Undernutrition in children with a neurodevelopmental disability

Nutrition Committee, Canadian Paediatric Society

Objective: To offer guidelines for optimal nutritional care in children with a neurodevelopmental disability and an associated impairment in their ability to eat and drink.
Options: Assessment of nutritional status by skinfold thickness measurement, high-energy nutrition supplementation given orally and feeding by nasogastric tubes, gastrostomy tubes or gastrojejunal tubes.
Outcomes: Children receiving adequate nourishment are generally calmer and appear more normal than those who are undernourished. Patients with less severe disabilities have an increased functional status with improved nutrition. In patients with gastroesophageal reflux and aspiration of food, the use of gastrojejunal tubes prevents pneumonia and reduces the need for surgery to correct the reflux. Economic benefits of various options were not considered.
Evidence: Members of the Nutrition Committee of the Canadian Paediatric Society, most of whom are involved in caring for children with a neurodevelopmental disability, reviewed the literature. Members interpreted the literature and developed the guidelines on the basis of their experience and research activities.
Values: Improved psychologic, nutritional and functional status were all given a high value.
Benefits, harms and costs: Supplemental tube feeding allows caregivers to devote less time to feeding and more time to stimulating and educating children with this type of disability. The need for surgery to correct reflux, along with the associated risks and costs, has been greatly reduced with the development of percutaneous placement of the gastrostomy and gastrojejunal tubes.
Recommendations: It is unacceptable not to treat undernutrition associated with a neurodevelopmental disability. Management of nutrition in patients who require tube feeding is greatly simplified by the use of percutaneous enterostomy. Energy needs in children with this type of disability are lower than in other children, ranging from 2900 to 4600 kJ per day. Because they require less energy, such children should be given a formula designed for children less than 6 years of age that has a high ratio of nutrients to energy. Every effort should be made to improve the oral-motor skills of children with a mild disability.
Validation: The guidelines were reviewed and approved by the board of the Canadian Paediatric Society. There are no equivalent guidelines from the Committee on Nutrition of the American Academy of Pediatrics.

Objectif : Produire des lignes directrices sur le soin nutritionnel optimal des enfants qui ont une déficience neurologique du développement et une déficience connexe de la capacité de boire et de manger.
Options : Évaluation de l'état nutritionnel par mesure de l'épaisseur du pli cutané, administration par voie orale de suppléments nutritifs à haute énergie et alimentation par sondes nasogastriques, tubes gastrostomiques ou tubes gastrojéjunaux.

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Résultats : Les enfants bien nourris sont en général plus calmes et semblent plus normaux que ceux qui sont mal nourris. Les patients qui ont des incapacités moins graves fonctionnent mieux quand ils sont mieux nourris. Chez les patients atteints de reflux gastroesophagien et d'aspiration d'aliments, les tubes gastrojéjunaux préviennent la pneumonie et diminuent le besoin de recourir à la chirurgie pour corriger le reflux. On n'a pas tenu compte des avantages économiques des diverses options.

Preuves : Les membres du Comité de la nutrition de la Société canadienne de pédiatrie, dont la plupart s'occupent d'enfants qui ont une déficience neurologique du développement, ont examiné les écrits. Les membres du comité ont interprété les documents et élaboré les lignes directrices en se fondant sur leur expérience et sur les résultats de leurs recherches.

Valeurs : On a accordé une grande valeur à l'amélioration de l'état psychologique, nutritionnel et fonctionnel.

Avantages, préjudices et coûts : Une alimentation d'appoint par gavage permet aux soignants de consacrer moins de temps à l'alimentation et plus de temps à la stimulation et à l'éducation des enfants atteints de telles incapacités. L'évolution de la mise en place percutanée des tubes gastrostomiques et gastrojéjunaux a réduit considérablement le besoin d'interventions chirurgicales pour corriger le reflux, ainsi que les risques et les coûts connexes.

Recommandations : Il est inacceptable de ne pas traiter une dénutrition liée à une déficience neurologique du développement. L'entérostomie percutanée simplifie considérablement l'alimentation des patients qu'il faut gaver. Les enfants atteints d'une telle incapacité ont besoin de moins d'énergie que les autres enfants : leurs besoins varient de 2 900 à 4 600 kJ par jour. Comme il leur faut moins d'énergie, il faudrait leur donner une formule conçue pour les enfants de moins de 6 ans et dont la teneur en nutriments est plus forte que la teneur en énergie. Il faut faire tous les efforts possibles pour améliorer les capacités oromotrices des enfants atteints d'une incapacité bénigne.

Validation : Les lignes directrices ont été examinées et approuvées par le Conseil de la société canadienne de pédiatrie. Le Comité de nutrition de l'American Academy of Pediatrics n'a pas produit de lignes directrices équivalentes.

During the past 10 years greater attention has been paid to the causes and management of undernutrition in children with a neurodevelopmental disability.[1-5] Because of their difficulties in eating and drinking, many of these patients can achieve an adequate nutritional status only with tube feeding. Nasogastric tubes have been used, but they are unsightly and tend to contribute to clinically significant gastroesophageal reflux. The advent of percutaneously inserted gastrostomy and gastrojejunal tubes has opened the way to more successful nutritional management in these children. Although some questions concerning management remain, the members of the Nutrition Committee feel that guidelines are needed. These are based on an up-to-date critical review of the literature, interpreted by committee members, most of whom are involved in the care of these children.

Undernutrition is a frequent problem in children with severe cerebral palsy (spastic quadriplegia), who often have significant impairment of their eating and swallowing mechanisms.[1,6,7] Cerebral palsy occurs in 3 to 4 per 1000 live births, and one third of these children are severely affected.[8] Even without intervention, some people with a severe disability live more than 30 years; the average death rate in severe cerebral palsy is 5% or less per year. Pseudobulbar palsy, which occurs in severe cerebral palsy, affects eating and swallowing. As a result, food intake is decreased and eating time increased. Thus oral feeding may meet with little success, despite the efforts of caregivers.[1,9,10] Gastroesophageal reflux and aspiration of food often compound the problem.

The early alternative to oral feeding was feeding through a nasogastric tube; however, the use of such tubes is associated with unacceptable long-term complications — mainly reflux and vomiting.[10,11] A new approach is feeding though a percutaneous gastrostomy tube, which bypasses most problems with oral feeding and reflux. In the past most children with severe cerebral palsy lived in institutions, but they are now returning to the community to live in group homes or with their families. This makes a systematic approach to their nutrition even more important.

Many of these children have clinically important gastroesophageal reflux regardless of whether they have been fed through a nasogastric tube.[12-14] The cause of reflux in such patients is unclear; it is probably related to intestinal dysmotility and delayed gastric emptying.[12] If reflux is significant and frequent, it may increase the risk of food aspiration and aspiration pneumonia. In addition to reflux, aspiration of food or, especially, of liquids while being fed is a risk in children with a severe disability.[15,16]

The effect of undernutrition on physiologic and brain growth and on development is well recognized.[17-20] Undernourished infants and children do not achieve normal length and weight for their ages. Furthermore, their neurologic development is significantly impaired. A child who habitually chokes on and may aspirate food or drink reacts to being fed in a way that clearly signals discomfort. Undernourished children generally feel miserable, whereas well-nourished children are more alert.

Parents comment on how much calmer their child becomes after proper nourishment is restored. An additional benefit for caregivers is that the time previously spent feeding can be used for other important activities, such as stimulation, education and play.

For these reasons, undernutrition in children with a neurodevelopmental disability and an eating problem should be corrected to avoid compounding the disability. Several centres across Canada have established clinics in which the disabilities and eating impairments of these children are systematically evaluated and managed.[1,10,21,22] If caregivers are unable to meet a child's nutritional needs through oral feeding, then tube feeding is used, either as a supplement to or instead of oral feeding.[10,21] Increasingly, such children are fed through a tube placed by enterostomy.[13,21,23,24] Development of percutaneous techniques to place gastrostomy tubes has made this treatment option much more attractive.[25] Percutaneous endoscopy was the first technique introduced for placing tubes; over the past 3 years it has been replaced, at the Hospital for Sick Children (Toronto, Ont.), by the retrograde percutaneous radiologic technique.[25] Patients are under only sedation and local anesthesia during placement, and they are usually discharged 3 days later. With this technique patients experience much less pain and discomfort than with tube placement by laparotomy.

Ethical issues

The committee members feel it is unacceptable not to treat secondary undernutrition in children with neurodevelopmental disability. The percutaneous placement of gastrostomy tubes has changed the risk–benefit considerations in instituting tube feeding. As a result, in a child who requires tube feeding for longer than 6 to 8 weeks, the committee strongly recommends the use of a gastrostomy tube or gastrojejunal tube placed percutaneously. Before placing a tube, practitioners must ensure that the parents or caregivers are fully infomed and give their consent.[25]

Another important consideration is the nature of the disability, particularly whether it is progressive. Most children with a neurodevelopmental disability have a nonprogressive condition such as cerebral palsy. Feeding through a tube placed by enterostomy is strongly recommended in children with a nonprogressive condition who require tube feeding; however, in those with progressive disabilities a full, informed discussion of treatment options is even more important.

Methods

These guidelines were written by the principal coauthors (J.P. and P.B.P.) on the basis of an extensive and current review of the literature. They were reviewed twice by all members of the Nutrition Committee, most of whom care for such children and several of whom have contributed to knowledge in this field. The draft guidelines were also reviewed by pediatric clinical dietitians on behalf of the Canadian Dietetic Association and by the Committee on Nutrition of the American Academy of Pediatrics. All comments were considered in formulating the final recommendations.

Results

Nutritional needs and assessment

There is little information on the nutritional needs of patients with a severe disability and quadriplegia. In a recent article Bandini and associates[26] showed that adolescents with cerebral palsy or myelodysplasia expend less energy than other adolescents. Energy expenditure is significantly lower in patients with a disability who are not ambulatory than in those who are.[26] Once patients who are being fed entirely by gastrostomy tube have reached an adequate nutritional status, as judged by skinfold measurement, they require only 2900 to 4600 kJ per day.[21] Higher energy levels rapidly result in obesity. Thus, with rare exceptions, the energy needs of children with a neurodevelopmental disability are lower than those given in the Nutrition Recommendations published by Health Canada.[27] The energy expenditure of patients with dystonia was thought to be higher than that of patients without dystonia, but results of studies by Bandini and associates[26] and Fried and Pencharz[21] involving patients fed through gastrostomy tubes contradict this hypothesis. Krick and collaborators[28] support the view that the energy needs of children with cerebral palsy cannot be determined from the Nutrition Recommendations[27] but should be calculated from the estimated basal metabolic rate. Unfortunately, the nomograms used to determine this rate are not always reliable in children with spastic quadriplegia.[29]

There are few experimental data on requirements for nutrients, including protein, minerals, trace elements and vitamins. There are concerns that standard polymeric formulas designed for adults, such as Ensure, Isocal, Isosource (Sandoz, Whitby, Ont.), and Nutren (Clintec Nutrition, Mississauga, Ont.), that have fixed amounts of minerals and trace elements per unit of energy could lead to nutrient deficiencies when daily energy needs are low. Information is available on iron deficiency in children with such disabilities; this problem is due primarily to blood loss caused by gastroesophageal reflux and esophagitis. Hence, blind adherence to the Nutrition Recommendations[27] intended for normal children seems to be ill advised. The study by Fried and Pencharz[21] showed that feeding children with a disability a formula designed for children under 6 to 8 years of age, such as PediaSure, that has a higher ratio of nutrients to energy eliminates the risk that nutrient intakes will be significantly below those recommended. Objective studies of the nutrient needs of children with a disability are required.

The usual way to assess the nutritional status of a child is to measure weight and length (or height) and compare the results with growth charts.[30–32] However, a child with quadriplegia has musculoskeletal deformities that may make measurement of total length impossible.[31] Some investigators have studied the value of measuring segments of limbs, such as the ulna and the fibula,[31] but at present these measurements are useful only in research. Problems also arise in measuring weight. The denervation of skeletal muscle results in atrophy; similarly, malnutrition causes wasting of skeletal muscle and adipose tissue. However, there is no evidence that the neurodevelopmental disability *per se* affects adipose tissue. Most researchers now consider skinfold measurement the most useful method of assessing nutritional status. North American standards for the triceps skinfold have been developed.[33] Researchers may take multiple skinfold measurements, but, for clinical purposes, comparison of triceps skinfold measurements with population norms is sufficient.

A child with virtually no fat tissue is clearly undernourished. Appropriate feeding should restore the child's adipose store to the normal range. The child will then have a normal weight that the treatment team can use as a basis for measuring the child's subsequent growth.

Biochemical assessment of nutritional status in such children does not usually yield useful results, except for determining hemoglobin and iron status. Likewise, bone age is not routinely used in assessing these children. Anthropometry, as outlined above, is an effective and inexpensive way of monitoring the response of the children to feeding.

Assessment of eating ability

The following questions should guide assessment of a child's eating ability.

- What are the child's eating and drinking mechanics?[34] If an infant, can he or she suckle? If older, can he or she eat with a spoon? Can the child close his or her lips properly? When drinking from a cup, can he or she form a proper seal? A formal evaluation should involve not only the physician but also health care professionals with varied backgrounds and training, including speech therapists, occupational therapists and physiotherapists, who take a special interest in eating problems.[1,4,12,15,16,22]
- How long does it take the child to eat? From video recordings of children eating, investigators have developed norms for eating efficiency. Most children with a severe disability and an eating problem have efficiencies of less than 10%.[1,6,22] Caregivers may spend half or more of the waking day trying to feed these children, who still remain emaciated. Parents and caregivers have repeatedly remarked that the use of supplemental feeding through a gastrostomy tube has taken the pressure off feeding and provided more time for play, stimulation and education.
- Has the child ever required admission to hospital for pneumonia? Is there any evidence of food aspiration? If so, careful investigation is required. Aspiration during feeding can usually be detected by radiologic techniques, but food aspiration caused by gastroesophageal reflux is harder to determine.[35] In some cases a milk technetium study is helpful.[14,36] On occasion, food aspiration can be determined only by stopping regular feeding completely and providing the child with total parenteral nutrition; a child who is suffering respiratory distress caused by food aspiration will then show progressive improvement.
- How much of a problem are gastroesophageal reflux and vomiting?[14,15] Although none of the investigations for reflux is foolproof, esophageal pH measurements, endoscopy and biopsy are the most valuable methods. In addition to the risk of food aspiration, reflux and vomiting cause concern because of the resulting esophagitis and the loss of ingested nutrients. Esophagitis, reflux and vomiting can usually be managed medically. However, the clinical concern is whether the child retains enough food to thrive.

A skilled feeding therapist can offer a useful clinical assessment of a child's oral-motor eating skills. Cineradiologic studies are being used more and more to provide objective data. Eating mechanics, from using the lips to swallowing, are assessed with different textures and types of foods and liquids. These studies involve teamwork between the radiologist and the feeding therapist.

An approach to management

Experience has shown that a multidisciplinary team approach is the most useful. The team should include a clinical dietitian, an enterostomy nurse, a feeding therapist (i.e., occupational therapist, speech therapist or physiotherapist), a pediatrician (usually trained in nutrition or gastroenterology), a radiologist and a pediatric surgeon. Other professionals, such as a pediatric dentist, a neurologist and an otorhinolaryngologist, may be added depending on their interest and expertise.

If there is no concern about food aspiration, the first strategy in treating undernutrition is to increase the energy concentration of ingested food.[15,22,37] Providing the child with supplemental beverages with an energy density of 4200 to 6300 kJ/L is helpful. In children who can eat puréed solids, the energy density of these types of food can be increased by adding fat. An increase in the viscosity of liquids has resulted in a higher intake in some patients. If possible, the increase in energy density should be accompanied by instruction of the parents or other caregivers in feeding techniques, with the aim of improving the child's eating mechanics.[4] However, most children with a neurodevelopmental disability, an eating problem and resulting undernutrition have such impaired ability to eat that they are unable to meet their energy needs even with high-energy supplements. These patients require supplemental tube feeding while efforts are made

to maintain and improve their oral-motor skills. Some can eat more easily if they are fed solids, including purées and food with more texture, rather than liquids.

Nasoenteric feeding: Children who are unable to eat are frequently fed with the use of a nasogastric tube; this should be viewed as a short-term measure.[10,11] If a nasogastric tube is left in place for a long period, gastroesophageal reflux is likely.[24] The committee members have noted that the children refuse to eat orally if they are fed through nasogastric tubes for some time. If it appears that a child must depend on a tube for more than a few weeks, consideration should be given to placing an enterostomy tube.

Nasojejunal tubes are used in a child who is vomiting. The placement and maintenance of such a tube present difficulties; hence, such tubes are not practical for home use.

Enterostomy feeding: Most reports on feeding children with a neuromuscular disability concern the use of gastrostomy.[12,14,21,23,24] Many of them mention that a high proportion (75% to 80%) of children so fed have gastroesophageal reflux;[14,15,23,24,38] some investigators advocate the performance of a surgical procedure to correct reflux in any infant or child with such a disability who has a gastrostomy.[15,38] However, this type of surgery is not minor[36] and frequently involves sequelae such as eating intolerance, esophagitis (which may result in bleeding, anemia, esophageal ulceration, stricture and perforation) and retching.

Some centres have started to use percutaneous gastrostomy, which is a much less invasive procedure,[23–25] with medical follow-up. If reflux can be managed medically, surgery is avoided. One study showed that more than half of children managed this way did not require subsequent surgery to correct reflux.[23] Medical treatment consists of the use of prokinetic drugs[25,39] and antacids, including H_2-blockers.[40] Recently developed gastric-enzyme (proton-pump) inhibitors, such as omeprazole, offer an alternative in managing reflux esophagitis; however, experience with these drugs is limited, and we are not aware of any controlled studies of these drugs in patients with a neurodevelopmental disability. A study involving elderly adults with percutaneous endoscopic gastrostomy showed that rapid bolus feeding through a gastrostomy tube caused gastric distention and relaxation of the lower esophageal sphincter and promoted free reflux to the sternal notch. Conversely, slow, continuous feeding through a gastrostomy tube did not alter the pressure on the sphincter or promote reflux.[41] Gastroesophageal reflux in undernourished children with spastic quadriplegia, which necessitates feeding through a gastrostomy tube, is reduced or eliminated by proper feeding.[42] Enteral formulas with casein as their protein source (including Pediasure, Ensure, Isocal, Isosource and Nutren) delay gastric emptying. In children 4 years of age and older, use of a whey-hydrolysate formula has improved gastric emptying and reduced the frequency of regurgitation[12] and gastroesophageal reflux.[43] Another treatment strategy being explored is placement of a gastrojejunal tube.[25,44] Careful clinical trials are needed to identify the best match between patient and treatment.

Surgical advances have been made in the placement of jejunostomy tubes. Although there is little published information on the use of jejunostomy in children with a neuromuscular disability, successful use of supplemental feeding through a jejunostomy tube has been reported in patients with cystic fibrosis, who may suffer gastroesophageal reflux and undernutrition.[45] Jejunal feeding should be continuous, and it is, therefore, better to regulate such feeding with a pump; bolus feeding results in cramps and diarrhea.[25]

Restoration of eating: It has proven possible to restore nourishment in these children with the use of enterostomy. As a result, those with a nonprogressive disability show improvement in meeting their developmental milestones. The question arises Is it possible to return these children to normal eating and to discontinue tube feeding? The committee relied on the background of its members in this area, since articles on the subject are scarce. Experience has shown that any child who is prevented from eating for a significant period because of an underlying medical problem may present a behavioural eating problem once he or she can be fed orally. It has proven useful to repeat the assessment of eating ability when clear improvement in the child's development is seen. The ability to control the head, the disappearance of drooling, the disappearance of stridor and the development of speech[11,15,16] are clinical signs of an improvement in bulbar function. Assessment should answer the basic question of whether it is safe for the child to eat. Does he or she aspirate food, and, if so, what textures of foods can he or she eat without any risk of aspiration?[2,4] Experience has shown that many children who aspirate liquids are safe with purées. When a child can eat safely, caregivers are encouraged to feed at least part of the daily intake by mouth; otherwise, the child may lose the limited oral skills he or she has. Overnight tube feeding regulated by a pump has proven useful because it separates tube feeding from eating.[25] We have found that the child often must sense hunger and thirst in order to respond successfully to a behaviour modification program (Dr. Diane Benoit, infant psychiatrist, Hospital for Sick Children, Toronto: personal communication, 1993, 1994). Even when a child's oral-motor skills have progressed to the point that he or she can thrive by eating alone, we have found that it may take months to wean the child away from tube feeding.

Unresolved issues

• How should undernourished children with a progressive neuromuscular disability be managed? The committee members believe that management of these children must be considered individually, with the fully informed consent of parents and caregivers. For many of

these children enterostomy has helped improve the quality of life as well.

• Many and perhaps all children with a neurodevelopmental disability have intestinal dysmotility, evinced by gastroesophageal reflux, delayed gastric emptying and constipation. A better understanding of intestinal function and motility and their management is needed.

• Little is known about the nutrient needs of patients with a neurodevelopmental disability. Existing pediatric enteral products have a limited calcium and phosphorus content. Bone mineralization in these children should be evaluated to determine whether present levels of calcium and phosphorus intake are too low.

• Study is needed to determine the best behavioural approaches to children whose oral-motor skills have advanced to the point that they are capable of eating but who are unable to eat because of a behavioural problem.

Recommendations

The following recommendations are based on existing, mainly descriptive, studies and on the expert opinion of the committee.

1. Secondary undernutrition due to an eating problem in children with a neurodevelopmental disability should be treated or, ideally, prevented. Restoring the nutrition of these children and reducing the time spent feeding them each day should be regarded as an important part of their general care.

2. The nutritional status of these children is best determined by techniques that measure body fat stores and for which there are normative data, such as triceps skinfold measurements.

3. Treatment should start with high-energy supplementation, given orally. However, in children with a severe disability, therapy must involve tube feeding, either to supplement oral feeding or to replace it. The advent of percutaneous enterostomy has introduced a welcome alternative for any child who requires tube feeding for more than 6 to 8 weeks.

4. Daily energy needs are lower in patients with a neurodevelopmental disability than in other patients because they are inactive and have reduced muscle mass; energy needs range from 2900 to 4600 kJ per day.

5. Hence, formulas designed for infants or children less than 6 years of age should be used because of their higher ratios of nutrients to energy.

6. In children with mild disabilities, oral-motor skills should be maintained and improved. One effective strategy is to feed the child through an enterostomy tube only when he or she is asleep, usually at night. The child is then likely to get thirsty and hungry during the day and want to eat, which gives the caregiver or therapist an opportunity to promote oral-motor skills.

7. The management of undernutrition in children with a neurodevelopmental disability is best carried out by a multidisciplinary team.

Validation

These guidelines were reviewed and approved by the board of the Canadian Paediatric Society. There are no equivalent guidelines from the Committee on Nutrition of the American Academy of Pediatrics.

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42. Lewis D, Khoshoo V, Pencharz PB et al: Impact of nutritional rehabilitation on gastroesophageal reflux in neurologically impaired children. *J Pediatr Surg* 1994; 29: 167–170
43. Khoshoo V, Fried M, Pencharz P: Incidence of gastroesophageal reflux with casein and whey-based formulas. [letter] *J Pediatr Gastroenterol Nutr* 1993; 17: 116–117
44. Albanese CT, Towbin RB, Ulman I et al: Percutaneous gastrojejunostomy versus Nissen fundoplication for enteral feeding of the neurologically impaired child with gastroesophageal reflux. *J Pediatr* 1993: 123: 371–375
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Conferences
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Oct. 21–23, 1994: 3rd World Biomedical Conference of the Hellenic Diaspora
Athens, Greece
Conference Secretariat, 84 Hippocratous St., GR-106 80 Athens, Greece; tel 011-30-1-36-26-972, 011-30-61-424-273, 011-30-1-72-11-845; fax 011-30-1-36-26-972, 011-30-1-72-15-082

Oct. 24–25, 1994: 6th Annual Palliative Care Conference, Education and Research Days (sponsored by Caritas Health Group)
Edmonton
Linda Aubrey, tel (403) 930-5852, fax (403) 930-5970

Oct 24–26, 1994: Bioethics: 2nd World Congress (sponsored by the International Association of Bioethics)
Buenos Aires, Argentina
Escuela Latinoamericana de Bioética, Fundación Dr. J.M. Mainetti, Calle 508 e. 16 y 18, (1897) M.B.Gonnet, Argentina; tel 011-54-21-71-1160, ext. 63; fax 011-54-21-71-2222; or Secretaría en Buenos Aires, Fundación Favaloro — Comité de Etica, Solis 453 (1093) Buenos Aires, Argentina; tel 011-54-1-383-1110, -0098, -1327, -1371, -1468 or -5080, ext. 3105; fax 011-54-1-383-9077, -1474 or -0323

Oct. 24–28, 1994: Cirugía/Surgery '94 (includes the Cuban Society of Surgery 5th Congress, the Iberian–Latin-American Society of Surgeons 2nd Congress, 1st International Meeting on Laser in Surgery, 2nd International Meeting on Endoscopic Surgery and 1st International Meeting on Trauma Surgery)
Havana, Cuba
Official languages: Spanish and English
Cirugía '94, Palacio de las Convenciones, Apartado Postal 16046, Havana, Cuba; tel 011-537-20-4653 or -22-6011 to -6019, ext. 2391; fax 011-537-22-8382 or -33-1657; or Iberian–Latin-American Society of Surgeons, Apartado Postal 6996, Havana, Cuba

Oct. 24–28, 1994: Prevention in Practice: Workplace Health in the 21st Century — 1994 State-of-the-Art Conference
Denver
American College of Occupational and Environmental Medicine, 55 W Seegers Rd., Arlington Heights, IL 60005-3919; tel (708) 228-6850, fax (708) 228-1856

Oct. 30–31, 1994: 15th Annual Conference for Generalists in Medical Education — Medical Education in an Age of Reform
Boston
Dr. Phillip K. Fulkerson, Department of Family and Community Medicine, Medical College of Wisconsin, 8701 Watertown Plank Rd., Milwaukee, WI 53226; tel (414) 257-8664, fax (414) 257-8575

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