

Appendix A: Opioid Equianalgesic Conversion Ratios for use with examples:

Morphine 10 mg parenteral = Morphine 30 mg oral = Hydromorphone 1.5 mg parenteral =
Hydromorphone 7.5 mg oral

A. Change route, keeping drug the same (e.g. oral to IV morphine)

- Example: Change 90 mg q12 Extended Release Morphine to Morphine by IV continuous infusion
 1. Calculate the 24 hour current dose: 90mg q 12 = 180 mg Morphine/24 hours
 2. Use the oral to parenteral equianalgesic ratio: 30 mg PO Morphine = 10 mg IV Morphine
 3. Calculate new dose using ratios: $180/30 \times 10 = 60$ mg IV Morphine/24

B. Change drug, keep the same route (e.g. po morphine to po hydromorphone)

- Example: Change 90 mg q 12 Extended Release Morphine to oral Hydromorphone.
 1. Calculate the 24 hour current dose: 90 Q12 x 2 = 180 mg PO Morphine/24 hrs
 2. Use the equianalgesic ratio: 30 mg PO Morphine = 7.5 mg PO Hydromorphone
 3. Calculate new dose using ratios: $180/30 \times 7.5 = 45$ mg oral Hydromorphone/24 hours.

C. Changing drug and route (e.g. oral morphine to IV hydromorphone)

- Example: Change from 90 mg q12 Extended Release Morphine to IV Hydromorphone as a continuous infusion.
 1. Calculate the 24 hour current dose: 90 Q12 x 2 = 180 mg PO Morphine/24 hrs
 2. Use the equianalgesic ratio of PO to IV morphine: 30 mg po Morphine = 10 mg IV Morphine
 3. Calculate new dose using ratios: $180/30 \times 10 = 60$ mg IV Morphine/24 hours
 4. Use the equianalgesic ratio of IV Morphine to IV Hydromorphone: 10 mg Morphine = 1.5 mg Hydromorphone
 5. Calculate new dose using ratios: $60/10 \times 1.5 = 9$ mg IV Hydromorphone/24 hours

Equivalent to Morphine 10 mg parenteral (iv, sc, im)

Morphine parenteral	10 mg
Morphine oral	30 mg
Codeine parenteral	100
Codeine oral	200
Hydromorphone parenteral	1.5
Hydromorphone oral	7.5
Oxycodone oral	20
Hydrocodone po	30
Oxymorphone parenteral	1 mg
Oxymorphone rectal	10
Oxymorphone oral	15
Levorphanol parenteral	2
Levorphanol oral	4
Methadone parenteral	10
Methadone oral	20
Fentanyl parenteral	0.1 mg
Fentanyl transdermal	Approximate equivalent doses for oral morphine, IV/SQ morphine, and TD fentanyl 60 mg/day oral \approx 20 mg/day IV/SQ \approx 25 micrograms/hour TD 120 mg/day oral \approx 40 mg/day IV/SQ \approx 50 micrograms/hour

	TD 180 mg/day oral \approx 60 mg/day IV/SQ \approx 75 micrograms/hour TD 240 mg/day oral \approx 80 mg/day IV/SQ \approx 100 micrograms/hour TD
Fentanyl oral	0.1 mg
Buprenorphine oral	0.4
Buprenorphine parenteral	0.3
Buprenorphine transdermal	0.01/hour
Tapentadol	75
Tramadol parenteral	100
Tramadol oral	120
Meperidine parenteral	100
Meperidine oral	300
Pentazocine	100
Propoxyphene	65

Appendix B: ICD-9 codes

Code Description	ICD-9 Code
<i>Primary Outcomes</i>	
Obstructive Sleep Apnea	327.23
Other codes for Obstructive Sleep Apnea	327.20 – 327.21
	327.26 – 327.27
	780.51
	780.53
	780.57
	786.04
Noninvasive Ventilation	93.90
Invasive Mechanical Ventilation	96.04
	96.70 - 96.72
<i>Bariatric Surgery Procedure categories</i>	
Adjust size gastric restrictive device	7.62
Open/ other partial gastrectomy	43.89
High gastric bypass	44.31
Laparoscopic gastroenterostomy	44.38
Gastroenterostomy NEC	44.39
Laparoscopic gastropasty	44.68
Laparoscopic gastric restrictive procedure	44.95
Laparoscopic revision of gastric restrictive procedure	44.96
Laparoscopic removal of gastric restrictive device	44.97
Small-to-small intestinal anastomosis	45.91
Part gastrectomy w/jejunum anast	50.11
Intestinal anastomosis NOS	85.32
Size reduction plastic operation	86.83
<i>Secondary Outcomes</i>	
<i>Delirium</i>	
Pre-senile dementia with delirium	290.11
Senile dementia with delirium	290.3
Vascular dementia with delirium	290.41
Drug-induced delirium	292.81
Sub-acute delirium	293.1
Reactive confusion	298.2
<i>Cardiac Arrest</i>	
Personal history of sudden cardiac arrest	V12.53
Cardiopulmonary resuscitation, not otherwise specified	99.60
Closed chest cardiac massage	99.63
Cardiac arrest	427.5

Exacerbations of heart failure	
Congestive heart failure, unspecified	428.0
Left heart failure	428.1
Acute systolic heart failure	428.21
Acute on chronic systolic heart failure	428.23
Acute diastolic heart failure	428.31
Acute on chronic diastolic heart failure	428.33
Acute combined systolic and diastolic heart failure	428.41
Acute on chronic combined systolic and diastolic heart failure	428.43
Acute coronary syndrome/ Acute Myocardial Infarction	
Intermediate coronary syndrome	411.1
Acute myocardial infarction	410.xx
Atrial and ventricular arrhythmias	
Conversion of cardiac rhythm	99.6
Atrial cardioversion	99.61
Cardiac dysrhythmias (exclude 427.6, premature beats)	427.xx
Atrial fibrillation/ flutter	
Atrial fibrillation	427.31
Atrial flutter	427.32

Table S1: Covariates in matched sample (815 out of 996, 82% are matched)

	Overall (N=1630)	Early postoperative NIV (N=815)	No Early postoperative NIV (N=815)	p-value
<i>Patient Characteristics</i>				
Gender, n (%)				0.34
Female	1112 (68.2%)	547 (67.1%)	565 (69.3%)	
Male	518 (31.8%)	268 (32.9%)	250 (30.7%)	
Age, Median (Q1, Q3)	50 (43, 57)	50 (43, 57)	51 (43,58)	0.55
Race, n (%)				0.24
White	1160 (71.2%)	568 (69.7%)	592 (72.6%)	
Black	178 (10.9%)	94 (11.5%)	84 (10.3%)	
Hispanic	32 (2.0%)	21 (2.6%)	11 (1.4%)	
Other	260 (16.0%)	132 (16.2%)	128 (15.7%)	
Insurance Payor, n (%)				0.21
Medicare	441 (27.1%)	230 (28.2%)	211 (25.9%)	
Medicaid	87 (5.3%)	50 (6.1%)	37 (4.5%)	
Managed care	844 (51.8%)	420 (5.5%)	424 (52.0%)	
Commercial-Indemnity	129 (7.9%)	58 (7.1%)	71 (8.7%)	
Other	129 (7.9%)	57 (7.0%)	72 (8.8%)	
Comorbidities, n (%)				
Hypertension	1212 (74.4%)	617 (75.7%)	595 (73.0%)	0.21
Diabetes	834 (5.1%)	421 (51.7%)	413 (50.7%)	0.69
Depression/ Psychoses	588 (36.1%)	296 (36.3%)	292 (35.8%)	0.84
Chronic pulmonary disease	561 (34.4%)	275 (33.7%)	286 (35.1%)	0.57
Liver disease	216 (13.3%)	109 (13.4%)	107 (13.1%)	0.88
Hypothyroidism	260 (16.0%)	124 (15.2%)	136 (16.7%)	0.42
Deficiency Anemias	194 (11.9%)	97 (11.9%)	97 (11.9%)	1.00
Congestive Heart Failure	120 (7.4%)	58 (7.1%)	62 (7.6%)	0.70
Renal failure	93 (5.7%)	58 (7.1%)	35 (4.3%)	0.01
Neurological disorders	85 (5.2%)	43 (5.3%)	42 (5.2%)	0.91
Combined Comorbidity score, Median (Q1,Q3)	0 (0, 1)	0 (0, 1)	0 (0, 1)	0.20
ABG or Chest X-ray day 1 or 2, n (%)	681 (41.8%)	369 (45.3%)	312 (38.3%)	0.004
ABG or Chest X-ray day 1, n (%)	559 (34.3%)	304 (37.3%)	255 (31.3%)	0.01
Medications on day of surgery, n (%)				
IV Narcotics short acting	1503 (92.2%)	752 (92.3%)	751 (92.1%)	0.93
Total Narcotic	38.78 (19.6, 76.3)	36.67 (19.25, 72.29)	40 (19.9, 80.5)	0.32
Oral Acetaminophen	695 (42.6%)	350 (42.9%)	345 (42.3%)	0.80
Total Benzo	4 (4, 8)	4 (4, 8)	4 (4, 8)	0.39
Medications on day after surgery, n (%)				
Total Narcotic	26.7 (10, 52.5)	24.75 (10, 53.3)	26.67 (10, 50)	0.62
Total Benzo	4 (4, 8)	4 (2.5, 8)	4 (4, 8)	0.73

	Overall (N=1630)	Early postoperative NIV (N=815)	No Early postoperative NIV (N=815)	p- value
Anesthesia, n (%)				0.71
General Anesthesia Only	1415 (86.8%)	707 (86.7%)	708 (86.9%)	
General Anesthesia + Neuraxial	43 (2.6%)	24 (2.9%)	19 (2.3%)	
Unclear Anesthesia	172 (10.6%)	84 (10.3%)	88 (10.8%)	
Bariatric surgery type, n (%)				0.51
Restrictive	340 (20.9%)	179 (22.0%)	161 (19.8%)	
Laparoscopic Bypass	1068 (65.5%)	524 (64.3%)	544 (66.7%)	
Open Bypass	222 (13.6%)	112 (13.7%)	110 (13.5%)	
<i>Hospital Characteristics</i>				
Urban/ Rural, n (%)				0.49
Rural	53 (3.3%)	29 (3.6%)	24 (2.9%)	
Urban	1577 (96.8%)	786 (96.4%)	791 (97.1%)	
Teaching, n (%)				0.46
Yes	801 (49.1%)	408 (50.1%)	393 (48.2%)	
No	829 (50.9%)	407 (49.9%)	422 (51.8%)	
Bed size, n (%)				0.80
Small (< 200)	84 (5.2%)	45 (5.5%)	39 (4.8%)	
Medium (200 – 399)	722 (44.3%)	360 (44.2%)	362 (44.4%)	
Large (≥ 400)	824 (50.6%)	410 (50.3%)	414 (50.8%)	
Provider area, n (%)				0.97
Midwest	704 (43.2%)	350 (42.9%)	354 (43.4%)	
Northeast	360 (22.1%)	181 (22.2%)	179 (22.0%)	
South	378 (23.2%)	187 (22.9%)	191 (23.4%)	
West	188 (11.5%)	97 (11.9%)	91 (11.2%)	
OSA rate for Bariatric Patients, Median(IQR)	0.60 (0.48, 0.68)	0.6 (0.48, 0.74)	0.6 (0.48, 0.75)	0.65
Hospital NIV Rate, Median (IQR)				
Bariatric OSA Patients	0.27 (0.06,0.27)	0.27 (0.19, 0.39)	0.27 (0.19, 0.39)	0.73
All Surgical Patients (Day 1, 2)	0.019 (0.01,0.033)	0.019 (0.01, 0.03)	0.019 (0.01, 0.03)	0.62
Surgical OSA Patients (Day 1, 2)	0.173 (0.12,0.225)	0.169 (0.12,0.26)	0.178 (0.12, 0.23)	0.73

ABG = Arterial Blood Gas, CXR = Chest X-Ray, IQR = Interquartile Range, OSA = Obstructive Sleep Apnea

Table S2: Outcomes in propensity score matched sample (471 out of 575, 82% were matched) for patients without ABG or CXR on the day of surgery (with or without early NIV)

	Overall (N=942)	Early NIV (N=471)	No Early NIV (N=471)	p-value
IMV within 3 days, n (%)	33 (3.5%)	19 (4.0%)	14 (3.0%)	0.38
IMV prolonged, n (%)	10 (1.1%)	4 (0.9%)	6 (1.3%)	0.52
Acute coronary syndrome/ Myocardial Infarction, n (%)	2 (0.2%)	1 (0.2%)	1 (0.2%)	1.00
Atrial and ventricular, n (%) arrhythmias	111 (11.8%)	58 (12.3%)	53 (11.3%)	0.61
Atrial fibrillation/ Flutter, n (%)	19 (2.0%)	10 (2.1%)	9 (1.9%)	0.82
Exacerbations of heart failure, n (%)	12 (1.3%)	5 (1.1%)	7 (1.5%)	0.56
Cardiac arrest, n (%)	3 (0.3%)	1 (0.2%)	2 (0.4%)	1.00
Delirium, n (%)	3 (0.3%)	2 (0.4%)	1 (0.2%)	1.00
Naloxone, n (%)	46 (4.9%)	29 (6.2%)	17 (3.6%)	0.07