

unsuitable, then the NST would recommend another method of feeding. It must be stressed that the patient, if turned down for PN, would receive input from the NST on appropriate nutritional management and be reviewed for a few days after the initial referral in case any complications arose.

The nutrition nurse specialist was funded from the Trust on a permanent basis and 0.3 whole time equivalent of a dietitian was seconded to the team for help on daily rounds. We also continued our general nutrition education sessions. These sessions were aimed especially at the junior medical staff because they rotated more frequently through the system than the previously targeted groups.

## RESULTS FROM THE AUTHORIZATION PERIOD

During the advisory period 221 of 235 (94%) patients received PN compared with 72 of 156 (46%) during the authorization period. The inappropriate prescribing rate decreased from 21% to 3%. The two patients who received PN did so only for a short period (Table I).

It is interesting to note the decrease in referral rate for PN during the authorization period. It might be attributed to the NST conducting education sessions regarding the appropriate use of PN and thereby influencing the referral behavior.

The material cost of PN dropped dramatically over 1 y. A saving of £65 000 (74%) was made on materials alone and was caused solely by patients not being prescribed PN. The wastage was again reduced but only by another £1500.

The infection rate also decreased further, but not as dramatically as during the advisory period. This can be attributed to the increased use of dedicated feeding lines and peripheral access, which increased by 20%, from 31 to 51%. The reduced infection rate provided a hidden cost saving and reduced clinical risk to the patients.

As a result, the NST now has permanent authorization status for the prescribing of PN within the Trust and its own budget. There are still a small number of patients who are given PN inappropriately and, although we would like this value to be zero, it is often difficult in certain cases to predict the patient's recovery period or risk of complications. Sometimes for the sake of diplomacy and cordial working relationships with clinical colleagues, a request is passed. The team still has a significant educational role to play, with each team member being involved in lectures and workshops. Audit activity will now be focused on NST involvement in critical-care areas.

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## Improvement in Protein Utilization in Nursing-Home Patients on Tube Feeding Supplemented With an Enzyme Product Derived From *Aspergillus niger* and Bromelain

The impact of an enzyme-based digestive aid derived from *Aspergillus niger* and bromelain (AbsorbAid) on nutritional status was studied in 16 nursing-home patients who were bedridden, nourished with enteral intubation, and free from episodes of sepsis immediately before and after three consecutive 15-d study periods. After the initial 15-d "run-in" period and ensuring that all patients were clinically stable, the 16 patients were given AbsorbAid (1 teaspoon mixed with water and placed down the feeding tube, four times daily) for 15 d. AbsorbAid was then withdrawn during a 15-d "washout" period. Analysis of variance indicated that total protein concentration improved significantly during AbsorbAid supplementation (mean increase:  $0.32 \pm 0.12$  g/dL,  $P = 0.02$ ). Albumin concentration and lymphocyte count also tended to improve during supplementation, although the changes were not statistically significant. White blood cell count, hematocrit, and hemoglobin concentration did not change ( $P > 0.05$ ). When the supplement was withdrawn, total protein and albumin concentrations and lymphocyte count returned to pretreatment levels. Adding AbsorbAid to the feeding regime of nursing-home patients fed by enteral intubation improved patients' nutritional status as shown by significant improvements in total protein concentration and tendencies for albumin concentration and lymphocyte count to increase.

## INTRODUCTION

Non-volitional feeding in the institutionalized elderly presents two fundamental and often vexing challenges. Because the production of the enzymes necessary for the digestion of food into absorbable nutrients decreases by about 10% per decade after age 20 y, the administration of enteral nutrition with compromised digestive function can result in progressively worsening flatus and, in some cases, frank malabsorption with diarrhea and paradoxical malnutrition. Deterioration in nutrition status secondary to chronic malnutrition typically is associated with deteriorating immune status and reduced production of albumin and other visceral proteins. Other complications that accompany protein malnutrition, such as pressure ulcers, also can occur.

AbsorbAid (Nature's Sources, Morton Grove, IL, USA) is a nutritional supplement derived from *Aspergillus niger* and bromelain. This oral supplement contains the digestive enzymes lipase, amylase, protease, cellulase, and lactase. In previous research, AbsorbAid was shown to decrease the frequency and water content of the stools of patients with short bowel syndrome, acquired immune deficiency syndrome, and inflammatory bowel disease who had normal intestinal microfloral activity.<sup>1-3</sup>

Because the provision of food that cannot be digested is pointless and potentially harmful, this research investigated whether AbsorbAid affected the nutrition status of institutionalized elderly patients suffering from diarrhea who were receiving enteral nutrition support.

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TABLE I.

Variable	Change in variable (mean $\pm$ SEM)		
	Before AbsorbAid	With AbsorbAid	After withdrawal of AbsorbAid
Total protein (g/dL)	-0.06 $\pm$ 0.18 <sup>a</sup>	0.32 $\pm$ 0.12 <sup>b</sup>	-0.24 $\pm$ 0.10 <sup>c</sup>
Albumin (g/dL)	0.01 $\pm$ 0.08	0.07 $\pm$ 0.08	0.01 $\pm$ 0.06
Lymphocyte count	-0.25 $\pm$ 1.72	1.93 $\pm$ 1.30	-0.34 $\pm$ 1.34
WBC	-0.06 $\pm$ 0.85	-0.46 $\pm$ 0.56	0.49 $\pm$ 0.60
Hematocrit	0.81 $\pm$ 0.57	1.02 $\pm$ 0.81	0.33 $\pm$ 0.52
Hemoglobin (mg/dL)	0.31 $\pm$ 0.23	0.37 $\pm$ 0.24	0.18 $\pm$ 0.23

<sup>a,b,c</sup> Means with different superscripts are different,  $P < 0.05$ .

SEM, standard error of the mean; WBC, white blood cell count.

## METHODOLOGY

We studied elderly patients (62–87 y old, mean age = 76 y) resident within a nursing home who were clinically stable, bedridden, receiving nutrition through enteral intubation, and free from sepsis before the initiation of the study. Before, during, and after the study, the patients were fed an enteral feeding solution (Ensure, Ensure Plus, or the equivalent; Ross Laboratories, Columbus, OH, USA) in amounts that provided approximately 2000 kcal/d and between 1.0 and 1.5 g/d of protein.

The study consisted of three consecutive 15-d segments. During the first “run-in” segment, all patients received the normal care and nutrition provided by the residential institution. During the subsequent “test” segment, all patients received normal institutional care and nutrition plus AbsorbAid, a nutritional supplement derived from *Aspergillus niger* and bromelain and containing the digestive enzymes lipase, amylase, protease, cellulase, and lactase. One teaspoon of the AbsorbAid powder was mixed with water and placed down the feeding tube, four times daily. During the final “washout” segment, supplementation with AbsorbAid powder was withdrawn and all patients received normal institutional care and nutrition.

Blood samples were drawn at the beginning of the study and at the end of each study segment. Hematocrit, white blood cell count, lymphocyte count, and total lymphocyte count were determined from whole blood using standard laboratory methods. Plasma was separated, and the concentrations of total protein, albumin, and hemoglobin were measured.

Data were analyzed by analysis of variance for repeated measures, with an a priori value for  $\alpha = 0.05$ .<sup>4</sup> When the null hypothesis of “no effect of AbsorbAid” was rejected ( $P < 0.05$ ), means separation was performed with Fisher’s least-significant difference test for multiple comparisons.

## RESULTS

The clinical status of the 16 patients remained stable and unchanged throughout the 45 d of the study. The supplement was well tolerated, and no adverse reactions or side effects were attributed to the supplement.

From the analyses of variance for repeated measures, we determined that total plasma protein concentration increased significantly ( $P = 0.02$ ) during the supplementation segment of the study, with a mean increase of  $0.32 \pm 0.12$  g/dL (Table I). This

increase was reversed after withdrawal of the supplement, with a mean decrease during the “washout” segment of  $0.24 \pm 0.10$  g/dL. Plasma albumin concentrations and total lymphocyte counts also tended to improve during supplementation, although the changes were not statistically significant ( $P > 0.05$ ). Total white blood cell count, hematocrit, and plasma hemoglobin concentration were not affected by supplementation.

## DISCUSSION

Malabsorption is common in the elderly and can compromise nutrition status, disease resistance, overall health, and longevity.<sup>5–7</sup> The techniques for safe continuous non-volitional tube feeding were established more than 20 y ago in a relatively young population of males aged 18 to 40 y.<sup>8</sup> Unfortunately, non-volitional feeding often worsens the clinical condition of elderly patients with compromised digestive function.<sup>9,10</sup> In contrast, adding AbsorbAid to the feeding regimen of elderly nursing-home patients fed by enteral nutrition improved their nutrition status as shown by a significant increase in total plasma protein concentration and tendencies for plasma albumin concentration and total lymphocyte count to increase during the period of supplementation. That these benefits are attributable to the supplement was confirmed by their reversal after withdrawal of the supplement.

Compromised digestion and absorption can be ameliorated in the elderly by incorporating digestive enzymes with the nutrition-support protocol. Because malnutrition is associated with increased morbidity and mortality and nutrition support decreases the incidence of costly complications and length of hospital stay, the routine use of exogenous digestive enzymes in the tube-fed elderly is warranted.<sup>11–18</sup> This study has demonstrated that supplementation of enteral nutrition with AbsorbAid is a safe and effective means of increasing the digestibility of enteral nutrients, improving protein status, and enhancing immunocompetence in institutionalized elderly patients.

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