feeding via a nasogastric tube however, suppresses colonic motor activity in association with the development of diarrhoea. These results suggest that neither the enteral diet nor the presence of a nasogastric tube *in situ*, causes the abnormal suppression of distal colonic motor activity in response to bolus nasogastric tube feeding, and thus these are not causes of enteral-feeding related diarrhoea. These results confirm that it is the instillation of enteral diet via a nasogastric tube rather than orally, that is the cause of enteral tube feeding-related diarrhoea. This could be due to the fact that enteral tube feeding is a process that does not elicit the cephalic phase of feeding.

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The influence of the acute - phase response on energy balance in advanced cancer patients. By MICHELLE N. HARVIE[1], I.T. CAMPBELL[1], A. HOWELL[3], N. THATCHER[3] and A. BAILDAM[2],[1]*University Department of Anaesthesia and* [2]*University Department of Surgery, Withington Hospital, Manchester M20 2LR and* [3]*University Department of Medical Oncology, Christie Hospital, Manchester M20 4BX*

The acute- phase protein response (APPR) is reported in non-small-cell lung cancer (NSCLC) (Staal-van den Brekel *et al.* 1995), and pancreatic cancer (Wigmore *et al.* 1997) where it was associated with hypermetabolism and weight loss. In pancreatic cancer an associated decrease in dietary intake is considered to be the major factor in weight loss. We determined the presence of the APPR and its effect on resting metabolic rate (RMR) and dietary intake in metastatic breast cancer and metastatic melanoma patients, conditions in which weight loss and cachexia are not often observed and in which evidence of an APPR has not previously been sought; we also studied patients with advanced NSCLC.

Fifteen patients with metastatic melanoma (BMI 22.5 - 32.1 (median 26.45) kg/m^2; weight change over previous 2 months, -7% to + 5%, median 0), fourteen patients with metastatic breast cancer (BMI 16.3 - 48.7 (median 25.7) kg/m^2; weight change over previous 2 months, -14% to +24%, median 0) and thirty-eight patients with NSCLC (BMI 17.8 - 34.2, (median 25.1) kg/m^2; weight change over previous 2 months, -14% to +14%, median -4%) were studied. RMR was measured using the Deltatrac Indirect Calorimeter (Vohra *et al.* 1995). All patients were apyrexial, fasted for 12h and studied supine after at least 30 min rest. Energy and protein intakes were determined from 4d weighed food diaries. The presence of an APPR was determined using serum C-reactive protein (CRP) and was defined as a serum CRP >5 mg/l. The data were analysed to determine whether there was any relationship between an APPR (CRP>5mg/l) and weight loss, dietary intake and RMR.

Thirty-three of thirty-eight (84%) lung cancer patients had an APPR (CRP 5 - 193 (median 64) mg/l); three of nine (33%) breast cancer patients (5 - 165 (median <5) mg/l); five of fifteen (33 %) melanoma patients (5 - 172 (median <5) mg/l).

CRP values for each of the three groups were as follows: NSCLC 5-193, (median 64) mg/l; breast cancer 5-165 (median <5) mg/l; melanoma <5 - 172 (median < 5) mg/l.

Lung cancer patients with CRP >5 mg/l had a significantly higher RMR expressed as a percentage of "basal" metabolic rate predicted from the Harris-Benedict equation, than those with a CRP $\leq$ 5 mg/l (115.4 (SE 3.1)% *v.* 101.2 (SE 4.9)%; $P<0.05$). This relationship could not be demonstrated in the melanoma patients (109.8 (SE 8.9)% *v.* 101.0 (SE 1.8)%; $P = 0.385$), or in patients with breast cancer (97.0 (SE 14)% *v.* 92.8 (SE 2.7)%; $P = 0.816$). There was a significant correlation between CRP and weight change in lung cancer (Spearman's rank correlation coefficient -0.3287, $P = <0.05$) and in melanoma patients (Spearman's rank correlation coefficient -0.5401, $P <0.05$). There was no relationship in any of these groups between the presence of an APPR and dietary intake.

This confirms that an increased metabolic rate appears to be a major component in weight loss in lung cancer but the mechanism of weight loss in the melanoma patients has yet to be defined.

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Non-invasive measurement of intracellular skeletal muscle triacylglycerol. By J. RICO-SANZ[1], E.L. THOMAS[1], J.V. HAJNAL[1], S. MIERISOVÁ[1], P MCKEIGUE[2] and J.D. BELL[1], [1]*The Robert Steiner MR Unit, Hammersmith Hospital, London W12 0HS and* [2]*The London School of Hygiene and Tropical Medicine, London WC1E 7HT.*

There is increasing interest in the role of muscle triacylglycerols and their possible involvement in insulin resistance. Recently it has been shown that high muscle triacylglycerol levels are inversely related to glucose utilization (Pan *et al.* 1997). Normally, studies investigating the role of intracellular muscle triglycerides (IT) in human subjects have been carried out by direct biochemical analysis of biopsy material and by tracer estimation of IT oxidation. However, the use of the muscle biopsy technique in human subjects presents ethical and practical considerations especially in longitudinal studies. Furthermore, IT measurement from biopsies is not without complication and can show great variability (Wendling *et al.* 1996). Recently, it has been shown that it is possible to obtain a non-invasive measurement of intramuscular lipids by means of proton magnetic resonance spectroscopy (^{1}H MRS) (Schick *et al.* 1993; Boesch *et al.* 1997). The main purpose of the present study was to non-invasively evaluate intracellular muscle triacylglycerols.

Magnetic resonance (MR) imaging and spectroscopy data were acquired from eight healthy volunteers on a 1.5T Picker prototype system using a quadrature bird cage coil of 300 mm diameter. In each examination subjects lay in a supine position with the left leg placed along the axis of the coil and immobilized with firm padding. The right leg was supported outside the coil. Transverse T_1 weighted MR images (TR 300, TE 30 ms) were acquired with a slice thickness of 10 mm, a 140 mm field of view and 128 x 256 data matrix. These were used to determine the placement of the ^{1}H MRS voxels. Spectra for determination of concentrations of IT and other muscle metabolites were obtained from the soleus muscle. A PRESS sequence with TE/TR=135/1500 ms was used with an 8 cm^3 voxel positioned within each of the muscles examined. The *in vivo* ^{1}H MRS data were analysed by VARPRO, a non-linear least square fitting algorithm operating in the time domain. Muscle triacylglycerols were quantified by using the creatine signal as an internal standard. The total creatine concentration was assumed to be 100.6 mmol/kg dry weight (Edström *et al.* 1982) and 64% MR visibility (Savabi. 1988).

The intra-examination cv for ^{1}H MRS measurements of IT in the soleus muscle was found to be 4%, while the cv for repeated determinations in three different examinations was 11%. This is significantly lower than that reported by Wendling *et al.* (1996) who obtained a 24% cv for IT in repeated biopsies of human skeletal muscle. The mean IT concentration as measured by ^{1}H MRS in the soleus muscle was 32 SD 3 mmol/kg dry weight. This value is in close agreement with published values (35 mmol/kg dry weight) obtained by biochemical analysis of biopsies (Starling *et al.* 1997).

The results of the present study suggest that ^{1}H MRS is a fast and highly reproducible non-invasive technique for the measurement of intracellular muscle triacylglycerols. This opens up the possibility of determining the impact of muscle triacylglycerol levels on health and disease.

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Manganese requirement and intoxication in patients on home parenteral nutrition. By N. REYNOLDS[1], W. McNAB[2], J.P. BAXTER[1] and C.R. PENNINGTON[1], *Departments of [1]Digestive Disease and [2]Radiology, Ninewells Hospital, Dundee DD1 9SY*

Debate continues as to the optimal micronutrient requirement for patients on home parenteral nutrition (HPN) (Elia, 1995). Replacement of trace elements by commercial solutions is often based on inexact knowledge and hindered by our limited experience as to the long-term demands for nutrients when given parenterally. Estimation of plasma concentrations may not reflect concentrations in other body compartments.

Two of nine patients currently on the HPN programme reported overwhelming lethargy and character change for no obvious reason. Thorough clinical examination failed to offer an explanation except that plasma Mn concentrations (normal 7-27 nmol/l) taken at least 6 h post infusion were two times above the normal range. Neither patient exhibited features of Parkinson's disease nor was there any evidence of cholestasis. Magnetic resonance imaging (MRI) scanning revealed in each case increased signal in the basal ganglia compatible with Mn deposition (Mirowitz *et al* 1991). There was no evidence of other intercurrent illness and sampling error was excluded. The withdrawal of Mn supplementation has led to the resolution of symptoms in one patient so far. Repeat MRI scanning is planned after a 3 month interval. On the basis of this finding all patients on the HPN programme were assessed for potential Mn toxicity. One further patient had a Mn value greater than two times the upper limit of normal and in this case the MRI scan also showed evidence of Mn deposition. So far two patients receiving similar nutritional regimens with normal serum values have had normal MRI scans. One patient (no. 9) with elevated plasma concentrations could not undergo MRI scanning.

All had received compounded nutritional bags (9-14 g N, 6.7 - 9.2 MJ) with Additrace (Pharmacia) containing a maximum 0.28 mg Mn / bag. Patient details and the mean daily parenteral Mn provision, calculated from the number of bags supplied each week, are shown in Table 1.

Patient	Diagnosis	Time on HPN(months)	Total / supplemental	Plasma Mn	Mn (mg) daily
1	Crohn's disease	62	S	127	0.23†
2	Visceral myopathy	48	T	62	0.23*
3	Crohn's disease	28	T	100	0.23*
4	Dysmotility	18	T	24	0.23
5	Radiation enteritis	23	S	22	0.12
6	Dysmotility	20	T	32	0.23†
7	Crohn's disease	76	S	39	0.23†
8	Crohn's disease	9	S	26	0.19
9	Short bowel syndrome	41	S	49	0.19†

*Symptomatic.
†High plasma concentrations but asymptomatic.

Accumulation in some patients and not others may be due to amount of oral diet taken with subsequent stimulation of bile flow and Mn excretion. Intestinal resection may also have caused disruption of entero-hepatic circulation of Mn. We conclude that standard solutions may provide an excess of Mn as 0.1 mg / d is probably sufficient. Unfortunately, there is no other commercially available trace element solution in the UK which provides less Mn. In all cases careful individual biochemical monitoring is essential. The response to withdrawal in one patient suggests some symptoms in part may be associated with Mn toxicity.

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The effect of early adequate enteral nutrition (EN) on clinical outcome in head injury. By S.J. TAYLOR, S.B. FETTES, C. JEWKES, and R.J. NELSON, *Department of Nutrition and Dietetics, Frenchay Hospital, Bristol BS16 1LE*

Major head injury results in hypermetabolism, hypercatabolism and depressed immunocompetence (Lin et al. 1992). This is associated with a high incidence of infective complications exacerbated by poor nutrition. EN is usually started slowly because of head injury-associated gastroparesis and aspiration risk. This was a prospective randomized controlled trial (PRCT) to determine the effect of attempting early adequate EN v. conventional (i.e. initially minimal) EN on clinical outcome. Consecutive patients requiring mechanical ventilation, with a Glasgow Coma Score (GCS) above 3 and at least one pupil reactive within 24 h of injury, were randomized. Outcome measures included good neurological outcome (Glasgow Outcome Scale 4 or 5) at 3 and 6 months, incidence of major complications and hospital stay.

Eighty two patients suffering head injury and requiring mechanical ventilation were randomized to receive conventional (initially minimal) EN (n = 41) or adequate EN (n = 41) from day 1. Disease severity in terms of best pre-intubation GCS, presence of fixed dilated pupils, injury severity score (ISS), APACHE II and age were similar between groups. The median percentage of energy and N requirements met by EN was higher in intervention patients over the first 6 and 7 days post-injury, respectively ($p < 0.02$). More intervention patients achieved a good neurological outcome at 3 months than controls (61% versus 39%, $p = 0.08$). This association had disappeared by 6 months. Fewer intervention patients had an infective complication (61% versus 85%, $p = 0.02$) or more than one total complication (37% versus 61%, p 0.046) compared to controls. Improved EN was associated with a reduction in the ratio of serum concentration of C-reactive protein: albumin up to day 6 post-injury ($p = 0.02$), a measure of the inflammatory response. In patients with a hospital stay between 20 to 100 days, intervention patients had a reduced stay (median 36 versus 48 days in controls, $p = 0.01$)

Improved EN accelerates neurological recovery with a similar efficacy to early parenteral nutrition (Young et al 1987) but at less cost. This effect may be mediated by a reduction in the post-injury inflammatory response, itself the result of a reduction in major complications. The results should be re-tested in a larger multi-centre PRCT.

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Relationship of serum levels of interleukin-6, soluble interleukin-6 receptor and tumour necrosis factor receptors to the acute phase protein response in advanced pancreatic cancer. By MATTHEW D. BARBER, KENNETH C.H. FEARON and JAMES A. ROSS, *University Department of Surgery, Royal Infirmary of Edinburgh, Edinburgh EH3 9YW*

The level of the acute phase protein response (APPR) is a major predictor of survival in patients with advanced pancreatic cancer and seems to be related to ongoing loss of weight. Various cytokines have been implicated in causing the APPR, notably interleukin-6 (IL-6). The role of soluble receptors for these cytokines remains unclear; it has been suggested that soluble IL-6 receptors aid transmission of the IL-6 signal (Tamura et al. 1993) and that tumour necrosis factor (TNF) receptors may either bind and inactivate excess TNF or may hold it in the circulation to maintain levels for an extended period. Soluble TNF receptors have also been used as surrogate markers of tissue levels of TNF. The present study examined the association between the APPR, as determined by serum C-reactive protein, with serum levels of IL-6, soluble IL-6 receptor and the soluble TNF receptors (sTNF-R).

Thirty-four blood samples were collected from thirteen patients with advanced pancreatic cancer. Levels of C-reactive protein, IL-6, soluble IL-6 receptor, sTNF-R55 and sTNF-R75 were measured by indirect ELISA (CLB, Amsterdam and DAKO, High Wycombe).

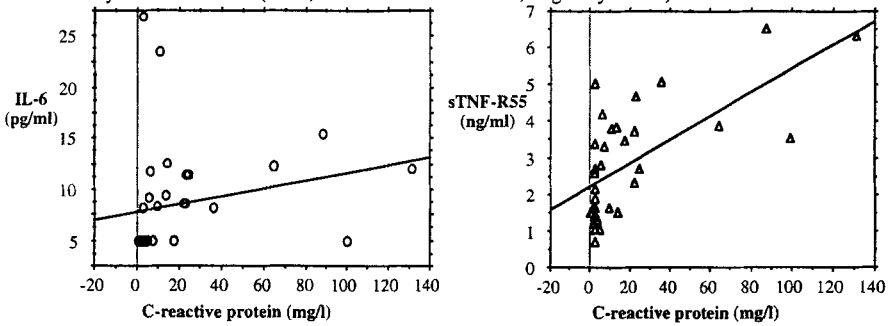

Fig. Relationship between C-reactive protein and interleukin-6 and sTNF-R55 in patients with advanced pancreatic cancer (P=0.0003 and 0.0002 respectively).

A significant positive association was found between the level of the APPR and serum levels of IL-6, sTNF-R55 and sTNF-R75 (P<0.001 in all cases, Spearman's rank correlation). There was also a close association between the levels of the two TNF receptors (P <0.0001). No association was found between levels of soluble IL-6 receptor and any other factor.

The association between IL-6 levels and the APPR would be expected as IL-6 has been implicated in having a causative role in the APPR. The soluble TNF receptors have been used as an indirect measure of tissue TNF release and thus their association with the level of the APPR again may reflect a role in stimulating the APPR which has been suggested by previous studies. However, the suggestion that soluble IL-6 receptor levels may be important in transmission of the IL-6 signal to produce the APPR is not supported by these data.

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The nutritional consequences of radiotherapy in early laryngeal squamous cell cancer (LSCC). By M.M.COLLINS, R.G.WIGHT, and G.PARTRIDGE, *Department of Otolaryngology and Dietetics, North Riding Infirmary, Newport Rd, Middlesbrough TS1 5JE*

LSCC patients represent a nutritionally 'at risk' group, but most research has focused on patients with more advanced disease, where up to two-thirds of patients are undernourished at presentation (Goodwin & Byers, 1993). Radiotherapy may compromise nutritional intake further and the multisystem impact of malnourishment occurs once 5% body weight has been lost (Powell-Tuck, 1997).

Laryngeal patients with small field radiotherapy treatment may be less severely affected than other groups (Enig *et al*, 1985), but nutritionally this has not been confirmed. We aimed therefore to document the nutritional consequences of radiotherapy in patients with early LSCC.

A retrospective analysis was undertaken of Otolaryngology, Radiotherapy, and Dietetic records on sixty-one patients treated for T1 and T2 N0 LSCC with primary radical radiotherapy, over a 3-year period 1993-1995 inclusive.

At presentation, 96.7% had their weight and height recorded, enabling calculation of the BMI; 40% presented with a suboptimal BMI (<25 kg/m^2), and a further 13% with a BMI<20 kg/m^2. Sixteen patients (26%) presented with a mean percentage weight loss of 5.35%. During treatment , forty-eight (79%) patients had their weight recorded and thirty (49%) had a documented mean percentage weight loss of 6.4%. The mean BMI at the end of treatment was 23.5 kg/m^2, significantly lower than at presentation: 25 kg/m^2 (two-sample t test P=0.03, 95%CI). These effects occurred despite 80% of patients having at least one dietetic consultation (mean number of consultations 3.5), 75% receiving high protein/energy supplementation and 5% of these enteral nutrition.

We concluded that significant numbers of patients with early LSCC are undernourished at presentation. Even with dietetic support this group endure considerable nutritional problems during radiotherapy. Small field radiotherapy compromises oral nutritional intake, leading to weight loss sufficient to cause physiological impairment in some patients. The effects of such malnourishment on recurrence, prognosis and survival in LSCC are unknown, but attention to nutritional issues improves tolerance and response to treatment as well as quality of life (Goodwin & Byers, 1993).

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Relationships between physical activity, disease activity and quality of life in inoperable lung cancer. By J.A. KRAMER, E. CROWE, O. DEWIT and M. ELIA, *MRC Dunn Clinical Nutrition Centre, Cambridge CB2 2DH*

Physical activity is the most variable component of total energy expenditure, and has not been measured directly in cancer patients. The aim of the present study, in patients with inoperable lung cancer, was to assess whether measurements of physical activity level (PAL, total energy expenditure/basal metabolic rate; TEE/BMR) obtained with an accelerometer, relate to biochemical measures of disease activity (degree of hypoalbuminaemia, plasma α-1 antichymotrypsin (ACT)), subjective measures of physical function and quality of life, and observer-assessed performance status.

Twenty-one subjects were studied (seventeen male, four female; median age 75 (range 50-83) years; majority weight stable with ≤ 1.5 kg change in body weight in the preceding month). Physical activity was measured by the Caltrac accelerometer as multiples of BMR. The European Organisation for Research and Treatment of Cancer (EORTC QLQ-C30) questionnaire was used to assess physical function, symptoms and quality of life (subject-rated, scores from which are scaled from 0-100. Higher function and quality of life scores indicate higher function and quality; higher symptom scores indicate greater symptomatology). WHO performance status was assessed on a five point scale, 0 being fully active and 4 totally dependent.

The mean PAL value was found to be only 1.32 (SD 0.07), which is much lower than reported mean values of 1.5 for those over 75 years (Fuller *et al.* 1996) and 1.6 for those over 65 years (Black *et al.* 1996), consistent with a sedentary lifestyle reported by most patients (mild activity indoors). The table shows that within the group, low PAL was related significantly to disease activity (biochemical indices), fatigue, and poor physical function and performance status. No relationship was found between PAL and global quality of life.

			PAL	
	Mean	SD	*r* value	*P* value
ACT (g/l)	0.6	0.3	-0.56**	0.01
Albumin (g/l)	34.9	7.1	0.61**	0.005
Fatigue	45.0	20.6	-0.56**	0.008
Physical function	62.9	21.3	0.59**	0.005
Performance status	median 1	range 0-2	-0.70**	0.000
Quality of life	58.2	19.4	0.23	0.33

r value is Pearson's correlation coefficient for albumin, fatigue and physical function; *r* is Spearman's rho for ACT, performance status and quality of life

**Correlation significant at the 0.01 level

n 21, except for ACT where *n* 20.

The study suggests that these patients with inoperable lung cancer have low PAL (measured by an accelerometer), which relates significantly to disease activity and to subjective and objective assessments of physical function. The study also suggests that the PAL is not a useful indicator of quality of life.

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Safety of glutamine administration to Gambian infants. By P. G. LUNN, D. CAMPBELL and M. ELIA, *MRC Dunn Nutrition Centre, Cambridge CB4 1XJ and Keneba, The Gambia.*

Administration of large doses of glutamine has been shown to have a marked trophic effect on the mucosa of the small intestine and, especially in animal models, to lower the levels of morbidity and mortality associated with severe inflammatory enteropathies. The poor growth of many infants and young children in rural communities in The Gambia is associated with persistent inflammation in the mucosa of the small intestine and it is possible that this may respond to glutamine administration. However, the safety of such administration must be considered as the initial breakdown products of glutamine are glutamate and ammonia, both toxic compounds. Consequently, there is a need to show that the concentrations of these metabolites do not increase to toxic levels in the peripheral blood of subjects receiving glutamine supplementation. Although studies into this safety aspect of glutamine supplementation have been carried out for various age groups, this is the first study to be performed on infants.

Two studies were undertaken. (1) Following a finger-prick blood sample to determine baseline plasma concentrations of ammonia, glutamate and glutamine, nine Gambian infants (aged 4-10 months) were given an oral (bolus) glutamine dose of 0.25 g/kg body-weight as a suspension in water. A further blood sample was obtained 45 min later and the plasma concentrations of these metabolites reassessed. (2) Six infants received twice daily glutamine doses of 0.25 g/kg for 30 d following which their pre- and 45 min post-dose levels of metabolites were measured as for (1). Plasma concentrations were as shown in the Table.

	Ammonia (μmol/l)		Glutamic acid (μmol/l)		Glutamine (μmol/l)	
	Mean	sd	Mean	sd	Mean	sd
Before daily glutamine supplementation						
Pre-dose	124	42	173	60	654	66
45 min after dose	157	38	226	47	1285***	346
Following 30 day glutamine supplementation						
Pre-dose	54	22	131	53	735	261
45 min after dose	95*	39	165	69	1138*	420

Mean values were significantly different from pre-dose: *$P<0.05$, ***$P<0.001$.

Only small and clinically unimportant increases in both ammonia and glutamate concentrations were detected following glutamine administration, although the rise in ammonia in children who had been supplemented for 30 d was statistically significant. On the other hand, plasma glutamine concentrations increased substantially both before and after the 30 d supplementation. There was no evidence of a slow accumulation of ammonia or glutamate in infants who had been supplemented for 30 d. In fact, ammonia levels appear higher in the pre-supplementation group but this is probably an artifact due to longer storage of the samples prior to analysis. During supplementation, infants were examined daily but no suggestion of either acute or chronic side effects and in particular, no clinical signs of neurotoxicity were observed. The clinical data thus supports the biochemical assessment that glutamine administration at 0.25 g/kg, twice daily is safe in Gambian infants.

The stability and cytoprotective effects of N-acetylcysteine in cervical cancer patients undergoing radiotherapy. By P.B. AGUILAR[1], J. FAINTUCH[1] and G. HARDY[2]. [1]*Radiotherapy Service, Hospital das Clinicas, São Paulo, Brazil and* [2]*Oxford Nutrition OX8 7PT*

N-acetylcysteine (NAC) is a freely soluble amino acid with antioxidant properties which can be prepared, in an inert atmosphere, as a sterile 200 g/l aqueous solution, in O_2-impermeable multilayer bags. At room temperature, in the absence of O_2, NAC activity losses in solution are <0.01% per d, conferring 30 d stability on the solution for oral or intravenous use.

The influence of NAC on haematological toxicity was assessed in a prospective randomized double-blind study with fifty-six cervical cancer patients referred for pelvic radiotherapy (RT). The patients (54.7 (SD 11.6) years) received 4000-4500 cGy along with high-dose brachytherapy (three or four sessions) during a period of 6-8 weeks and were randomized to receive orally once daily either 3.6 g NAC (22 mmol) (*n* 29) or an isoenergetic commercial protein supplement as placebo (*n* 27) before the RT, during the entire therapeutic period. The groups were comparable regarding age, tumour stage, and metabolic/nutritional status (serum albumin ≥35 g/l, weight ≥80% ideal, Karnofsky ≥70). Sepsis, shock, terminal disease or intolerance to the supplement were criteria for exclusion from the study. General monitoring during the study included anthropometrics, haematological counts and general biochemical tests (plasma proteins, liver enzymes, renal function, coagulation profile, inflammatory markers, and blood gases). A standard nutritional regimen providing 167 KJ (40 kcal) and 1.5 g protein/kg per d was followed and actual intake of at least 60% of the prescription was confirmed throughout the study.

Tolerance to the supplements was excellent and no patient in either group discontinued the regimens. Both populations displayed non-significant reductions of weight, BMI and serum albumin. Liver enzymes, coagulation profile, renal function, blood gases and pH, all remained normal. The control group exhibited lower counts of erythrocytes, leucocytes and lymphocytes after radiotherapy, with a marginally significant decrease in platelets (P=0.059). At the same time the erythrocyte sedimentation rate (ESR) increased, confirming the existence of an inflammatory response to irradiation. Subjects receiving the NAC supplement did not, however, suffer significant changes in erythrocyte or platelet count and the lymphocytopenia tended to be less marked (P=0.001). Moreover, no inflammatory reaction (as determined by a non-significant change in ESR) was observed in the NAC group.

In conclusion; an oral supplement of NAC is stable in solution and was well tolerated by patients at the employed dosage. The impact of radiotherapy on erythrocytes and lymphocytes was less negative in NAC-treated patients and the supplement may have helped suppress the acute phase inflammatory response to the irradiation.

The implementation of guidelines : another drain on the NHS purse? By N. REYNOLDS, J. P. BAXTER and C. R. PENNINGTON. *Department of Digestive Disease and Clinical Nutrition, Ninewells Hospital, Dundee DD1 9SY*

Patient management is increasingly driven by guidelines issued by expert bodies to improve the quality of patient care. Guidelines have funding implications and resources may not always be available. Malnutrition is common in hospital patients, often escapes recognition and is associated with increased morbidity and mortality. There is increasing evidence however that artificial nutritional support is effective in expediting patient recovery and minimizing complications. The aim of the present study was to assess the additional cost of enteral feeds incurred by the observation of the British Society of Gastroenterology (BSG) guidelines for the delivery of artificial nutritional support. Data collected prospectively had revealed that 44% of patients admitted to three medical units were malnourished but only 10% were referred for nutritional support (McWhirter & Pennington 1994). These core data provided the basis for estimating the financial repercussions of implementing BSG guidelines. All malnourished patients would have been referred for nutritional support, either oral supplements (at a cost of £2 daily) or enteral tube feeding (costing £15 daily). These values do not take into account administrative, nursing and medical costs. Patients receiving parenteral nutritional support were not included in the analysis. The average duration of artificial nutritional support is 18.3 days per patient in these units with 70 % of patients receiving oral supplements and 30 % requiring nasogastric feeding. Table 1 demonstrates the potential annual expenditure of meeting the guidelines in comparison with clinical referral patterns at the time of the study.

	No. admitted per annum	No. referred (10%)	Referral according to guidelines	Actual cost	Cost following guidelines
General medicine	11 630	1163	5117	£125 592	£552 485
Respiratory medicine & infectious disease	3476	347	1529	£37 436	£165 075
Care of elderly	382	38	168	£4102	£18 140
Total				£167 126	£735 700

These values although a very crude index, which fails to take into account many hidden costs and variables, suggest that the implementation of BSG guidelines could lead to at least a 300-400% increase in referrals to dietetics and a similar increase in expenditure on nutrient solutions.

In conclusion, it seems that implementation of these guidelines incorporates considerable financial burden but in an NHS seeking to find value for money, future research must address the issue of whether improved nutritional status results in greater savings in other areas of patient management so as to justify any increased initial outlay.

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Nutritional knowledge and request for parenteral nutrition in a tertiary referral paediatric hospital. By S. MURRAY, I. SMITH, H. NAWROCKA and A. PIERRO, *Institute of Child Health and Great Ormond Street Hospital for Children, London WC1N 1EH*

Nutritional support in the form of parenteral nutrition (PN) has contributed to the recent improvement in survival of infants and children. However the indications for PN in paediatrics are still undefined. At Great Ormond Street Hospital for Children, approximately 350 patients receive PN annually but 40% of these remain on PN for a short time (<7d). Therefore we have recently established a PN audit project team to survey our current practice. The aim of this prospective study was to assess what influences the decision to request PN by evaluating: (1) the nutritional knowledge of main users of the PN service (Host Defence, Surgery, Intensive Care, Gastroenterology); (2) the use of individual clinical team protocols; (3) consideration of ethical issues.

A survey of the specialities frequently requesting PN in our hospital was done from November 1996 to January 1997 by a dietitian not involved in patient care (S.M.). Twenty-nine consultants were sent a postal questionnaire, sixteen completed and five incomplete questionnaires were returned. Forty-one nurses and fourteen junior doctors involved in the decision to request PN were interviewed, using the same questionnaire. The questionnaire was analysed quantitatively and qualitatively. A scoring system was devised to quantify the level of nutritional knowledge in assessing nutritional status (range score 0-9), assessing energy requirements (range 0-6) and alternative options of nutritional support (range 0-6).

PN protocol was available only in Intensive Care. However only 18% of professionals from this area knew about the protocol. Overall 73% of nurses and 41% of doctors did not know whether their clinical teams had a protocol. The need for always involving a dietitian in requesting PN ranged from 100% in Gastroenterology to 60 % in General Surgery and Intensive Care. Of those surveyed, 80-85% in Gastroenterology and General Surgery said that ethical issues arose when requesting or using PN compared with only 45-50% in Host Defence and Intensive Care. Results of nutritional knowledge score are reported in Table.

	Nutritional status	Energy requirements	Alternative nutrition
	Mean SE	Mean SE	Mean SE
Speciality			
Gastroenterology	1.7 ± 1.0	1.4 ± 0.9	2.4 ± 1.3
Surgery	1.3 ± 0.8	0.7 ± 0.8	2.3 ± 1.3
Host defense	1.4 ± 1.0	0.7 ± 0.9	2.5 ± 0.9
Intensive care	1.4 ± 1.1	1.0 ± 0.7	2.4 ± 1.1
Professionals			
Consultants	0.9 ± 0.7	0.4 ± 0.5	1.8 ± 0.9
Junior doctors	1.5 ± 0.5	1.3 ± 1.0	2.5 ± 1.0
Nurses	1.6 ± 0.9	0.7 ± 0.8	2.7 ± 1.1

This study demonstrates that in paediatrics: (1) nutritional assessment needs to be improved; (2) specific nutritional training and support is required for professionals involved in the decisions to request PN; (3) specific protocols for PN in infants and children are needed.

Effect of nasogastric tube feeding regimens on voluntary food intake and hunger in healthy volunteers. By R.J. STRATTON[1], R.J. STUBBS[2] and M. ELIA[1], [1]*MRC Dunn Clinical Nutrition Centre, Hills Road, Cambridge CB2 2DH,* [2] *Rowett Research Institute, Greenburn Road, Aberdeen AB2 9SB*

The aims of this study were twofold: to investigate whether nasogastric (NG) tube feeding in healthy subjects replaces or adds to energy consumed orally; and to assess the effect of the timing of tube feeding on both food intake and hunger. Six healthy men (weight stable, aged 36 (SD 8) years, initial BMI 21.9 (SD 2.21) kg/m^2), were studied during three 9 d periods. With the NG tube *in situ* throughout each study, the following protocol was used: on days 1 and 2, volunteers consumed a 'maintenance' diet (energy provision 1.5 x BMR); on days 3 and 4, water, coloured so it had the appearance of feed, was administered through the NG tube; on days 5-7, a standard, 4.18 kJ/ml feed (mean provision 6.9 (SD 0.5) MJ) was administered; and on days 8 and 9, coloured water was again administered. Each subject was studied on three occasions, in a random order, receiving nocturnal (21.00-09.00 hours), diurnal (09.00-21.00 hours) and continuous (24 h) tube feeding, delivered using a portable volumetric pump and giving set. Throughout the tube feeding period (days 3-9) subjects had *ad libitum* access to covertly manipulated, isoenergetically dense foods (550 kJ/100 g) all of which contained 13% of energy from protein, 47% from carbohydrate and 40% from fat. Unknown to volunteers, energy intake was assessed using a weighed food inventory. Subjective assessment of hunger was made using 100 mm visual analogue scales ('not at all hungry' (score 0) to 'as hungry as I have ever felt' (score 100)) (Blundell, 1979; Hill & Blundell, 1982) which were completed during each waking hour throughout the study. Repeated measures ANOVA and Student's paired *t* test were used for statistical analysis.

The different tube feeding schedules (days 5-7) produced similar effects on hunger. Voluntary oral energy intake was lowest when the diurnal tube feeding schedule was used (Table).

	Diurnal (12 h) feeding		Nocturnal (12 h) feeding		Continuous (24 h) feeding	
	Mean	SD	Mean	SD	Mean	SD
Mean oral energy intake (MJ/d)*†	12.5	2.5	13.9	3.78	14.3	3.72
Mean daily hunger score (0 - 100 mm)*	29	11	28	12	31	12

* ANOVA, not significant.
† Diurnal *v.* continuous feeding $P<0.09$, paired *t* test (two-tailed).

Compared with the periods when coloured water was administered (days 3-4 and days 8-9), the period of tube feed administration (days 5-7) was associated with less than a 10% reduction in daily voluntary oral energy intake for all feeding schedules combined, (mean 14.9 MJ (days 3-4), 13.5 MJ (days 5-7), 13.9 MJ (days 8-9) ANOVA, ns). Only the diurnal tube feeding schedule was associated with a voluntary food intake on days 5-7 that was significantly lower (17% reduction) than the intake during coloured water administration (days 3-4) (12.5 *v.* 14.9 MJ, $P<0.05$). There was no significant difference in mean hunger during the coloured water and feed periods for all tube feeding schedules combined (mean scores 31, 30, 31 mm for water (days 3-4), feed (days 5-7) and water (days 8-9), ANOVA, ns). Hence, significant increases in total energy intakes during tube feed administration were observed (overall mean 20.5 MJ, ANOVA, $P<0.01$).

This study found that 3 d of tube feeding in healthy subjects (daily energy provision 1 x BMR), failed to suppress hunger, and the average oral energy intakes across treatments continued almost unabated. The lowest recorded food intake occurred during diurnal tube feeding.

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Hill, A.J. & Blundell, J.E. (1982). *Journal of Psychological Research* **17**, 203-212.

Bacterial contamination of feed during home enteral tube feeding. By C.J. SHAW[1], I. MATTHEWS[2], M. FARRINGTON[2], C. BALDWIN[1], S. COTTEE[3], O. DEWIT[1], and M. ELIA[1], [1]*Dunn Clinical Nutrition Centre, Hills Road, Cambridge CB2 2DH;* [2] *Department of Microbiology, and* [3] *Nutrition Team, Addenbrooke's NHS Trust, Cambridge CB2 2QQ*

Information about bacterial contamination of feeds during tube feeding is restricted almost entirely to the hospital setting, but the potential for bacterial contamination is greater outside hospital (home tube feeding) where unhygienic procedures may be followed by patients and/or carers. The purposes of the present study were (a) to measure the extent of bacterial contamination of the feed in the reservoirs and delivery systems used in patients on tube feeding in their own homes and residential care facilities, and (b) to relate the findings to standards of hygiene and to published results of bacteriological studies undertaken in hospital.

Eight patients were studied (age range 42-81 years, median 52years), four that were home-living and four in residential care homes, who had been receiving cyclic nocturnal tube feeding (500-1000 ml over 8-10h) for at least 15 months for swallowing dysfunction. Questions were asked on steps taken for ensuring cleanliness during feed preparation, and on the condition of the gastrostomy tube. Two 10 ml feed samples were taken at the end of an overnight feed using aseptic techniques:(1) directly from the feed-bottle by piercing above the level of feed with a sterile needle attached to a syringe, and (2) from the giving set, by disconnecting its distal end from the gastrostomy tube, and 'running' approximately 10 ml feed directly into a sterile tube. The samples of feed were plated on blood agar and incubated in an atmosphere of 5% CO_2 to obtain aerobic counts.

None of the patients had diarrhoea or vomiting, and their gastrostomy sites did not appear infected. All the eight carers washed their hands with soap or antiseptic, but only four swabbed the bottle tops before piercing them with the administration sets. All the ends of the gastrostomy tubes had been replaced recently (1-6 weeks) and were intact. There was no bacterial growth in the feed obtained from the bottle. In contrast feed from the giving set was universally contaminated with bacteria (10^2-10^7 colony forming units (cfu) /ml), but in only one patient did the bacterial count exceed 10^6 cfu /ml. The results in patients living at home were similar to those living in residential care.

		Giving Set		Feed Bottle	
		Bacteria present	Count (cfu/ml)	Bacteria present	Count (cfu/ml)
Home-living patients	1	*Candida albicans*	10^2-10^3	No bacteria or fungi present	-
		Enterococcus faecalis	10^6-10^7		
	2	Staphylococcus (coagulase neg)	10^2-10^3	No bacteria or fungi present	-
	3	Pseudomonas species	10^4-10^5	No bacteria or fungi present	-
		Klebsiella species	10^4-10^5		
	4	*Enterococcus faecalis*	10^4-10^5	No bacteria or fungi present	-
Residential care patients	5	Staphylococcus (coagulase neg)	10^4-10^5	No bacteria or fungi present	-
		Enterococcus faecalis	10^4-10^5		
		Klebsiella species	10^4-10^5		
	6	Staphylococcus (coagulase neg)	10^2-10^3	No bacteria or fungi present	-
	7	Staphylococcus (coagulase neg)	10^4-10^5	No bacteria or fungi present	-
	8	*Candida albicans*	10^3-10^4	No bacteria or fungi present	-
		Streptococcus viridans group	10^4-10^5		

This pilot study on home enteral tube feeding suggests that not all hygienic procedures for administering feed were followed, and that the type and extent of bacterial contamination of feed occur in the giving set,with bacterial counts similar to those observed in the hospital setting (Kohn,1991).

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Kohn,C.L.(1991). *Journal of Parenteral and Enteral Nutrition* **15**, No.5, 567-571.

Circulating concentrations of vitamins D and C in a cross-sectional group of patients on long-term tube feeding at home or in residential care. By C. BALDWIN, J. SHAW, O. DEWIT and M. ELIA, *Dunn Clinical Nutrition Centre, Hills Road, Cambridge CB2 2DH*

Despite the rapid growth of home enteral tube feeding (HETF), there is remarkably little information on the vitamin status of such patients. The aim of the present study was to assess the status of a fat-soluble vitamin (vitamin D), and a water soluble vitamin (vitamin C) by measuring their circulating concentrations in metabolically stable patients on HETF.

Eighteen patients (eight males, ten females; mean age 51.2 years; four aged >65 years) with swallowing dysfunction, who had been receiving cyclic enteral tube feeding for more than 3 months, had blood taken after 6 h of stopping their nocturnal feed (Baldwin *et al.* 1997). Vitamin C was measured using a fluorometric assay (Vuilleumier& Keck 1989), and 25-hydroxy vitamin D (25-OH D) using a radioimmunoassay (Clemens, 1986). Results are presented as means and standard deviations unless otherwise stated.

Oral intake, assessed by dietary history, was nil in eight patients, minimal in nine, and a small amount in one patient (maximum 2 MJ/24 h). Two patients administered 200-300 ml cranberry juice through the percutaneous gastrostomy. Based on labelling information provided by feed manufacturers, the calculated intake of vitamin D (6.3 (SD 1.2) µg/24 h, range 4-8.5 µg/24 h) was lower than the UK reference nutrient intake for adults >65 years of age (10 µg/24 h). Most of the patients were house-bound. The circulating concentration of 25-OH D was 20.5 (SD 10.0) µg/l. Overt deficiency may be found when the circulating concentrations are below 10 µg/l (Holick, 1994) and marginal deficiency when the concentrations are 10-20 µg/l (Manual of Nutritional Therapeutics, 1995) although a calcium sparing effect of vitamin D has been reported even when the concentrations are as high as 25 µg/l (Dawson-Hughes *et al* 1991). In our sample 50% of patients had circulating concentrations below 15 µg/l (population reference range of 15-35 µg/l for summer months (DoH Report on Health and Social Subjects 41)) Ten of our samples were obtained in the summer.and five of these had concentrations below 15 µg/l. All patients however had normal plasma concentrations of Ca, inorganic phosphate, and alkaline phosphatase.

The calculated intake of vitamin C from the feed (again based on labelling information) was 64.0 (SD 13.8) mg/24 h, and was in every case higher than the UK reference nutrient intake for adults (40 mg/24 h). The circulating vitamin C concentration was 7.9 (SD 4.0) mg/l (*n* 15), with 20% of patients having values below 5 mg/l suggesting marginal deficiency (reference range 5-14 mg/l). Forty four percents of our patients had an acute-phase protein response as judged by C-reactive protein >6mg/l, but their mean vitamin C concentration (8.1 (SD 4.1) mg/l) was virtually identical to the group as a whole. There was no clinical evidence of vitamin deficiencies. There was no relationship between circulating concentrations of vitamins D and C. There was no effect of duration of enteral feeding on the circulating concentrations of vitamins.

The results suggest that under the conditions of this small study, patients receiving long-term HETF commonly show suboptimal circulating concentrations of vitamins D and C.

The study was supported by a grant from Nutricia Corporate Research, The Netherlands.

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The role of British gastroenterologists in the provision of artificial nutrition support. By CAROLINE STOCKDALE and CHRISTOPHER R. PENNINGTON, *Department of Digestive Diseases and Nutrition, Ninewells Hospital and Medical School, Dundee DD1 9SY*

Malnutrition is common in hospital patients, many patients require nutritional support, and nutritional management is often inadequate. Nutritional support is often supervized by gastroenterologists. The purpose of the present survey was to determine: the impact of nutritional support provision upon the workload of gastroenterologists, the available resources, and compliance with guidelines of the British Association for Parenteral and Enteral Nutrition. A questionnaire which included questions on the appreciation of malnutrition, nutritional measurement and screening, the type of nutritional support administered, the incidence of complications, the use of protocols, the resources and the availability of a nutrition support team, was sent to all 483 consultant gastroenterologists with the approval of the British Society of Gastroenterology audit office.

There were 336 responses from 483 recipients (69.6%), 190 respondents were based in district general hospitals (DGH), and 124 in teaching hospitals (TH), twenty-two had dual appointments. All except two respondents recognized malnutrition in patients under their care; 53% thought that 20% or more of their patients were malnourished, 30% believed 10-19% were affected. Only 3.0% of respondents did not record weight for outpatients (OP) and the corresponding value for inpatients (IP) was 15.5%. Of DGH consultants 76.3% weighed IP, compared with 91.1% of TH consultants ($P<0.001$). Height was not recorded by 60.7% for OP and by 79.2% for IP. Of respondents 58.3% did not arrange nutritional screening of IP; 76.8% of consultants supervized patients with enteral feeding (EN), and 64% supervized parenteral feeding (PN). Jejunostomy was used more often by TH consultants (60.5%) than DGH consultants (37.9%) ($P<0.001$). The majority of consultants would permit previously fit, and post-operative patients, only 3-5 d without food before initiating nutritional support; 21% would allow an anticipated minimum period of 4 weeks of nasogastric feeding before percutaneous endoscopic gastrostomy tube insertion, but 61% would plan a placement at 2 weeks. Of consultants 54% supervized patients on home EN, 19.6% of consultants had responsibility for home PN, most consultants looked after 1-4 patients. Of respondents 44.6% did not follow written protocols for peripheral PN and 38.4% for central PN; 54.8% monitored PN catheter complications of whom 44.0% reported an infection rate in more than 5.0% of patients; 26.5% of respondents were members of nutrition support teams, 29.5% of DGH consultants, 21.0% of TH consultants ($P<0.02$). Of gastroenterologists 96.1% had access to a dietitian, 55.4% to a nutrition support team and 36.3% to a nutrition nurse specialist (NNS). A NNS was available to 56.5% of TH consultants but only 23.2% of DGH consultants ($P<0.001$).

Gastroenterologists have a major role in nutritional support, their facilities are suboptimal, and the observance of guidelines may improve nutritional care of patients. These findings have implications for resources, training and postgraduate education.

An investigation into the effect of riboflavin deficiency induced post-weaning on the morphology and cytokinetics of the rat small intestine. By E.A. WILLIAMS[1], R.D.E. RUMSEY[2] and H.J. POWERS[1], [1]*University Department of Paediatrics, Sheffield Children's Hospital, S10 2TH, and* [2]*Department of Biomedical Science, University of Sheffield, S10 2TN*

Riboflavin deficiency induced from weaning disturbs the normal cytokinetic and morphological development of the rat small intestine (Williams *et al.* 1996; Yates *et al.* 1997). Some of these effects are not readily reversible by correcting the riboflavin deficiency (Williams *et al.* 1996). The aim of the current investigation was to explore the effects on the rat small intestine of feeding a riboflavin-deficient diet at two stages after weaning.

Twelve 4-week-old rats were weight-matched and divided into two dietary groups: riboflavin-deficient (RD) and weight-matched control (WM). A second group of twelve 10-week-old rats were similarly weight-matched and divided into the two dietary groups. Rats allocated to a RD diet were fed *ad libitum*. WM animals were fed on a complete diet and weight-matched to their riboflavin-deficient partners throughout by adjusting feed. Rats were maintained on their diets for 50 d. At 24 h prior to kill rats were given an intra-peritoneal injection of bromodeoxyuridine (BrdU) and 20 min prior to kill rats were injected with vincristine. Rats were killed by cervical dislocation, the small intestine (SI) removed and its length measured. Two 20 mm length segments of duodenum taken 20 mm distal from the pylorus were fixed in 10% formalin. The first segment was standard paraffin-wax-embedded and longitudinally sectioned. Sections were used to measure crypt and villus dimensions and for immunohistochemical detection of BrdU labelled cells. The second segment was used for the measurement of crypt cell production rate (CCPR), crypt:villus ratio, and villus number.

	4-week-old rats				10-week-old rats			
	RD (*n* 6)		WM (*n* 6)		RD (*n* 6)		WM (*n* 6)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Villus length (μm)	596	35.9	523	35.3	527	29.9	475	14.4
Crypt depth (μm)	199	12.9	188	18.6	165	3.5	163	5.9
Villus number*	1283	92.0	1405	114.4	1284	71.6	1408	77.5
Crypt:villus ratio	24.0	1.12	21.2	0.83	24.8	1.16	25.3	0.99
CCPR†	18		20		18		17	
Leading edge (μm)‡	152	18.5	157	13.7	89	9.7	90	14.2
SI length (mm)	597	20.1	557	26.9	532	21.0	525	9.9

* Number of villi in a 10mm length segment of duodenum.

† Number of cells produced in the crypt per h.

‡ Distance of the leading edge of the cohort of BrdU labelled cells from the base of the villus.

Riboflavin deficiency induced in 4- and 10-week-old rats did not have a significant effect on any of the variables measured. However, there did appear to be a trend towards an increased villus length and fewer villi in the two age groups of RD rats which may be of biological significance.

These observations suggest that the structure and cytokinetics of the rat small intestine may be less susceptible to riboflavin deprivation in the post-weaning period than around weaning.

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A comparison of estimated energy requirements with resting metabolic rate measured using indirect calorimetry in hospital patients. By M.A. KEEGAN[1], A. GARRETT[2], Y. BRADBURN[2] and I.T.CAMPBELL[1], *[1]University Department of Anaesthesia and [2]Department of Nutrition and Dietetics, Withington Hospital, Manchester M20 2LR*

Clinically, energy requirements are estimated by calculating 24 h "basal" metabolic rate (BMR) using a standard formula (Schofield *et al.* 1985) and adding additional factors to take into account "metabolic stress," activity, body temperature etc. Resting metabolic rate (RMR) can be measured by indirect calorimetry. Ideally the estimated energy requirements (EER) would be 10-30% greater than the measured RMR to allow for activity (Todorovic & Micklewright, 1989). We compared EER with RMR measured using indirect calorimetry.

Forty-one medical and surgical patients (27M, 14F; aged 31-84 (median 64.5)years; height 1.48-1.93(median 1.74) cm; weight 44.5-93 (median 70) kg) referred to the Dietetic Department for assessment of nutrient requirements for intravenous feeding were studied. The 24 h EER were assessed using the formula recommended by the Parenteral and Enteral Nutrition Group (PEN) of the British Dietetic Association (Todorovic & Micklewright, 1989) and RMR was measured using the Deltatrac Indirect Calorimeter (Vohra *et al.* 1995). The patients were studied after at least 30 min rest; if mobile, or if confined to bed they were studied supine, if nursed sitting out of bed they were studied in that position (n = 4). Measurements were made at any time of day and in nine patients intravenous feeding had already started.

All patients (n = 41)	Median	Range	Interquartile Range
Predicted BMR (MJ/24 h)	5.82	4.80 - 7.94	5.23 - 6.35
24 h EER (MJ/24 h)	8.36	6.65 - 10.8	7.52 - 9.40
RMR (MJ/24 h)	6.60	4.68 - 10.4	5.51 - 6.94
EER-RMR (% of RMR)	34.3	-8.1 - 91.8	8.5 - 51.9
Patients fasted and supine (n = 30)			
EER - RMR (% of RMR)	32.8	-8.1 - 91.8	7.2 - 49.2

There was a negative correlation between RMR and the size of the difference between RMR and EER (r = -0.623; P<0.001). This correlation was more marked when the difference was expressed as a percentage of the measured RMR (r = -0.714; P<0.001). For the thirty patients who were both supine and starved the results were similar; the correlation between RMR and the difference between RMR and EER was -0.688 (P<0.001) and -0.743 (P<0.001) with the RMR/EER difference expressed as a percentage of RMR.

It is concluded that for the population the PEN formula appears to be a reliable method of predicting 24 h energy requirements of hospital patients, but for individuals the errors may be considerable and appear to be greater the lower the level of energy expenditure.

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Muscle glycogen and electrolyte concentrations in multiple organ failure. By I.T. CAMPBELL,[1] C.J. GREEN[1] and M.J. JACKSON[2]. *[1]University Department of Anaesthesia and [2]University Department of Medicine, Royal Liverpool University Hospital, Liverpool L69 3BX.*

A major energy store in muscle is glycogen; K is the major intracellular cation and Na the major extracellular cation. In multiple organ failure (MOF) the ability to store infused glucose, presumably as glycogen in muscle, is impaired (Green *et al.* 1995) and in "catabolic illness" there are thought to be disturbances in ionic distribution, with a rise in intracellular Na and a loss of K. We have measured muscle glycogen, K and Na concentrations in the muscle of patients with MOF to determine to what extent these abnormalities exist in this condition, whether glycogen synthesis takes place and if changes in muscle glycogen content reflect changes in nutritional status (nutrient balance).

Muscle biopsies were taken using a conchotome from the tibialis anterior of fifteen patients with MOF (7F,8M; age 35-72, (median 58) years; weight 53-101, (median 77.4) kg; height 1.54-1.88, (median 1.68) cm at various stages of the illness, on 1-5 (median 2) occasions. When more than one biopsy was taken on a patient (n = 10) mean values were used in describing the population.

	Glycogen (μmol/100 μmol creatine)	Sodium (μmol/100 μmol creatine)	Potassium (μmol/100 μmol creatine)	Total Creatine (μmol/g dry wt)
Patients Median	164	201	274	94.6
Range	78-407	125-507	175-485	43.3-121
Normal Range	151-383	40-132	319-415	108-159

For glycogen three patients (20.0%) fell outside the normal range although the median value was at the lower end of this range. For Na twelve patients (80.0%; 95%CI 52%-96%) were outside our normal range (P<0.05) and for K fourteen (93.3%; 95%CI 68% -100%; P<0.05).

Correlations were sought in the ten patients with more than one biopsy between change in muscle glycogen and change in various indicators of nutritional status: energy expenditure, energy balance, glucose infused, glucose balance and N balance, but none were found. Glycogen concentrations rose in three patients and fell in twelve despite the balance of glucose infused and oxidized being positive in all instances.

It is concluded there are disturbances in muscle Na and K concentrations in MOF as might be predicted, that muscle glycogen concentrations do not follow changes in nutritional status in terms of macronutrient balance and that some of these these patients do appear to be capable of synthesizing some muscle glycogen.

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Comparison of body composition analysis using whole body magnetic resonance imaging, bioimpedance and skinfold anthropometry in lean and obese healthy and Prader-Willi syndrome subjects. By E.L. THOMAS[1], A.E. BRYNES[2], A.P. GOLDSTONE[3], N. SAEED[1], J.V. HAJNAL[1], G. FROST[2], A. HOLLAND[4], S.R. BLOOM[3] and J.D. BELL[1], *[1]The Robert Steiner MRI Unit, Departments of [2]Dietetics and [3]Metabolic Medicine, Imperial College School of Medicine, Hammersmith Hospital, London W12 0NN; [4]Department of Psychiatry, University of Cambridge, Cambridge CB2 2AH.*

The accurate quantification of regional fat depots is important as they display different biochemical properties with associated metabolic consequences (Abate, 1996). Recent advances in magnetic resonance imaging (MRI) have facilitated such measurements. Prader-Willi syndrome (PWS) is a genetic disorder characterized by morbid obesity and short stature. Assessment of body composition using total body water measurements has suggested that percentage body fat content in PWS is much higher than predicted using standard anthropometric techniques and bioimpedance (Schoeller *et al.* 1988; Davies & Joughin, 1992). However such techniques do not provide any information on body fat distribution and are technically difficult, especially given the other clinical features of PWS. We therefore compared body composition measured by whole body MRI, skinfold thickness and bioimpedance in lean (BMI<30 kg/m^2) and obese (BMI>30 kg/m^2) healthy and PWS female adults.

Subjects underwent four-site skinfold (triceps, biceps, sub-scapular, supra-iliac) and bioimpedance (BodyStat™, Isle of Man) measurements. Total and regional (internal and subcutaneous) fat masses were determined using whole-body MRI (Picker 1.0T HPQ system, T_1-weighted spin-echo sequence, 10 mm slices every 30 mm) with interactive image analysis (Barnard *et al.* 1996). Subject details are given as median and range:

	Age (years)	Weight (kg)	Height (m)	BMI (kg/m^2)	Waist:hip ratio	Skinfold (% fat)	Impedance (% fat)	MRI (% fat)	Sc:int fat ratio
Lean (*n* 26)	29 (18-45)	68.1* (49.4-81.1)	1.65 (1.53-1.78)	24.4* (19.6-28.6)	0.77* (0.71-0.82)	30.2* (19.5-37.0)	27.3* (16.1-39.6)	37.5* (23.1-46.3)	5.58 (4.28-8.18)
Obese (*n* 17)	36 (18-44)	102.2 (73.8-146.8)	1.63 (1.54-1.77)	37.1 (30.2-57.3)	0.82 (0.70-0.91)	41.1 (35.5-44.6)	41.9 (37.3-58.2)	54.3 (46.1-65.1)	5.78 (3.42-8.40)
PWS (*n* 13)	24 (20-38)	71.6* (54.9-144.0)	1.49*† (1.37-1.67)	32.0† (23.6-51.6)	0.84† (0.76-0.95)	36.0*† (24.6-43.1)	50.0† (29.1-58.3)	54.5† (44.2-68.1)	6.84*† (4.59-10.0)

Mean values were significantly different from obese: *P<0.05 (Mann-Whitney U test).
Mean values were significantly different from lean: †P<0.05 (Mann-Whitney U test).

Linear regression analysis showed significant correlations between BMI, skinfold percentage body fat, bioimpedance percentage body fat and MRI percentage body fat for both control (r^2 0.79, r^2 0.71, r^2 0.88; all P<0.01) and PWS subjects (r^2 0.87, r^2 0.70, r^2 0.86; all P<0.01). However the absolute values were different within each group. In lean subjects skinfold and bioimpedance slightly underestimated percentage body fat compared with MRI (P<0.05, P<0.01, Wilcoxon signed rank test). In obese and PWS subjects skinfold underestimated percentage body fat compared with MRI (P<0.05, P<0.01) but there was no difference between impedance and MRI (P=0.2, P=0.6). In linear regression analysis BMI (P<0.01) and skinfold (P<0.01), but not bioimpedance (P=0.5), underestimated MRI percentage body fat in PWS compared with controls. Subcutaneous:internal (Sc:int) fat ratio was greater in PWS than either lean or obese controls (P<0.05).

MRI provides useful information on total fat content, which correlates well to standard techniques. However the discrepancy between skinfold and MRI rises with increased fat deposition, especially in PWS, where there is marked fat deposition in the extremities. Although bioimpedance relies on assumptions about body shape and fat hydration, which may be altered in extreme obesity, values were similar to MRI measurements. However no information is provided about body fat distribution. The value of this is seen in the increased subcutaneous fat in PWS, which is not reflected in the waist:hip ratio.

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Enteral feeding tolerance in critically ill paediatric patients given adult formula. By RACHEL M. TAYLOR[1], ALASTAIR BAKER[1], PAUL CHEESEMAN[1], VICTOR R. PREEDY[2], FIONA BARTLETT[1] and GEORGE K. GRIMBLE[3], *[1]Child Health, Kings College Hospital, Denmark Hill, Londo, SE5 9RS.[2]Rayne Institute, Coldharbour Lane, London SE5 9PJ [3]Roehampton Institute, West hill, London* SW15 3SN.

During a period of critical illness it may be the quality of the nutrition rather than its quantity which is important. *n*-3-fatty acids, arginine and RNA precursors are examples of novel substrates which have been shown to be beneficial in critically ill adult patients (Cerra *et al.* 1991). At present these nutrients combined are only available in an adult formula (Impact, Novartis), which has higher protein content, higher osmolarity and a different electrolyte ratio compared with standard paediatric formulas. In the process of investigating the beneficial effects of these substrates in critically ill children it was necessary to confirm feeding tolerance in children receiving adult formulas compared with paediatric formulas and parenteral nutrition. The present study therefore compared tolerance outcomes.

Twenty-five children, aged 1.5 - 15.8 years (four female) received adult formula (Novartis) for 1 - 14 days, nine aged 1.2 - 9 years (five female) received paediatric formula (Nutrison/ Generaid) for 3 - 18 days and eleven aged 0.8 - 19.3 years (five female) received parenteral nutrition for 2 - 21. All the children were admitted with neurological, hepatological or respiratory illness. Energy and N intake, volume of gastric aspirate and the number of stools were recorded and biochemical indices of nutrition were measured.

Biochemical indices were comparable between adult formulae and paediatric formulae but parenteral nutrition was associated with significantly higher plasma Na, urea and lower albumin concentrations.

	Adult formula			Paediatric formula			Parenteral nutrition		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Sodium (mmol/l)	137.3	5.5	125-152	138.4	4.06	129-148	147.0	7.5	130-170
Urea (mmol/l)	11.1	11.0	1.1-47	8.6	6.9	2.2-28.9	16.3	7.5	3.8-34
Albumin (g/l)	37.8	6.5	16-53	37.1	8.5	26-66	34.6	5.6	25-49
Energy (kJ/kg per d)	116.3	118.8	0-725.9	144.8	84.5	0-378.7	127.6	61.1	0-342.3
Nitrogen (g/kg per d)	0.25	0.3	0-1.62	0.11	0.1	0-0.39	0.22	0.17	0-0.83

Mean values were significantly different from adult formula: *p < 0.05

Stool frequency was similar (0 - 9 per d) whilst parenteral nutrition was associated with higher gastric aspirates (3.2 (range 0-64.9) ml/kg/day, p< 0.05) than either adult or paediatric formula (0.3 (range 0-29) & 0 (range 0-7.3) ml/kg/day respectively).

The nutritional goal of 209-418 kJ/kg per d was not attained in any group. However patients receiving the adult formula achieved greater N intake than those receiving paediatric formula but with a similar level of tolerance. These data show that not only is it safe to use modified adult formulas in

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Improved nutritional awareness alone does not improve recording practices of weight and height by nurses working on acute medical and care of the elderly wards. By MARY COONEY, CHRISTINA JONES and RICHARD D. GRIFFITHS, *Department of Medicine, University of Liverpool, Liverpool L69 3BX and Whiston Hospital, Prescot, L35 5DR*

Malnutrition is still a largely unrecognized problem in hospital patients (Lennard-Jones 1992). Audits have shown recording practices of height and weight to be poor (Davison & Stables 1996). The aim of the present study was to assess the effect of a nutritional awareness education programme, using the British Association for Parenteral and Enteral Nutrition (BAPEN) minimum (Lennard-Jones *et al* 1995) as the core, on height and weight recording on selected wards within our Trust. As surgical patients require a weight to be recorded prior to the theatre for the anaesthetic, it was decided to audit the acute medical and care of the elderly wards.

An initial audit of height and weight recording was undertaken. This was followed by a Trust-wide educational programme consisting of newsletters, study days, roadshows and specially trained nutritional link nurses to promote the recording of the BAPEN minimum on all patients. All wards in the Trust were asked to nominate at least one nurse to train as a link nurse, 86% were able to comply. Monthly educational meetings of 1 h duration were organized, and if a link nurse could not attend then they were provided with handouts of the topic covered. Each link nurse was provided with educational posters outlining the BAPEN minimum and monthly newsletters for their ward area and were asked to keep a folder on the ward containing all of the educational material for use by other staff members.

After 18 months a re-audit was undertaken and the notes of all the patients on acute medical and care of the elderly wards examined over a 1 d period to see what percentage of patients had had their weight and height recorded. Despite improved awareness, the results showed only a very modest improvement in the recording of weight and height (see Table).

	Pre-education (*n* 48)		Post-education (*n* 104)	
Weight considered important (%) ...	91		96	
Height considered important (%) ...	40***		71***	
	Median	Range	Median	Range
Weight recording (%)				
Acute medical	15		18	7-26
Care of the elderly	0	0	22	0-44
Height recording (%)				
Acute medical	0	0	2	0-17
Care of the elderly	0	0	0	0

Chi^2 *** $p < 0.001$

Encouragingly, 17% of the patients on one medical ward had had their height recorded and one of the care of the elderly wards, with a very keen link nurse, had managed to weigh 44% of their patients. A parallel audit of nutritional awareness of the importance of nutrition to patients' recovery and the need to record patients' weight and height on admission had shown an increase in knowledge levels, but practice had not followed suit. In part this could be explained by the fact that a clear place in the hospital notes to record height and weight was not achieved until 2 months before the second audit and some wards had only just started to use the new format. The discrepancy between increased nutritional awareness and poor clinical practice provides not only a challenge but also a framework for future research. Clearly practical memory prompts for nurses as they admit patients are needed.

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Home parenteral nutrition:- review of protocols to prevent catheter occlusion. By J.M. TAIT, J.P. BAXTER and C.R. PENNINGTON, *Department of Digestive Diseases and Clinical Nutrition, Ninewells Hospital, Dundee DD1 9SY*

Catheter care and the preservation of venous access are particularly important for patients on home parenteral nutrition (HPN). Catheter occlusion is one of the major complications of HPN. Causes of line blockage include lipid deposits, fibrin deposits, amorphous debris and mechanical problems. The use of lipid containing mixtures is particularly associated with the development of blockage. An ethanol flush has been shown to significantly reduce this risk of lipid occlusion (Johnston et *al*), and heparin is used to prevent the deposition of fibrin and thrombus. There are no nationally agreed policies for the use of ethanol, or the amount of heparin. There are relatively few studies which support the use of ethanol, and there is concern about the potential long term effect of heparin on bone.

The aim of the present study was to evaluate the efficacy of our current protocols for the prevention of line occlusion, and to stimulate debate about the evaluation of the different methods which are employed in various centres.

Since 1990 it has been our policy to use an alcohol flush after lipid infusions.Alcohol (10ml, 200ml/l) is given then 3 ml heparin 1 000 iu/ml is used as a lock. Glucose infusions are flushed with 10 ml NaCl (9g/l) and a heparin lock is applied as before. A survey was carried out on all patients receiving HPN during a period of 84 months from 1990 until 1997 prior to a protocol review. Thirty patients were studied during thirty eight episodes of parenteral nutrition. Catheters were *in situ* for 19,240 (52.8 patient years), range 30 - 2250 (mean 420). Of the patients surveyed twenty four had a Cuff Cath®, 6six had a Port-a-Cath® or Intraport® two had Life Caths®, and 6 had Broviac® lines *in situ*.

There was one episode of mechanical obstruction, and two episodes of intra luminal occlusion recorded, all in the external catheters. Thus there was one episode of occlusion per 12.7 episodes and 17.6 patient years of treatment.

Whereas our polices were effective in minimizing the risk of patients losing their catheter due to occlusion, similar results may have been achieved without ethanol and with lower doses of heparin, at reduced cost and increased safety. There may be a need for further studies to address the suitability of different catheter protocols. These data do not permit conclusions about the tendency to occlude in relation to catheter type, however the transparent polyurethane Cuff Cath™ (Ohmeda) had the advantage of allowing lipid sludge or blood flash-back to be seen and remedied at an early stage.

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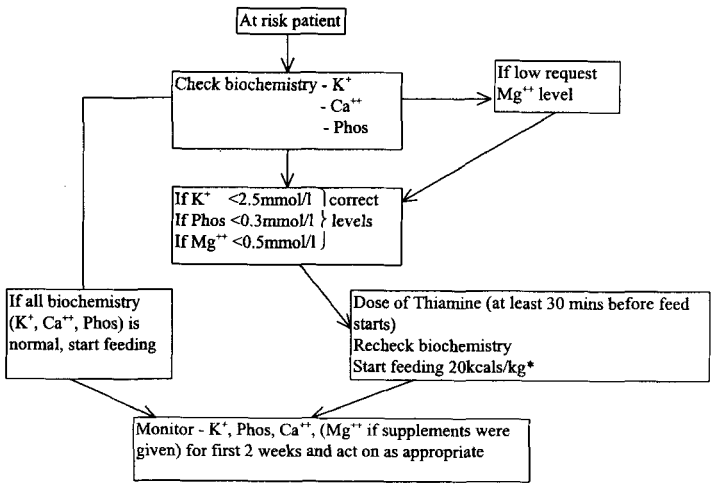
Refeeding syndrome: the need for practical guidelines. By HELEN M. DEWAR[1] and RITA HORVATH[2], *Nutrition and Dietetic[1], and Clinical Biochemistry Department[2], Oxford Radcliffe Hospital, Headley Way, Oxford OX3 9DU*

Refeeding syndrome can be defined as severe fluid and electrolyte shifts and vitamin deficiencies in "at risk" patients undergoing refeeding. "At risk" patients include chronic alcoholics, patients suffering from chronic malnutrition, anorexia nervosa, those on chronic diuretics and/or antacids, or oncology patients with deranged electrolyte homeostasis. Refeeding syndrome can lead to sudden severe drops in phosphate, K, and Mg once nutritional support is started. Clinically this may result in serious disturbances in body systems, most importantly in the heart where cardiac arrhythmias can occur (Weisner & Krumdieck, 1981). Refeeding syndrome is not a new phenomenon, as many cases were reported in Japanese prisoners of war camps during the last World War (Solomon & Kirby, 1990). However, a case in our hospital has raised our awareness of the seriousness of this syndrome and illustrated a general lack of knowledge of how to manage the consequences. Together with a clinical biochemist, practical guidelines have been developed in order to prevent future cases and to enable patients undergoing nutritional repletion to be managed safely.

Refeeding syndrome flow chart



* 20 kcals/kg for the first 24 hrs. then increase gradually within the first week to full feeding, with careful monitoring of electrolytes as required.

The most important parts of these guidelines are to identify "at risk" patients; to monitor and correct serum electrolytes particularly before nutritional support is initiated; give relevant vitamins; introduce artificial nutrition support slowly and continue to monitor electrolytes at least for the first week of refeeding. These guidelines are currently being used in our hospital and have proved to be useful in dealing with potential cases of the refeeding syndrome.

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The alternative - dietary practice of a selected group of oncology patients receiving conventional medical treatment. By VALERIE M. SWABY, *Department of Nutrition and Dietetics, St George's Healthcare, Tooting, London SW17 OQT*

The relationship between diet and cancer has attracted much attention in recent years with consistent support from epidemiological studies. However, the possible role of specific diets and their pursuit by cancer patients has received little attention. To date no one has been able to answer the question 'Does diet cure cancer?'. In the present study cancer patients were surveyed to establish use of alternative - diet therapies (modification of normal diet to treat or cure cancer), assess motivation for their use and determine nutritional adequacy by comparing mean 24 h energy and protein intake with reference values (Elia,1990; Department of Health, 1991). A consecutive series of patients were recruited from the oncology day unit of St George's hospital, participants following alternative diets were compared with a disease and age matched group consuming their normal diet. All subjects completed a self-completion questionnaire and 7 d food diary.

Among the fifty-one patients surveyed prevalence of alternative dietary practice was 15.7% (eight respondents), popular diets included herbal (one respondent), Bristol (*n* 3), organic (*n* 1), juice-plus (*n* 1) and vitamin + mineral supplementation (*n* 2). The main reason for their use was the need for self-help and hope of cure.

	Alternative diet						Normal diet					
	Study (*n* 5)		RNI*†		Elia+‡		Study (*n* 5)		RNI*†		Elia+‡	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Energy (MJ)	7.91	2.03	9.00	1.95	8.59	1.69	5.46	0.96	8.80	1.36	8.64	1.34
Protein (g)	73.1	12.7	58.6	8.2	97.7	13.7	56	11.5	50.8	10.2	84.7	17

*Recommended nutrient intake (RNI) for energy estimated from BMR X (Physical activity level) =1.4.
†Protein RNI requirements estimated at 0.75g/kg/per d.
+Energy requirements calculated from BMR + (Physical activity level) of 25% + 10% for metabolic rate.
‡Protein requirements based on (g N/kg/per d)^2.

The Table shows that the mean energy and protein intakes of patients following alternative diets were greater than those of patients consuming their normal diet. When compared with reference values mean energy and protein intake calculated according to Elia (1990) for both groups were below recommended intakes, while the RNI for protein was achieved by both groups. However, some individual intakes on both diets were low. The results failed to support the findings of Hunter (1991) that alternative diets are nutritionally inadequate. These findings suggest that some cancer patients consume nutritionally adequate alternative diets whilst receiving conventional medical treatment and that recommended energy intakes for the majority of patients are difficult to achieve. A large scale prospective survey of in - and outpatients appears to be warranted.

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An examination of the effect of dietary sodium restriction on energy and protein intake in the treatment of ascites in cirrhosis. By CLARE T. SOULSBY, *Department of Nutrition and Dietetics, Royal Free (Hampstead) NHS Trust, Pond Street, London NW3 2QG.*

Low Na diets are used in the treatment of ascites. Although such diets lead to a faster resolution of ascites, their benefits, when used in conjunction with potent diuretics and over longer periods of time are negligible (Reynolds *et al.* 1978; Gauthier *et al.* 1986) . Low Na diets are unpalatable and, in other patient populations, have been shown to have a deleterious effect on energy and protein intake (Gillum *et al.* 1983; van der Maten 1995; van Buul *et al.* 1995).

The aim of the study was to compare energy and protein intake of subjects with ascites due to cirrhosis while following a low Na and a no added salt diet. The effect of the diets on degree of ascites was not quantitatively assessed.

Six stable subjects with cirrhosis and ascites completed a randomized crossover trial. The subjects comprised two women and four men, aged 44-60 years. Subjects followed the two diets in random order for 4 weeks. The dietary regimens were a low Na diet (40 mmol/d) and a no added salt diet (80-100 mmol/d). All subjects were nutritionally assessed during each phase of the study using anthropometry to measure mid arm muscle circumference. Weighed dietary records (7 d) were verified against resting energy expenditure assessed by indirect calorimetry and 24 h urinary N. Dietary compliance was evaluated by the determination of urinary Na excretion (completeness of 24 h urine collections was verified by *p*-amino benzoic acid excretion).

Energy and protein intakes were lower during the period on the low Na diet compared with the no added salt diet. Clinical assessment showed no change in degree of ascites. The low Na diet was associated with a loss of mid arm muscle circumference. The validity of the food record was confirmed and, while subjects consumed less Na on the low Na diet, there was a high incidence of dietary non-compliance.

In conclusion, the low Na diets compromised energy and protein intake more than less restrictive no added salt diets, and were associated with detrimental changes in nutritional status. While this study was undertaken on a small sample of subjects, further work is required to confirm these results and help rationalize future dietary management of ascites in liver disease.

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Health-related quality of life after percutaneous endoscopic gastrostomy. By E. BANNERMAN, J. PENDLEBURY, F. PHILLIPS and S. GHOSH. *Gastrointestinal Unit, Western General Hospital, Crewe Road, Edinburgh EH4 2XU*

Feeding via percutaneous endoscopic gastrostomy (PEG) is currently considered the method of choice for long-term enteral feeding. Though PEG feeding leads to fewer interruptions to feeding than naso-gastric feeding (Park *et al.* 1992) and is cosmetically more acceptable (Ghosh & Eastwood, 1994) there is little information on health-related quality of life (HR-QOL) in these patients. Measuring HR-QOL in patients fed via PEG presents special challenges, as these patients often have significant cognitive and intellectual impairment. The aim of the present study was to assess the HR-QOL of patients after PEG placement, using a battery of standard instruments, so that the applicability of standard HR-QOL tools in PEG patients could be determined.

Patients who had received PEG during the period 1994 - 1996 were identified and current status determined through contact with their GP. All patients still living were invited for follow-up assessment in terms of nutritional status and quality of life. HR-QOL was assessed using the Short Form-36 (SF-36) (Jenkinson *et al.* 1993) and the Hospital Anxiety and Depression scale (HAD) (Wade, 1992). Questions specific to the impact of PEG on the social and personal QOL of the patient were also asked (PEG-QU). Anthropometric and biochemical nutritional assessments were performed.

Out of 215 patients who had received a PEG during 1994 - 1996, current feeding status was ascertained in 186 patients (87%), of whom 102 (55%) were still living (median age 53 (range 17-91) years, fifty-seven (56%) males). Of those still living, fifty five (54%) patients agreed to follow-up assessment (*n* 32 still feeding via PEG, *n* 23 having resumed 'normal' oral intake).

It is of interest to note that only thirty patients (*n* 14 still feeding via PEG: *n* 16 having resumed oral intake) were able to complete the SF-36 and HAD scales and twenty-two able to answer questions regarding PEG. Scores from the SF-36 showed that physical functioning was poor in this group of patients compared with the general population (Jenkinson *et al.* 1993) (a higher score indicates better function). Assessment of mental health status showed, surprisingly, that not all these patients were anxious or depressed; however, they did report that role functioning was affected by emotional problems (SF-36 scores are detailed in the Table below).

Health variable	Physical function	Role function (physical problems)	Role function (emotional problems)	Mental health
General population mean SF-36 score * (%)	79.2	76.5	75.0	73.7
PEG patients' mean SF-36 score (%)	36.1 (SD 33.6)	32.2 (SD 40.4)	51.6 (SD 43.8)	69.0 (SD 18.7)

* Jenkinson *et al.* (1993).

When comparing patients' perceptions of health using the SF-36 questionnaire, those patients with PEG *in situ* were not significantly different from those who had resumed oral intake, other than the perception of their general health (41.4 (SD 26.5)% *v.* 60.9 (SD 23.5)%, P=0.04). In terms of the specific impact of PEG on HR-QOL, almost half (10/22; 45%) the patients indicated PEG had a positive effect (PEG-QU).

The results from this study illustrate the difficulties involved in trying to assess the quality of life of PEG patients using standardized HR-QOL. Even resumption of normal feeding did not improve patients' perceptions of health apart from general health. A specific PEG-related QOL questionnaire needs to be designed and validated to determine the impact of PEG-feeding on QOL. An ongoing study is currently assessing HR-QOL prospectively prior to and after PEG insertion to acquire more data.

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A team approach to the audit of nutritional care of oncology patients. By SARAH HARKESS and VICTORIA SHERER and CATHY STEELE. *Nutrition and Dietetic Department, Leicester Royal Infirmary, Leicester LE1 5WW*

Malnutrition in hospital is becoming increasingly prevalent on admission and worsens during hospital stay (McWhirter & Pennington 1994). Cancer site, cancer treatments and the cachexia syndrome can also have a significant effect on morbidity and mortality of the patient (Cozzaglio *et al.* 1992). This present study aimed to audit nutritional care currently being offered by the Oncology Unit, Leicester Royal Infirmary, using baseline data of nursing, medic and Professions Allied to Medicine documentation of nutrition-related problems, nutrition knowledge of staff and meal provision to oncology patients.

As part of this audit the Leicestershire Nutrition Screening Tool (NST) was implemented on one of two oncology wards and documentation of nutrition was compared pre- and post-implementation. The pre-implementation audit showed that documentation of nutrition care required following team assessment was done in only 18% of inpatients. It was found post-implementation that this rose to 28%. Only 25% of patients were weighed on the oncology wards, the majority of whom were chemotherapy patients. No BMI was documented pre-screening and this increased to 20% after NST implementation. This may be due to reluctance to emphasize weight loss with cancer patients. Post implementation, 30% of patients admitted to the ward in the first month had an NST completed. Of those whose score was >10 (indicating risk of malnutrition and referral to a dietitian) only 46% were referred to the dietitian. Number of referrals over the 1-month period post implementation increased by 120%. This indicated an increased awareness of nutrition-related problems and an improved nutritional care provision.

Nutrition knowledge of health care professionals was also audited. Of the respondents 41% were not confident in ascertaining nutritional assessment and status of patients. Lack of knowledge was also highlighted in food choice and food composition and in complex diet therapy (31%); 59% of respondents understood that active nutritional support does not accelerate tumour growth. From this a teaching and education programme can be planned focusing on areas where knowledge was demonstrated to be poor. A weighed food intake survey found that 85% of the estimated average requirements (EAR) for energy and 145% of the reference nutrient intake (RNI) for protein was offered to the patients. The actual amount consumed was 53% of EAR for energy and 101% of RNI for protein. Nutrient analysis highlighted that the carbohydrate content of meals was low and provision of extra snacks would improve the energy profile of the menus. Observation audit showed that on occasions menu choices were inappropriate for the needs of the individual patient and therefore the nutritional composition of menus provided may have been inadequate. It is recommended that an education programme for ward staff/support workers should be implemented regarding food presentation and appropriate menu choices.

The audit highlighted areas for improvement within the multi-disciplinary team with regards to nutritional care for the cancer patient. By more stringent screening and documentation patients could be tracked and therefore more accurately assessed by a dietitian.

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A 1- year audit of home enteral feeding practice. By FIONA A.R. GIBSON, *Dietetic Department,Derriford Hospital, Plymouth PL6 8DH*

Dietitians liaise with patients/carers and relevant professionals regarding the safe discharge of patients on nutritional support into the community (McAtear & Wright, 1996). Within Derriford Hospital Dietetic Department, up until May 1997 no set departmental standard of practice for home enteral feeding (HEF) existed.

A 1- year retrospective audit of all adult HEF patients was undertaken, reviewing dietetic record cards to: (1) identify the key steps in the education of the patient/carer on HEF involving the dietitian; (2) assess the information recorded on the dietetic record card; (3) design a checklist for dietitians to complete when discharging a patient on HEF to ensure consistency and accuracy of advice.

Twenty-eight patients were discharged to their own home within the previous year, so these dietetic record cards were looked at. Data were recorded on a proforma and analysed by the Department of Clinical Audit, Derriford Hospital, Plymouth.

	yes	no
Was the GP contacted? (by telephone)	79%	21%
(by letter)	18%	82%
Was a written regime provided?	82%	18%
Was follow-up organized with the community dietitian?	68%	32%

The Table shows the inconsistencies arising in the recording of detail on the record card, and in the education of patients/carers on HEF. The audit resulted in the creation of a checklist, and the following recommendations were made: (1) the checklist is to be completed by all dietitians involved in discharging a patient on HEF; (2) the completed checklist and the dietetic record card are to be handed over to the community dietitian on the patients discharge to their own home.

This is now a departmental standard for all patients being discharged on HEF. It ensures that all dietitians are working in a consistent manner and liaising with patients/carers and other health professionals in a similar way, ensuring a smooth and safe discharge of patients on HEF into the community.

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Energy intakes fail to meet requirements on texture modified diets. By AUDREY E. BRYNES, REBECCA J. STRATTON, LUCY WRIGHT and GARY S. FROST, *Department of Nutrition and Dietetics, Hammersmith Hospital, London W12 0HS*

Norton *et al.* (1996) recently demonstrated a reduction in mortality and shorter hospital stays when nutritional requirements of acute dysphagic patients were met via a percutaneous endoscopic gastrostomy (PEG). Elderly dysphagic individuals are a population at high risk of developing malnutrition (Keller 1993). This may be multifactorial in origin. One factor may be the use of texture modified diets (TMD) which are also known as pureed diets.

Few data are available on the nutritional adequacy of such diets, despite their widespread use. We report the results of a study carried out between August 1995 and July 1996 investigating the nutritional intake of dysphagic patients whose swallow was deemed unsafe by a formal assessment and who therefore required a TMD. Nutritional requirements were determined by a dietitian (Schofield, 1985; Elia, 1990), and a TMD with nutritional supplements if appropriate, was prescribed. All patients received nutritional supplements. In addition, nasogastric feeding (NG) was attempted in 52% of patients. Weighed food and drink intakes (24h) were recorded and compared with previous data collected from non-dysphagic patients as controls (Marshall *et al.* 1994). The median length on a TMD was 5 (range 1-23) weeks.

Non-parametric testing was used as the data were not normally distributed. Values are presented as the median and range. Comparison between the groups was made by Kruskal-Wallis ANOVA. Subjects in the control and puree groups were well matched for age (81 (range 69-90) v. 82 (range 57-98) years) and BMI (19.2 (range 14.2-25.8) v. 19.7 (range14.5-28.4) kg/m^2). The male : female ratio was equal. Results are presented in the Table below. Energy intakes were inadequate in the control group. The difference was even greater in the TMD group. Both results were significant.

	Intake (MJ)		% of estimated energy requirements
	Median	Range	
Control group (n 47)	1054	(115-2496)***	75
TMD group with supplements / NG (n 23)	863	(0-1900)†	45
Theoretical TMD only	233	(0-588)††	14.5

***p<0.0001 compared with energy requirements.

†p<0.05 when compared with control group.

††p<0.01 when compared with TMD group with supplements.

The results from our study indicate that patients on a TMD diet with supplements only met 45% of their energy requirements. This would fall to 14.5% if nutritional supplementation had not been instigated. Despite the addition of NG feeds nutritional requirements were still not met due to the recognized problems of this modality (Norton *et al.* 1996).

In conclusion we would argue that PEG feeding should be considered in all dysphagic patients so as to minimize the risk of malnutrition. Associated decreases in morbidity, length of hospital stay and ultimately treatment cost might also be predicted.

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Survey of the use of supplements (sip feeds) in hospitals in the south of England. By S. BROSNAN, J. MUNRO, C. HADFIELD, H. RIVERS and B. MARGETTS, *Wessex Dietetic Managers Group and The Wessex Institute for Health Research and Development, Southampton General Hospital, Southampton SO16 6YD*

Controlled experimental studies have shown both short - and long-term benefits from using supplemental feeds (Delmi et al. 1990; Larsson et al. 1990; Keele et al.1997). Supplement use has become accepted as a way of improving nutrition and is increasing rapidly in both the hospital and community settings. However there is concern that supplements are being used widely without formal supervision and documentation making it difficult to establish efficacy.

The aim of the present study was to assess the prevalence of the use of supplements in routine care in district general, psychiatric and community hospitals in the former Wessex Region and to explore the factors which affected this use; specifically (a) to describe the reported use of supplements and (b) to assess whether decision to use supplements were based on sound criteria.

The study consisted of a survey of patient notes and structured interviews with dietetic and nursing staff. A cross-sectional sample of 1857 adults patients was drawn from ten district, four psychiatric and three community hospitals. Within each district hospital, random weighted (forty subjects per speciality per hospital) samples were drawn from the following specialities: medicine, surgery, orthopaedics, elderly and medicine/elderly. Staff data were gathered using a structured interview with two senior members of nursing staff per speciality (ninety-four in total) and one dietitian per dietetic department (thirteen in total).

Overall 14% of patient records indicated that supplements had been used; community hospitals reported a higher prevalence (17%) than psychiatric hospitals (9%). Within the ten district hospitals, patients in elderly specialities (20%) were more likely to be receiving supplements than patients in orthopaedics (8%) ($P < 0.05$). Longer stay patients (> 1 week) were more likely to be receiving supplements than short-stay patients (21% compared with 6%) ($P < 0.05$). The reasons given for the use of supplements were depressed appetite (47%), reduced intake (44%) and weight change (23%). Generally the level of documentation was poor. The decision to give supplements was often subjective. Although most hospitals recommend that patients are weighed on admission, on average weight was recorded in only 40% of case notes examined. Overall 90-100% nursing staff felt that supplements were useful but 38-62% felt they were not being used effectively.

The results suggest that criteria need to be established to ensure that appropriate patients are being supplemented.

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Review of enteral and parenteral feeding practice between 1994 and 1996: maintaining positive change. By HILARY J PEAKE., JULIA M. STANFORD and GARY S. FROST, *Nutrition and Dietetic Department. Hammersmith Hospital, London, W12 0HS*

Malnutrition is a significant factor in determining recovery from illness. Nutritional support is therefore a vital adjunctive therapy. Continued audit of nutritional support (excluding sip feeds) by clinical dietitians using a database has enabled the provision of nutritional support to be re-evaluated. Following an audit completed in 1992 a number of measures were employed to promote the importance of nutritional support (Frost *et al.*1994). Nutritional support strategies encompassed multi-disciplinary education and the development of a Trust-wide nutritional support policy, driven by a nutritional advisory group. Table 1 compares a 6 month period in each year, it demonstrates a sustained increase in the number of patients receiving enteral nutritional support between 1994 and 1996 attributed to the continued proactive approach to nutritional support within the trust.

	No.	Increase	Age		Days fed (as % patients)					
Year	Patients	%	(years)	Duration of feeding (d)	1	2-5	6-10	11-15	16-20	21+
1992	52	*	67 (34-86)	*	26	37	11	4	4	15
1994	115	121	72 (31-94)	37 (0-555)	8	24	24	10	5	28
1996	123	7	56 (16-97)	37 (1-1017)	0	37	23	10	7	23

* Data not available

The results identify the following changes (1) 100 % reduction in the number of patients fed for less than 1 d; (2) 54 % increase in the number of patients fed for 5 d, reasons for termination of enteral feed included, ability to take oral diet (32%), death (31%), other enteral feeding (9%) e.g. percutaneous endoscopic gastrostomy (PEG), naso-jejunostomy and parenteral nutrition (7%): (3) since 1994 there has been a 112% increase in the number of individuals fed for more than 50 days although the average length of feeding episode has remained unchanged (37 d). There has been no change in the choice of enteral feeding routes when values are expressed as a percentage of the patients (see Table 2below).

	Method of feeding (as % patients)				
Year	NG	PEG	Naso-jejunostomy	Jejunostomy	Gastro-jejunostomy
1992	93	7	0	0	0
1994	70	15	3	7	0
1996	77	11	3	8	0.6

Analysis of the parenteral nutrition data shows that there has been a 30% reduction in parenteral nutrition usage between 1994 and 1996. This is explained by a 7% increase in enteral feeding within Hammersmith Hospital resulting from a continued drive to promote enteral feeding as a first-line route for nutritional support. Other reasons include a change in speciality patient case mix, for example a reduction in colorectal surgery and relocation of ward within the Trust.

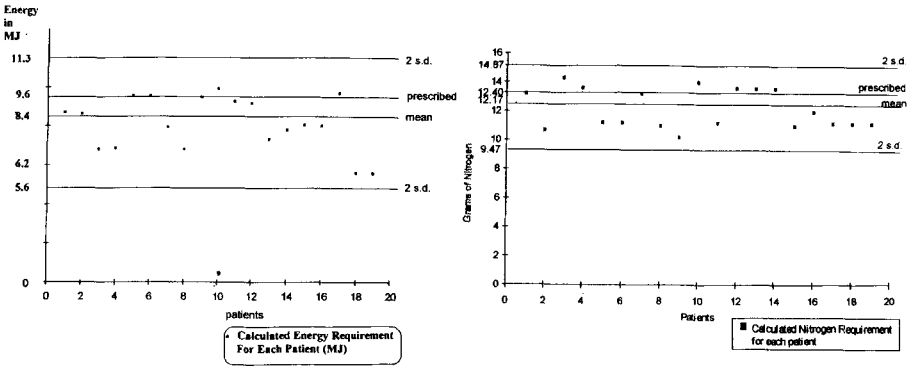
Frost, G.S., Stanford, J.M., Masters, K., Taylor, T.,Ward., L and Walters, J.R.(1994). *Journal of Nutrition and Dietetics*, 7: 61-68

Standard renal parenteral nutrition does meet our patients' nutritional requirement. By FRANCES PRZYGRODZKA, *Chief Renal Dietitian, Department of Dietetics and Nutrition, Nottingham City Hospital NHS Trust, Nottingham NG5 1PB*

In 1993 five standard parenteral nutrition (PN) regimens were introduced and as a result £20 000 per year was saved. Previously PN was compounded in pharmacy on an individual prescribed basis. One of the five standard PN regimens was specifically designed to meet the nutritional requirements of renal patients. As the renal directorate was the second highest user of PN, a 2 - year prospective audit was carried out to look in detail at the standard renal PN regimen and assess if it meets the nutritional requirements of renal patients admitted on to a renal ward. It also looked at usage of PN and compared this to the recommendations of Pennington (1996).

Nutritional requirements for all patients were calculated using the method of Elwyn (1980) for N requirement. Energy requirement was based on BMR equations (Schofield, 1985) with additions for activity and stress (Elia, 1982).

Twenty six patients were included in the audit, nineteen of which were given the complete volume of the standard renal PN to meet their nutritional requirement.



These scattergrams demonstrate that for all nineteen patients given standard renal PN, their calculated N and energy requirement lay within two standard deviations from the calculated mean, and there was very little difference between the calculated mean and the amount of N and energy received. Reasons for selecting PN, type of feeding line used, feeding line problems, length of time on PN and outcome of PN were also documented.

The audit demonstrated that a standard PN designed for renal patients with variable electrolyte content can provide the necessary N and energy requirement in the majority of patients.

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Home enteral tube-feeding in the community: are disabled children's rights to support services being denied? By RUTH J. TOWNSLEY and CAROL E. ROBINSON, *Norah Fry Research Centre, University of Bristol, 3 Priory Road, Bristol, BS8 1TX*

There are increasing numbers of disabled children living in the community who require enteral tube-feeds to optimize their nutritional status. Whilst there appears to be evidence of health gains, for some children there may also be serious and unintended social deprivations resulting from the need to be tube-fed. In particular, a recent national survey of health professionals has indicated that many children on home enteral tube-feeding (HETF) are being denied access to some social services and to school or nursery (Townsley & Robinson, 1997).

Of those professionals who responded to our survey, 26% (*n* 21) of dietitians and 40% of nutrition nurses (*n* 4) had encountered examples of children's difficulties in participating in education and social services.

Reasons given to explain exclusions were varied: 'Respite care is not possible due to a lack of trained carers'; 'At respite centres where children are not 100% reliant of being fed via a gastrostomy tube they are just not fed during their stay'; 'New guidance on the training of carers means that care is being withdrawn until appropriate training takes place, but there are not enough professionals to do the training'; 'Access to school has been very difficult and much debated with threats of being denied access if District Nurses are not able to visit frequently enough to give feeds'; 'In some cases mothers are expected to go to school several times a day to carry out bolus feeding'.

With reference to current research findings and other relevant sources, this paper reviews the nature of support services for disabled children on HETF. In particular, some of the difficulties that health, education and social care professionals are experiencing in trying to provide support services to tube-fed children and their families are highlighted. These include: lack of guidance and training for social services and education staff on administering tube feeds; inconsistencies between existing local authority guidance and advice; unequal access to services for families from different areas; and a lack of clarity over legal liability.

It is argued that national guidance should be developed which clarifies the position of all non-parent carers and staff who are willing to administer enteral tube feeds. Such guidance should also ensure that enterally fed children have the same access to educational and social services as other children and that families are given the opportunity to make informed decisions about the implications of enteral feeding prior to it being established. All children have the right both to education and access to reasonable levels of support. It is time to rethink the way services are organized to ensure that the entitlements of this growing group of children are not ignored.

Townsley, R. & Robinson, C. (1997). *On Line Support. Effective Support Services to Disabled Children who are Tube Fed, First Interim Report to the NHS Executive Mother and Child Health Programme*, Bristol: Norah Fry Research Centre.

The role of the dietitian in optimizing nutrition support for the infant. By CHRIS JARVIS, *Senior Childrens Dietitian, Department of Dietetics and Nutrition, Nottingham City Hospital NHS Trust, Nottingham NG5 1PB.*

A dietitian is an integral member of the paediatric team liasing with all members to provide the best nutrition in the most appropriate way. Dietitians skills involve:

- assessing nutritional requirements,
- designing appropriate parenteral regimens in conjunction with the pharmacist,
- balancing combined parenteral and enteral regimens within metabolic constraints,
- monitoring biochemistry,
- growth monitoring,
- practical feeding regimens for home.

There are three main clinical areas in which specialized nutritional care is needed in intensive care neonates: very-low-birthweight preterm infants; infants with necrotising enterolcolitis; infants with congenital gastrointestinal abnormalities. The former are by far the largest group posing a variety of nutritional problems, though some infants may fall into more than one category.

The major challenge when dealing with infants (and children) is that of growth and development. This is of particular relevance in preterm delivery where the short-term aim is to mimic the growth and development that occurs *in utero*. However, we are also becoming increasingly aware of the profound influence of nutrition in this period on later growth and development (Lucas *et al.* 1990) and the potential impact on adult morbidity (Barker 1990).

As the importance of nutrition in infancy becomes more widely accepted so the expertise of the dietitian in the provision of not only enteral, but also parenteral nutrition is utilized as part of an holistic approach.

The dietetic expertise available is used most effectively through good communication within a multidisciplinary team.

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