HEALTH ECONOMIC BENEFITS OF ENTERAL NUTRITION

Dr. Hélène Chevrou-Séverac, Ph.D.
Global Head of Health Economics, Nestlé Health Science

Introduction

Enteral nutrition (EN) by tube feeding has been demonstrated to be the prefered feeding method as compared to parenteral nutrition (PN) in patients eligible for EN (Marik and Zaloga, 2004; Simpson and Doig, 2005). In critically ill patients requiring nutrition therapy, the European, Canadian and American guidelines recommend the enteral feeding route (Kreymann et al. 2006, Heyland et al. 2003, and McClave et al. 2009, respectively). Currently, the debate has shift from the best feeding route to the best feeding timing. Although the costs of the PN therapy are well known to exceed those of the EN therapy, no study has emphasized the health economic benefits of enteral nutrition in ICU patients. This article presents a recent publication on the cost-effectiveness analysis of EN in hospitalized patients, and identifies the premises of the health economic benefits of early EN in critically patients.

Enteral nutrition in hospitalized patients: a cost-effective nutritional strategy

In hospitalized patients, a recent meta-analysis (Cangelosi et al., 2011) has analysed the cost-effectiveness of EN as compared with PN. The study included 31 randomized clinical trials (RCT) of patients admitted to hospital either in ICU (trauma, burns, pancreatitis, and head injury) or for planned surgery (gastrointestinal surgery). Compared to PN, EN was demonstrated to have a significant protective effect on major infections (relative risk of 0.58 with 95% Confidence Interval=[0.44, 0.77]), and on major non-infectious complications (RR=0.73; 95%CI=[0.59, 0.91]). The major infections included, among others, pneumonia and sepsis, whereas the major non-infectious complications included fistula, GI anatomostic leak, wound dehiscence. In terms of impact on healthcare resource use, compared to PN, EN decreased significantly the total length of hospital stay by 1.66 days per patient (95%CI=[0.95, 2.37]).
Both the decrease in complications and length of stay will likely produce savings for the hospitals. Cangelosi and co-authors demonstrated that the reduction in major infections led to savings of $1,074 per patient (95%CI=[$199 to $2,587]), furthermore the reduction in major non-infectious complications allowed hospital to save $261 per patient (95%CI=[$34 to $518]). While the cost of PN formula can reach $200 per litre and the EN formula $24 per litre, when considering total hospital cost for patients using either PN or EN, the difference in daily hospital cost was of 10% only. Therefore, the authors used a daily hospitalization cost of $1,490 per day for both groups regardless of the nutrition therapy. Based on this value, and on the decrease in total hospital length of stay of 1.66 days due to EN, hospital can save $2,473 per patient (95%CI=[$1416, $3531]) by switching patients from PN to EN, when medically appropriate. The authors concluded that in 2008, if 10% of the 231,000 American patients hospitalized on PN could have used EN instead, $57 million (95%CI=[$33 to $82 million]) would have been saved annually by American hospitals.
Hence use of EN instead of PN, when medically appropriate, can improve health outcomes of patients as well as reduce the cost to hospitals. The health economic benefits of EN compared to PN go beyond the cost reduction of artificial nutrition.

Estimation of health economic benefits of early enteral nutrition in ICU patients

In intensive care units, enteral nutrition is the recommended feeding method for patients able to tolerate it (European, Canadian and American guidelines). The hazards of PN have been demonstrated to be worse than those of EN, especially on organ failure, infections and complications, mechanical ventilators duration and length of ICU stay (Minard and Kudsk, 1998; Simpson and Doig, 2005). Interestingly in Simpson's 2005 publication, the benefit of EN over PN seemed to be correlated with the timing of enteral feeding. Since then, the debate on artificial nutrition in ICU patients has moved from the best feeding route to the best feeding timing with EN. Recent studies have been shown to improve clinical outcomes with early feeding (Marik et al., 2001; Doig et al, 2009 and 2011). In recent meta-analysis by Doig and co-authors (2009 and 2011) EEN was defined as EN within 24 h of ICU admission or injury. A meta-analysis of 6 RCTs (234 patients) done by Doig and co-authors (2009) demonstrated that EEN significantly reduced the risk of mortality compared to late EN (odds ratio OR=0.34 with 95%CI=[0.14-0.85]) as well as the risk of pneumonia (OR=0.31 with 95%CI=[0.12-0.78]). Despite the few number of ICU studies with EEN defined as within 24hafter ICU admission , the reduction in risk of pneumonia can likely lead to economic benefits of EEN for hospitals. In the US, the hospital costs of treating pneumonia were estimated to be $91,292 for hospital-acquired pneumonia (HAP) and $150,841 for ventilator-acquired pneumonia (VAP) (2003 $) by Kollef et al. (2005). Therefore, based on these hospital costs updated in 2012 $ value[1] and the relative risk of pneumonia[2] of 0.51 adapted from Doig et al. (2009), savings for hospital due to the use of EEN might range from $10,693 to $58,343 per patient. Hence, based on these crude estimations, EEN might be cost-saving in addition of being more clinically effective than late EN.

Premise of health economics benefits of enteral nutrition in PICU patients

In paediatric intensive care units (PICU), although EEN has been demonstrated to be well tolerated by paediatric patients (Sillkman and Wischmeyer, 2008), feeding them accurately is more challenging. Incidence of malnutrition in the PICU patients is still high ranging from 25% to 70% (Prieto et al., 2011). Mehta and co-authors (2012) estimated from an international prospective cohort study of 31 PICU (500 patients under mechanical ventilation for more than 48 hours) that 30% of these patients had severe malnutrition on admission. However, only 38% of the prescribed energy and 43% of the prescribed protein were administrated to PICU patients. Chronic underfeeding in PICU patients is mainly due to many EN interruptions which undermined achievement of caloric goal. However most of these EN interruptions are estimated to be avoidable. Mehta and co-authors (2010) found that 30% of PICU patients experienced EN interruptions with 58% of those interruptions deemed as avoidable. The three leading causes of avoidable EN interruptions were: intubation and extubation of patients (81%), feeding tube issues (75%), and perceived EN intolerance by attending physicians (48%). All of these interruptions increased length of PICU stay with a risk of more PN use, failure to achieve caloric goal or prolonged duration to achieve it. The use of PN was found to be 4-fold higher in patients experiencing EN interruption compared to those not experiencing (Mehta et al., 2010). Consequently if EN feeding in PICU patients could be administrated early whenever possible and avoidable interruption carefully monitored, then healthcare cost might be better controlled and patients' health outcome improved, leading to potential cost-effectiveness.

1.Translation based on an average of the Consumer Price Index for Medical Care (CPIMEDSL) over the first 4 months of 2003 and 2012 of respectively 293 and 410 (Federal Reserve Board, 21.05.2012, http://research.stlouisfed.org/fred2/series/CPIMEDSL/downloaddata?cid=32419). 2. Computation based on the following formulas : RR=OR/(1-Rc+(RcXOR)), with RR=relative risk, OR=risk ratio and Rc=absolute risk in the control group; Rc computed as a pooled Rc=0.5641 from Doig et al (2009) data.

References: **Marik PE, Zaloga GP.** Meta-analysis of parenteral nutrition versus enteral nutrition in patients with acute pancreatitis. *BMJ* 2004;328:1407. **Simpson and Doig.** Parenteral vs. enteral nutrition in the critically ill patient: a meta-analysis of trials using the intention to treat principle. *Intensive Care Med* 2005;31:12-23. **Heyland DK *et al.*** Canadian Critical Care Clinical Practice Guidelines Committee; Canadian clinical practice guidelines for nutrition support in mechanically ventilated, critically ill adult patients; *JPEN J Parenter Enteral Nutr.* 2003 Sep-Oct;27(5):355-73. **Kreymann KG *et al.*** ESPEN Guidelines on Enteral Nutrition: Intensive care, *Clinical Nutrition* (2006) 25, 210–223. **McClave SA *et al.*** Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *J Parenter Enteral Nutr* 2009; 33:277-316. **Cangelosi MJ *et al.*** A clinical and economic evaluation of enteral nutrition; *Current Medical Research & Opinion* Vol. 27, No. 2, 2011, 413–422. **Minard G *et al.*** Nutritional support and infection: Does the route matter? *World J Surg* 1998; 22:213–219. **Marik PE and Zaloga GP.** Early enteral nutrition in acutely ill patients: A systematic review; *Crit Care Med* 2001 Vol. 29, No. 12. **Doig GS *et al.*** Early enter al nutrition, provided within 24h of injury or intensive care admission, significantly reduces mortality in critically ill patients: a meta-analysis of randomised controlled trials; *Intensive Care Med* (2009) 35:2018-2027.**Doig GS *et al.*** Early enter al nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials; Injury, *Int. J. Care Injured* 42 (2011) 50–56. **Kollef MH *et al.*** Epidemiology and Outcomes of Health-care Associated Pneumonia: Results From a Large US Database of Culture-Positive Pneumonia; *Chest* 2005; 128:3854-3862. **Skillman HE *et al.*** Nutrition therapy in critically ill infants and children. *JPEN J. Parenter. Enteral. Nutr.* 2008, 32, 520-534. Prieto MB and López-Herce Cid J. Malnutrition in the Critically Ill Child: The Importance of Enteral Nutrition; *Int. J. Environ. Res. Public Health.* 2011, 8, 4353-4366. **Mehta NM *et al.*** Nutritional practices and their relationship to clinical outcomes in critically ill children-An international multicenter cohort study; *Crit Care Med.* 2012 Vol. 40, No.7. **Rogers EJ *et al.*** Barriers to adequate nutrition in critically ill children. *Nutrition.* 2003;19:865-868. **Mehta NM *et al.*** Challenges to Optimal Enteral Nutrition in a Multidisciplinary Pediatric Intensive Care Unit; *JPEN J Parenter Enteral Nutr.* 2010 34:38