5.1 Strategies to Optimize Delivery and Minimize Risks of EN: Feeding Protocols

Question: Does the use of a feeding protocol result in better outcomes in the critically ill adult patient?

Summary of evidence: In this section, we have included 3 cluster RCTs that examined the impact of a systematic effort to standardize and improve nutrition delivery (feeding protocols or bedside algorithms) in the ICU setting. The protocol components studied in each study varied greatly (see Table 1) and given the cluster nature of the randomization, a meta-analysis was not done. Two patient-based randomized trials (Pinilla 2001, Zavetailo 2010) that were previously included in this topic have been moved to topic 3.2 Enhancing EN.

Mortality: One study that reported on mortality (Martin 2004) found a trend towards a reduction in hospital mortality in the ICUs that received the evidence based algorithms/education (p=0.058), whereas no such difference was observed in the other trials that reported on mortality.

Infections: Heyland et al reported reduced incidences of pneumonia in the feeding protocol group (7/252 (2.8%) vs 16/267 (6%)), although this was not statistically different (p=0.43). The other two studies did not report on infections.

LOS and Ventilator days: In all three trials, no differences in ICU/hospital length of stay was observed, except the hospital length of stay was significantly lower in the ICUs that received the evidence based algorithms/education in one trial (p=0.003, Martin 2004). Only Heyland et al reported on ventilator days and found no difference between groups.

Other outcomes: The number of days that 100% of goal calories were met was higher in the ICUs that were randomized to the practice change group in the Doig study (p=0.03). The time from ICU admission to start of enteral nutrition was lower in the ICUs that were randomized to the intervention group in all three cluster RCTs (Martin 2004 p=0.17, Doig 2008 p<0.001, Heyland 2013 p=0.10). The use of a feeding protocol (PEP uP) was associated with a 12% (95% CI, 5–20%; *p* = 0.004), increase in calories and a 14% (95% CI, 5–23%; *p* = 0.005) increase in protein over the first 12 days of ICU (Heyland 2013).

Conclusions:

1) Feeding protocols/algorithms may be associated with a reduction in hospital mortality and hospital length of stay.
2) Feeding protocols/algorithms do result in an earlier start of EN and improved overall nutritional adequacy.

Level 1 study: *if all of the following are fulfilled: concealed randomization, blinded outcome adjudication and an intention to treat analysis.*
Level 2 study*: If any one of the above characteristics are unfulfilled.*

Table 1. Randomized studies evaluating feeding protocols in critically ill patients

Study	Population	Methods (score)	Intervention	Mortality # (%)		P-value	Infections # (%)‡		P-value
				Intervention	Control		Intervention	Control	
1) Martin 2004	Cluster RCT of 14 mixed ICU's N = 492	C.Random: no ITT: no Blinding:no (5)	Nutrition algorithms with prokinetics+post pyloric feeding+ supplemental parenteral nutrition to meet at least 80% caloric goal vs. none	Hospital 72/269 (27)	Hospital 82/223 (37)	0.058	NR	NR	NR
2) Doig 2008	Cluster RCT of 27 ICUs. Patients expected to remain in ICU >2 days N = 1118	C.Random: yes ITT: yes Blinding: no (8)	Development of evidence-based guideline + implementation of a practice-change strategy (including staff education, in-services) composed of 18 specific interventions vs. Site monitoring + data collection only	Hospital 172/561 (28.9) ICU 137/561 (24.5)	Hospital 153/557 (27.4) ICU 121/561 (21.5)	0.75 0.43	NR	NR	NR
3) Heyland 2013	Cluster RCT, Multicenter, ICUs previously demonstrating poor nutritional adequacy N=1059	C.Random: No ITT: yes Blinding: no (11)	PEP uP protocol – started feeds at higher target rate, volume-based goal, semi-elemental feeding, protein supplements starting day 1, metoclopramide starting day 1 prophylactically, GRV threshold of 300 ml. Nursing education of protocol, plus bedside tools available.	ICU 35/252 (13.9) 60 Day 68/252 (27)	ICU 42/267 (15.7) 60 Day 63/267 (23.6)	0.57 0.53	ICU acquired pneumonia, by pt 7/252 (2.8)	ICU acquired pneumonia, by pt 16/267 (6.0)	0.53

Table 1. Randomized studies evaluating feeding protocols in critically ill patients (continued)

Study	LOS (days) Intervention	LOS (days) Control	Nutritional and other Outcomes Intervention	Nutritional and other Outcomes Control
1) Martin 2004	Algorithms Hospital 25 p=0.003 ICU 10.9 p=0.7	No algorithms Hospital 35 ICU 11.8	Algorithms Days from ICU admit to start of EN 1.61 P=0.17 Days to 80% goal rate of EN 4.80 P=0.78 Calorie intake per patient day (cals) 1269 P=0.31	No algorithms 2.16 5.10 1002
2) Doig 2008	ICU 9.1 (8.2 - 10.1) p=0.42 Hospital 24.2 (22.2 - 26.8) p=0.97	ICU 9.9 (8.9 - 11.1) Hospital 24.3 (22.3 - 26.4)	Time (days) from ICU admission to EN or PN (mean) 0.75 (0.64 - 0.87) P=0.04 Energy (kcal) intake (mean) 1241 (1121 - 1374) P=0.62 Protein (g) intake (mean) 50.1 (45.4 - 55.3) P=0.22 100% Goal of kcal intake (days) 6.1 (5.6 - 6.65) P=0.03	 1.37 (1.17 - 1.60) 1065 (961 - 1179) 44.2 (40.0 - 48.9) 5.02 (4.61 - 5.48)

3) Heyland 2013	ICU 7.2 (3.4-11.1) P=0.35 Hospital 13.5 (8.1-28.4) P=0.73	ICU 5.7 (2.8-11.8) Hospital 13.8 (7.1-26.6)	Ventilator Days 4.3 (1.1-9.9) 3.0 (1.4-7.3) P=0.57 % calories from total nutrition 48.2 ± 32.5 37.9 ± 30.3 P=0.01 % protein from total nutrition 48.4 ± 34.3 34.4 ± 30 P=0.004 % calories from EN 43.6 ±32.1 33.6 ± 29.5 P=0.004 % protein from EN 47.4 ± 34.7 33.8 ± 29.9 P=0.005 vomiting (p=.45) regurgitation (p=.39) macroaspiration (p=.11)

C.Random: concealed randomization
ITT: intent to treat
RV: residual volume
GRV: gastric residual volume
Ventilator days: not reported

± ( ) : mean ± Standard deviation (number)
‡ refers to the # of patients with infections unless specified
NA: not available
** RR= relative risk, CI= Confidence intervals