5.3 Strategies to optimize delivery and minimize risks of EN: Small bowel feeding vs. GastricJanuary 31st 2009

Recommendation:

Based on 11 level 2 studies, small bowel feeding compared to gastric feeding may be associated with a reduction in pneumonia in critically ill patients. In units where small bowel access is feasible, we recommend the routine use of small bowel feedings. In units where obtaining access involves more logistical difficulties, small bowel feedings should be considered for patients at high risk for intolerance to EN (on inotropes, continuous infusion of sedatives, or paralytic agents, or patients with high nasogastric drainage) or at high risk for regurgitation and aspiration (nursed in supine position). Finally, where obtaining small bowel access is not feasible (no access to fluroscopy or endoscopy and blind techniques not reliable), small bowel feedings should be considered for those select patients that repeatedly demonstrate high gastric residuals and are not tolerating adequate amounts of EN intragastrically.

Discussion: The committee noted an overall modest effect size with respect to pneumonia with wide confidence intervals amongst studies that were heterogenous. There were also concerns expressed around implementation of small bowel feeding and the associated costs, which are institution dependent. In other words, the cost-benefit ratio would vary from institution to institution and the recommendation needed to reflect this fact. The committee also noted that the data on improved nutritional endpoints was favourable and it was decided that a recommendation be made that incorporated these improvements in nutritional intake.

	Definition	Score 0, 1, 2 or 3
Effect size	Magnitude of the absolute risk reduction attributable to the intervention listed—a higher score indicates a larger effect size	2 (pneumonia)
Confidence interval	95% confidence interval around the point estimate of the absolute risk reduction, or the pooled estimate (if more than one trial)—a higher score indicates a smaller confidence interval	2 with Taylor 1without Taylor
Validity	Refers to internal validity of the study (or studies) as measured by the presence of concealed randomization, blinded outcome adjudication, an intention to treat analysis, and an explicit definition of outcomes—a higher score indicates presence of more of these features in the trials appraised	2
Homogeneity or Reproducibility	Similar direction of findings among trials—a higher score indicates greater similarity of direction of findings among trials	1
Adequacy of control group	Extent to which the control group represented standard of care (large dissimilarities = 1, minor dissimilarities=2, usual care=3)	3
Biological plausibility	Consistent with understanding of mechanistic and previous clinical work (large inconsistencies =1, minimal inconsistencies =2, very consistent =3)	3
Generalizability	Likelihood of trial findings being replicated in other settings (low likelihood i.e. single centre =1, moderate likelihood i.e. multicentre with limited patient population or practice setting =2, high likelihood i.e. multicentre, heterogenous patients, diverse practice settings =3.	2
Low cost	Estimated cost of implementing the intervention listed—a higher score indicates a lower cost to implement the intervention in an average ICU	2
Feasible	Ease of implementing the intervention listed—a higher score indicates greater ease of implementing the intervention in an average ICU	1 depending upon technique
Safety	Estimated probability of avoiding any significant harm that may be associated with the intervention listed—a higher score indicates a lower probability of harm	2

5.3 Topic: Strategies to optimize benefits and minimize risks of EN: Small Bowel feeding vs. Gastric

January 31st, 2009

Question: Does enteral feeding via the small bowel compared to gastric feeding result in better outcomes in the critically ill adult patient?

Summary of evidence: There were eleven randomized trials that were reviewed, all of which were level 2 studies. In the Taylor et al study, only 34 % of the patients achieved small bowel access in this study (large number of protocol violations) and hence the meta-analysis was done with and without this study. Minard et al compared outcomes in patients receiving early immune enhanced enteral nutrition via the small bowel to those receiving delayed immune enhanced enteral nutrition via the gastric route. A meta-analysis on the time dependent variables (LOS) was done with and without the Minard study.

Mortality: Based on the 9 studies that reported on mortality, no significant differences between the groups were found (RR 0.93, 0.72-1.20, p = 0.6) (see figure 1). When the Taylor et al study was excluded, the relative risk did not change (see figure 2).

Infections: Based on the 9 studies that reported on infections, the meta-analysis showed that small bowel feeding was associated with a significant reduction in infections (RR 0.77, 0.60-1.00, p = 0.05) when compared to gastric feeding. The study by Taylor et al contributes greatly to the results of this meta-analysis and when the meta-analysis was done without the Taylor study, the statistical significance of reduction in infections outcomes with small bowel feeding disappeared (RR 0.83, p= 0.3). (figure 3, 4).

LOS: Based on the 5 studies that reported the LOS, a trend towards a reduction in ICU LOS with gastric feeding (weighted mean difference {WMD} 1.86, 95 % CI -0.38, 4.11 p = 0.10) was seen (figure 5). The presence of significant statistical heterogeneity weakens this estimate. When the Minard study was excluded from the analysis, this weak trend disappeared (WMD 1.26, 95 % CI -1.08, 3.60, p =0.29) however heterogeneity was also present (figure 6).

Ventilator days: Only reported in 1 study and no difference in ventilator days between groups receiving small bowel feeding vs gastric was noted (Montecalvo).

Other complications: Only a few studies reported on other issues, such as vomiting, diarrhea and abdominal bloating. There was no difference between interventions. The studies that reported nutritional delivery generally showed better success at meeting goal targets and reaching them sooner. However, this was confounded because of different gastric feeding strategies. The group that had a more aggressive feeding regimen and small bowel feeding (Taylor) had fewer major complications and a better neurological outcome at 3 months than the group receiving gastric feeds.

Conclusions:

1) Small bowel feeding, compared to gastric feeding maybe associated with a reduction in pneumonia in critically ill patients.
2) No difference in mortality or ventilator days in critically ill patients receiving small bowel vs.gastric feedings.
3) Small bowel feeding improves calorie and protein intake and is associated with less time taken to reach target rate of enteral nutrition when compared to gastric feeding.

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 small bowel feeding vs. gastric in critically ill patients

Study	Population	Methods (score)	Intervention	Mortality # (%)†		Pneumonia # (%)‡	
				Small bowel	gastric	Small bowel	gastric
1. Montecalvo 1992	Med/Surg ICU Anticipated feed >3days N =38 from 2 ICUs	C.Random: not sure ITT: no Blinding: no (8)	Small bowel feeding vs gastric	5/19 (26)	5/19 (26)	4/19 (21)	6/19 (32)
2. Kortbeek 1999	Trauma ISS>16 Vent >48h N = 80 from 2 ICUs	*C.Random: yes* ITT: yes Blinding: no (11)	Small bowel feeding vs gastric	4/37 (11)	3/43 (7)	10/37 (27)	18/43 (42)
3. Taylor 1999	Head injured ventilated > 10 yrs n = 82	C.Random: not sure ITT: yes Blinding: no (10)	Small bowel feeding vs gastric	5/41(12.2) 6 months	6/41 (14.6) 6 months	Pneumonia 18/41 (44) total infections 25/41 (61)	26/41 (63) 35/41 (85)
4. Kearns 2000	MICU Feed >3days APACHE ~21 N = 44	C.Random: not sure ITT: yes Blinding: no (9)	Small bowel feeding vs gastric	5/21 (24)	6/23 (26)	4/21 (19)	3/23 (13)
5. Minard 2000	Trauma GCS 3-10 N = 27	C.Random: not sure ITT: no Blinding: no (7)	Small bowel feeding vs gastric	1/12 (8)	4/15 (27)	6/12 (50)	7/15 (47)
6. Esparaza 2001	MICU MV = 98% APACHE ~25 N = 54	C.Random: not sure ITT: yes Blinding: no (8)	Small bowel feeding vs gastric	10/27 (37)	11/27 (41)	NA	NA

7. Boivin 2001	Med/Surg/Neuro MV~98% Feed >96h APACHE~16 N =80	C.Random: not sure ITT: no Blinding: no (6)	Small bowel feeding vs gastric	18/39 (46)	18/39 (46)	NA	NA
8. Day 2001	Neurological ICU APACHE ~ 48 N=25	C.Random: not sure ITT: yes Blinding: no (5)	Small bowel feeding vs gastric	NA	NA	0/14	2/11 (18)
9. Davies 2002	Med/surg/trauma Feed > 3days MV=90%; APACHE~21 N = 73	C.Random: not sure ITT: no Blinding no (8)	Small bowel feeding vs gastric	4/34 (12)	5/39 (13)	2/31 (6)	1/35 (3)
10. Neumann 2002	MICU N = 60	C.Random: not sure ITT: yes Blinding: no (6)	Small bowel feeding vs gastric	NA	NA	1/30 (3) aspiration	0/30 (0) aspiration
11. Montejo 2002	14 ICU's APACHE ~18 Feed >5days N = 101 from 11 ICUs	C.Random: not sure ITT: yes Blinding: no (6)	Small bowel feeding vs gastric	19/50 (38)	22/51 (43)	16/50 (32)	20/51 (39)

Table 2 Randomized studies evaluating small bowel feeding vs. gastric in critically ill patients

Study	LOS days Small bowel	LOS days gastric	Ventilator days Small bowel	Ventilator days gastric	Nutritional Outcomes Small bowel / gastric	Other Small bowel	Other gastric
1. Montecalvo 1992	11.7 ± 8.2 (19) ICU	12.3 ± 10.8 (19) ICU	10.2 ± 7.1 (19)	11.4 ± 10.8 (19)	Daily caloric intake (%) 61 ± 17 / 46.9 ± 25.9	7/19 (37) GI bleed 12/19 (63) diarrhea 3/19 (16) vomiting	6/19 (32) GI bleed 9/19 (47) diarrhea 3/19 (16) vomiting
2. Kortbeek 1999	10 (3-24) ICU 30 (16-47) hospital	7 (3-32) ICU 25 (9-88) hospital	9 (2-13)	5 (3-15)	Time to tolerate full feeds 34 ± 7.1 hrs / 43.8 ± 22.6 hrs	NA	NA
3. Taylor 1999	NA	NA	NA	NA	% energy needs met (mean) 59.2 / 36.8 % nitrogen needs met (mean) 68.7 / 37.9	37 % major complications 61 % had better neurological outcome at 3 months	61 % major complications 39 % had better neurological outcome at 3months
4. Kearns 2000	17 ± 2 (21) ICU 39 ± 10 (21) hospital	16 ± 2 (23) ICU 43 ± 11 (23) hospital	NA	NA	Calories (Kcal/kg/day) 18 ± 1 / 12 ± 2 Protein (gm/kg/day) 0.7 ± 0.1 / 0.4 ± 0.1 % REE delivered 69 ± 7 / 47 ± 7	3 days diarrhea	2 days diarrhea
5. Minard 2000	18.5 ± 8.8 (12) ICU 30 ± 14.7 (12) hospital	11.3 ± 6.1 (12) ICU 21.3 ± 14.7 (12) hospital	15.1 ± 7.5 (12)	10.4 ± 6.1 (15)	Time feeding initiated (hours) 33 ± 15 / 84 ± 41 Avg kcals/ day 1509 ± 45 / 1174 ± 425 Days fed 13 ± 3.7 / 8 ± 4.5 # patients with > 50 % goal for ≥ 5 days 10/12 (83) / 7/15 (47)	11/12 (92) diarrhea 1/12 (8) vomiting	8/15 (53) diarrhea 3/15 (20) vomiting
6. Esparaza 2001	NA	NA	NA	NA	Feed days (average) 3.6 / 4.1 Average daily % of goal 66 / 64	NA	NA

7. Boivin 2001	NA	NA	NA	NA	Time of placement 304 minutes 13 minutes Time to goal rate achieved and maintained for 4 hours 33 hours 32 hours	NA	NA
8. Day 2001	NA	NA	NA	NA	Calories and protein received were significantly higher only on days 2 and 3 in the gastric group. No difference between the groups on Days 1, 4-10. Replaced tubes 16/14 9/11	7/14 (50) diarrhea	5/11 (45) diarrhea
9. Davies 2002	13.9 ± 1.8 (34) ICU	10.4 ± 1.2 (39) ICU	NA	NA	Time to reach target rate (Mean ± SE) 23.2 ± 3.9 23.0 ± 3.4 Time to start feeds (Mean ± SE) 81.2 ± 13.4 54.5 ± 4.9	3/31 (10) GI bleed 4/31 (13) diarrhea	0/35 (0) GI bleed 3/35 (9) diarrhea
10. Neumann 2002	NA	NA	NA	NA	Time from initial attempt to start of feeding 27.0 ∀ 22.6 11.2 ∀ 11.0 Time to reach goal rate (from initial placement attempt) 43 ∀ 24.1 28.8 ∀ 15.9 Time to reach goal rate (from successful tube placement) 17.3 ∀ 15.7 17.0 ∀ 11.9	NA	NA
11. Montejo 2002	15 ± 10 (50) ICU	18 ± 16 (50) ICU	NA	NA	High gastric residuals 1/50 (2) 25/51 (49) Caloric intake (mean) 1286 ± 344 1237 ± 342 Volume ratio at day 7 (%) 80 ± 28 75 ± 30	7/50 (14) diarrhea 4/50 (8) vomiting	7/51 (14) diarrhea 2/51 (4) vomiting

C.Random: concealed randomization
ITT: intent to treat
† presumed ICU mortality unless otherwise specified
‡ refers to the # of patients with infections unless specified

± ( ) : mean ± Standard deviation (number)
(-) : median (range)
NA: not available
Cost : not reported

Figure 1.

Comparison: 01 Small Bowel vs Gastric
Outcome: 02 Mortality

Study	Small Bowel n/N	Gastric n/N	Weight %	RR (95%CI Random)	Year
Boivin	18 / 39	18 / 39	28.9	1.00[0.62,1.62]	2001
Davies	4 / 34	5 / 39	4.4	0.92[0.27,3.15]	2002
Esparaza	10 / 27	11 / 27	14.8	0.91[0.47,1.78]	2001
Kearns	5 / 21	6 / 23	6.3	0.91[0.33,2.55]	2000
Kortbeek	4 / 37	3 / 43	3.2	1.55[0.37,6.48]	1999
Minard	1 / 12	4 / 15	1.6	0.31[0.04,2.44]	2000
Montecalvo	5 / 19	5 / 19	5.9	1.00[0.35,2.90]	1992
Montejo	19 / 50	22 / 51	29.6	0.88[0.55,1.42]	2002
Taylor	5 / 41	6 / 41	5.4	0.83[0.28,2.52]	1999
Total(95%CI)	71 / 280	80 / 297	100.0	0.93[0.72,1.20]	

Test for heterogeneity chi-square=1.78 df=8 p=0.99
Test for overall effect z=-0.57 p=0.6

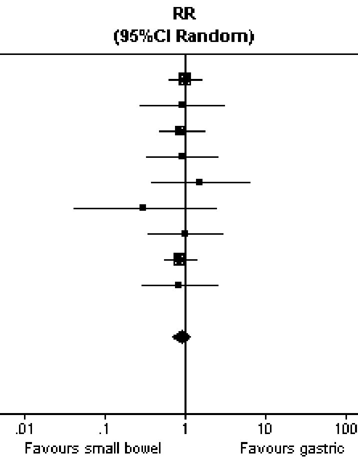


Figure 2. Mortality without Taylor

Comparison: 01 Small Bowel vs Gastric
Outcome: 02 Mortality

Study	Small Bowel n/N	Gastric n/N	Weight %	RR (95%CI Random)	Year
Boivin	18 / 39	18 / 39	30.5	1.00[0.62,1.62]	2001
Davies	4 / 34	5 / 39	4.6	0.92[0.27,3.15]	2002
Esparaza	10 / 27	11 / 27	15.6	0.91[0.47,1.78]	2001
Kearns	5 / 21	6 / 23	6.6	0.91[0.33,2.55]	2000
Kortbeek	4 / 37	3 / 43	3.4	1.55[0.37,6.48]	1999
Minard	1 / 12	4 / 15	1.7	0.31[0.04,2.44]	2000
Montecalvo	5 / 19	5 / 19	6.2	1.00[0.35,2.90]	1992
Montejo	19 / 50	22 / 51	31.3	0.88[0.55,1.42]	2002
Total(95%CI)	66 / 239	74 / 256	100.0	0.93[0.72,1.22]	

Test for heterogeneity chi-square=1.74 df=7 p=0.97
Test for overall effect z=-0.51 p=0.6

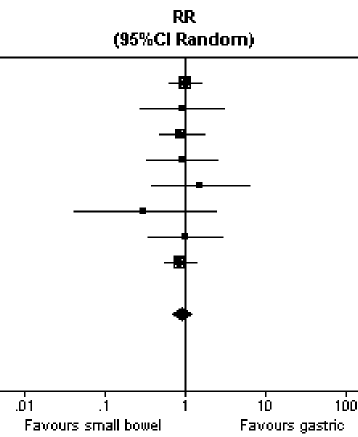


Figure 3.

Comparison: 01 Small Bowel vs Gastric
Outcome: 01 Infectious Complications

Study	Small Bowel n/N	Gastric n/N	Weight %	RR (95%CI Random)	Year
Davies	2 / 31	1 / 35	1.2	2.26[0.22,23.71]	2002
Day	0 / 14	2 / 11	0.8	0.16[0.01,3.03]	2001
Kearns	4 / 21	3 / 23	3.5	1.46[0.37,5.78]	2000
Kortbeek	10 / 37	18 / 43	16.3	0.65[0.34,1.22]	1999
Minard	6 / 12	7 / 15	10.7	1.07[0.49,2.34]	2000
Montecalvo	4 / 19	6 / 19	5.5	0.67[0.22,1.99]	1992
Montejo	16 / 50	20 / 51	23.5	0.82[0.48,1.39]	2002
Neumann	1 / 30	0 / 30	0.7	3.00[0.13,70.83]	1999
Taylor	18 / 41	26 / 41	37.9	0.69[0.46,1.05]	1999
Total(95%CI)	61 / 255	83 / 268	100.0	0.77[0.60,1.00]	

Test for heterogeneity chi-square=4.79 df=8 p=0.78
Test for overall effect z=-1.96 p=0.05

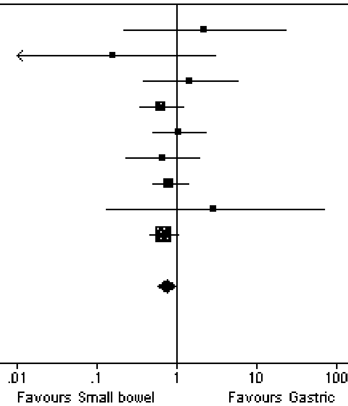


Figure 4. Infections without Taylor

Comparison: 01 Small Bowel vs Gastric
Outcome: 01 Infectious Complications

Study	Small Bowel n/N	Gastric n/N	Weight %	RR (95%CI Random)
Davies	2 / 31	1 / 35	1.9	2.26[0.22,23.71]
Day	0 / 14	2 / 11	1.2	0.16[0.01,3.03]
Kearns	4 / 21	3 / 23	5.6	1.46[0.37,5.78]
Kortbeek	10 / 37	18 / 43	26.2	0.65[0.34,1.22]
Minard	6 / 12	7 / 15	17.3	1.07[0.49,2.34]
Montecalvo	4 / 19	6 / 19	8.9	0.67[0.22,1.99]
Montejo	16 / 50	20 / 51	37.8	0.82[0.48,1.39]
Neumann	1 / 30	0 / 30	1.1	3.00[0.13,70.83]
Total(95%CI)	43 / 214	57 / 227	100.0	0.83[0.60,1.15]

Test for heterogeneity chi-square=4.35 df=7 p=0.74
Test for overall effect z=-1.14 p=0.3

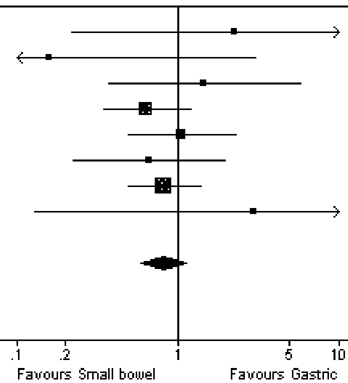


Figure 5.

Review: Small Bowel vs Gastric
Comparison: 01 Small Bowel vs Gastric
Outcome: 03 ICU Stay

Study or sub-category	N	Small Bowel Mean (SD)	N	Gastric Mean (SD)	Weight %	WMD (random) 95% CI	Year
Montecalvo	19	11.70(8.20)	19	12.30(10.80)	9.85	-0.60 [-6.70, 5.50]	1992
Kearns	21	17.00(2.00)	23	16.00(2.00)	32.71	1.00 [-0.18, 2.18]	2000
Minard	12	18.50(8.80)	15	11.30(6.10)	10.43	7.20 [1.34, 13.06]	2000
Davies	34	13.90(1.80)	39	10.40(1.20)	34.72	3.50 [2.79, 4.21]	2002
Montejo	50	15.00(10.00)	51	18.00(16.00)	12.30	-3.00 [-8.19, 2.19]	2002
Total (95% CI)	136		147		100.00	1.86 [-0.38, 4.11]	

Test for heterogeneity: Chi² = 20.74, df = 4 (P = 0.0004), I² = 80.7%
Test for overall effect: Z = 1.63 (P = 0.10)

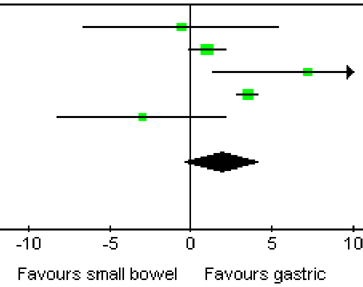
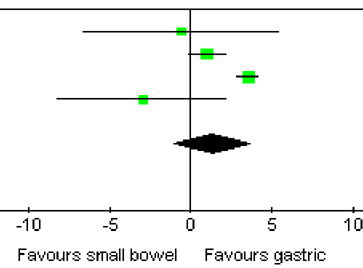


Figure 6. ICU stay without Minard

Review: Small Bowel vs Gastric
Comparison: 01 Small Bowel vs Gastric
Outcome: 03 ICU Stay

Study or sub-category	N	Small Bowel Mean (SD)	N	Gastric Mean (SD)	Weight %	WMD (random) 95% CI	Year
Montecalvo	19	11.70(8.20)	19	12.30(10.80)	10.79	-0.60 [-6.70, 5.50]	1992
Kearns	21	17.00(2.00)	23	16.00(2.00)	36.69	1.00 [-0.18, 2.18]	2000
Davies	34	13.90(1.80)	39	10.40(1.20)	39.02	3.50 [2.79, 4.21]	2002
Montejo	50	15.00(10.00)	51	18.00(16.00)	13.51	-3.00 [-8.19, 2.19]	2002
Total (95% CI)	124		132		100.00	1.26 [-1.08, 3.60]	

Test for heterogeneity: Chi² = 18.52, df = 3 (P = 0.0003), I² = 83.8%
Test for overall effect: Z = 1.06 (P = 0.29)



TOPIC: 5.3 Small Bowel vs. Gastric

Article inclusion log

Criteria for study selection

Type of study: RCT or Meta-analysis
Population: critically ill, ventilated patients (no elective surgery patients)
Intervention: EN
Outcomes: mortality, LOS, QOL, functional recovery, complications, cost. Exclude studies with only biochemical, metabolic or nutritional outcomes.

	Author	Journal	I	E	Why Rejected
1	Grahm	Neurosurgery 1989		√	Pseudorandomized
2	Montecalvo	Crit Care Med 1992	√		
3	Strong	JPEN J Parenter Enteral Nutr 1992		√	Not ICU patients
4	Kortbeek	J Trauma 1999	√		
5	Taylor	Crit Care Med 1999	√		
6	Kearns	Crit Care Med 2000	√		
7	Minard	JPEN J Parenter Enteral Nutr 2000	√		
8	Boivin	Crit Care Med 2001	√		
9	Day	J of Neuroscience 2001	√		
10	Esparaza	Int Care Med 2001	√		
11	Heyland	Crit Care Med 2001		√	No clinical outcomes
12	Davies	Crit Care Med 2002	√		
13	Heyland	JPEN 2002			Systematic review, Individual studies looked at
14	Montejo	Crit Care Med 2002	√		
15	Neumann	Crit Care Med 2002	√		
16	Marik	Critical Care 2003			Systematic review, Individual studies looked at
17	Ho	Intensive Care Med 2006			Meta-analysis, Individual studies looked at

I = included, E = excluded

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