Brief History of Parenteral and Enteral Nutrition in the Hospital in the USA

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Abstract

The meteoric rise in parenteral and enteral nutrition was largely a consequence of the development of total parenteral nutrition and chemically defined diets in the late 1960s and early 1970s and the recognition of the extensive prevalence of protein calorie malnutrition associated with disease in this same period. The establishment of Nutrition Support Services (NSS) using the novel, multidisciplinary model of physician, clinical nurse specialist, pharmacist, and dietitian, which, at its peak in the 1990s, approached 550 well-established services in about 10% of the US acute care hospitals, also fostered growth. The American Society of Parenteral and Enteral Nutrition, a multidisciplinary society reflecting the interaction of these specialties, was established in 1976 and grew from less than 1,000 members to nearly 8,000 by 1990. Several developments in the 1990s initially slowed and then stopped this growth. A system of payments, called diagnosis-related groups, put extreme cost constraints on hospital finances which often limited financial support for NSS teams, particularly the physician and nurse specialist members. Furthermore, as the concern for the nutritional status of patients spread to other specialties, critical care physicians, trauma surgeons, gastroenterologists, endocrinologists, and nephrologists often took responsibility for nutrition support in their area of expertise with a dwindling of the model of an internist or general surgeon with special skills in nutrition support playing the key MD role across the specialties. Nutrition support of the hospitalized patient has dramatically improved in the US over the past 35 years, but the loss of major benefits possible and unacceptable risks of invasive nutritional support if not delivered when appropriate, delivered without monitoring by nutrition experts, or employed where inappropriate or ineffective will require continued attention by medical authorities, hospitals, funding agencies, and industry in the future.
The rapid ascension of parenteral and enteral nutrition into an important component of clinical care in the hospital setting can be traced to three developments that occurred over an about 5-year period in the late 1960s and early 1970s. First and foremost was the first successful use of total parenteral nutrition (TPN), initially in beagle dogs to show the feasibility, and then its successful extension to 30 patients with chronic, complicated gastrointestinal disease by Dudrick et al. [1] at the University of Pennsylvania. At about the same time chemically defined or elemental diets were developed in normal volunteers to be employed in the US Mercury Space Program [2] where storage space and a low residue made these diets very desirable. These novel formulas were subsequently used in clinical conditions in which digestion and/or absorption was impaired and were provided usually through nasoenteric feeding tubes [3]. Both parenteral and enteral nutrition were initially studied in surgical patients in whom protein calorie malnutrition through gut malfunction had long been an often insurmountable problem. The third and final development was the identification of the extraordinary prevalence of malnutrition in hospitalized patients occurring in up to half of those on both surgical [4] and medical [5] services described in 1974 and 1976 respectively, when defined by simple anthropometric tools of weight, height, and upper arm anthropometry and serum albumin levels.

At this point one can view the glass as half full or half empty. From the optimistic or glass half full standpoint the period from 1975 to 1985 after the above advances could be described as a logarithmic phase of growth in clinical nutrition. Nutrition Support Services (NSS) using the novel, multidisciplinary model of physician, nurse specialist, pharmacist, and dietitian initially began in the early 1970s [6, 7] and at their high point probably approached 550 well-established services [8] in about 10% of America's acute care hospitals by 1990. A number of studies during this early period demonstrated the ability of such groups to dramatically reduce the risk of catheter-related sepsis and to limit the development of electrolyte and metabolic abnormalities with TPN and to reduce complications and increase the adequacy of enteral nutrition [9]. Financial benefits were less certain in part due to difficulties to fully estimate costs and benefits [9], but at the very least were cost neutral in most circumstances [10].

The American Society of Parenteral and Enteral Nutrition which reflected this unique multidisciplinary membership of the NSS was established and had its first meeting in Chicago in 1976. Membership, initially less than 1,000 grew to nearly 8,000 by 1990 and was composed of approximately 20% physicians, 15% nurses, 15% pharmacists, and 50% dietitians in 1990. The annual ASPEN Clinical Congress, which continues to date, became an important venue to educate and train and provide a forum for the presentation of new research findings.

Fellowships in parenteral and enteral nutrition, clinical nutrition, or metabolic support became widely available during this period as well, with annual
growth throughout the 1970s and 1980s. For instance in our training program at the New England Deaconess Hospital, which averaged from 3 to 6 fellows/year from 1975–2000, there were 3 training paths. The most common, 1 year of clinical training in parenteral and enteral nutrition including primary responsibility for central catheter placement and care, hyperalimentation and enteral nutrition order writing, and conduct of a clinical research project, was primarily taken by mid-level surgical residents, board-eligible internists interested in clinical nutrition as a field or in preparation for a gastroenterology fellowship, and gastroenterologists and endocrinologists at the completion of their fellowship training. Longer fellowships with 6 months to 1 year of clinical training as above as a component of a usual 3- to 4-year PhD program and shorter clinical rotations of 1–3 months for medical and surgical residents in training as an elective were the other options. All these individuals, which in total exceeded 100 fellows, generally met their goals of either being able to join or direct a NSS at a new institution or to practice clinical nutrition as a component of their practice. Even at the discontinuation of our fellowship program in 2002, with the semi-retirement of the two co-directors, there were many more applicants than positions available each year.

Finally from a personal perspective when I first became involved with nutrition support during my PhD training in Nutritional Biochemistry and Metabolism at MIT from 1972 to 1975, a period in which we were conducting the early surveys of nutritional status [4, 5], there was a general lack of appreciation for the nutritional status of patients. Protein calorie malnutrition was so widespread and undertreated that we developed a system of measurement of delayed cutaneous hypersensitivity to document cutaneous anergy [11] in order to convince clinicians that their patients required invasive nutritional support to reverse anergy. By 1990 there was a general appreciation that hospital protein calorie malnutrition was common, that invasive feeding could improve outcome, and that lack of feeding for periods of longer than 7–10 days in critically ill patients was an unacceptable practice. During this period from 1975 to 1990 there was a steady increase in the number of converts to better nutritional practices, particularly in surgical patients and in the critically ill in intensive care units, both medical and surgical. Testing for cutaneous anergy was abandoned at our medical center in the mid 1980s [12], principally because prolonged inadequate feeding became so uncommon, and there was little difficulty in convincing the primary physician of the need for invasive feeding when appropriate.

What happened subsequent to 1990? Now we can discuss the glass that is half empty, and this largely relates to medical funding. In the early 1980s the Medicare system in the US began a system of hospital payments based on diagnosis-related groups, where a fixed amount of money was paid according to diagnosis rather than actual costs. Medicare is the government system of reimbursement for patients 65 years or older, the disabled, or those receiving dialysis therapy. But the other source of hospital payments from medical
care for the indigent through the government program Medicaid is the joint responsibility of the individual state and the federal government, and private insurance links their payments to government policy. The severe cost-containment pressures brought on by these changes in medical insurance have adversely affected nutrition support team staffing which began to have its greatest impact in the 1990s and was particularly harsh on hyperalimentation nurses and physicians involved in nutrition support. Although there are medical and financial costs associated with the termination of a nutrition support nurse [13], this cost must often be forcefully documented with hospital authorities, and generally can be in terms of unacceptable rates of catheter infection without their presence. With physicians there is no acknowledged medical specialty for clinical nutrition, although there was a split vote of 2–1 against by the American Board of Medical Specialties in the 1990s which would have accomplished this had it passed. Therefore, if the local hospital administrator or chairmen of medicine or surgery cannot be convinced of the value of providing partial financial support to nutrition support physicians for their clinical participation, then either it is done as a free service as an avocation by these individuals or done as a component of their underlying specialty. Thus most intensivists will provide parenteral and enteral nutrition as part of their care, as will many surgical specialists, particularly trauma surgeons, burn surgeons, and general surgeons. Oversight for home parenteral and enteral nutrition is often provided by gastroenterologists. However it is likely in many instances that nutritional care by these specialists is at an acceptable if perhaps not ideal level. For medical patients parenteral and enteral nutritional support is now often delivered under the care of dietitians which is reasonably good vis-à-vis enteral nutrition, but with parenteral nutrition may sometimes be outside their level of clinical competence, particularly for the management of fluid and electrolyte disorders and insulin management in diabetic patients. Dietitians have been less severely impacted by cost considerations, because there is a Joint Commission on Accreditation of Hospital Organizations (JCAHO) requirement that hospitals nutritionally monitor their patients. Pharmacists are also very important in the provision of parenteral nutrition, particularly by determining compatibilities of parenteral nutrition admixtures, checking the stability of orders from day-to-day, and by making certain of the completeness of parenteral regimens. Their continued availability to provide this level of expertise is also mandated by JCAHO as well as by their own professional standards.

With these cost constraints there have been a number of changes in the provision of nutritional support over the past decade. In 1992 we conducted a survey of NSS. Of a total of 425 surveys, 144 responses (34%) were analyzed. The average size hospital was 387 beds with a range of 28–1120 beds. As a percentage of hospital beds (3.5%) received TPN ranging from 3.2 to 3.7% in hospitals with <200, between 200 and 499, and >499 beds. 35% of the hospitals surveyed used 3-in-1 admixtures, accounting for 60% of parenteral
formulas prescribed. 75% of hospitals used the parenteral admixture as a drug vehicle including H2-receptor antagonists, heparin, albumin, insulin, and metoclopramide. The vast majority of TPN orders were written by internists or surgeons. Thus the conclusion at that time was that TPN was widely but not excessively employed in US hospitals and that innovations like 3-in-1 formulas begin in larger hospitals [14]. The number of NSS has almost certainly declined in the ensuing decade. This development has occurred despite continued evidence as to the medical benefits of nutrition support teams [15–17] that are at the very least cost neutral [10, 13].

There has also been a change in the membership of ASPEN that reflects this trend. After an initial fall of total members through the 1990s, the number has more recently stabilized, but there has been a dramatic decrease in nurses from nearly 1,000 to about 300 in 1999 and less than 200 at present (2006) with a concomitant increase in dietitians to about 60% of a total of 5,000 members, which has been relatively stable for the past 7 years, and a slowly diminishing number of physicians from 1,000 (20%) in 1999 to 735 (15%) in 2006. However both physician and pharmacist numbers have stabilized from 2001 to 2006, at approximately 750 and 620 members. Fellowship opportunities for physicians have also diminished, and there is some concern about what the future holds for physicians principally interested in parenteral and enteral nutrition. The second major American society for clinical nutrition after ASPEN was an independent group of academic physicians and PhD nutritionists interested in this field, the American Society for Clinical Nutrition. Last year by vote of its members it chose to disband and become a component of the American Society of Nutrition. Hopefully this group of individuals will maintain their interest in this field and continue to promote the improvement of parenteral and enteral nutrition for the hospitalized patient. However the likelihood of getting specialty recognition from the American Board of Medical Specialties is dim under the present conditions.

How does this bode for the future? Presumably there will always be some physicians trained in clinical nutrition, but some programs, like the exemplary program at MIT which trained many of the academic clinical nutritionists, have been discontinued and not been replaced. Certainly there is ample evidence for the need for such individuals. For instance one of the most important recent developments in clinical medicine has been the demonstration that tight blood glucose control in the critically ill can dramatically improve the morbidity and mortality of patients [18]. However this was primarily a study in cardiac surgical patients, and a similar study in medical patients by the same group demonstrated that tight blood glucose control improved morbidity but did not affect mortality [19]. In fact in those medical patients who received therapy for less than 3 days, mortality was actually increased. These superb innovative studies were primarily conducted by an endocrinologist who is a specialist in critical care. However an important variable in these two landmark studies, not previously commented on, is that in the surgical study
the patients also received hypertonic dextrose initially for the first 24 h and TPN subsequently [18]. The medical patients in the second study received the initial hypertonic dextrose followed by inadequate nasogastric tube feeding for the first 3 days providing substantially less calories and grossly inadequate protein [19]. It may well be that it is the combination with tight glucose control in the setting of adequate feeding that is essential to achieve all the benefits rather than the control of hyperglycemia alone. Similarly a recent study in cardiac surgical patients receiving tight glucose control during their surgery and tight regulation of both treatment and control postoperatively showed no benefit and, in fact, a suggestion of harm in the treatment group [20]. Perhaps lowering blood glucose in cardiac patients not receiving hypertonic dextrose before revascularization may deprive the heart of an essential fuel. Having some physicians thoroughly trained in clinical nutrition to discern these possibilities may be important in the future to design and interpret the results of clinical trials.

However it would appear that the delivery of nutritional support will need to be adjusted for the clinical realities in the US. Intensivists from both medical and surgical services will be largely responsible in many settings for the initiation and monitoring of parenteral nutrition. Dietitians can be of assistance to advise on parenteral nutrition in terms of the standard provision of adequate nutrients but are more limited in their ability to advise on the combination of nutritional and metabolic support together in one formula. Dietitians have more direct responsibility for enteral nutrition in terms of the amount and choice of product, since enteral support is generally not employed to meet fluid, electrolyte, and metabolic needs. Surgical specialists, such as trauma surgeons and general surgeons, will perform the same functions with or without the assistance of dietitians. Backing them both will be pharmacists who will have the ultimate word in the composition of parenteral admixtures. In certain venues, particularly in very large academic institutions, physicians specifically trained in nutrition from either surgery, endocrinology, gastroenterology, or internal medicine will be able to convince their respective chairmen that the very highest level of parenteral and enteral nutrition support can be provided by a physician-directed team. From such teams we can expect most of the new developments to occur in nutritional therapy. As a corollary to this, it is essential that, nurse specialists care for central and peripherally inserted central catheters used in parenteral nutrition to reduce the unacceptably high level of infectious complications in virtually any circumstance without their involvement. Furthermore it will demand the continued demonstration in future randomized clinical trials of the value of nutritional support, the added benefits of nutrition specialists in many settings, and the value of new support techniques and novel compounds such as glutamine, n-3 fatty acids, or hormone, vitamin or mineral supplementation.

In conclusion nutritional support of the hospitalized patient has dramatically improved in the US over the past 35 years. The recent development of
severe cost constraints has made it imperative to convince as many hospital administrators and clinical chiefs as possible of the major benefits and unacceptable risks of invasive nutritional support if not delivered when appropriate, delivered without monitoring by nutrition experts, or employed where inappropriate or ineffective. The subject of the level of expertise necessary to meet these needs and how this is to be achieved in the future will require continued attention.

References

Discussion

Dr. Labadarios: Regarding a comment that was made earlier, if you are now proposing that in the future there should be randomized control trials, should reinvestment go the drug way? You said that we will have randomized control trials, and earlier we were discussing the pharma or nutrition route, and the point was made that if we do randomized control trials, one of the ways of proceeding might be the pharma route. Does that have implications? Is that why you mentioned it?

Dr. Bistrian: I mentioned it because the data are already available for the general value of nutritional support, either as enteral or parenteral nutrition. I think that you ought to popularize that a little more and industry ought to have white papers written or do whatever they can to make sure that this kind of information becomes more broadly available. For the randomized trials to come, I believe that you will need to identify – we had a discussion with Dr. Hoffer on this earlier – homogenous sets of patients to do new trials for certain disease states. As I said to Dr. Hoffer earlier, the reason why getting rid of the grey zone is important is that on the medical service, malnutrition is a reasonable indication. However, I think that the future lies in finding the value among different disease states and having large enough trials with your products.

I believe that the future is great for new therapies. People have been doing work with antioxidants that appear to make a difference and there are some new anti-inflammatories that also appear to make a difference. There are a lot of things that industry will need to do in the future and, for me, the pharma model is not bad because the Food and Drug Administration (FDA) and the other regulatory agencies, at least in the US, will not hold you to such a high standard of how many patients you need to have as for a usual drug trial. When statins were studied, many 1,000's of 1,000 patients were needed – we are talking about a reasonable number of patients. The last trial I worked on in pharma was an MCT/LCT trial in 100 patients, and they allowed us to be a phase-3 trial for drug approval.

Mr. Parver: I would like to bring up something that we might just want to be mindful of if we pursue drug benefits that include parenteral nutrition, for example. As I mentioned yesterday, the TPN that is covered under Medicare at the moment is for long-term parenteral nutrition of at least 90 days. Congress recently enacted a prescription drug benefit which covers those things that are not covered under Part B. That therefore means that short-term TPN would be covered under this drug benefit, except that the agency – Centers for Medicare and Medicaid Services (CMS) – has determined that the only things that they will cover under the benefit are those components of TPN that are regulated as drugs. Therefore, the vitamins, minerals and other non-drug components would not be covered.

Dr. Bistrian: When the vitamins go into the TPN, there is FDA approval on that formula, and vitamins, amino acids and glucose are included in this. It is interesting that you should mention this because the home TPN patients are fed 365 days/year while the average duration of TPN in the hospital is only 10 days/person. About half of the TPN formulations given in the country are therefore given to home TPN patients and half are given in the hospital.

Another issue here is that we always thought of TPN as being extremely expensive therapy. That is old information. The lipids that are used are now a commodity item and, for usual use, cost USD 2/day. The amino acids cost USD 0.10/g, and therefore cost about USD 7–8/day, and glucose is really cheap. Most patients in a critical care unit have a central line placed in any case, and TPN in many instances is therefore much cheaper than most of the special enteral formulas. Things have changed and the cost of the formulas will never be a big factor.
Mr. Parver: If there is something that indicates that the vitamins should be covered, I would like to see it, because they have been telling us that they are not covered and have denied us several claims for vitamins under the drug benefits. I would love to see that and use it.

Dr. Bistrian: We got an orphan drug acceptance from the FDA for the company that makes most of the vitamins to change the vitamin's formulation.

Mr. Parver: The other thing that I just wanted to mention was that unfortunately the drug benefit explicitly does not cover the parenteral pump services or even supplies. All that is covered is the drug – or, at least, component parts of the drug – which is no way to run a railroad. Additionally, it is probably not being very widely used under that benefit. With a pharmaceutical benefit approach, therefore, you have to be careful that it is not being taken as literally as the one in the US because it is not really working that way.

Dr. Hoffer: In terms of the home parenteral nutrition program, I need a little clarification. If there is no coverage for the pumps or to make it economically possible for people who require home parenteral nutrition, it seems to me that this will self-correct because the patients will die.

Dr. Bistrian: What is happening is that they are getting the service in another setting. They will therefore get it in a hospital or nursing home. We have no evidence that the lack of coverage is resulting in the lack of care in the home benefit; we are seeing rather that they are just getting it somewhere else, often in a more expensive setting than the homecare setting.

Dr. Hoffer: We provide home parenteral nutrition in the province of Quebec, but it is extremely limited and rationed. However, the argument that made the Ministry of Health act in that way was that if home parenteral nutrition was not provided, these patients would be treated in hospital for unlimited periods of time. It did not take long to make the cost calculation. Surely that cost calculation is so obvious, with the cost per day of hospitalization that, again, this has to self-correct as long as there is someone who has functioning neurons in the administration of the policies?

Dr. Bistrian: You are right. That should be the case and, in fact, it was that concern about hospital cost that led to the decision to cover home TPN and enteral nutrition in the first place. Having said that, the way the congressional budget office and CMS have looked at issues means that they have compartmentalized things to such a degree that covering home enteral or parenteral nutrition is simply a cost to Part B. The implications for Part A are not being fleshed out. How you keep score and ask the question determines the policy. Right now, they have urged us to go to Congress because they will not fix it on their own. If we want the TPN services to be covered under the drug benefit, we need to get Congress to do it, and if we want an extended coverage of infusion therapy or anything else under Part B, we have to go to Congress. They feel hamstrung in how they and their own Office of the Actuary have interpreted the budget rules and are therefore not doing the very commonsense thing that you have described, which is to look at the whole picture. They are simply not doing that. They understand that this makes them look very silly, but they just cannot get themselves out of Congress stepping in for them.

Dr. Hoffer: In the early days of home TPN – where Mr. Parver helped us – in fact it was not covered by many private insurers. We had no difficulty saying that we would just keep the patients in hospital to receive it there. We had no problem doing that. Medicare is actually a minor player in home TPN because people have to be over 65 or get disability. Private insurers are extremely large in the home TPN field and Medicaid.
Dr. Jensen: Our Institute of Medicine committee called for a change in this particular ruling back in 2000 and of course nothing has actually transpired. The reality is very simple in the United States in that many practitioners will simply document that the requirement for parenteral/enteral support will be 90 days or more, even though they know full well that that is not going to be what happens.