5.3 Strategies to Optimize Delivery and Minimize Risks of EN: Small Bowel Feeding vs. Gastric

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 seventeen 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. Meta-analyses on mortality, infections & time dependent variables (LOS) were done with and without the Minard study.

Mortality: Based on the 14 studies that reported on mortality, no significant differences between the groups were found (RR 1.01, 95% CI 0.84, 1.22, p=0.89, heterogeneity I²=0%; figure 1). When the Taylor et al & Minard studies was excluded, the relative risk did not change (RR 1.03, 95% CI 0.85, 1.24, p=0.77, heterogeneity I²=0%; figure 2).

Infections (Pneumonia): Based on the 14 studies that reported on pneumonia, the meta-analysis showed that small bowel feeding was associated with a reduction in pneumonia when compared to gastric feeding (RR 0.78, 95% CI 0.61, 1.00, p=0.05, heterogeneity I²=28%; figure 3). When the studies by Taylor et al and Minard et al were removed from the analysis, small bowel feeding was associated with only a trend in the reduction of pneumonia (RR 0.77, 95% CI 0.57, 1.06, p=0.11, heterogeneity I²=36%; figure 4).

LOS: When all 10 studies that reported ICU LOS were aggregated, enteral feeding via the small bowel had no effect on ICU length of stay (WMD - 1.19, 95% CI -3.46, 3.07, p=0.91, heterogeneity I²=98%; figure 5). When the Minard study was excluded from the analysis, the signal did not change (WMD -0.86, 95% CI -4.25, 2.53, p=0.62, heterogeneity I²=98%; figure 6). Based on the aggregation of the 5 studies that reported hospital LOS, enteral feeding via the small bowel had no effect on hospital length of stay (WMD 0.56, 95% CI -3.60, 4.73, p=0.79, heterogeneity I²=24%; figure 7) when compared to gastric feeding.

Ventilator days: Based on the aggregation of the 6 studies that reported duration of ventilation, enteral feeding via the small bowel compared to gastric feeding had no effect on duration of ventilation (WMD -0.89, 95% CI -2.75, 0.97, p=0.35, heterogeneity I²=81%; figure 8).

Nutritional Outcomes: Many studies reported on nutritional complications, such as GI bleeds, vomiting, diarrhea, constipation and abdominal bloating. There was no difference between the 2 groups in some studies (Davies 2011, White, Eatock, Friedman), while other reported a significant improvement in nutritional outcomes in the group fed via small bowel such as better nutrition efficiency (Hsu, Acosta-Escribano), calorie/protein intake & less time to reach goal (Hsu), vomiting (Hsu) and significantly less gastrointestinal tract colonization and high gastric residual volumes

(Acosta Escribano). The studies that reported nutritional delivery generally showed better success at meeting goal targets and reaching them sooner. However, this could also be explained by the confounded nature of different gastric feeding strategies. When the data from the 6 studies that reported nutritional efficiency (% goal rate received) as a mean \pm standard deviation were aggregated, small bowel feeding compared to gastric feeding was associated with a significantly greater percentage of nutritional efficiency (WMD 10.59, 95% CI 4.76, 16.41, p=0.0004, heterogeneity I²=88%; figure 9). When the data from the 4 studies that reported the time to reach nutritional goal rate were aggregated, small bowel feeding compared to gastric feeding had no effect on the time to reach nutritional goals (WMD -3.41, 95% CI -13.45, 6.62, p=0.51, heterogeneity I²=87%; figure 10). One study (Friedman 2015) reported a significant increase in cost when using small bowel vs gastric feeds, though the details on this calculation and the statistical significance was not reported.

Other complications: 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 may be associated with a reduction in pneumonia in critically ill patients.
- 2) Small bowel feeding, compared to gastric feeding has no effect on mortality or ventilator days in critically ill patients receiving small bowel vs. gastric feedings.
- 3) Small bowel feeding is associated with improved calorie and protein intake and 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.

Study	Population	Methods (score)		t y # (%) † Gastric	Pneumor Small bowel	nia # (%)‡ _{Gastric}
1. Montecalvo 1992	Med/Surg ICU Anticipated feed >3days N=38 from 2 ICUs	C.Random: not sure ITT: no Blinding: no (8)	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)	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)	6-month 5/41(12)	6-month 6/41 (15)	Pneur 18/41 (44) Total In 25/41 (61)	26/41 (63)
4. Kearns 2000	MICU Feed >3days APACHE ~21 N=44	C.Random: not sure ITT: yes Blinding: no (9)	5/21 (24)	6/23 (26)	4/21 (19)	3/23 (13)
5. Minard 2000	Trauma GCS 3-10 N=27	GCS 3-10 ITT: no		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)	10/27 (37)	11/27 (41)	NR	NR
7. Boivin 2001	Med/Surg/Neuro MV~98% Feed >72h APACHE~16 N=80	C.Random: not sure ITT: no Blinding: no (6)	18/39 (46)	18/39 (46)	NR	NR

Table 1. Randomized studies evaluating small bowel feeding vs. gastric in critically ill patients	Table 1. Randomized	studies evaluating	small bowel feeding vs	aastric in critically	/ ill patients
---	---------------------	--------------------	------------------------	-----------------------	----------------

8. Day 2001	Neurological ICU APACHE ~ 48 N=25	C.Random: not sure ITT: yes Blinding: no (5)	NR	NR	0/14 (0)	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)	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)	NR	NR	NR	NR
11. Montejo 2002	14 ICU APACHE ~18 Feed >5days N=101 from 11 ICUs	C.Random: not sure ITT: yes Blinding: no (6)	19/50 (38)	22/51 (43)	16/50 (32)	20/51 (39)
12. Hsu 2009	Medical ICU Anticipated feed >3days N=121	C.Random: Yes ITT: Yes Blinding: No (9)	26/59 (44)	24/62 (39)	5/59 (9)	15/62 (24)
13. White 2009	Medical ICU mechanically ventilated >24hrs N=108	C.Random: Yes ITT: Yes Blinding: No (7)	11/50 (22)	5/54 (9)	5/50 (10)	11/54 (20)
14. Acosta- Escribano 2010	Traumatic brain injury, mechanically ventilated patients in ICU required EN for >5 days N=104	C.Random: No ITT: Yes Blinding: No (9)	30-day 6/50 (12)	30-day 9/54 (17)	16/50 (32)	31/54 (57)

15. Davies 2012	Critically ill , mechanically ventilated, on narcotic infusion with elevated GRV from 17 ICUs N=181	C.Random: Yes ITT: Yes Blinding: No (11)	13/91 (14)	12/89 (13)	18/91 (20)	19/89 (21)	
16. Friedman 2015	Critically ill adults withour contraindication for enteral nutrition, expected ICU LOS >48 hrs N=115	C.Random: Yes ITT: Yes Blinding: No (9)	ICU 20/54 (37)	ICU 22/61 (36)	13/54 (24)	12/61 (20)	
17. Wan 2015	Mixed ICU patients. Single Centre. N=70	C.Random: Yes ITT: Yes Blinding: No (8)	NR	NR	Aspiration pneumonia 0/35	Aspiration pneumonia 10/35	

Table 1. Randomized studies evaluating small bowel feeding vs. gastric in critically ill patients (continued)

Study	LOS Small bowel	days _{Gastric}	Ventilat Small bowel	or days _{Gastric}	Nutritional (Small bowel	Outcomes _{Gastric}	Other Small bowel Gastric	
1. Montecalvo 1992	ICU 11.7 ± 8.2 (19)	ICU 12.3 ± 10.8 (19)	10.2 ± 7.1 (19)	11.4 ± 10.8 (19)	Daily caloric 61 ± 17	intake (%) 46.9 ± 25.9	GI bleeding 7/19 (37) Diarrhea 12/19 (63) Vomiting 3/19 (16)	GI bleeding 6/19 (32) Diarrhea 9/19 (47) Vomiting 3/19 (16)
2. Kortbeek 1999	ICU 10 (3-24) Hospital 30 (16-47)	ICU 7 (3-32) Hospital 25 (9-88)	9 (2-13)	5 (3-15)	Time to toleral 34 ± 7.1	te full feeds 43.8 ± 22.6	NR	NR

3. Taylor 1999	NR	NR	NR	NR	% 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	ICU 17 ± 2 (21) Hospital 39 ± 10 (21)	ICU 16 ± 2 (23) Hospital 43 ± 11 (23)	NR	NR	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	Diarrhea 3 days	Diarrhea 2 days
5. Minard 2000	ICU 18.5 ± 8.8 (12) Hospital 30 ± 14.7 (12)	ICU 11.3 ± 6.1 (12) Hospital 21.3 ± 14.7 (12)	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)	Diarrhea 11/12 (92) Vomiting 1/12 (8)	Diarrhea 8/15 (53) Vomiting 3/15 (20)
6. Esparaza 2001	NR	NR	NR	NR	Feed days (average) 3.6 4.1 Average daily % of goal 66 64	NR	NR
7. Boivin 2001	NR	NR	NR	NR	Time of placement 304 minutes 13 minutes Time to goal rate achieved and maintained for 4 hours 33 hours 32 hours	NR	NR
8. Day 2001	NR	NR	NR	NR	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	Diarrhea 7/14 (50)	Diarrhea 5/11 (45)

9. Davies 2002	ICU 13.9 ± 1.8 (34)	ICU 10.4 ± 1.2 (39)	NR	NR	Time to reach target rate 23.2 ± 3.9 23.0 ± 3.4 Time to start feeds 81.2 ± 13.4 54.5 ± 4.9	GI bleeding 3/31 (10) Diarrhea 4/31 (13)	GI bleeding 0/35 (0) Diarrhea 3/35 (9)
10. Neumann 2002	NR	NR	NR	NR	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	Aspiration 1/30 (3)	Aspiration 0/30 (0)
11. Montejo 2002	ICU 15 ± 10 (50)	ICU 18 ± 16 (50)	NR	NR	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	Diarrhea 7/50 (14) Vomiting 4/50 (8)	Diarrhea 7/51 (14) Vomiting 2/51 (4)
12. Hsu 2009	ICU 18.20 \pm 11.80 Hospital 36.0 \pm 24.2	ICU 18.20 ± 11.20 Hospital 31.7 <u>+</u> 21.1	28.5 ± 24.9 (59)	23.8 ± 18.2 (62)	$\begin{array}{llllllllllllllllllllllllllllllllllll$	Vomiting 1/59 (2) GI bleeding 7/59 (12) Time to reach goal 32.4 (27.1) hrs	Vomiting 8/62 (13) GI bleeding 9/62 (15) Time to reach goal 54.5 (51.4) hrs
13. White 2009	ICU 5.3 (2.73-9.89) 7.12 ± 6.00 (51)	ICU 5.02 (1.98-9.99) 9.10 ± 10.55 (55)	3.93 (2.3-8.38) 5.73 ± 5.29 (51)	3.92 (1.5-8.54) 7.68 ± 9.81 (55)	Caloric intake (median, IQR) 1463 (1232-1804) 1588 (913-1832) Protein intake (median, IQR) 63 (50-78) 69 (45-87)	Time to reach goal 4.1 (3.4-5.0) hrs	Time to reach goal 4.3 (4.0-5.0)
14. Acosta- Escribano 2010	ICU 16 ± 9 (50) Hospital 38 ± 24 (50)	ICU 18 ± 7 (54) Hospital 41 ± 28 (54)	7.3 ± 4 (50)	8.9 ± 4 (54)	Nutritional efficiency (%) 92 ± 7 84 ± 15	High GRVs 3/50 (6) GIT complications 7/50 (14)	High GRVs 15/54 (28) GIT complications 27/54 (47)

15. Davies 2012	ICU 10 (7-15) 12.5 ± 8.6 (91) Hospital 20 (11-33) 28.8 ± 26.1 (91)	ICU 11 (7-16) 12.7 ± 9.8 (89) Hospital 24 (15-32) 27.4 ± 21.1 (89)	8 (6-12) 9.8 ± 6.2 (91)	8 (5-14) 9.7 ± 6.3 (89)	Nutritional efficiency (%) 72 71 p=0.66 Caloric intake (mean) 1497 \pm 521 1444 \pm 485	Major haemorrhage 2/91 (2) Minor haemorrhage 12/91 (13) Vomiting 30/91 (33) Aspiration 5/91 (5) Diarrhea 26/91 (29) Abdom distention 16/91 (18)	Major haemorrhage 2/89 (2) Minor haemorrhage 3/89 (3) Vomiting 30/89 (30) Aspiration 4/89 (5) Diarrhea 26/89 (30) Abdom distention 18/89 (20)
16. Friedman 2015	ICU 10 (7-21) (54)	ICU 12 (8-20) (61)	4 (2-11) (54)	7 (3-13) (61)	NR	Cost, US\$ 1163 Diarrhea 15/54 (28) Vomiting 14/54 (26) Constipation 9/54 (17)	Cost, US\$ 467 Diarrhea 11/61 (18), p=0.306 Voming 18/61, p=0.826 Constipation 14/61 (23), p=0.544
17. Wan 2015	ICU 12.2 <u>+</u> 0.7 (35)	ICU 17.1 <u>+</u> 1.0 (35)	5.2 <u>+</u> 0.3 (35)	8.5 <u>+</u> 0.5 (35)	NR	Cost 5203 <u>+</u> 247 Diarrhea 9/35 Reflux 1/35	Cost 7786 <u>+</u> 555, P <0.01 Diarrhea 9/35 Reflux 14/35, P <0.01

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) NR: not reported

8

Figure 1. Mortality

	Small B	owel	Gasti	ric		Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
Montecalvo	5	19	5	19	3.1%	1.00 [0.35, 2.90]	
Kortbeek	4	37	3	43	1.7%	1.55 [0.37, 6.48]	
Taylor	5	41	6	41	2.8%	0.83 [0.28, 2.52]	
Kearns	5	21	6	23	3.3%	0.91 [0.33, 2.55]	
Minard	1	12	4	15	0.8%	0.31 [0.04, 2.44]	· · · · · · · · · · · · · · · · · · ·
Esparaza	10	27	11	27	7.7%	0.91 [0.47, 1.78]	
Boivin	18	39	18	39	15.1%	1.00 [0.62, 1.62]	
Davies 2002	4	34	5	39	2.3%	0.92 [0.27, 3.14]	
Montejo	19	50	22	51	15.4%	0.88 [0.55, 1.42]	
Hsu	26	59	24	62	19.1%	1.14 [0.74, 1.74]	
White	11	51	5	57	3.6%	2.46 [0.92, 6.60]	
Acosta-Escribano	6	50	9	54	3.8%	0.72 [0.28, 1.88]	
Davies 2012	13	91	12	89	6.5%	1.06 [0.51, 2.19]	
Friedman	20	54	22	61	14.9%	1.03 [0.63, 1.66]	
Total (95% CI)		585		620	100.0%	1.01 [0.84, 1.22]	. ◆
Total events	147		152				
Heterogeneity: Tau ² =	= 0.00; Chi	² = 6.11	df = 13 (P = 0.9	4); I ² = 09	6	
Test for overall effect:							0.1 0.2 0.5 1 2 5 10
							Favours small bowel Favours gastric

Figure 2. Mortality (excluding Taylor and Minard)

	Small B	owel	Gastr	ic		Risk Ratio		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	Year	M-H, Random, 95% Cl
Montecalvo	5	19	5	19	3.2%	1.00 [0.35, 2.90]	1992	
Kortbeek	4	37	3	43	1.8%	1.55 [0.37, 6.48]	1999	
Kearns	5	21	6	23	3.4%	0.91 [0.33, 2.55]	2000	
Esparaza	10	27	11	27	8.0%	0.91 [0.47, 1.78]	2001	
Boivin	18	39	18	39	15.6%	1.00 [0.62, 1.62]	2001	
Davies 2002	4	34	5	39	2.4%	0.92 [0.27, 3.14]	2002	
Montejo	19	50	22	51	16.0%	0.88 [0.55, 1.42]	2002	
Hsu	26	59	24	62	19.9%	1.14 [0.74, 1.74]	2009	
White	11	51	5	57	3.7%	2.46 [0.92, 6.60]	2010	
Acosta-Escribano	6	50	9	54	3.9%	0.72 [0.28, 1.88]	2010	
Davies 2012	13	91	12	89	6.8%	1.06 [0.51, 2.19]	2012	
Friedman	20	54	22	61	15.4%	1.03 [0.63, 1.66]	2015	
Total (95% CI)		532		564	100.0%	1.03 [0.85, 1.24]		◆
Total events	141		142					
Heterogeneity: Tau² =	: 0.00; Chi ^a	² = 4.73,	, df = 11 (P = 0.9	4); I ^z = 09	6		
Test for overall effect:	Z = 0.30 (P = 0.77	7)					0.1 0.2 0.5 1 2 5 10 Favours small bowel Favours gastric

Figure 3. Pneumonia

5	Small Bo	owel	Gastr	ic		Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
Montecalvo	4	19	6	19	4.3%	0.67 [0.22, 1.99]	
Kortbeek	10	37	18	43	9.9%	0.65 [0.34, 1.22]	
Taylor	18	41	26	41	15.8%	0.69 [0.46, 1.05]	
Kearns	4	21	3	23	2.9%	1.46 [0.37, 5.78]	
Minard	6	12	7	15	7.4%	1.07 [0.49, 2.34]	
Day	0	14	2	11	0.7%	0.16 [0.01, 3.03]	•
Davies 2002	2	31	1	35	1.1%	2.26 [0.22, 23.71]	
Montejo	16	50	20	51	12.4%	0.82 [0.48, 1.39]	
Hsu	5	59	15	62	5.5%	0.35 [0.14, 0.90]	
White	11	57	5	51	5.1%	1.97 [0.73, 5.28]	
Acosta-Escribano	16	50	31	54	14.2%	0.56 [0.35, 0.89]	
Davies 2012	18	91	19	89	11.2%	0.93 [0.52, 1.65]	
Friedman	13	54	12	61	8.8%	1.22 [0.61, 2.45]	
Wan	0	35	10	35	0.8%	0.05 [0.00, 0.78]	•
Total (95% CI)		571		590	100.0%	0.78 [0.61, 1.00]	◆
Total events	123		175				
Heterogeneity: Tau ² =	0.06; Chi ^a	² = 18.0 ¹	7, df = 13	(P = 0.	15); I ² = 2	8%	
Test for overall effect:	Z = 1.99 (F	P = 0.05	j)	-			0.1 0.2 0.5 1 2 5 10 Favours Small bowel Favours Gastric

Figure 4. Pneumonia	(excluding	Taylor	and Minard)
---------------------	------------	--------	-------------

	Small B	owel	Gastr	ic		Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
Montecalvo	4	19	6	19	6.3%	0.67 [0.22, 1.99]	
Kortbeek	10	37	18	43	12.7%	0.65 [0.34, 1.22]	
Kearns	4	21	3	23	4.3%	1.46 [0.37, 5.78]	
Day	0	14	2	11	1.1%	0.16 [0.01, 3.03]	←
Davies 2002	2	31	1	35	1.7%	2.26 [0.22, 23.71]	
Montejo	16	50	20	51	15.2%	0.82 [0.48, 1.39]	
Hsu	5	59	15	62	7.8%	0.35 [0.14, 0.90]	-
White	11	57	5	51	7.3%	1.97 [0.73, 5.28]	
Acosta-Escribano	16	50	31	54	16.8%	0.56 [0.35, 0.89]	-
Davies 2012	18	91	19	89	14.1%	0.93 [0.52, 1.65]	
Friedman	13	54	12	61	11.6%	1.22 [0.61, 2.45]	
Wan	0	35	10	35	1.2%	0.05 [0.00, 0.78]	·
Total (95% CI)		518		534	100.0%	0.77 [0.57, 1.06]	•
Total events	99		142				
Heterogeneity: Tau ² =	= 0.10; Chi ^a	² = 17.1	6. df = 11	(P = 0.	10); I ² = 3	6%	
Test for overall effect:	-		-	,	<i></i>		0.1 0.2 0.5 1 2 5 10 Favours Small bowel Favours Gastric

Figure 5. ICU LOS

5	Small Bowel			0	Gastric			Mean Difference	Mean Difference			
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI			
Montecalvo	11.7	8.2	19	12.3	10.8	19	8.1%	-0.60 [-6.70, 5.50]				
Kearns	17	2	21	16	2	23	11.2%	1.00 [-0.18, 2.18]	⊢			
Minard	18.5	8.8	12	11.3	6.1	15	8.3%	7.20 [1.34, 13.06]	│ ———→			
Davies 2002	13.9	1.8	34	10.4	1.2	39	11.3%	3.50 [2.79, 4.21]				
Montejo	15	10	50	18	16	51	8.8%	-3.00 [-8.19, 2.19]				
Hsu	18.2	11.8	59	18.2	11.2	62	9.6%	0.00 [-4.10, 4.10]				
White	7.12	6	51	9.1	10.55	55	10.2%	-1.98 [-5.22, 1.26]				
Acosta-Escribano	16	9	50	18	7	54	10.3%	-2.00 [-5.12, 1.12]				
Davies 2012	12.5	8.6	91	12.7	9.8	89	10.6%	-0.20 [-2.90, 2.50]				
Wan	12.2	0.7	35	17.1	1	35	11.4%	-4.90 [-5.30, -4.50]	+			
Total (95% CI)			422			442	100.0%	-0.19 [-3.46, 3.07]				
Heterogeneity: Tau ² =	24.35; 0	Chi²=	456.45	, df = 9 ((P < 0.0)	0001);1	²=98%		-10 -5 0 5 10			
Test for overall effect:	Z = 0.12	2 (P = 0	0.91)						Favours Small Bowel Favours Gastric			

Figure 6. ICU LOS (excluding Minard)

0	•											
	Small Bowel			6	Gastric			Mean Difference		Mean Difference		
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	Year	IV, Random, 95% Cl		
Montecalvo	11.7	8.2	19	12.3	10.8	19	8.9%	-0.60 [-6.70, 5.50]	1992			
Kearns	17	2	21	16	2	23	12.3%	1.00 [-0.18, 2.18]	2000	⊢		
Davies 2002	13.9	1.8	34	10.4	1.2	39	12.4%	3.50 [2.79, 4.21]	2002			
Montejo	15	10	50	18	16	51	9.6%	-3.00 [-8.19, 2.19]	2002			
Hsu	18.2	11.8	59	18.2	11.2	62	10.5%	0.00 [-4.10, 4.10]	2009			
White	7.12	6	51	9.1	10.55	55	11.2%	-1.98 [-5.22, 1.26]	2010			
Acosta-Escribano	16	9	50	18	7	54	11.3%	-2.00 [-5.12, 1.12]	2010			
Davies 2012	12.5	8.6	91	12.7	9.8	89	11.5%	-0.20 [-2.90, 2.50]	2012			
Wan	12.2	0.7	35	17.1	1	35	12.4%	-4.90 [-5.30, -4.50]	2015	+		
Total (95% CI)			410			427	100.0%	-0.86 [-4.25, 2.53]				
Heterogeneity: Tau ² = Test for overall effect				, df = 8 ((P < 0.0)	0001);	° = 98%			-10 -5 0 5 10		
restion overall effect	. 2 - 0.30		5.02)							Favours Small Bowel Favours Gastric		

Figure 7. Hospital LOS

	Small Bowel			G	astric			Mean Difference		Mean Difference				
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	Year	IV, Random, 95% CI				
Keams	39	10	21	43	11	23	29.3%	-4.00 [-10.21, 2.21]	2000	← =				
Minard	30	14.7	12	21.3	14.7	12	10.9%	8.70 [-3.06, 20.46]	2000					
Hsu	36	24.2	59	31.7	21.1	62	20.1%	4.30 [-3.81, 12.41]	2009					
Acosta-Escribano	38	24	50	41	28	54	14.4%	-3.00 [-13.00, 7.00]	2010	• • • • • • • • • • • • • • • • • • •				
Davies 2012	28.8	26.1	91	27.4	21.1	89	25.3%	1.40 [-5.53, 8.33]	2012					
Total (95% CI)			233			240	100.0%	0.56 [-3.60, 4.73]						
Heterogeneity: Tau ² =	5.40; Ch	ni² = 5.	25, df =	= 4 (P =	0.26);	² = 24	%							
Test for overall effect:									F	-10 -5 0 5 10 Favours Small Bowel Favours Gastric				

Figure 8. Duration of ventilation

5	Small Bowel			G	astric			Mean Difference	Mean Difference		
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI		
Montecalvo	10.2	7.1	19	11.4	10.8	19	7.2%	-1.20 [-7.01, 4.61]			
Minard	15.1	7.5	12	10.4	6.1	15	8.3%	4.70 [-0.55, 9.95]			
Hsu	28.5	24.9	59	23.8	18.2	62	4.6%	4.70 [-3.10, 12.50]			
White	5.73	5.29	51	7.68	9.81	55	15.0%	-1.95 [-4.92, 1.02]			
Acosta-Escribano	7.3	4	50	8.9	4	54	20.9%	-1.60 [-3.14, -0.06]			
Davies 2012	9.8	6.2	91	9.7	6.3	89	19.7%	0.10 [-1.73, 1.93]	+		
Wan	5.2	0.3	35	8.5	0.5	35	24.3%	-3.30 [-3.49, -3.11]	•		
Total (95% CI)			317			329	100.0%	-0.89 [-2.75, 0.97]	-		
Heterogeneity: Tau ² =	= 3.70; C	hi ² = 3	1.48, di	f= 6 (P	< 0.00	01); I ^z =	81%				
Test for overall effect:	Z = 0.94	4 (P = (0.35)						Favours Small Bowel Favours Gastric		

Figure 9. Nutritional efficiency (%)

	Smal	/el	G	astric		Mean Difference			Mean Difference		
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	Year	IV, Random, 95% CI	
Montecalvo	61	17	19	46.9	25.9	19	9.7%	14.10 [0.17, 28.03]	1992		
Kearns	69	- 7	21	47	7	23	19.7%	22.00 [17.86, 26.14]	2000		
Montejo	80	28	50	75	30	51	12.0%	5.00 [-6.31, 16.31]	2002		
Hsu	95	5	59	83	6	62	21.3%	12.00 [10.04, 13.96]	2009	+	
Acosta-Escribano	92	- 7	50	84	15	54	19.4%	8.00 [3.55, 12.45]	2010		
Davies 2012	72	21	91	71	19	89	17.9%	1.00 [-4.85, 6.85]	2012		
Total (95% CI)			290			298	100.0%	10.59 [4.76, 16.41]		•	
Heterogeneity: Tau² =	40.41; C	∶hi²=	40.66,	df = 5 (F	× 0.00	0001);	l² = 88%			-50 -25 0 25 50	
Test for overall effect:	Z = 3.56	(P = (0.0004)	l						Favours Gastric Favours Small Bowel	

Figure 10. Time to reach EN target

5	Sma	all Bow	/el	G	astric			Mean Difference		Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	Year	IV, Random, 95% CI
Kortbeek	34	7.1	37	43.8	22.6	43	26.9%	-9.80 [-16.93, -2.67]	1999	
Davies 2002	23.2	3.9	31	23	3.4	35	30.8%	0.20 [-1.58, 1.98]	2002	•
Neumann	43	24.1	30	28.8	15.9	30	23.4%	14.20 [3.87, 24.53]	2002	 −−∎−−
Hsu	32.4	27.1	59	54.5	51.4	62	18.8%	-22.10 [-36.64, -7.56]	2009	_
Total (95% CI)			157			170	100.0%	-3.41 [-13.45, 6.62]		-
Heterogeneity: Tau ² =	= 84.16; •	Chi²=	23.32,	df = 3 (F	× 0.00	001); I ^z	= 87%			-50 -25 0 25 50
Test for overall effect:	Z = 0.67	7 (P = 0	0.51)							Favours small bowel Favours gastric

Table 2. Excluded Articles

#	Reason excluded	Citation
1	Pseudo-randomized	Grahm TW, Zadrozny DB, Harrington T. The benefits of early jejunal hyperalimentation in the head-injured patient. Neurosurgery 1989 Nov;25(5):729-35.
2	Not ICU patients	Strong RM, Condon SC, Solinger MR, Namihas BN, Ito-Wong LA, Leuty JE. Equal aspiration rates from postpylorus and intragastric-placed small-bore nasoenteric feeding tubes: a randomized, prospective study. JPEN J Parenter Enteral Nutr. 1992 Jan-Feb;16(1):59-63.
3	No clinical outcomes	Heyland DK, Drover JW, MacDonald S, Novak F, Lam M. Effect of postpyloric feeding on gastroesophageal regurgitation and pulmonary microaspiration: results of a randomized controlled trial. Crit Care Med 2001;29(8):1495-501.
4	Systematic review	Heyland DK, Drover JW, Dhaliwal R, Greenwood J. Optimizing the benefits and minimizing the risks of enteral nutrition in the critically ill: role of small bowel feeding. JPEN J Parenter Enteral Nutr. 2002 Nov-Dec;26(6 Suppl):S51-5; discussion S56-7.
5	Systematic review	Marik PE, Zaloga GP. Gastric versus post-pyloric feeding: a systematic review. Crit Care. 2003 Jun;7(3):R46-51. Epub 2003 May 6.
6	<50% ICU patients	Eatock FC, Chong P, Menezes N, Murray L, McKay CJ, Carter CR, Imrie CW. A randomized study of early nasogastric versus nasojejunal feeding in severe acute pancreatitis. Am J Gastroenterol. 2005 Feb;100(2):432-9.
7	Meta-analysis	Ho KM, Dobb GJ, Webb SA. A comparison of early gastric and post-pyloric feeding in critically ill patients: a meta-analysis. Intensive Care Med. 2006 May;32(5):639-49.
8	Not ICU patients	Kumar A, Singh N, Prakash S, Saraya A, Joshi YK. Early enteral nutrition in severe acute pancreatitis: a prospective randomized controlled trial comparing nasojejunal and nasogastric routes. J Clin Gastroenterol. 2006 May-Jun;40(5):431-4.
9	No clinical outcomes	Zeng R, Jiang F. Comparison of nose jejunal tube and nasogastric tube in providing early enteral nutrition for patients with severe craniocerebral injury. Chinese Journal of Clinical Nutrition. 2010;18(6):355-357.
10	Meta-analyses	Jiyong J, Tiancha H, Huiqin W, Jingfen J. Effect of Gastric Versus Post-pyloric Feeding on the Incidence of Pneumonia in Critically ill Patients: Observations From Traditional and Bayesian Random-Effects meta-analysis. Intensive Care Med. 2013;32(1):8-15
11	Not ICU patients	Singh N, Sharma B, Sharma M, Sachdev V, Bhardwaj P, Mani K, Joshi YK, Saraya A. Evaluation of early enteral feeding through nasogastric and nasojejunal tube in severe acute pancreatitis: a noninferiority randomized controlled trial. Pancreas. 2012 Jan;41(1):153-9.
12	Identical study as Hsu 2009	Huang HH, Chang SJ, Hsu CW, Chang TM, Kang SP, Liu MY. Severity of illness influences the efficacy of enteral feeding route on clinical outcomes in patients with critical illness. Journal of the Academy of Nutrition and Dietetics. 2012.
13	Systematic Review	Deane AM, Dhaliwal R, Day AG, Ridley EJ, Davies AR, Heyland DK. Comparisons between intragastric and small intestinal delivery of enteral nutrition in the critically ill: a systematic review and meta-analysis.Crit Care. 2013 Jun 21;17(3):R125.
14	Meta-analyses	Wang X, Dong Y, Han X, Qi X-Q, Huang C-G, Hou L. (2013) Nutritional Support for Patients Sustaining Traumatic Brain Injury: A Systematic Review and Meta-Analysis of Prospective Studies. PLoS ONE. 8(3): e58838.
15	Meta analyses	Alkhawaja S, Martin C, Butler RJ, Gwadry-Sridhar F. Post-pyloric versus gastric tube feeding for preventing pneumonia and improving nutritional outcomes in critically ill adults. Cochrane Database Syst Rev. 2015 Aug 4;(8):CD008875.