APPENDIX 1: LITERATURE SEARCH STRATEGY

Clinical Effectiveness Studies

OVERVIEW	
Interface:	Ovid
Databases:	EMBASE <1988 to 2007 Week 23> International Pharmaceutical Abstracts < 1970 to June 2007> Medline® <1950 to May Week 3 2007> Pascal <1987 to June 2007> * Note: Subject headings have been customized for each database.
Date of Search:	June 13 and 20, 2007
Date of Update	November 26 (MEDLINE) and 29 (EMBASE), 2007
Study Types:	Applied filter for randomized controlled trials, controlled clinical trials. Prospective observational studies filter used for EMBASE. Left open for all other databases
Limits:	Adults

SYNTAX GUIDE	
/	At the end of a phrase, searches the phrase as a subject heading
MeSH	Medical Subject Heading
fs	Floating subheading
exp	Explode a subject heading
$	Truncation symbol, or wildcard: retrieves plural or variations of a word
*	Indicates that the marked subject heading is a primary topic
ADJ	Requires words are adjacent to each other (in any order)
ADJ#	Adjacency within # number of words (in any order)
.ti	Title
.ab	Abstract
.jn.	Journal
.mp	Title, Abstract, Subject Heading, CAS Registry/EC Number Word
.pt	Publication type
.rn	CAS registry number

MULTI-FILE STRATEGY

Line #	Search	Results
1	exp Emergency Service, Hospital/	

2	emergency medical services/
3	exp emergencies/
4	"HOSPITAL EMERGENCY SERVICE".mp.
5	(ED or ER).mp.
6	(EDs or ERs).mp.
7	((emergenc$ adj5 (departmen$ or ward$ or service$ or unit$ or room$ or hospital$ or care or patient$ or physician$ or doctor$ or medicine or treatment$)).mp.
8	(emergency or emergencies).jn.
9	exp Emergency Medicine/
10	or/1-9
11	exp conscious sedation/
12	(procedur$ adj3 sedat$).mp.
13	psaa.ti,ab.
14	exp propofol/
15	2078-54-8.rn.
16	propofol$.mp.
17	disoprofol.mp.
18	diprovan.mp.
19	diprivan.mp.
20	aquafol.mp.
21	disoprivan.mp.
22	fresofol.mp.
23	"ici-35,868".mp.
24	"ici-35868".mp.
25	ivofol.mp.
26	recofol.mp.
27	diisopropylphenol.mp.
28	rapinovet.mp.
29	exp Ketamine/
30	6740-88-1.rn.
31	ketamin$.mp.
32	cetamina.mp.
33	"ci581".mp.
34	(ci-581 or "ci 581").mp.

35	cn523722.mp.
36	(cl369 or cl-369 or "cl 369").mp.
37	calipsol.mp.
38	calypsol.mp.
39	esketamine.mp.
40	kalipsol.mp.
41	ketalar.mp.
42	ketolar.mp.
43	ketanest.mp.
44	ketaset.mp.
45	ketavet.mp.
46	ketased.mp.
47	katamine.mp.
48	ketaject.mp.
49	ketoject.mp.
50	ketaminol.mp.
51	narkamon.mp.
52	velonarcon.mp.
53	vetalar.mp.
54	"special k".ti,ab.
55	exp Etomidate/
56	33125-97-2.rn.
57	etomidat$.mp.
58	ethomidat.mp.
59	amidate.mp.
60	ethomidate.mp.
61	hypnomidate.mp.
62	(r26490 or r7405).mp.
63	"r 26 490".mp.
64	(r 7405 or r 26490).mp.
65	radenarkon.mp.
66	radenarcon.mp.
67	ketafol.mp.
68	"propofol/ketamine".mp.
69	((short adj acting) or dissociative) adj3 (agent$ or medication$)).ti,ab.

70	or/11-68	
71	10 and 70	
72	limit 71 to "all adult (19 plus years)"	
73	(adult$ or men or man or women or woman or elderly).mp.	
74	71 and 73	
75	72 or 74	375

OVERVIEW	
Interface:	EBSCO
Databases:	Academic Search Premier (1865 to 2007); CINAHL Plus with Full Text (1937 to 2007); Health Source: Nursing/Academic Edition (1975 to 2007)
Date of Search:	June 15, 2007
Study Types:	Left open
Limits:	None Applied

SYNTAX GUIDE	
.sh	At the end of a phrase, searches the phrase as a subject heading
MH	Major Subject Heading
+	Explode a subject heading
*	Truncation symbol, or wildcard: retrieves plural or variations of a word
TI	Title
SO	Journal or Source

MULTI-FILE STRATEGY

Line #	Search	Results
S14	S12 not S13	297
S13	TI pediatric* or child*	
S12	S11 and S7	
S11	S10 or S9 or S8	
S10	(Emergency or emergencies) or ((emergenc*) and (departmen* or ward* or service* or unit* or room* or hospital* or care or patient* or physician* or doctor* or medicine or treatment* or nurs* or staff*))	
S9	SO emergency or emergencies	
S8	(MH "Emergency Nurse Practitioners") or (MH "Physicians, Emergency") or (MH "Emergency Service+") or (MH "Emergency Medical Services")	

S7	S6 or S5 or S4 or S3 or S2 or S1
S6	(MH "Ketamine")
S5	(MH "Etomidate") or (MH "Propofol")
S4	(MH "Anesthetics, Dissociative+")
S3	(MH "Premedication")
S2	(MH "Conscious Sedation")
S1	(procedural sedat*) or etomidat* or amidate or hynomidate or propofol or diprovan or disoprofol or diisopropylpheno or ketamin* or esketamin* or cetamina or (conscious sedat*) or (short acting agent*) or (dissociative agent*)

OVERVIEW	
Interface:	Wiley
Databases:	The Cochrane Library (Issue 2 2007) Cochrane Database of Systematic Reviews (CDSR) Database of Abstracts of Reviews of Effects (DARE) Cochrane Central Register of Controlled Trials (CENTRAL) Health Technology Assessment Database (HTA)
Date of Search:	June 14, 2007
Study Types:	Not required
Limits:	None Applied
SYNTAX GUIDE	
MeSH descriptor	Medical Subject Heading
Explode all trees	Explode a subject heading
*	Truncation symbol, or wildcard: retrieves plural or variations of a word
NEXT	Requires words are adjacent to each other (in any order)
ti	Title
ab	Abstract
kw	Heading Word; usually includes subject headings and controlled vocabulary
MULTI-FILE STRATEGY	
#1	(procedural sedat*):ti,ab,kw
#2	(etomidat* or amidate or hynomidate):ti,ab,kw
#3	(propofol or diprovan or disoprofol or diisopropylpheno):ti,ab,kw
#4	(ketamin* or esketamin* or cetamina):ti,ab,kw
#5	(conscious sedat*):ti,ab,kw

#6	(short acting agent*):ti,ab,kw
#7	(dissociative agent*):ti,ab,kw
#8	MeSH descriptor Anesthetics, Dissociative explode all trees
#9	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8)
#10	ED or EDs or ER or ERs
#11	emergency NEXT (department* or ward* or service* or unit* or room* or hospital* or care or patient* or physician* or doctor* or medicine or treatment*)
#12	(#10 OR #11)
#13	(#9 AND #12)
#14	(pediatric* or child*):ti
#15	(#13 AND NOT #14)

OVERVIEW	
Interface:	ISI Thomson Research
Databases:	BIOSIS Previews® (1969-2007) Web of Science® (1900-2007)
Date of Search:	June 18, 2007
Date of Update:	November 27, 2007
Study Types:	Left open
Limits:	None

SYNTAX GUIDE	
TS=	Topic
*	Truncation symbol, or wildcard: retrieves plural or variations of a word
SAME	Finds records containing terms in the title, the same sentence in the abstract, or the same keyword phrase
TI=	Title of Article
SO=	Source

MULTI-FILE STRATEGY

Line #	Search	Results
#14	#12 not #13	464
#13	TS=(rat or rats or mouse or mice or rodent* or rabbit or rabbits or horse or horses or equine or veterinar* or bovine or cow or cows or pig or pigs or porcine)	
#12	#10 NOT #11	
#11	TI=(pediatr* or paediatr* or child*)	
#10	#8 and #9	
#9	#6 OR #5 OR #4	
#8	#7 OR #3	
#7	TI=Emergency or TI=emergencies or TI=ED or TI=EDs or TI=ER or	

	TI=ERs
#6	TS=(conscious sedat*)
#5	TS=((short act*) SAME (dissociative agent*))
#4	TS=(procedural sedat*) or TS=etomidat* or TS=amidate or TS=hynomidate or TS=propofol or TS=diprovan or TS=disoprofol or TS=diisopropylpheno or TS=ketamin* or TS=esketamin* or TS=cetamina
#3	#1 or #2
#2	SO=(ACADEMIC EMERGENCY MEDICINE OR AMERICAN JOURNAL OF EMERGENCY MEDICINE OR ANNALS OF EMERGENCY MEDICINE OR ARCHIVES OF EMERGENCY MEDICINE OR EMERGENCY MEDICAL SERVICES OR EMERGENCY MEDICINE OR EMERGENCY MEDICINE CLINICS OF NORTH AMERICA OR EMERGENCY MEDICINE JOURNAL OR JACEP JOURNAL OF THE AMERICAN COLLEGE OF EMERGENCY PHYSICIANS OR JEMS JOURNAL OF EMERGENCY MEDICAL SERVICES OR JOURNAL OF ACCIDENT EMERGENCY MEDICINE OR JOURNAL OF EMERGENCY MEDICINE OR JOURNAL OF EMERGENCY NURSING OR PREHOSPITAL EMERGENCY CARE OR SAFETY OLDER DRIVERS TRAFFIC LAW ENFORCEMENT MANAGEMENT SCHOOL TRANSPORTATION EMERGENCY EVACUATION TRUCK "AND" BUS "AND" MOTORCYCLES)
#1	TS=Emergency or TS=emergencies or TS=ED or TS=EDs or TS=ER or TS=ERs

OVERVIEW	
Interface:	OCLC
Databases:	WorldCat - LILACS (1982-2007) PapersFirst (1993-2007)
Date of Search:	June 20, 2007
Study Types:	Left open
Limits:	None
SYNTAX GUIDE	
kw:	Keyword
*	Truncation symbol, or wildcard: retrieves plural or variations of a word
ti:	Title of Article
li:	Library

MULTI-FILE STRATEGY		
Line #	**Search**	**Results**
	(kw: procedural and kw: sedat*) or kw: etomidat* or kw: amidate or kw: hynomidate or kw: propofol or kw: diprovan or kw: disoprofol or kw: diisopropylpheno or kw: ketamin* or kw: esketamin* or kw: cetamina or (kw: conscious and kw: sedat*) or (kw: short and kw: acting and kw: agent*) or (kw: dissociative and kw: agent*) and (kw: Emergency or kw: emergencies or kw: ed or kw: eds or kw: er or kw: ers) not (ti: pediatr* or ti: paediatr* or ti: child*) and li: LILAC (ti: procedural and ti: sedat*) or ti: etomidat* or ti: amidate or ti: hynomidate or ti: propofol or ti: diprovan or ti: disoprofol or ti: diisopropylpheno or ti: ketamin* or ti: esketamin* or ti: cetamina or (ti: conscious and ti: sedat*) or (ti: short and ti: acting and ti: agent*) or (ti: dissociative and kw: agent*) and (ti: Emergency or ti: emergencies or ti: ed or ti: eds or ti: er or ti: ers) not (ti: pediatr* or ti: paediatr* or ti: child*) and li: LILAC	

OTHER DATABASES		
Database	**Search terms**	**Date of Search**
Canada's Adverse Drug Reaction Database	Etomidate, ketamine, propofol	19Jun07
Current Controlled Trials	(etomidat% OR amidate OR hynomidate OR propofol OR diprovan OR disoprofol OR diisopropylpheno% OR ketamin% OR esketamin%) AND (emergency or emergencies or ED or EDs or ER or ERs)	20Jun07
Dissertation Abstracts <1861 to 2007)	TITLE((procedural sedat*) or etomidat* or amidate or hynomidate or propofol or diprovan or disoprofol or diisopropylpheno or ketamin* or esketamin* or cetamina or (conscious sedat*) or (short acting agent*) or (dissociative agent*)) AND NOT TITLE (pediatr* or child* or paediatr* or horse* or animal* or rat* or mouse or mice)	19Jun07
National Research Register	#1. ((procedural next sedat*) or etomidat* or amidate or hynomidate or propofol or diprovan or disoprofol or diisopropylpheno or ketamin* or esketamin* or cetamina or (conscious next sedat*)	20Jun07

	or (short next acting next agent*) or (dissociative next agent*)) #2. (emergency or emergencies or ed or eds or er or ers) #3. (#1 and #2) 24	
Research Findings Register	Etomidate, amidate, ketamine, propofol, diprovan, disoprofol, diisopropylphenol	20Jun07
TOXNET	etomidate and emergency ketamine and emergency propofol and emergency	20Jun07

Grey Literature and Hand Searches

Dates for Search:	May 2007 – November 2007
Keywords:	Procedural sedation, consciouis sedation, fractures, dislocations, etomidate, ketamine, propofol, diprivan
Limits:	Publication years: 2002-2007

Conference Abstracts

Canadian Association of Emergency Physicians (CAEP)
http://caep.ca/

American College of Emergency Physicians (ACEP)
http://www.acep.org/

Australasian College for Emergency Medicine (ACEM)
http://www.acem.org.au/

British Association of Emergency Medicine (BAEM)
http://www.emergencymed.org.uk/BAEM/

Society for Academic Emergency Medicine (SAEM)
http://www.saem.org/

Websites for Safety and Adverse Effects

Australian Adverse Drug Reactions Bulletin
http://www.tga.gov.au/adr/aadrb.htm

European Agency for the Evaluation of Medicinal Products (EMEA)
http://www.emea.europa.eu/

Health Canada. Advisories Warnings and Recalls
http://www.hc-sc.gc.ca/dhp-mps/advisories-avis/index_e.html

Medicines and Healthcare Products Regulatory agency (MHRA)
http://www.mhra.gov.uk/home/idcplg?IdcService=SS_GET_PAGE&nodeId=5

Prescriber Update (New Zealand)
http://www.medsafe.govt.nz/profs/PUarticles.asp

Swiss Medic: Swiss Agency for Therapeutic Products
http://www.swissmedic.ch/

U.S. Food and Drug Administration - Center for Drug Evaluation and Research
http://www.fda.gov/cder/drug/default.htm#Drug%20Safety

World Health Organization (WHO) Pharmaceutical Newsletter
http://www.who.int/medicines/publications/newsletter/en/index.html

Search Engines

Google
http://www.google.ca/

LITERATURE SEARCH STRATEGY

COST-EFFECTIVENESS STUDIES

OVERVIEW	
Interface:	Ovid
Databases:	EMBASE <1988 to 2007 Week 23> International Pharmaceutical Abstracts <1970 to June 2007> Medline® <1950 to May Week 3 2007> * Note: Subject headings have been customized for each database.
Date of Search:	June 13, 2007
Date of Update:	November 27, 2007
Study Types:	Economic Filter applied (line 1-71)
Limits:	Adults

SYNTAX GUIDE	
/	At the end of a phrase, searches the phrase as a subject heading
MeSH	Medical Subject Heading
fs	Floating subheading
exp	Explode a subject heading
$	Truncation symbol, or wildcard: retrieves plural or variations of a word
*	Indicates that the marked subject heading is a primary topic
ADJ	Requires words are adjacent to each other (in any order)
ADJ#	Adjacency within # number of words (in any order)
.ti	Title
.ab	Abstract
.jn.	Journal
.mp	Title, Abstract, Subject Heading, CAS Registry/EC Number Word
.tw	Textword: Title, Abstract and Subject Heading
.pt	Publication type
.rn	CAS registry number

MULTI-FILE STRATEGY

#	Search History	Results
1	exp Economics/	
2	quality of life/	
3	value of life/	

4	Quality-adjusted life years/
5	models, economic/
6	markov chains/
7	monte carlo method/
8	decision tree/
9	ec.fs.
10	ut.fs.
11	economic$.tw.
12	(cost? or costing? or costly or costed).tw.
13	(price? or pricing?).tw.
14	(pharmacoeconomic? or (pharmaco adj economic?)).tw.
15	socioeconomic$.mp.
16	budget$.tw.
17	expenditure$.tw.
18	(dollar$ or money$ or inexpensive or purchas$ or accounts or accounting or payment$ or funds or finances or taxes).mp.
19	(hospital adj charg$).mp.
20	(value adj1 (money or monetary)).tw.
21	(rate adj setting).mp.
22	(fee or fees).tw.
23	"quality of life".tw.
24	qol$.tw.
25	hrqol$.tw.
26	"Quality adjusted life year$".tw.
27	qaly$.tw.
28	cba.tw.
29	cea.tw.
30	cua.tw.
31	utilit$.tw.
32	exp "Drug Utilization"/
33	exp "utlization review"/
34	markov$.tw.
35	monte carlo.tw.
36	sensitivity analy$.mp.
37	(decision adj2 (tree$ or analys$ or model$)).tw.

38	((clinical or critical or patient) adj (path? or pathway?)).tw.
39	(managed adj2 (care or network?)).tw.
40	"costs and cost analysis"/
41	Cost allocation/
42	Cost-benefit analysis/
43	Cost control/
44	Cost savings/
45	Cost of illness/
46	Cost sharing/
47	"deductibles and coinsurance"/
48	Medical savings accounts/
49	Health care costs/
50	Direct service costs/
51	Drug costs/
52	Employer health costs/
53	Hospital costs/
54	Health expenditures/
55	Capital expenditures/
56	Value of life/
57	exp economics, hospital/
58	exp economics, medical/
59	Economics, nursing/
60	Economics, pharmaceutical/
61	exp "fees and charges"/
62	exp budgets/
63	(low adj cost).mp.
64	(high adj cost).mp.
65	(health?care adj cost$).mp.
66	(fiscal or funding or financial or finance).tw.
67	(cost adj estimate$).mp.
68	(cost adj variable).mp.
69	(unit adj cost$).mp.
70	(economic$ or pharmacoeconomic$ or price$ or pricing).tw.
71	or/1-70
72	exp Emergency Service, Hospital/

73	emergency medical services/
74	exp emergencies/
75	"HOSPITAL EMERGENCY SERVICE".mp.
76	(ED or ER).mp.
77	(EDs or ERs).mp.
78	(emergenc$ adj5 (departmen$ or ward$ or service$ or unit$ or room$ or hospital$ or care or patient$ or physician$ or doctor$ or medicine or treatment$)).mp.
79	(emergency or emergencies).jn.
80	exp Emergency Medicine/
81	or/72-80
82	(procedur$ adj3 sedat$).mp.
83	psaa.ti,ab.
84	exp hypnotics/ and sedatives/
85	exp anesthetics, combined/
86	exp anesthetics, dissociative/
87	exp anesthetics, general/
88	exp anesthetics, inhalation/
89	exp anesthetics, intravenous/
90	exp preanesthetic medication/
91	exp conscious sedation/
92	exp propofol/
93	2078-54-8.rn.
94	propofol$.mp.
95	disoprofol.mp.
96	diprovan.mp.
97	diprivan.mp.
98	aquafol.mp.
99	disoprivan.mp.
100	fresofol.mp.
101	"ici-35,868".mp.
102	"ici-35868".mp.
103	ivofol.mp.
104	recofol.mp.
105	diisopropylphenol.mp.

106	rapinovet.mp.
107	exp Ketamine/
108	6740-88-1.rn.
109	ketamin$.mp.
110	cetamina.mp.
111	"ci581".mp.
112	(ci-581 or "ci 581").mp.
113	cn523722.mp.
114	(cl369 or cl-369 or "cl 369").mp.
115	calipsol.mp.
116	calypsol.mp.
117	esketamine.mp.
118	kalipsol.mp.
119	ketalar.mp.
120	ketolar.mp.
121	ketanest.mp.
122	ketaset.mp.
123	ketavet.mp.
124	ketased.mp.
125	katamine.mp.
126	ketaject.mp.
127	ketoject.mp.
128	ketaminol.mp.
129	narkamon.mp.
130	velonarcon.mp.
131	vetalar.mp.
132	"special k".ti,ab.
133	exp Etomidate/
134	33125-97-2.rn.
135	etomidat$.mp.
136	ethomidat.mp.
137	amidate.mp.
138	ethomidate.mp.
139	hypnomidate.mp.
140	(r26490 or r7405).mp.

141	"r 26 490".mp.
142	(r 7405 or r 26490).mp.
143	radenarkon.mp.
144	radenarcon.mp.
145	ketafol.mp.
146	"propofol/ketamine".mp.
147	((short adj acting) or dissociative) adj3 (agent$ or medication$)).ti,ab.
148	diazepam.mp.
149	439-14-5.rn.
150	valium.mp.
151	flurazepam.mp.
152	17617-23-1.rn.
153	isumin.mp.
154	lorazepam.mp.
155	846-49-1.rn.
156	ativan.mp.
157	midazolam$.mp.
158	59467-70-8.rn.
159	dormicum.mp.
160	alfentanil$.mp.
161	71195-58-9.rn.
162	alfentanyl$.mp.
163	fentanyl$.mp.
164	437-38-7.rn.
165	fentanil$.mp.
166	fentura.mp.
167	duragesic.mp.
168	durogesic.mp.
169	(pentanil or phentanyl or pentanyl).mp.
170	sentonil$.mp.
171	meperidine.mp.
172	57-42-1.rn.
173	demerol.mp.
174	(phetidine or petydyn$ or pethidin$ or petidin$).mp.
175	morphine$.mp.

176	57-27-2.rn.	
177	morfin$.mp.	
178	sufentanil$.mp.	
179	56030-54-7.rn.	
180	sufentanyl$.mp.	
181	chronogesic.mp.	
182	sufenta.mp.	
183	methohexital$.mp.	
184	151-83-7.rn.	
185	(metohexital$ or metoesital).mp.	
186	thiopentone.mp.	
187	76-75-5.rn.	
188	(thiopental or tiopentale or intraval).mp.	
189	or/84-188	
190	71 and 81 and 189	
191	(adult$ or men or women or elderly or man or woman).mp.	
192	190 and 191	
193	limit 190 to "all adult (19 plus years)"	
194	192 or 193	
195	exp Dislocations/	
196	exp fractures, bone/ or exp fractures, cartilage/	
197	exp Electric Countershock/	
198	(fractur$ or dislocat$ or cardiover$).mp.	
199	or/195-198	
200	199 and 71 and 81	
201	200 and 191	
202	limit 200 to "all adult (19 plus years)"	
203	201 or 202	1480

OVERVIEW	
Interface:	EBSCO
Databases:	Academic Search Premier (1865 to 2007); CINAHL Plus with Full Text (1937 to 2007); Health Source: Nursing/Academic Edition (1975 to 2007) * Note: Subject headings have been customized for each database.
Date of Search:	June 26-27, 2007
Study Types:	Economic Filter applied (S16-S26)
Limits:	None Applied

SYNTAX GUIDE	
.sh	At the end of a phrase, searches the phrase as a subject heading
DE	Descriptor
MH	Major Subject Heading
+	Explode a subject heading
*	Truncation symbol, or wildcard: retrieves plural or variations of a word
TI	Title
SO	Journal or Source

MULTI-FILE STRATEGY

#	Search Terms	Results
S34	S33 not TI (pediatr* or paediatr* or child*)	935
S33	S32 and S27	
S32	S31 or S30 or S29 or S28	
S31	fractur* or dislocat* or cardiover*	
S30	(MH "Cardioversion") or (MH "Defibrillation")	
S29	(MH "Dislocations+")	
S28	(MH "Fractures+")	
S27	S26 and S14	
S26	S25 or S24 or S23 or S22 or S21 or S20 or S19 or S18 or S17 or S16	
S25	"rate setting" or quality adjusted life year* or (qaly*or cba or cea or cua or utilit* or monte carlo or sensitivity analy*)	
S24	(economic* or dollar* or money* or inexpensive or purchas* or accounts or accounting or payment* or funds or finances or taxes or value or charge or charged or charges) or (fee or fees) or "quality of life"	

S23	pharmacoeconomic* or pharmaco economic*
S22	(cost or costing or costly or costed) or (price or prices or pricing) or (socioeconomic* or budget* or expenditure*)
S21	managed and (care or network?)
S20	decision and (tree* or analys* or model*)
S19	((clinical or critical or patient) and (path? or pathway?))
S18	(MH "Utilization Review+")
S17	(MH "Costs and Cost Analysis+") or (MH "Decision Trees")
S16	(MH "Economics+")
S15	(S14 and S10)
S14	(S13 or S12 or S11)
S13	(Emergency or emergencies) or ((emergenc*) and (departmen* or ward* or service* or unit* or room* or hospital* or care or patient* or physician* or doctor* or medicine or treatment* or nurs* or staff*))
S12	SO emergency or emergencies
S11	(MH "Emergency Nurse Practitioners") or (MH "Physicians, Emergency") or (MH "Emergency Service+") or (MH "Emergency Medical Services")
S10	S9 or S8 or S7 or S6 or S5 or S4 or S3 or S2 or S1
S9	short acting agent*
S8	(MH "Thiopental")
S7	(MH "Fentanyl+") or (MH "Sufentanil")
S6	(MH "Etomidate") or (MH "Flurazepam") or (MH "Diazepam") or (MH "Lorazepam") or (MH "Midazolam") or (MH "Propofol")
S5	(MH "Anesthetics, Dissociative+")
S4	dissociative agents
S3	(MH "Premedication")
S2	(MH "Conscious Sedation")
S1	(procedural sedat*) or etomidat* or amidate or hynomidate or propofol or diprovan or disoprofol or diisopropylpheno or ketamin* or esketamin* or cetamina or midazolam or dormicum or flurazepam or diazepam or valium or alfentanil* or alfentanyl* or lorazepam or ativan or sufentanil or sufentanyl* or chronogesic or sufenta or meperidine or demerol or phetidine or petydyn* or pethidin* or petidin* or morphine* or morfin* or fentanyl*

or fentanil* or durogesic or duragesic or pentanil or phentanyl or pentanyl or (conscious sedat*) or (short acting agent*) or (dissociative agent*) or methohexital* or metohexital* or metoesital or thiopentone or thiopental or tiopentale or intraval

OVERVIEW	
Interface:	Wiley
Databases:	The Cochrane Library (Issue 2 2007) Cochrane Database of Systematic Reviews (CDSR) Database of Abstracts of Reviews of Effects (DARE) Cochrane Central Register of Controlled Trials (CENTRAL) Health Technology Assessment Database (HTA) NHS Economic Evaluation Database (NHS EED)
Date of Search:	June 14, 2007
Study Types:	Economic Filter applied (#25-#67)
Limits:	None Applied

SYNTAX GUIDE	
MeSH descriptor	Medical Subject Heading
Explode all trees	Explode a subject heading
*	Truncation symbol, or wildcard: retrieves plural or variations of a word
NEXT	Requires words are adjacent to each other (in any order)
ti	Title
ab	Abstract
kw	Heading Word; usually includes subject headings and controlled vocabulary

MULTI-FILE STRATEGY

ID	Search
#1	(procedural sedat*):ti,ab,kw
#2	(etomidat* or amidate or hynomidate):ti,ab,kw
#3	(propofol or diprovan or disoprofol or diisopropylpheno):ti,ab,kw
#4	(ketamin* or esketamin* or cetamina):ti,ab,kw
#5	(midazolam or dormicum):ti,ab,kw
#6	(flurazepam):ti,ab,kw
#7	(diazepam or valium):ti,ab,kw
#8	(alfentanil* or alfentanyl*):ti,ab,kw
#9	(lorazepam or ativan):ti,ab,kw
#10	(sufentanil or sufentanyl* or chronogesic or sufenta):ti,ab,kw

#11	(meperidine or demerol or phetidine or petydyn* or pethidin* or petidin*):ti,ab,kw
#12	(morphine* or morfin*):ti,ab,kw
#13	(fentanyl* or fentanil* or durogesic or duragesic or pentanil or phentanyl or pentanyl):ti,ab,kw
#14	(conscious sedat*):ti,ab,kw
#15	(short acting agent*):ti,ab,kw
#16	(dissociative agent*):ti,ab,kw
#17	MeSH descriptor Anesthetics, Dissociative explode all trees
#18	(methohexital* or metohexital* or metoesital):ti,ab,kw
#19	(thiopentone or thiopental or tiopentale or intraval):ti,ab,kw
#20	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19)
#21	ED or EDs or ER or ERs
#22	emergency NEXT (department* or ward* or service* or unit* or room* or hospital* or care or patient* or physician* or doctor* or medicine or treatment*)
#23	(#21 OR #22)
#24	(#20 AND #23)
#25	MeSH descriptor Economics explode all trees
#26	MeSH descriptor Quality of Life explode all trees
#27	MeSH descriptor Value of Life explode all trees
#28	MeSH descriptor Quality-Adjusted Life Years explode all trees
#29	MeSH descriptor Models, Economic explode all trees
#30	MeSH descriptor Markov Chains explode all trees
#31	MeSH descriptor Monte Carlo Method explode all trees
#32	MeSH descriptor Decision Trees explode all trees
#33	Any MeSH descriptor with qualifier: EC
#34	Any MeSH descriptor with qualifier: UT
#35	economic*
#36	cost OR costs or costing or costly or costed
#37	(price or prices or pricing):ti,ab,kw
#38	(pharmacoeconomic* or (pharmaco NEXT economic*)):ti,ab,kw
#39	socioeconomic*:ti,ab,kw
#40	budget*:ti,ab,kw
#41	expenditure*:ti,ab,kw
#42	(dollar* or money* or inexpensive or purchas* or accounts or accounting or payment* or funds or finances or taxes):ti,ab,kw
#43	(hospital NEXT charg*):ti,ab,kw
#44	(value NEXT (money or monetary)):ti,ab,kw
#45	(rate NEXT setting):ti,ab,kw
#46	(fee or fees):ti,ab,kw
#47	"quality of life":ti,ab,kw
#48	qol*:ti,ab,kw
#49	hrqol*:ti,ab,kw
#50	"Quality adjusted life year*":ti,ab,kw
#51	qaly*:ti,ab,kw
#52	cba:ti,ab,kw

#53	(cea or cua or utlit$):ti,ab,kw
#54	MeSH descriptor Drug Utilization explode all trees
#55	markov*:ti,ab,kw
#56	monte carlo:ti,ab,kw
#57	sensitivity analy*:ti,ab,kw
#58	(decision NEAR/2 (tree* or analys* or model*)):ti,ab,kw
#59	((clinical or critical or patient) NEXT (path? or pathway?)):ti,ab,kw
#60	(managed NEAR/2 (care or network?)):ti,ab,kw
#61	MeSH descriptor Medical Savings Accounts explode all trees
#62	MeSH descriptor Value of Life explode all trees
#63	MeSH descriptor Fees and Charges explode all trees
#64	MeSH descriptor Budgets explode all trees
#65	(fiscal or funding or financial or finance):ti,ab,kw
#66	(economic* or pharmacoeconomic* or price* or pricing):ti,ab,kw
#67	(#25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66)
#68	(#24 AND #67)
#69	(#24 AND NOT #68)
#70	MeSH descriptor Fractures, Bone explode all trees
#71	MeSH descriptor Dislocations explode all trees
#72	MeSH descriptor Electric Countershock explode all trees
#73	(fractur* or dislocat* or cardioversion):ti,ab,kw
#74	(#70 OR #71 OR #72 OR #73)
#75	(#23 AND #67 AND #74)
#76	(#75 OR #68)

OVERVIEW

Interface:	ISI Thomson Research
Databases:	BIOSIS Previews® (1969-2007) Web of Science® (1900-2007)
Date of Search:	June 18, 2007
Date of Update	November 27, 2007 (Web of Science)
Study Types:	Economic Filter applied (#4 - #11)
Limits:	None

SYNTAX GUIDE

TS=	Topic
*	Truncation symbol, or wildcard: retrieves plural or variations of a word
SAME	Finds records containing terms in the title, the same sentence in the abstract, or the same keyword phrase.
TI=	Title of Article

SO= Source

MULTI-FILE STRATEGY

#	Search	Results
#20	#19 not #14	438
#19	#18 not #13	
#18	#17 AND #15 AND #11	
#17	#16 OR #2	
#16	SO=(ACADEMIC EMERGENCY MEDICINE OR AMERICAN JOURNAL OF EMERGENCY MEDICINE OR ANNALS OF EMERGENCY MEDICINE OR ARCHIVES OF EMERGENCY MEDICINE OR EMERGENCY MEDICAL SERVICES OR EMERGENCY MEDICINE OR EMERGENCY MEDICINE CLINICS OF NORTH AMERICA OR EMERGENCY MEDICINE JOURNAL OR JACEP JOURNAL OF THE AMERICAN COLLEGE OF EMERGENCY PHYSICIANS OR JEMS JOURNAL OF EMERGENCY MEDICAL SERVICES OR JOURNAL OF ACCIDENT EMERGENCY MEDICINE OR JOURNAL OF EMERGENCY MEDICINE OR JOURNAL OF EMERGENCY NURSING OR PREHOSPITAL EMERGENCY CARE OR SAFETY OLDER DRIVERS TRAFFIC LAW ENFORCEMENT MANAGEMENT SCHOOL TRANSPORTATION EMERGENCY EVACUATION TRUCK "AND" BUS "AND" MOTORCYCLES)	
#15	TS=(cardiover* or fractur* or dislocat*)	
#14	#12 NOT #13	
#13	TI=(child* or pediatric*)	
#12	#11 AND #3	
#11	#10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4	
#10	TS=(managed SAME (care or network*))	
#9	TS=((clinical or critical or patient) SAME (path? or pathway?))	
#8	TS=(decision SAME (tree* or analys* or model*))	
#7	TS=(monte carlo) or TS=(sensitivity analy*)	
#6	TS=(Quality adjusted life year*)	
#5	TS=(quality of life)	

#4	TS=(economic* or cost* or utili* or budget* or fiscal or expenditure* or price* or pricing or pharmacoeconomic* or socioeconomic* or fee or fees or markov or dollar* or money* or inexpensive or purchas* or accounts or accounting or payment* or funds or finances or taxes or qol*or qaly*or cba or cea or cua or hqol* or deductible* or insurance)
#3	#2 AND #1
#2	TS=Emergency or TS=emergencies or TS=ED or TS=EDs or TS=ER or TS=ERs
#1	TS=(procedural sedat*) or TS=etomidat* or TS=amidate or TS=hynomidate or TS=propofol or TS=diprovan or TS=disoprofol or TS=diisopropylpheno or TS=ketamin* or TS=esketamin* or TS=cetamina or TS=midazolam or TS=dormicum or TS=flurazepam or TS=diazepam or TS=valium or TS=alfentanil* or TS=alfentanyl* or TS=lorazepam or TS=ativan or TS=sufentanil or TS=sufentanyl* or TS=chronogesic or TS=sufenta or TS=meperidine or TS=demerol or TS=phetidine or TS=petydyn* or TS=pethidin* or TS=petidin* or TS=morphine* or TS=morfin* or TS=fentanyl* or TS=fentanil* or TS=durogesic or TS=duragesic or TS=pentanil or TS=phentanyl or TS=pentanyl or TS=(conscious sedat*) or TS=(short acting agent*) or TS=(dissociative agent*) or TS=methohexital* or TS=metohexital* or TS=metoesital or TS=thiopentone or TS=thiopental or TS=tiopentale or TS=intraval

OTHER DATABASES		
Database	**Search terms**	**Date of Search**
Dissertation Abstracts (1861-2007)	(procedural sedat*) or etomidat* or amidate or hynomidate or propofol or diprovan or disoprofol or diisopropylpheno or ketamin* or esketamin* or cetamina or midazolam or dormicum or flurazepam or diazepam or valium or alfentanil* or alfentanyl* or lorazepam or ativan or sufentanil or sufentanyl* or chronogesic or sufenta or meperidine or demerol or phetidine or petydyn* or pethidin* or petidin* or morphine* or morfin* or fentanyl* or fentanil* or durogesic or duragesic or pentanil or phentanyl or pentanyl or (conscious sedat*) or (short acting agent*) or (dissociative agent*) or methohexital* or metohexital* or metoesital or thiopentone or thiopental or tiopentale or intraval And Emergency or emergencies or ed or eds or er or ers And economic* or cost* or utili* or budget* or fiscal or expendit* or price* or pricing or pharmacoeconomic* or socioeconomic* or fee or fees or markov or dollar* or money* or inexpensive or purchas* or accounts or accounting or payment* or funds or finances or taxes or qol* or qaly* or cba or cea or cua or hqol	29May07
Research Findings Register	(Emergency or emergencies or ed or eds or er or ers) AND (cardiover* or fractur* or dislocat*) (free-style search):	27Jun07

GREY LITERATURE AND HAND SEARCHES

Dates for Search:	September 2007 – November 2007
Keywords:	procedural sedation, conscious sedation, etomidate, ketamine, propofol, diprivan
Limits:	Publication years: 2002-2007

Clinical Practice Guidelines

Canadian Association of Emergency Physicians (CAEP)
http://caep.ca/

American College of Emergency Physicians (ACEP)
http://www.acep.org/
American Society of Anesthesiologists (ASA)
http://www.asahq.org/

Australasian College for Emergency Medicine (ACEM)
http://www.acem.org.au/

British Association of Emergency Medicine (BAEM)
http://www.emergencymed.org.uk/BAEM/

Canadian Anesthesiologists' Society (CAS)
http://www.cas.ca/

Canadian Medical Association CMA Infobase
http://mdm.ca/cpgsnew/cpgs/index.asp

National Emergency Nurses Affiliation (NENA)
http://www.nena.ca/

National Guidelines Clearinghouse
http://www.guideline.gov/

National Health and Medical Research Council Clinical Practice Guidelines (Australia)
http://www.nhmrc.gov.au/publications/subjects/clinical.htm

National Library of Guidelines (UK and International)
http://www.library.nhs.uk/guidelinesFinder/

Search Engines

Google
http://www.google.ca/

APPENDIX 2: EXCLUDED STUDIES

Clinical Review (N = 200)

Publication Type (N = 100)

The following studies were not primary research evaluating the management or use of ED PSA in Canada, the efficacy and safety of ED PSA, the costs of ED PSA or reports of barriers to the use of etomidate, ketamine, or propofol for ED PSA use.

1. Clinical nurse's forum. Using ketamine in the emergency department. *J Emerg Nurs* 2004;30(5):475-7.

2. Critical pat network. Improve patient safety to comply with new standards: demonstrate evidence to JCAHO surveyors. *Hosp Case Manag* 2001;9(7):103-6.

3. Drug news. *Emerg Med* 2004;36(8):42-3.

4. Emergency Nurses Association position statement... conscious sedation. *J Emerg Nurs* 1993;19(3):47A.

5. Policy statement. Delivery of agents for procedural sedation and analgesia by emergency nurses. *Ann Emerg Med* 2005;46(4):368.

6. Policy statement. Procedural sedation in the emergency department. *Ann Emerg Med* 2005;46(1):103-4.

7. Statement on clinical principles for procedural sedation. *Emerg Med* (Freemantle) 2003;15(2):205-6.

8. What you must know about new patient safety standards. *RN* 2001;64(6):24.

9. Adams HA. Ketamine in emergency care: new standard or exclusive alternative? *Anasthesiol Intensivmed Notfallmed Schmerzther* 2003;38(3):192-5.

10. Alling C. Out patient sedation and general anesthesia. In: Alling, CC and Parker EM, editors. *Facial pain*. Philadelphia (PA): Lea and Febiger; 1977. p. 257-64.

11. Annetta MG, Iemma D, Garisto C, Tafani C, Proietti R. Ketamine, new indications for an old drug. *Curr Drug Targets* 2005;6(7):789-94.

12. Atkinson S. *Studies concerning the sedative and anaesthetic properties of midazolam and propofol* [dissertation]. Belfast (UK): Queen's University of Belfast; 1994.

13. Ayanoglu HO, Uyar M, Cokmez B, Erhan E. *Lowest doses of propofol or midazolam used in combination with low dose fentanyl infusion for the sedation of critically ill patients.* In: Vincent JLP, editor. 16th International symposium on Intensive Care Medicine; 1996; 22(Suppl 1). Brussels: Springer; 1996. p. 110.

14. Bahn EL, Holt KR. Procedural sedation and analgesia: a review and new concepts. *Emerg Med Clin North Am* 2005;23(2):503.

15. Baker GW, Sleigh JW, Smith P. Electroencephalographic indices related to hypnosis and amnesia during propofol anaesthesia for cardioversion. *Anaesth Intensive Care* 2000;(4):386-91.

16. Berman D, Graber D. Sedation and analgesia. *Emerg Med Clin North Am* 1992;10(4):691-705.

17. Berning D. *Einfluss von Ketamin und Midazolam auf motorisch evozierte Potentiale: eine tierexperimentelle Untersuchung* [dissertation]. Bonn (Germany): Rheinische Friedrich-Wilhelms-Universitaet; 2001. (German).

18. Biddinger PD, Nadel ES, Brown DFM. Blunt trauma with a medical twist. *J Emerg Med* 2000;(2):247-51.

19. Burton JH. Etomidate. *Acad Emerg Med* 1995;2(1):72-3.

20. Corfield AR, Stevenson J. Vertical patellar dislocation: a case report. *Eur J Emerg Med* 2004;11(3):170-1.

21. Cromhout A. Ketamine: its use in the emergency department. *Emerg Med* 2003;15(2):155.

22. Crozier TA. The "propofol infusion syndrome": myth or menace? *Eur J Anaesthesiol* 2006;23(12):987-9.

23. Cydulka RK. Comparison of intra-articular lidocaine and intravenous sedation for reduction of shoulder dislocations: a randomized, prospective study. *Ann Emerg Med* 2003;42(3):435.

24. Deitch KC. Can emergency physicians recognize respiratory depression in patients who do not become hypoxic during ED procedural sedation and analgesia? *Ann Emerg Med* 2007;50(3):S122.

25. Djalali AG. *Die Wirkung gebrauchlicher Injektionsnarkotika (Propofol, Etomidat, Methohexital, Thiopental) auf die periphere Mikrozirkulation, gemessen mit Laser-Doppler-Flowmetrie und Photopulsplethysmographie* [dissertation]. Tübingen (Germany): Eberhard Karls Universität; 1995. (German)

26. Doenicke A. *Etomidate: an intravenous hypnotic agent first report on clinical and experimental experience* [monograph]. Berlin: Springer-Verlag; 1977.

27. Doenicke A. Etomidate a new hypnotic agent for intravenous application. In: Doenicke A, series editor. *Anaesthesiology and resuscitation. Etomidate: an intravenous hypnotic agent first report on clinical and experimental experience*. Vol 106. Berlin: Springer-Verlag; 1977. p. 25-30.

28. Doenicke A. Etomidate a new hypnotic agent in intravenous anesthesia. In: Doenicke A, editor. *Anaesthesiology and resuscitation. Etomidate: an intravenous hypnotic agent first report on clinical and experimental experience*. Vol 106. Berlin: Springer-Verlag; 1977. p. 152-5.

29. Eggers M. *Vergleichende Schlafpolygraphische Untersuchungen zum einfluss des Ketamin und seines Rechtsdrehenden Isomers auf den Rem-Schlaf gesunder Versuchspersonen* [dissertation]. Bonn (Germany): Rheinische Friedrich-Wilhelms-Universität; 1994.

30. Fatovich DM, Gope M, Paech MJ. A pilot trial of BIS monitoring for procedural sedation in the emergency department. *Emerg Med Australas* 2004;16(2):103-7.

31. Foster F. Conscious sedation... coming to a unit near you. *Nurs Manage* 2000;31(4):45.

32. Fragen RJ. Total intravenous anesthesia. In: Fragen RJ, editor. *Drug infusions in anesthesiology*. New York: Raven Press; 1991. p. 129-46.

33. Gilligan P, Jennings P, Cooper J, Hegarty D, Lee J, Khan A, et al. Synopsis of Cochrane Reviews applicable to emergency services episode II. *Emerg Med J* 2007;24(1):37-9.

34. Gowda RM, Misra D, Khan IA, Schweitzer P. Acute pulmonary edema after cardioversion of cardiac arrhythmias. *Int J Cardiol* 2003;92(2-3):271-4.

35. Green SM. Fasting is a consideration—not a necessity—for emergency department procedural sedation and analgesia. *Ann Emerg Med* 2003;42(5):647-50.

36. Green SM, Rothrock SG. Intramuscular ketamine and apnea. *Ann Emerg Med* 1994;23(1):139-40.

37. Green SM. Modern anesthesiologists receive limited training with ketamine—implications for emergency medicine. *Acad Emerg Med* 2000;7(7):839-41.

38. Green SM, Krauss B. Procedural sedation terminology: moving beyond "conscious sedation". *Ann Emerg Med* 2002;39(4):433-5.

39. Green SM. Propofol for emergency department procedural sedation—not yet ready for prime time. *Acad Emerg Med* 1999;6(10):975-8.

40. Green SM, Krauss B. Propofol in emergency medicine: pushing the sedation frontier *Ann Emerg Med* 2003;42:792. Erratum in: *Ann Emerg Med* 2004;43(1):142.

41. Green SM, Krauss B. Pulmonary aspiration risk during emergency department procedural sedation—an examination of the role of fasting and sedation depth. *Acad Emerg Med* 2002;9(1):35-42.

42. Green SM. Research advances in procedural sedation and analgesia. *Ann Emerg Med* 2007;49(1):31-6.

43. Handly N. Propofol for deep procedural sedation in the ED. *Ann Emerg Med 2005;*46(4):388-9.

44. Heller MB, Melanson SW. Conscious sedation: we are getting sleepy, very sleepy. *Am J Emerg Med* 1996;14(4):440.

45. Hohenhaus SM. Clinical nurses forum. An informal discussion of emergency nurses' current clinical practice: what's new and what works. *J Emerg Nurs* 2006;32(3):261-2.

46. Hughes G. In search of excellence. *Emerg Med J* 2006;23(11):822.

47. Ilbeigi MS, Davidson ML, Yarmush JM. An unexpected arousal effect of etomidate in a patient on high-dose steroids. *Anesthesiology* 1998;89(6):1587-9.

48. Isbell P. Competency for procedural moderate sedation. *J Emerg Nurs* 2005;31(4):393.

49. Jackson R, Carley S. Use of propofol for sedation in the emergency department. *Emerg Med J* 2001;18(5):378-9.

50. Jagim M, Proehl J, Johnson J, Treece N, Howard D, Anderson D, et al. Managers forum. Conscious sedation. *J Emerg Nurs* 2000;26(3):252-4.

51. Jagim M. Procedural sedation in the emergency department: where do we draw the line? *J Emerg Nurs* 2007;33(5):488-91.

52. Kalenda Z. The use of etomidate as an induction agent in fentanyl analgesia. In: Doenicke A, series editor. *Anaesthesiology and resuscitation. Etomidate: an intravenous hypnotic agent first report on clinical and experimental experience*. Vol 106. Berlin:Springer-Verlag; 1977. p. 130-9.

53. Koenig KL, Lambe S. A model emergency department systemic sedation record. *Acad Emerg Med* 1997;4(12):1178-80.

54. Kojodjojo P, Kanagaratnam P, Davies DW, Peters NS, Markides V. Role of electrophysiological study and ablation in the management of recurrent atrial flutter associated with haemodynamic compromise in a critically ill patient. *Anaesthesia 2005;*60(5):505-8.

55. Kramer DC, Grass G. Challenges facing the anesthesiologist in the emergency department. *Curr Opin Anaesthesiol* 2003;16(4):409-16.

56. Kraus GB. Ketamine in emergency medicine. *Dtsch Med Wochenschr* 1994;119(12):439.

57. Kugler J, Doenicke A, Laub M. The electrocardiogram after etomidate. In: Doenicke, A, series editor. *Anaesthesiology and Resuscitation. Etomidate: an intravenous hypnotic agent first report on clinical and experimental experience*. Vol 106. Berlin: Springer-Verlag; 1977. p.31-48.

58. Lanning CF, Harmel MH. Ketamine anesthesia. In: Creger, WP, editor. *Annual review of medicine selected topics in the clinical sciences*. Palo Alto (CA);1975 (26):137-41.

59. LeDuc TJ, Paris PM. Relieving the pain. *JEMS* 1997;21(12):74.

60. Lo GK, Fatovich DM, Haig AD. Biphasic cardioversion of acute atrial fibrillation in the emergency department. *Emerg Med J* 2006;23(1):51-3.

61. Loeffler B. *Advantages and disadvantages of the induction of anesthesia with lormetazepam-etomidate or midazolam and supplementation with fentanyl-alfentanil for short-acting analgesia*. Berlin: Springer-Verlag; 1986. (German).

62. Mauritz W. The polytraumatized patient—part II. *Anasthesiol Intensivmed Notfallmed Schmerzther* 1998;33(9):565-80. (German).

63. McClelland H. Research review. *Accid Emerg Nurs* 2005;13(4):264. Commentary on: Holger JS, Satterlee PA, Haugen S (2005) Nursing use between 2 methods of procedural sedation: midazolam and propofol. *Am J Emerg Med* 2005;23:248-52.

64. Memis D, Dokmeci D, Karamanlioglu B, Turan A, Ture M. A comparison of the effect on gastric emptying of propofol or dexmedetomidine in critically ill patients. *Crit Care* 2005;9(Suppl 1):374.

65. Miller MA, Levy P, Patel MM. Procedural sedation and analgesia in the emergency department: what are the risks? *Emerg Med Clin North Am* 2005;23(2):551-.

66. Miner JR, Biros MH, Seigel T, Ross K. The utility of the bispectral index in procedural sedation with propofol in the emergency department. *Acad Emerg Med* 2005;12(3):190-6.

67. Neff JA. Conscious sedation. *J Emerg Nurs* 1992;18(2):170-3.

68. Neyman GP. Review of conscious sedation. *Internet J Anesthesiol* 2006;11(1):10.

69. Orr NP. *Ambulatory care and conscious sedation* [dissertation]. Delaware: Wilmington College Division of Nursing; 2000.

70. Paris PM. Ketamine. *Emerg Med* 1986;18(7):55-6.

71. Pearson BV, Kuhns DW. Nursemaid's elbow in a 31-year-old female. *Am J Emerg Med* 2007;25(2):222-3.

72. Pigott DC. Images in emergency medicine. *Ann Emerg Med* 2007;49(1):14.

73. Prause G, Smolle-Juttner F, Ratzenhofer-Komenda B, Heydar-Fadai J. Ketamine in emergency medicine. *Acta Anaesthesiol Scand* 1998;42:215.

74. Prause G, Kaloud H, Ratzenhofer-Komenda B. Propofol in emergency care—areas of application and initial experiences. *Wien Klin Wochenschr* 1994;106(20):645-8. (German).

75. Proudfoot J. Analgesia, anesthesia, and conscious sedation. *Emerg Med Clin North Am* 1995;13(2):357-79.

76. Reddy MB. Can propofol cause keratitis? *Anaesthesia* 2002;57(2):206.

77. Richards NM. Critical/emergency care, breakthroughs beckon new approaches to existing procedures. *Nurs Manage* 2003;34(12):18.

78. Ringland R, Early S. Conscious sedation: documenting the procedure. *J Emerg Nurs* 1997 Dec;23(6):611-7.

79. Sacchetti A, Harris RH, Packard D. Emergency department procedural sedation formularies. *Am J Emerg Med* 2005;23(4):569-70.

80. Sadovsky R. Deep sedation options during cardioversion. *Am Fam Physician* 2004;70(3):584-5.

81. Schockenhoff B, Hoffmann P. Etomidate as a medicament in emergency medicine. *Fortschr Med* 1984;102(44):1146-8.

82. Schultz CH. Conscious sedation in the emergency department. *West J Med* 1993;159(5):600-1.

83. Schultz CH. Intramuscular ketamine and apnea. *Ann Emerg Med* 1994;23(1):139.

84. Sivilotti ML. Dr. Sivilotti responds. *Can J Emerg Med* 2007;9(1):3-4.

85. Slavik VZ. Combination ketamine and propofol for procedural sedation and analgesia. *Pharmacotherapy* 2007;27(11):1588-98.

86. Smally AJ, Nowicki TA. Sedation in the emergency department. *Current Opinion in Anaesthesiology* 2007 Aug;20(4):379-83.

87. Smith JA, Santer L. Intramuscular ketamine and apnea—reply. *Ann Emerg Med* 1994;23(1):140.

88. Snyder JA. Intravenous conscious sedation monitoring guidelines... how we do it. *J Emerg Nurs* 1992;18(5):413-5.

89. Sobel RM. Emergency physician ketamine administration complies with JCAHO regulations. *Am J Emerg Med* 2001;19(1):91.

90. Swoboda TK, Munyak J. Use of a sedation-analgesia datasheet in closed shoulder reductions. *J Emerg Med* 2005;29(2):129-35.

91. Tolksdorf W. *Neue Aspekte zu Ketamin in der Anaesthesie, Intensiv- und Notfallmedizin*. Fortbildungsveranstaltung, Mannheim May 16,1987. (German).

92. Tombasco M. The ins and outs of I.V. anesthetics. *Nurs Manage* 2006;37:2-5.

93. Vailly B, Feger JM. Anaesthesia for cardioversion: what's new in 1989? *Arch Mal Coeur Vaiss* 1989;82(12):2049-51. (French).

94. Walz AR. *Narkoseeinleitung mit Propofol: Mogliche Beeinflussung des fibrinolytischen Systems* [dissertation]. Tübingen (Germany): Eberhard Karls Universität; 1999. (German).

95. Ward KR, Yealy DM. Systemic analgesia and sedation in managing orthopedic emergencies. Orthopedic Emergencies, Part II [abstract]. *Emerg Med Clin North Am* 2000;18(1):141.

96. Weaver CH, Hauter,WH Duncan,CE Brizendine,EJ Cordell,WH. An assessment of the association of bispectral index with 2 clinical sedation scales for monitoring depth of procedural sedation. *Am J Emerg Med* 2007;25(8):918-24.

97. Weckbecker K. *Wirkung des intravenosen Anathetikums Etomidat auf einzelne Natriumkanale menschlicher Gehirn-Cortexzellen: elektrophysiologische Untersuchungen im Bilayerverfahren* [dissertation]. Bonn (Germany): Rheinische Friedrich-Wilhelms-Universität; 1997. (German).

98. Willemsen-Dunlop AM. *Assessing the competence of nurses trained to manage patients receiving procedural sedation and analgesia: a new application for generalizability theory* [dissertation]. Iowa City: The University of Iowa; 2004.

99. Willis AA, Verma NN, Thornton SJ, Morrissey NJ, Warren RF. Upper-extremity deep-vein thrombosis after anterior shoulder dislocation and closed reduction. *J Bone Joint Surg Am* 2005;87(9):2086-90.

100. Wood J, Ferguson C. Best evidence topic report. Procedural sedation for cardioversion. *Emerg Med J* 2006;23(12):932-4.

Study Design (N = 20)

The following studies were excluded because they were not randomized controlled clinical trials, controlled clinical trials, controlled before-and-after studies, or prospective observational studies.

1. Etomidate. *Reactions Weekly* 2006;(1108):10.

2. Safety and efficacy of etomidate for conscious sedation in ED orthopedic procedures. *Acad Emerg Med* 1999;6(5):468.

3. Altose MD, Leon-Ruiz E. Etomidate-induced pacemaker-mediated ventricular tachycardia. *Anesthesiology* 2007;106(5):1059-60.

4. Bermudez EA, Chen MH. Cardiac arrest associated with intravenous propofol during transesophageal echocardiography before DC cardioversion. *Heart Dis* 2002;4(6):355-7.

5. Cheung KW, Watson ML, Field S, Campbell SG. Aspiration pneumonitis requiring intubation after procedural sedation and analgesia: a case report. *Ann Emerg Med* 2007;49(4):462-4.

6. Dursteler BB, Wightman JM. Etomidate-facilitated hip reduction in the emergency department. *Am J Emerg Med* 2000;18(2):204-8.

7. Hickey KS, Martin DF, Chuidian FX. Propofol-induced seizure-like phenomena. *J Emerg Med* 2005;29(4):447-9.

8. Kannan S, Sherwood N. Termination of supraventricular tachycardia by propofol. *Br J Anaesth* 2002;88(6):874-5.

9. Konarzewski W, De'Ath S. Unrecognised fatal anaphylactic reaction to propofol or fentanyl. *Anaesthesia* 2001;56(5):497-8.

10. Martel M. Conscious sedation at an urban county hospital: a two-year retrospective review. *Ann Emerg Med* 2001;38(4 Suppl):335.

11. McHugh P. Acute choreoathetoid reaction to propofol. *Anaesthesia* 1991;46(5):425.

12. Nicol MF. A risk management audit: are we complying with the national guidelines for sedation by non-anaesthetists? *J Accid Emerg Med* 1999;16(2):120-2.

13. Perrone J, Band RA, Mathew R. Agitation complicating procedural sedation with etomidate. *Am J Emerg Med* 2006;24(4):511-2.

14. Petrack EM, Christopher NC, Kriwinsky J. Pain management in the emergency department: patterns of analgesic utilization. *Pediatrics* 1997;99(5):711-4.

15. Shuster J. ISMP adverse drug reactions—acute pancreatitis associated with propofol. *Hosp Pharm* 2002;37(6):589-93.

16. Sneyd JR. Catecholamine-resistant cardiovascular collapse after propofol, atracurium and gentamicin. *Eur J Anaesthesiol* 1998;15(5):600-2.

17. Swanson ER, Seaberg DC, Stypula RW, Troianos CA. Propofol for conscious sedation: a case series. *Acad Emerg Med* 1995;2(7):661-3.

18. Thong CL, Wang CY. Propofol-related myoclonic seizures. *Ambul Surg* 2004;10(4):207.

19. Totten VY, Zambito RF. Propofol bolus facilitates reduction of luxed temporomandibular joints. *J Emerg Med* 1998;16(3):467-70.

20. Van Keulen SG, Burton JH. Myoclonus associated with etomidate for ED procedural sedation and analgesia. *Am J Emerg Med* 2003;21(7):556-8.

Population (N = 34)

The following studies were excluded because they did not include a majority of adult patients (>18 yr.) or did not include a majority of procedures of interest (i.e., bone fractures, major joint dislocations, cardioversion).

1. Adrenocortical dysfunction following etomidate induction in ED patients [conference proceeding]. *Acad Emerg Med* 1999;6(5):449.

2. Policy statements. *Ann Emerg Med* 1997;29(6):834-6.

3. Ambesh SP, Kumar A, Sarkar P, Bajaj A. Emergence phenomena after ketamine anaesthesia: the influence of music. *Can J Anaesth* 1991;38(6):800.

4. Andreucci S, Putorti F, Dei E. PTL and incidence of hallucinosis in dissociative anesthesia. *Minerva Anestesiol* 1974;40(5):199-202. (Italian).

5. Baldy R. *Etomidat im Vergleich zu Methohexital und Thiopental* [dissertation]. Munich (Germany): Ludwig-Maximilians-Universität; 1994. (German).

6. Currie MA, Currie AL. Ketamine: effect of literacy on emergence phenomena. *Ann R Coll Surg Engl* 1984;66(6):424-5.

7. De Gaudio AR, Padelletti MB, Carassale GL, Donnini L. *La sedazione con propofol nella chirurgia plastica ambulatoriale*. Messina; Italy: Monduzzi Editore; 1989: p. 1105-10. (Italian).

8. Doenicke A, Spiess W, Grote B, Ranoji J. Clinical experience with etomidate in diagnostical interventions and operations of short duration. In: Doenicke A, series editor. *Anaesthesiology and resuscitation. Etomidate: an intravenous hypnotic agent first report on clinical and experimental experience*. Vol 106. Springer-Verlag: Berlin; 1977. p. 146-51.

9. Godambe SA. Comparison of propofol and fentanyl versus ketamine and midazolam for emergency orthopedic procedural sedation. *Ann Emerg Med* 2001;38(4 Suppl):8.

10. Grace RF. The effect of variable-dose diazepam on dreaming and emergence phenomena in 400 cases of ketamine-fentanyl anaesthesia. *Anaesthesia* 2003;58(9):904-10.

11. Green SM, Rothrock SG, Hestdalen R, Ho M, Lynch EL. Ketamine sedation in mentally disabled adults. *Acad Emerg Med* 1999;6(1):86-7.

12. Green SM, Krauss B. Should I give ketamine IV or IM? *Ann Emerg Med* 2006;48(5):613-4.

13. Gupta A, Lennmarken C, Vegfors M. Anaesthesia for cardioversion. A comparison between propofol, thiopentone and midazolam. *Anaesthesia* 1990;45(10):872-5.

14. Hofbauer R, Frass M. Ketamine a beneficial drug in emergency medicine. *Curr Opinion Clin Exp Res* 2002;4(3):70-4.

15. Hong W, Short T, Hui T. Hypnotic and anesthetic interactions between ketamine and midazolam in female patients. *Anesthesiology* 1993;79(6):1227-32.

16. Izard P, Coustets B, Olivier M, Villaceque-Tribut A, Malleterre R, Cathala B. Propofol and etomidate: a comparative study in emergency anesthesia in ASA I and II patients. *Can Anesthesiol* 1991;39(6):399-403. (French).

17. Lackner F, Griessner R, Khosropour R, Zimpfer M. Baroreceptor reflux control of the heart-rate in emergency anesthesia, with particular attention to ketamine. *Anasthesiol Intensivmed* 1986;27(9):268-72.

18. Lechleitner P, Genser N, Mitterschiffthaler G, Dienstl F. Propofol for direct current cardioversion in cardiac risk patients. *Eur Heart J* 1991;12(7):813-7.

19. Loh G, Dalen D. Low-dose ketamine in addition to propofol for procedural sedation and analgesia in the emergency department. *Ann Pharmacother* 2007;41(3):485-92.

20. Martinelli G, Melloni C, Di Marco MG, Franceschelli N, Vigano E, Caporali L, et al. Initial clinical experience with propofol (Diprivan) in repeated boluses and in continuous infusion. *Minerva Anestesiol* 1986;52(10):331-7. (Italian).

21. Maugat C. *La ketamine en milieu stomatologique chez des malades a composante psychiatrique: a propos de 50 observations* [dissertation]. Lyon, France: Universite Claude Bernard; 1974.

22. Melloni C, Fusari M, Taddei S, Coffa A, Mordini F, Cangini D. The relationship between propofol consumption and age. *Minerva Anestesiol* 1991;57(9):546-7. (Italian).

23. Moore CA, Hamilton SF, Underhill AL, Fagraeus L. Potentiation of etomidate anesthesia by verapamil: a report of two cases. *Hosp Pharm* 1989;24(1):24-5.

24. Nagyova B, Dorrington KL, Robbins PA. The influence of low doses of propofol on breathing pattern in adults [abstract]. Annual Congress of the European Respiratory Society (ERS), 1st-5th October 1994, Nice, France. *Eur Respir J* 1994;7(18 Suppl):396S

25. Muñoz Martineza T, Castedo Gonzáleza JF, Castañeda Saiza A, Dudagoitia Otaoleaa JL, Poveda Hernandeza Y, Iribarren Diarasarria S. Sedation for electrical cardioversion. A comparison of low doses of propofol and etomidate. *Med Intensiva* 2002;26(3):98-103. (Spanish).

26. Parlak M, Parlak I, Erdur B, Ergin A, Sagiroglu E. Age effect on efficacy and side effects of two sedation and analgesia protocols on patients going through cardioversion: a randomized clinical trial. *Acad Emerg Med* 2006;13(5):493-9.

27. Petrun-Ulaga M. Plasma catecholamines during low-dose Ketamine anesthesia. In: Matsuki A, Ishihara H and Oyama T, editors. *International congress series, 893 endocrine response to anesthesia and intensive care*; 4th International Symposium on Endocrinology in Anesthesia and Surgery, Osaka, Japan, September 14-15, 1989. 1990;21-8.

28. Ravagnan R, Chiello A, De CF. Variations in the side effects of ketamine employed at different dosages and combined with various preanesthetic and anesthetic drugs. *Minerva Anestesiol* 1977;43(9):521-6. (Italian).

29. Rundshagen I, Schnabel K, Schulte AM, Esch J. Impaired explicit memory after recovery from propofol/sufentanil anaesthesia is related to changes in the midlatency auditory evoked response. *Br J Anaesth* 2002;89(3):376-81.

30. Smith DC. A pilot study using low-dose ketamine as an analgesic for acute pain in adults. *Ann Emerg Med* 1999;34(4):249.

31. Smith DC, Mader TJ, Smithline HA. Low dose intravenous ketamine as an analgesic: a pilot study using an experimental model of acute pain. *Am J Emerg Med* 2001;19(6):531-2.

32. Valtonen M, Kanto J, Klossner J. Anaesthesia for cardioversion: a comparison of propofol and thiopentone. *Can J Anaesth* 1988;35(5):479-83.

33. Vinik H, Bradley ELJ, Kissin I. Triple anesthetic combination: propofol-midazolam-alfentanil. *Anesth Analg* 1994;78(2):354-8.

34. Wolffhardt SI. *Etomidat (Etomidat-Lipuro), Thiopental (Trapanal), Propofol (Disoprivan) zur Einleitung einer Allgemeinanasthesie : Kreislaufverhalten, Myoklonie, Venenreaktionen, Postoperative Ubelkeit und Erbrechen, Narkosevertraglichkeit* [disseration]. Munich (Germany): Ludwig-Maximilians-Universität; 2001. (German).

Setting (N = 6)

The following studies were excluded because they did not take place in the emergency department.

1. Brandt M. *Intramuskulare Applikation von Ketamin zur Analgesie bei Polytraumatisierten am Notfallort-Analgesie und Kinetik* [dissertation]. Mainz (Germany): Johannes Gutenberg-Universität; 1988. (German).

2. Price K, Allen U, Mandersloot G, Shirley P, McAuley D. Effect of a single dose of etomidate on adrenal function in patients with trauma. *Crit Care* 2005;9(Suppl 1):P392

3. Rose M. Use of ketamine in emergency medical care. *Anaesthesiol Reanim* 1988;13(5):287-93. (German).

4. Sefrin P, Omert P, Kuhnigk H, Zeisel U. Anesthesia in emergency medicine. *Intensivmedizin und Notfallmedizin* 1997;34(2):145-52. (German).

5. Sefrin P, Kern J. Pain treatment in emergency services. *Anasthesiol Intensivmed* 1998;39(10):507-13. (German).

6. Stoneham MD. Anaesthesia for cardioversion. *Anaesthesia* 1996;51(6):565-70.

Intervention (N = 9)

The following studies were excluded because they did not examine the administration of at least one of propofol, ketamine, etomidate, or combination drug (e.g., ketafol).

1. Austin T, Vilke GM, Nyheim E, Kelly D, Chan TC. Safety and effectiveness of methohexital for procedural sedation in the emergency department. *J Emerg Med* 2003;24(3):315-8.

2. Burton JH, Vinson DR, Drummond K, Strout TD, Thode HC, McInturff JJ. Electrical cardioversion of emergency department patients with atrial fibrillation. *Ann Emerg Med* 2004;44(1):20-30. Erratum in: *Ann Emerg Med* 2004;44(3):294.

3. Dlugose D. Risk management considerations in conscious sedation. *Crit Care Nurs Clin North Am* 1997;9(3):429-40.

4. Duncan RA, Symington L, Thakore S. Sedation practice in a Scottish teaching hospital emergency department. *Emerg Med J* 2006;23(9):684-6.

5. Frymann SJ, Cumberbatch GLA, Stearman ASL. Reduction of dislocated hip prosthesis in the emergency department using conscious sedation: a prospective study. *Emerg Med J* 2005;22(11):807-9.

6. Furia JP, Alioto RJ, Marquardt JD. The efficacy and safety of the hematoma block for fracture reduction in closed, isolated fractures. *Orthopedics* 1997;20(5):423-6.

7. Mace SE. Adverse events of emergency department procedural sedation. *Ann Emerg Med* 2006;48(4):S59.

8. Nelson MS, Walters VE, Watkins LM. Competency verification for conscious sedation. *J Emerg Nurs* 1996;22(2):116-9.

9. Poe SS, Nolan MT, Dang D, Schauble J, Oechsle DG, Kress L, et al. Ensuring safety of patients receiving sedation for procedures: evaluation of clinical practice guidelines. *Jt Comm J Qual Improv* 2001;27(1):28.

Outcome (N = 5)

The following studies were excluded because they did not report data on at least one outcome of interest.

1. Avoid problems with conscious sedation. *ED Nursing* 2003 Feb;6(4):50-2.

2. Blackburn P, Vissers R. Pharmacology of emergency department pain management and conscious sedation. *Emerg Med Clin North Am* 2000;18(4):803.

3. Brown TB, Lovato LM, Parker D. Procedural sedation in the acute care setting. *Am Fam Physician* 2005;71(1):85-90.

4. Hostetler MA, Auinger P, Szilagyi PG. Parenteral analgesic and sedative use among ED patients in the United States: combined results from the National Hospital Ambulatory Medical Care Survey (NHAMCS) 1992-1997. *Am J Emerg Med* 2002;20(3):139-43. Erratum in: *Am J Emerg Med* 2002 Sep;20(5):496.

5. Miller SL, Cleeman E, Auerbach J, Flatow EL. Comparison of intra-articular lidocaine and intravenous sedation for reduction of shoulder dislocations: a randomized, prospective study. *J Bone Joint Surg Am* 2002;84A(12):2135-9.

Abstracts of Full Publications (N = 6)

The following studies were excluded because they were abstracts of studies that were subsequently published as complete articles that have been included in the review.

1. Bock AJ, Burton JH, Strout TD. A randomized, controlled trial of etomidate and midazolam for procedural sedation during reduction of anterior shoulder dislocation [abstract]. *Acad Emerg Med* 2001;8(5):423.2.

2. Campbell SG, Magee KD, Kovacs GJ, Petrie DA, Tallon JM, McKinley R, et al. Procedural sedation and analgesia in a Canadian adult tertiary care emergency department: a case series [replaced by unpublished update]. *Can J Emerg Med* 2006;8(2):85-93.

3. Chudnofsky CR. Combination of midazolam and ketamine for procedural sedation in adult ED patients [abstract]. *Acad Emerg Med* 1999;6(5)1999:467.

4. Danahy MS, Miner JR, Moch A, Biros MH. Randomized clinical trial of etomidate vs. propofol for procedural sedation during fracture and dislocation [abstract]. *Ann Emerg Med* 2005;46(3):S72-S73.

5. Hunt GS, Spencer MT. Etomidate and midazolam for procedural sedation: prospective trial [abstract]. *Ann Emerg Med* 2003;42(4):S40.

6. Ruth WJ. Etomidate and emergency department procedural sedation [abstract]. *Ann Emerg Med* 1999;34(4):348.

Pending Translation (N = 6)

The following articles could not be assessed because they were pending translation.

1. Sedation in the intensive care and emergency medicine. 6th Consensus Conference on Intensive Care and Emergency Medicine, Paris, France, July 2, 1993. *Rev Pneumol Clin* 1994;50(2):88-91. (French).

2. Cavalli PL, Morscia C. Use of Ketalar in orthopedic, traumatologic and ophthalmologic anesthesia. *Minerva Anestesiol* 1974;40(7):328-30. (Italian).

3. Hirlinger WK, Dick W. Intramuscular ketamine analgesia in emergency patients. II. Clinical study of traumatized patients. *Anaesthesist* 1984;33(6):272-5. (German).

4. Hirlinger WK, Pfenninger E. Intravenous analgesia with ketamine for emergency patients. *Anaesthesist* 198;36(3):140-2. (German).

5. Koliutskaia OD, Bitsunov NS, Tsvetkova NA. Intravenous anesthesia with spontaneous breathing preserved in emergency traumatology. *Anesteziologiia i Reanimatologiia* 1979;Mar (2):11-3. (Russian).

6. Malacarne P, Vullo C, Biancofiore GD, Galli R, Massetani R. Total intravenous anaesthesia with propofol in continuous perfusion + fentanyl without NO2: clinical and EEG evaluation. *Acta Anaesthesiologica Italica* 1992;43(4):539-545. (Italian).

Unretrieved (N = 15)

The following articles or studies were unable to be retrieved and assessed by the deadline for the review.

1. Allen MD, Greenblatt DJ. *Hypnotics and Sedatives*. Boston (MA): Massachusetts General Hospital; 1980.

2. Colin C. *Contribution a l'etude de l'anesthesie au chlorhydrate de ketamine: a propos de 192 observations* [dissertation]. Lyon (France): Universite de Lyon; 1971. (French).

3. Crozier T. Etomidate a safe anesthetic. In: Fitzal WFS, Schalk DHV, editors. *Anaesthesiologie und intensivmedizin, 190. Aktueller stand der klinischen Anaesthesie* (Anesthesiology and intensive care medicine, 190. Current status of clinical anesthesia), Central European Anesthesia Congress, Part 1, Graz (Austria), Sept 11-14, 1985. Berlin: Springer-Verlag; 1986. p.78-86.

4. Doenicke A, Ulsamer B, Mueller OA, Suttmann H, Raps R, Wuttke W. Propofol. 1986. In: Fitzal WFS, Schalk DHV, series editors. *Anaesthesiologie und Intensivmedizin, 190. Aktueller Stand der klinischen Anaesthesie* (Anesthesiology and intensive care medicine, 190. Current status of clinical anesthesia), Central European Anesthesia Congress, Part 1, Graz (Austria), Sept 11-14, 1985. Berlin: Springer-Verlag; 1986. p.87-93.

5. Drummond G. Comparison of sedation/analgesia using midazolam and morphine, with the agents propofol and remifentanil, for reduction of shoulder dislocation, in terms of satisfactory operating conditions, recovery to street fitness, and tolerability. 2007. National Research Register (UK); 2007 [cited 20 June 2007)]. Available from: http://www.nrr.nhs.uk/ViewDocument.asp?ID=N0519141684

6. Howes MC. A randomised trial comparing propofol or midazolam for sedation in the A&E department for the sedation of patients requiring manipulation of a joint dislocation. 2002. National Research Register (UK); 2007 [cited 20 June 2007)]. Available from: http://www.nrr.nhs.uk/ViewDocument.asp?ID=N0188100794

7. Idrees U. Boy, that looks painful! Effective procedural sedation in the emergency department [abstract]. *ASHP Midyear Clinical Meeting* 2005;40:I-63.

8. Michael JA. Propofol use in the elderly emergency department patient [abstract]. *Ann Emerg Med* 1998;32(3):207.

9. Nimmo A. Study to determine suitable parameters for the administration of propofol by effect-site target controlled infusion for conscious sedation. 2006. National Research Register (UK); 2006 [cited 20 June 2007)]. Available from: http://www.nrr.nhs.uk/ViewDocument.asp?ID=N0519161590

10. Park R. Propofol for deep procedural sedation in the emergency department [abstract]. *Ann Emerg Med* 2001;34(4) Suppl:77.

11. Schulz-Merkel D. *Etomidate : ein neues IV Hypnotikum zur Narkoseeinleitung eine klinische Prufung* [dissertation]. Munich (Germany): Ludwig-Maximilians-Universität; 1974. (German).

12. Symington L. *An audit of procedural sedation of adult patients presenting to accident and emergency: are we adopting safe practice in the department as recommended by the report of the UK Academy of Medical Royal Colleges and their Faculties and are patients satisfied with their treatment in the department?* 2005. National Research Register (UK); 2007 [cited 20 June 2007)]. Available from: http://www.nrr.nhs.uk/ViewDocument.asp?ID=N0405149375

13. Wandel C, Neff S, Boehrer H, Motsch J. Emergency characteristics after sevoflurane versus propofol anaesthesia in adult outpatients. *Br J Anaesth* 1994;72(Suppl 1).

14. Weymar A, Patschke D, Tarnow J, Brueckner JB. Etomidate anesthesia for cardioversion. In: Doenicke, A, series editors. *Anaesthesiology and Resuscitation. Etomidate: an intravenous hypnotic agent first report on clinical and experimental experience*. Vol 106. Berlin: Springer-Verlag; 1977. p. 40-3.

15. Zeller AM. *Vergleich von Propofol und Thiopental als Mittel zur Narkosenunterhaltung* [dissertation]. Tübingen (Germany): Eberhard Karls Universität; 1987. (German).

APPENDIX 3: EXCLUDED STUDIES

Economic Evaluation (N = 175)

Study Design (N = 7)

The following studies were excluded because they were not randomized controlled clinical trials, controlled clinical trials, controlled before-and-after studies, or prospective observational studies.

1. Dorf E, Kuntz AF, Kelsey J, Holstege CP. Lidocaine-induced altered mental status and seizure after hematoma block. *J Emerg Med* 2006;31(3):251-3.

2. Fatovich DM, Gope M, Paech MJ. A pilot trial of BIS monitoring for procedural sedation in the emergency department. *Emerg Med Australas* 2004;16(2):103-7.

3. Handoll HHG, Madhok R. Closed reduction methods for treating distal radial fractures in adults. *Cochrane Database Syst Rev* 2003(1):CD003763.

4. Khalaiwi K, Al-Harbi F, Altamimi SA, Qashqari S. Anaesthesia for cardioversion. *Cochrane Database Syst Rev* 2007(2):CD006326.

5. Sadovsky R. Cardioversion of paroxysmal atrial fibrillation [abstract]. *Am Fam Physician* 1999;60(1):272.

6. Sadovsky R. Deep sedation options during cardioversion. *Am Fam Physician* 2004;70(3):584-5.

7. Smith E, Wasiak J, Boyle M. Antiemetic therapy in the emergency and ambulance setting for opioid induced nausea and vomiting. *Cochrane Database Syst Rev* 2007(2):CD005058.

Population (N = 54)

The following studies were excluded because they did not include a majority of adult patients (>18 yr.) or did not include procedures of interest (i.e., bone fractures, major joint dislocations, cardioversion).

1. CAEP Oral Presentations for ICEM 2006: Airway track [absract]. *Can J Emerg Med* 2006;8(3):208-211.

2. CAEP Oral Presentations for ICEM 2006: Injury track [abstract]. *Can J Emerg Med* 2006;8(3):178.

3. Bartfield JM, Flint RD, McErlean M, Broderick J. Nebulized fentanyl for relief of abdominal pain. *Acad Emerg Med* 2003;10(3):215-8.

4. Bijur PE, Kenny MK, Gallagher EJ. Intravenous morphine at 0.1 mg/kg is not effective for controlling severe acute pain in the majority of patients. *Ann Emerg Med* 2005;46(4):363-7.

5. Colman I, Rothney A, Wright SC, Zilkalns B, Rowe BH. Use of narcotic analgesics in the emergency department treatment of migraine headache. *Neurology* 2004;62(10):1695-700.

6. Cordell WH, Wright SW, Wolfson AB, Timerding BL, Maneatis TJ, Lewis RH, et al. Comparison of intravenous ketorolac, meperidine, and both (balanced analgesia) for renal colic. *Ann Emerg Med* 1996;28(2):151-8.

7. Coyne K, Grandy S, Paramore C, Mercader M, Zimetbaum P. Resource use and costs associated with atrial fibrillation in the US. *Circulation* 2004;110(17 Suppl S):826.

8. Coyte PC, Bronskill SE, Hirji ZZ, Daigle TG, Trerise BS, Wright JG. Economic evaluation of 2 treatments for pediatric femoral shaft fractures [abstract]. *Clin Orthop Relat Res* 1997;336:205-15.

9. Cramer KE, Glasson S, Mencio G, Green NE. Reduction of forearm fractures in children using axillary block anesthesia. *J Orthop Trauma* 1995;9(5):407-10.

10. Dominguez TE, Helfaer MA. Review of bispectral index monitoring in the emergency department and pediatric intensive care unit. *Pediatr Emerg Care* 2006;22(12):815-21.

11. England SP, Sundberg S. Management of common pediatric fractures. *Pediatr Clin North Am* 1996 Oct;43(5):991-1012. Erratum in: *Pediatr Clin North Am* 1997;44(1):xi.

12. Fleming JK, Ishida JT, Yamamoto LG. Sedation and local anesthesia preferences of emergency physician parents. *Am J Emerg Med* 2000;18(6):737-8.

13. Fortner BV, Demarco G, Irving G, Ashley J, Keppler G, Chavez J, et al. Description and predictors of direct and indirect costs of pain reported by cancer patients. *J Pain Symptom Manage* 2003;25(1):9-18.

14. Friedland LR, Pancioli AM, Duncan KM. Pediatric emergency department analgesic practice. *Pediatr Emerg Care* 1997;13(2):103-6.

15. Gibly R, Williams M, Walter FG, McNally J, Conroy C, Berg RA. Continuous intravenous midazolam infusion for Centruroides exilicauda scorpion envenomation. *Ann Emerg Med* 1999;34(5):620.

16. Goldman RD, Balasubramanian S, Wales P, Mace SE. Pediatric surgeons and pediatric emergency physicians' attitudes towards analgesia and sedation for incarcerated inguinal hernia reduction. *J Pain* 2005;6(10):650-5.

17. Goldner BG, Baker J, Accordino A, Sabatino L, DiGiulio M, Kalenderian D, et al. Electrical cardioversion of atrial fibrillation or flutter with conscious sedation in the age of cost containment. *Am Heart J* 1998;136(6):961-4.

18. Gronefeld G, Ehrlich JR, Hohnloser SH. Comparison of outpatient vs inpatient direct current cardioversion of atrial fibrillation: safety, efficacy and cost savings. *Eur Heart J Suppl* 2003;5(H):H19-H24.

19. Huang Z, Zhu JP, Huang HZ. Analysis of analgesics used for treatment of patients with cancer pain in the outpatient and emergency department of Changning District Central Hospital during the period 1999-2001. *Pharm Care Res* [*Yaoxue Fuwu Yu Yanjiu*] 2002;2(3):149-51. (Chinese)

20. Idrees U, Londner M. Pharmacotherapy overview of seizure management in the adult emergency department. *J Pharm Pract* 2005;18(5):394-411.

21. Jaffe JS. Conscious sedation for the performance of gynecologic examination of individuals with intellectual disability. *Conn Med* 2005;69(5):267-9.

22. Kendall JL, Reynolds M, Goldberg R. Intranasal midazolam in patients with status epilepticus. *Ann Emerg Med* 1997;29(3):415-7.

23. Knight S. Management of pulled elbows. *Emerg Nurse* 2006;14(5):18-9.

24. Knott JC, Taylor DM, Castle DJ. Randomized clinical trial comparing intravenous midazolam and droperidol for sedation of the acutely agitated patient in the emergency department. *Ann Emerg Med* 2006;47(1):61-7.

25. Lawrence LM, Wright SW. Sedation of pediatric patients for minor laceration repair: effect on length of emergency department stay and patient charges. *Pediatr Emerg Care* 1998;14(6):393-5.

26. Martel M, Sterzinger A, Miner J, Clinton J, Biros M. Management of acute undifferentiated agitation in the emergency department: a randomized double-blind trial of droperidol, ziprasidone, and midazolam. *Acad Emerg Med* 2005;12(12):1167-72.

27. McCloy RF, Pearson RC. Which agent and how to deliver it—a review of benzodiazepine sedation and its reversal in endoscopy. *Scand J Gastroenterol* 1990;25:7-11.

28. Morton L, Bridgman S, Dwyer J, Theis J. Interventions for treating femoral shaft fractures in children and adolescents. *Cochrane Database Syst Rev* 2002(1):CD003473.

29. Nelson DS, Hoagland JR, III, Kunkel NC. Costs of sedation using oral midazolam: money, time, and parental attitudes. *Pediatr Emerg Care* 2000;16(2):80-4.

30. Nobay F, Simon BC, Levitt MA, Dresden GM. A prospective, double-blind, randomized trial of midazolam versus haloperidol versus lorazepam in the chemical restraint of violent and severely agitated patients. *Acad Emerg Med* 2004;11(7):744-9.

31. Pershad J, Todd K, Waters T. Cost-effectiveness analysis of sedation and analgesia regimens during fracture manipulation in the pediatric emergency department. *Pediatr Emerg Care* 2006;22(10):729-36.

32. Petrack EM, Christopher NC, Kriwinsky J. Pain management in the emergency department: patterns of analgesic utilization. *Pediatrics* 1997;99(5):711-4.

33. Plint A, Clifford T, Perry J, Bulloch B, Pusic M, Lalani A, et al. Wrist buckle fractures: a survey of current practice patterns and attitudes toward immobilization. *Can J Emerg Med* 2003;5(2):95-100.

34. Plint AC, Perry JJ, Tsang JLY. Pediatric wrist buckle fractures: should we just splint and go? *Can J Emerg Med* 2004;6(6):397-401.

35. Pollauf LA, Lutes RE, Ramundo ML, Christopher NC. The educational experience of pediatric emergency medicine fellows in the use and application of procedural sedation/analgesia. *Pediatr Emerg Care* 2004;20(1):12-6.

36. Ratnapalan S, Schneeweiss S. Guidelines to practice: the process of planning and implementing a pediatric sedation program. *Pediatr Emerg Care* 2007;23(4):262-6.

37. Sagarin MJ, Barton ED, Sakles JC, Vissers RJ, Chiang V, Walls RM. Underdosing of midazolam in emergency endotracheal intubation. *Acad Emerg Med* 2003;10(4):329-38.

38. Siaplaouras S, Buob A, Heisel A, Bohm M, Jung J. Outpatient electrical cardioversion of atrial fibrillation: efficacy, safety and patients' quality of life. *Int J Cardiol* 2005;105(1):26-30.

39. Silverman ME, Shih RD, Allegra J. Morphine induces less nausea than meperidine when administered parenterally. *J Emerg Med* 2004;27(3):241-3.

40. Sivilotti MLA, Filbin MR, Murray HE, Slasor P, Walls RM. Does the sedative agent facilitate emergency rapid sequence intubation? *Acad Emerg Med* 2003;10(6):612-20.

41. Sivilotti MLA, Ducharme J. Randomized, double-blind study on sedatives and hemodynamics during rapid-sequence intubation in the emergency department: the SHRED Study. *Ann Emerg Med* 1998;31(3):313-24.

42. Sivilotti MLA. Dr. Sivilotti responds. *Can J Emerg Med* 2007;9(1):3-4.

43. Sivilotti MLA. You need tube, me give one amp of etomidate and SUX. *Can J Emerg Med* 2006 Sep;8(5):351-3.

44. Smith DC, Bergen JM, Smithline H, Kirschner R. A trial of etomidate for rapid sequence intubation in the emergency department. *J Emerg Med* 2000;18(1):13-6.

45. Stalnikowicz R, Mahamid R, Kaspi S, Brezis M. Undertreatment of acute pain in the emergency department: a challenge. *Int J Qual Health Care* 2005;17(2):173-6.

46. Stella J, Ellis R, Sprivulis P. Nerve stimulator-assisted femoral nerve block in the emergency department. *Emerg Med* 2000;12(4):322-5.

47. Swor R, McEachin CM, Seguin D, Grall KH. Prehospital pain management in children suffering traumatic injury. *Prehosp Emerg Care* 2005;9(1):40-3.

48. Tindale R. Journal scan. *Emerg Nurse* 2004;12(3):7.

49. Vipond A, de Mello W. Drugs used in anaesthetic emergencies: current practice and a cost analysis of prefilled syringes. *Anaesthesia* 2000;55(3):303-4.

50. Wilson JE, Pendleton JM. Oligoanalgesia in the emergency department. *Am J Emerg Med* 1989;7(6):620-3.

51. Wolfe JM, Lein DY, Lenkoski K, Smithline HA. Analgesic administration to patients with an acute abdomen: a survey of emergency medicine physicians. *Am J Emerg Med* 2000;18(3):250-3.

52. Zed PJ, Mabasa VH, Slavik RS, Abu-Laban RB. Etomidate for rapid sequence intubation in the emergency department: is adrenal suppression a concern? *Can J Emerg Med* 2006;8(5):347-50.

53. Zimmerman O, Halpern P. Opinion survey of analgesia for abdominal pain in Israeli emergency departments. *Isr Med Assoc J* 2004;6(11):681-5.

54. Zun LS, Downey LV, Gossman W, Rosenbaumdagger J, Sussman G. Gender differences in narcotic-induced emesis in the ED. *Am J Emerg Med* 2002 May;20(3):151-4.

Setting (N = 19)

The following studies were excluded because they did not take place in the emergency department.

1. Corrections. *Can J Emerg Med* 2006;8(3):147.

2. Adunsky A, Levy R, Heim M, Mizrahi E, Arad M. Meperidine analgesia and delirium in aged hip fracture patients. *Arch Gerontol Geriatr* 2002;35(3):253.

3. Barron S. At cross purposes. *Emerg Nurse* 2007;15(3):7.

4. Berry C, Stewart S, Payne EM, McArthur JD, McMurray JJV. Electrical cardioversion for atrial fibrillation: outcomes in 'real-life' clinical practice. *Int J Cardiol* 2001;81(1):29-35.

5. Boodhoo L, Bordoli G, Mitchell AR, Lloyd G, Sulke N, Patel N. The safety and effectiveness of a nurse led cardioversion service under sedation. *Heart* 2004;90(12):1443-6.

6. Botkin SB, Dhanekula LS, Olshansky B. Outpatient cardioversion of atrial arrhythmias: efficacy, safety, and costs. *Am Heart J* 2003;145(2):233-8.

7. Choong PF, Langford AK, Dowsey MM, Santamaria NM. Clinical pathway for fractured neck of femur: a prospective, controlled study. *Med J Aust* 2000;172(9):423-6.

8. De Paola AAV, Figueiredo E, Sesso R, Veloso HH, Nascimento LOT. Effectiveness and costs of chemical versus electrical cardioversion of atrial fibrillation. *Int J Cardiol* 2003;88(2-3):157-66.

9. Gale DW, Grissom TE, Mirenda JV. Titration of intravenous anesthetics for cardioversion: a comparison of propofol, methohexital, and midazolam. *Crit Care Med* 1993;21(10):1509-13.

10. Handoll HHG, Madhok R, Huntley JS. Different methods of external fixation for treating distal radial fractures in adults. *Cochrane Database Syst Rev* 2007(2):CD006522.

11. Handoll HHG, Madhok R, Huntley JS. External fixation versus conservative treatment for distal radial fractures in adults. *Cochrane Database Syst Rev* 2006(4):CD006194

12. Lehto M, Kala R. Persistent atrial fibrillation: a population based study of patients with their first cardioversion. *Int J Cardiol* 2003;92(2-3):145-50.

13. Mitchell ARJ, Chalil S, Boodhoo L, Bordoli G, Patel N, Sulke N. Diazepam or midazolam for external DC cardioversion (The DORM study). *Europace* 2003;5(4):391-5.

14. Najeb Y, Essadki B, Latifi M, Fikry T. Luxation bipolaire de l'avant-bras: luxation du coude et luxation transcapholunaire du carpe. Á propos d'un cas. [Bipolar dislocation of the forearm]. *Chirurgie de la Main* 2007;26(1):62-4. (French)

15. Santamaria N, Houghton L, Kimmel L, Graham A. Clinical pathways for fractured neck of femur: a cohort study of health related quality of life, patient satisfaction and clinical outcome. *Aust J Adv Nurs* 2003;20(3):24-9.

16. Schultz A, Grouven U, Zander I, Beger FA, Siedenberg M, Schultz B. Age-related effects in the EEG during propofol anaesthesia. *Acta Anaesthesiol Scand* 2004;48(1):27-34.

17. Smith I. A multicentre comparison of the costs of anaesthesia with sevoflurane or propofol. *Br J Anaesth* 1999;83(4):564-70.

18. Tombasco M. The ins and outs of I.V. anesthetics. *Nurs Manage* 2006;37:2-5.

19. Tondare AS, Nadkarni AV. Femoral nerve block for fractured shaft of femur. *Can Anaesth Soc J* 1982;29(3):270-1.

Intervention (N = 55)

The following studies were excluded because they did not examine the administration of at least one of propofol, ketamine, etomidate, or combination drug (e.g., ketafol) or a relevant narcotic or benzodiazepine comparator.

1. Injury trauma track [abstract]. *Can J Emerg Med* 2006;8(3):187-190.

2. Summaries for patients. Increasing the detection and treatment of osteoporosis in patients who present to an emergency department with a wrist fracture. *Ann Intern Med* 2004;141(5):I54.

3. Allgoewer, M. Cost implications of accidents and the type of fracture care. In: Border, JR, editor. *Blunt multiple trauma: comprehensive pathophysiology and care*. New York: Marcel Dekker, Inc.; 1990. p. 775-82.

4. Andrews M, Nelson BP. Atrial fibrillation. *Mt Sinai J Med* 2006;73(1):482-92.

5. Borgundvaag B, Ovens H. Cardioversion of uncomplicated paroxysmal atrial fibrillation: a survey of practice by Canadian emergency physicians. *Can J Emerg Med* 2004;6(3):155-60.

6. Boriani G, Diemberger I, Biffi M, Martignani C, Branzi A. Pharmacological cardioversion of atrial fibrillation: current management and treatment options. *Drugs* 2004;64(24):2741-62.

7. Brauer CA, Manns BJ, Ko M, Donaldson C, Buckley R. An economic evaluation of operative compared with nonoperative management of displaced intra-articular calcaneal fractures [abstract]. *J Bone Joint Surg* 2005;87(12):2741-9.

8. Coyne KS, Paramore C, Grandy S, Mercader M, Reynolds M, Zimetbaum P. Assessing the direct costs of treating nonvalvular atrial fibrillation in the United States. *Value Health* 2006;9(5):348-56.

9. Dancocks A, Rouse A, Hiscox J. A pilot study to assess the sensitivity and specificity of an intrasound device in the diagnosis of ankle fractures. *J Accid Emerg Med* 1997;14(4):230-2.

10. Day AC. Emergency management of pelvic fractures. *Hosp Med* 2003;64(2):79-86.

11. del Arco C, Martin A, Laguna P, Gargantilla P, Investigators in the Spanish Atrial Fibrillation in Emergency Medicine Study Group (GEFAUR). Analysis of current management of atrial fibrillation in the acute setting: GEFAUR-1 study. *Ann Emerg Med* 2005 Nov;46(5):424-30.

12. Dias JJ, Garcia-Elias M. Hand injury costs. *Injury* 2006;37(11):1071-7.

13. Dijkstra PU, Groothoff JW, ten Duis HJ, Geertzen JH. Incidence of complex regional pain syndrome type I after fractures of the distal radius. *Eur J Pain* 2003;7(5):457-62.

14. Eckman MH, Falk RH, Pauker SG. Cost-effectiveness of therapies for patients with nonvalvular atrial fibrillation. *Arch Intern Med* 1998;158(15):1669-77.

15. Emond M, Le Sage N, Lavoie A, Rochette L. Clinical factors predicting fractures associated with an anterior shoulder dislocation. *Acad Emerg Med* 2004;11(8):853-8.

16. Evers JA, Werpachowski D. Dealing with fractures. *RN* 1984;47(11):53-60.

17. Fraenkel L, LaValley M, Felson D. The use of radiographs to evaluate shoulder pain in the ED. *Am J Emerg Med* 1998;16(6):560-3.

18. Gronefeld GC, Lilienthal J, Kuck KH, Hohnloser SH. Impact of rate versus rhythm control on quality of life in patients with persistent atrial fibrillation: results from a prospective randomized study. *Eur Heart J* 2003;24(15):1430-6.

19. Hammel J, Legome E. Pelvic fracture. *J Emerg Med* 2006;30(1):87-92.

20. Handoll HHG, Madhok R. Conservative interventions for treating distal radial fractures in adults. *Cochrane Database Syst Rev* 2003(2):CD000314.

21. Hashemi-Nejad A, Goddard NJ. Radial head fractures. *Br J Hosp Med* 1994;51(5):223-6.

22. Hawksworth CRE, Freeland P. Inability to fully extend the injured elbow: an indicator of significant injury. *Arch Emerg Med* 1991;8(4):253-6.

23. Hendey GW, Chally MK, Stewart VB. Selective radiography in 100 patients with suspected shoulder dislocation. *J Emerg Med* 2006;31(1):23-8.

24. Hodge JC. Anterior process fracture or calcaneus secundarius: a case report. *J Emerg Med* 1999;17(2):305-9.

25. Jantos TJ, Paris PM, Menegazzi JJ, Yealy DM. Analgesic practice for acute orthopedic trauma pain in Costa Rican emergency departments. *Ann Emerg Med* 1996;28(2):145-50.

26. Kim MH, Morady F, Conlon B, Kronick S, Lowell M, Bruckman D, et al. A prospective, randomized, controlled trial of an emergency department-based atrial fibrillation treatment strategy with low-molecular-weight heparin. *Ann Emerg Med* 2002;40(2):187-92.

27. Kuzak N, Ishkanian A, Abu-Laban RB. Posterior sternoclavicular joint dislocation: case report and discussion. *Can J Emerg Med* 2006;8(5):355-7.

28. Lockey A. Anaesthetic for Colles' fracture. *J Accid Emerg Med* 1998;15(3):207.

29. Lubbeke A, Stern R, Grab B, Herrmann F, Michel JP, Hoffmeyer P. Upper extremity fractures in the elderly: consequences on utilization of rehabilitation care. *Aging Clin Exp Res* 2005;17(4):276-80.

30. Mabee JR, Pritchard B. An unusual transcapitate fracture of the wrist. *Am J Emerg Med* 1997;15(6):584-6.

31. Marco CA, Plewa MC, Buderer N, Black C, Roberts A. Comparison of oxycodone and hydrocodone for the treatment of acute pain associated with fractures: a double-blind, randomized, controlled trial. *Acad Emerg Med*;12(4):282-8.

32. Marco CA, Plewa MC, Buderer N, Hymel G, Cooper J. Self-reported pain scores in the emergency department: lack of association with vital signs. *Acad Emerg Med* 2006;13(9):974-9.

33. Marshall DA, Levy AR, Vidaillet H, Fenwick E, Slee A, Blackhouse G, et al. Cost-effectiveness of rhythm versus rate control in atrial fibrillation. *Ann Intern Med* 2004;141(9):653-61.

34. Matot I, Oppenheim-Eden A, Ratrot R, Baranova J, Davidson E, Eylon S, et al. Preoperative cardiac events in elderly patients with hip fracture randomized to epidural or conventional analgesia. *Anesthesiology* 2003;98(1):156-63.

35. Meerding WJ, Mulder S, van Beeck EF. Incidence and costs of injuries in the Netherlands. *Eur J Public Health* 2006;16(3):271-7.

36. Meyer J. Medical resource utilization and cost of fractures. *J Bone Miner Res* 2000;15(Suppl 1):S536.

37. Phillips DE, Langley JD, Marshall SW. Injury—the medical and related costs in New Zealand 1990. *N Z Med J* 1993;106(957):215-7.

38. Plociak BJ, Lato A, Palumbo M. Case study. Fractured ankle. *Orthop Nurs* 1999;18(4):21-6.

39. Resch S, Bjärnetoft B, Thorngren K. Preoperative skin traction or pillow nursing in hip fractures: a prospective, randomized study in 123 patients. *Disabil Rehabil* 2005;27(18/19):1191-5.

40. Reynolds MR, Essebag V, Zimetbaum P, Cohen DJ. Healthcare resource utilization and costs associated with recurrent episodes of atrial fibrillation: the FRACTAL registry. *J Cardiovasc Electrophysiol* 2007;18(6):628-33.

41. Rienstra M, Van Veldhuisen DJ, Hagens VE, Ranchor AV, Veeger NJGM, Crijns HJGM, et al. Gender-related differences in rhythm control treatment in persistent atrial fibrillation: data of the rate control versus electrical cardioversion (RACE) study. *J Am Coll Cardiol* 2005;46(7):1298-306.

42. Roudsari BS, Ebel BE, Corso PS, Molinari NA, Koepsell TD. The acute medical care costs of fall-related injuries among the U.S. older adults. *Injury* 2005;36(11):1316-22.

43. Steedman DJ, Payne MR, Mcclure JH, Prescott LF. Gastric-emptying following Colles' fracture. *Arch Emerg Med* 1991;8(3):165-8.

44. Sucov A, Nathanson A, McCormick J, Proano L, Reinert SE, Jay G. Peer review and feedback can modify pain treatment patterns for emergency department patients with fractures. *Am J Med Qual* 2005;20(3):138-43.

45. Summers A. Shoulder dislocation: reduction without sedation in the emergency department. *Emerg Nurs* 2007;15(1):24-8.

46. Swoboda TK, Munyak J. Use of a sedation-analgesia datasheet in closed shoulder reductions. *J Emerg Med* 2005;29(2):129-35.

47. Tindale R. Shoulder dislocation. *Emerg Nurs* 2005;13(3):6.

48. Vaca F, Fox JC, Mai D, Anderson CL, Kwon KT, Wiechmann WF. Skatepark-related injuries in a southern California skatepark and their associated short-term disability and healthcare utilization. *Clin J Sport Med* 2005;15(3):142-7.

49. van Riet YE, van der Schouw YT, van der Werken C. Fewer x-rays while maintaining quality of clinical care using clinical protocols for physical diagnosis of ankle injuries. *Ned Tijdschr Geneeskd* 2000 Jan 29;144(5):224-8. Erratum in: *Ned Tijdschr Geneeskd* 2000;144(30):1464. (Dutch)

50. Van Gelder I, Crijns HJ, Van Gilst WH, Verwer R, Lie KI. Prediction of uneventful cardioversion and maintenance of sinus rhythm from direct-current electrical cardioversion of chronic atrial fibrillation and flutter. *Am J Cardiol* 1991;68(1):41-6.

51. Wakai A, O'Neill J. Emergency management of atrial fibrillation. *Postgrad Med J* 2003;79(932):313-9.

52. Weingarten S, Riedinger MS, Sandhu M, Bowers C, Ellrodt AG, Nunn C, et al. Can practice guidelines safely reduce hospital length of stay? Results from a multicenter interventional study. *Am J Med* 1998;105(1):33-40.

53. You JS, Chung SP, Chung HS, Park IC, Lee HS, Kim SH. The usefulness of CT for patients with carpal bone fractures in the emergency department. *Emerg J Med* 2007;24(4):248-50.

54. Zhao L, Kolm P, Lewis C, Jasper SE, Klein AL, Weintraub WS. Economic analysis of low molecular heparin strategy compared with unfractionated heparin strategy for cardioversion of atrial fibrillation using transesophageal echrocardiography: results from the acute II study. *J Am Coll Cardiol* 2006;47(4 Suppl B):1B.

55. Zimetbaum P, Reynolds MR, Ho KK, Gaziano T, McDonald MJ, McClennen S, et al. Impact of a practice guideline for patients with atrial fibrillation on medical resource utilization and costs. *Am J Cardiol* 2003;92(6):677-81.

Outcome (N = 39)

The following studies were excluded because they did not report data on at least one outcome of interest.

1. Bijur PE, Bérard A, Esses D, Nestor J, Schechter C, Gallagher EJ. Lack of influence of patient self-report of pain intensity on administration of opioids for suspected long-bone fractures. *J Pain* 2006;7(6):438-44.

2. Brown JC, Klein EJ, Lewis CW, Johnston BD, Cummings P. Emergency department analgesia for fracture pain. *Ann Emerg Med* 2003;42(2):197-205.

3. Ceccarelli E, Bondi R, Campi S. Evidence in orthopaedics: comparison of intra-articular lidocaine vs. intravenous analgesia and sedation for reduction of acute shoulder dislocation [abstract]. *J Orthop Traumatol* 2004;5(3):194-6.

4. Ducharme J. Acute pain and pain control: state of the art. *Ann Emerg Med* 2000;35(6):592-603.

5. Fuentes EF, Kohn MA, Neighbor ML. Lack of association between patient ethnicity or race and fracture analgesia. *Acad Emerg Med* 2002;9(9):910-5.

6. Goldstein JR, Eilbert WP. Locked anterior-inferior shoulder subluxation presenting as luxatio erecta. *J Emerg Med* 2004;27(3):245-8.

7. Handoll HHG, Hanchard NCA, Goodchild L, Feary J. Conservative management following closed reduction of traumatic anterior dislocation of the shoulder. *Cochrane Database Syst Rev* 2006(1):CD004962.

8. Handoll HHG, Almaiyah MA. Surgical versus non-surgical treatment for acute anterior shoulder dislocation. *Cochrane Database Syst Rev* 2004(1):CD004325.

9. Harrington L. Staying alert about NAPS. *Nursing* 2006;36:4-10.

10. Hostetler MA, Auinger P, Szilagyi PG. Parenteral analgesic and sedative use among ED patients in the United States: combined results from the National Hospital Ambulatory Medical Care Survey (NHAMCS) 1992-1997. *Am J Emerg Med* 2002;20(3):139-43. Erratum in: *Am J Emerg Med* 2002;20(5):496.

11. Hubble C. Ankle fractures. *Emerg Nurs* 2005;13(4):32-8.

12. Jones JS, Johnson K, McNinch M. Age as a risk factor for inadequate emergency department analgesia. *Am J Emerg Med* 1996;14(2):157-60.

13. Kelly A. A process approach to improving pain management in the emergency department: development and evaluation. *J Accid Emerg Med* 2000;17(3):185-7.

14. Kendall JM, Allen PE, Mccabe SE. A tide of change in the management of an old fracture. *J Accid Emerg Med* 1995;12(3):187-8.

15. Kozlowski MJ, Wiater JG, Pasqual RG, Compton S, Swor RA, Jackson RE. Painful discrimination: the differential use of analgesia in isolated lower limb injuries. *Am J Emerg Med* 2002;20(6):502-5.

16. Lewis LM, Lasater LC. Are emergency physicians too stingy with analgesics? *South Med J* 1994;87(1):7.

17. Mcnally C, Gillespie M. Scaphoid fractures. *Emerg Nurs* 2004;12(1):21-5.

18. Mead GE, Elder AT, Flapan AD, Kelman A. Electrical cardioversion for atrial fibrillation and flutter. *Cochrane Database Syst Rev* 2005(3):CD002903.

19. Monzon DG, Iserson KV, Vazquez JA. Single fascia iliaca compartment block for post-hip fracture pain relief. *J Emerg Med* 2007;32(3):257-62.

20. Neighbor ML, Honner S, Kohn MA. Factors affecting emergency department opioid administration to severely injured patients. *Acad Emerg Med* 2004;11(12):1290-6.

21. Nelson TR. *Analysis of protocol use for patients with an extremity fracture in the emergency department* [dissertation]. Spokane (WA): Gonzaga University; 2002.

22. Neyman GP. Review of conscious sedation. *Internet J Anesthesiol* 2006;11(1):10.

23. Nicol MF. A risk management audit: are we complying with the national guidelines for sedation by non-anaesthetists? *J Accid Emerg Med* 1999;16(2):120-2.

24. Ritsema TS, Kelen GD, Pronovost PJ, Pham JC. The national trend in quality of emergency department pain management for long bone fractures. *Acad Emerg Med* 2007;14(2):163-9.

25. Russell JA, Holmes EM, III, Keller DJ, Vargas JH, III. Reduction of acute anterior shoulder dislocations using the Milch technique: a study of ski injuries. *J Trauma* 1981;21(9):802-4.

26. Sacchetti A, Senula G, Strickland J, Dubin R. Procedural sedation in the community emergency department: initial results of the ProSCED registry. *Acad Emerg Med* 2007;14(1):41-6.

27. Silka PA, Roth MM, Geiderman JM. Patterns of analgesic use in trauma patients in the ED. *Am J Emerg Med* 2002;20(4):298-302.

28. Summers A. Recognising and treating Colles' type fractures in emergency care settings. *Emerg Nurs* 2005;13(6):26-33.

29. Tamayo-Sarver JH, Hinze SW, Cydulka RK, Baker DW. Racial and ethnic disparities in emergency department analgesic prescription. *Am J Public Health* 2003;93(12):2067-73.

30. Tamayo-Sarver JH, Dawson NV, Hinze SW, Cydulka RK, Wigton RS, Albert JM, et al. The effect of race/ethnicity and desirable social characteristics on physicians' decisions to prescribe opioid analgesics. *Acad Emerg Med* 2003;10(11):1239-48.

31. Tamayo-Sarver JH, Dawson NV, Cydulka RK, Wigton RS, Baker DW. Variability in emergency physician decision making about prescribing opioid analgesics. *Ann Emerg Med* 2004;43(4):483-93.

32. Todd KH, Deaton C, D'Adamo AP, Goe L. Ethnicity and analgesic practice. *Ann Emerg Med* 2000;35(1):11-6.

33. Todd KH, Samaroo N, Hoffman JR. Ethnicity as a risk factor for inadequate emergency department analgesia. *JAMA* 1993;269(12):1537-9.

34. Vassiliadis J, Hitos K, Hill CT. Factors influencing prehospital and emergency department analgesia administration to patients with femoral neck fractures. *Emerg Med* (Fremantle) 2002;14(3):261-6.

35. Wakai A, O'Sullivan RG. Intra-articular lignocaine versus intravenous analgesia with or without sedation for manual reduction of acute anterior shoulder dislocation in adults. *Cochrane Database Syst Rev* 2004(3):CD004919.

36. Weiner T, Weiner B, Singer J. Pharmacoeconomic assessment of midazolam in two emergency departments. *Am J Emerg Med* 1998;16(6):616-7.

37. Weyland W, Brauer A, Weyland A, Janitzki AS, Braun U. The effect of sedation on oxygen uptake during spontaneous breathing. *Anaesthesist* 1993;42(6):391-5. (German)

38. Wilder-Smith OH, Mohrle JJ, Martin NC. Acute pain management after surgery or in the emergency room in Switzerland: a comparative survey of Swiss anaesthesiologists and surgeons. *Eur J Pain* 2002;6(3):189-201.

39. Willis AA, Verma NN, Thornton SJ, Morrissey NJ, Warren RF. Upper-extremity deep-vein thrombosis after anterior shoulder dislocation and closed reduction. *J Bone Joint Surg* 2005;87(9):2086-90.

Not retrieved (N = 1)

The following articles were unable to be retrieved by information services and assessed by the deadline for the review.

1. Heckman JD, Sarasohn-Kahn J. The economics of treating tibia fractures. The cost of delayed unions. *Bull Hosp Jt Dis* 1997;56(1):63-72.

APPENDIX 4: FORMS

INCLUSION/EXCLUSION CRITERIA: Clinical Review

Reviewer ID:	Date: / /2007	Record ID:

Criteria	Yes	No	Unclear/ Comments
1. PUBLICATION TYPE			
a. Primary research evaluating management and use of PSA (frequency, drug use, etc.) *in Canada*	☐	☐	☐
b. Primary research examining efficacy and effectiveness of PSA	☐	☐	☐
c. Report of barriers to use of PSA *in Canada*	☐	☐	☐
d. Primary research examining costs of PSA *in Canadian EDs*: economic evaluations, reports to gov/health regions, practice guidelines	☐	☐	☐
2. STUDY DESIGN			
a. Randomized controlled trial	☐	☐	☐
b. Controlled clinical trial	☐	☐	☐
c. Controlled before-and-after study	☐	☐	☐
d. Prospective observational study (cohort, interrupted time series, case series)	☐	☐	☐
e. Surveys	☐	☐	☐
f. Guideline or review	☐	☐	☐
g. Administrative data	☐	☐	☐
3. POPULATION			
Adult patients (>17 yrs)	☐	☐	☐
Patients requiring brief painful procedures (bone fractures, major joint dislocations, cardioversion)	☐	☐	☐
4. SETTING			
Procedure/study takes place in hospital emergency department	☐	☐	☐
5. INTERVENTION			
Administration of at least one of the short-acting dissociative agents under investigation			
a. Propofol (Propofol injection, Diprovan, etc.)	☐	☐	☐
b. Ketamine HCl (Ketamine, Ketalar)	☐	☐	☐
c. Etomidate (Amidate)	☐	☐	☐
d. Combination drug (e.g. "ketafol," propofol/fentanyl)	☐	☐	☐
6. COMPARATOR			
Opioid agents (e.g., codeine, morphine, meperidine, alfentanyl, fentanyl, etc.)	☐	☐	☐
Opioid agents in combination with sedative-hypnotic benzodiazepine (e.g., midazolam, diazepam (Valium), lorazepam (Ativan), etc.)	☐	☐	☐
Regional anesthesia (e.g., Bier's block, hematoma block, etc.)	☐	☐	☐
7. OUTCOME (for Q I, II and IV)			

Study reports data on at least one outcome of interest	☐	☐	☐

REVIEWER'S DECISION : Include ☐ **Exclude** ☐ **Unsure** ☐

FINAL DECISION: Include ☐ **Exclude** ☐ **Unsure** ☐
NOTE: Must clearly identify at least one of the above reasons for exclusion.

RELEVANT TO QUESTION(S): I. (1a, 2d-g) ☐ **II. (1b, 2a-d)** ☐ **III. (1c, 2d-f)** ☐ **IV. (1d, 2a-e, g)** ☐

Non-English report needing translation ☐ **Language** _____

INCLUSION/EXCLUSION CRITERIA: Economic Evaluation

Reviewer ID: **Date:** / /2007 **Record ID:**

Criteria	Yes	No	Unclear/ Comments
1. SETTING			
Procedure/study takes place in hospital emergency department	☐	☐	☐
2. POPULATION			
Adult patients (>17 yrs)	☐	☐	☐
3. PATIENTS REQUIRING BRIEF PAINFUL PROCEDURES IN THE ED			
a. Cardioversion	☐	☐	☐
b. Bone fracture	☐	☐	☐
c. Major joint dislocation	☐	☐	☐
4. ADMINISTRATION OF AN INTERVENTION OR COMPARATOR MUST BE PRESENT			
A. INTERVENTION			
Administration of at least one of the short-acting dissociative agents under investigation			
a. Propofol (Propofol, Diprovan, etc.)	☐	☐	☐
b. Ketamine HCl (Ketamine Hydrochloride, Ketalar)	☐	☐	☐
c. Etomidate (Amidate)	☐	☐	☐
d. Combination drug (e.g., "ketafol," propofol/fentanyl)	☐	☐	☐
B. COMPARATOR			
a. Opioid agents (e.g., codeine, morphine, meperidine, alfentanyl, fentanyl, etc.)	☐	☐	☐
b. Opioid agents in combination with sedative-hypnotic benzodiazepine (e.g., midazolam (Versed), diazepam (Valium), lorazepam (Ativan), etc.)	☐	☐	☐
c. Regional anesthesia (e.g., Bier's block, hematoma block, etc.)	☐	☐	☐
5. OUTCOME			
One of the following outcomes must be recorded to include article			
a. Event probability	☐	☐	☐
b. Resource measurement (utilization) or valuation (cost)	☐	☐	☐
c. HRQoL (disease specific, generic, and preference-based utility)	☐	☐	☐

REVIEWER'S DECISION : Include ☐ **Exclude** ☐ **Unsure** ☐

FINAL DECISION: Include ☐ **Exclude** ☐ **Unsure** ☐

NOTE: Must clearly identify at least one of the above reasons for exclusion.

RELEVANT TO QUESTION: IV. (1, 2a-c, 3) ☐

Non-English report needing translation ☐ **Language** _____

*For studies comparing two short-acting dissociative PSA regimes, complete "Intervention 1" and "Intervention 2." Complete the "Conventional Comparator" only for studies with opioid, benzodiazepine, or Bier block control.

DATA EXTRACTION: General Characteristics

1. GENERAL INFORMATION

Data Extractor: _____

Name of the study: (Ref ID #)	Publication date:
Principal investigator's name:	Start date: (data collection)
Country in which study took place:	Completion date: (data collection)
Specify source of funding: (check all that apply) Pharmaceutical industry ☐ Industry, other than pharmaceutical ☐ Government agency ☐ Foundation/charity ☐ Internal funds ☐ Professional organization ☐ Not Specified ☐ Other ☐ Specify:	
Role of funding organization:	
Contact with authors: (specify if required)	
Relevant to Question(s): **Q1.**Current usage in Canada ☐ **Q2.** Efficacy/safety ☐ **Q3.** Barriers to use ☐ **Q4.** Economic analysis ☐	

2. SPECIFIC INFORMATION

Study / data source characteristics

Setting: (check all that apply)
Emergency Department ☐ (must be checked for article's inclusion) Other ☐ Specify:
Setting type: University/teaching hospital ☐ Non-academic hospital ☐ Urban setting ☐ Rural setting ☐ Other ☐ Specify:
Design of study/data source: **Type of trial** RCT ☐ CCT ☐ **Trial design** Parallel ☐ Cross-over ☐ **Number of centers** Single ☐ Multicenter ☐ **Type of Observational Study/Data** Case-control ☐ Cohort ☐ Before/After ☐ ITS ☐ Surveys ☐ Administrative data ☐ Guidelines or review ☐ Prospective? ☐ Retrospective? ☐ Controlled? ☐ **Method of Data Collection: (e.g., chart review, case study)** **Major PSA drug under investigation:** Propofol ☐ Ketamine ☐ Etomidate ☐ Ketafol ☐ Other: Aim(s) of study:

General population characteristics:

Patient population			Type of primary health problem/condition/population: (describe)		
Adult☐ Elderly/Aged ☐ Mixture☐					
Specify body system involved: (check all that apply)					
Orthopedic: (not specified)	☐	n =	Complex laceration repair	☐	n =
Bone fracture	☐	n =	Abscess drainage	☐	n =
Cardioversion: atrial fibrillation	☐	n =	Other: (specify)	☐	n =
Joint dislocation	☐	n =	Other: (non specified)	☐	n =
% of cohort with indications relevant to this review:					
ASA Severity Class I: No.____/%_____		ASA Severity Class II: No.____/%_____		ASA Severity Class III: No.____/%_____	
Other severity scale: _____ (Specify class and no./% for each if reported)					
Selection criteria for participation in study:					
Inclusion			Exclusion		

Characteristics of patient care

PSA INTERVENTION GROUP 1				
PSA Drug Used:		Method of Administration: (e.g, IV bolus, titration)	Dosage:	
Co-interventions: (e.g., opioid or other drug; supp. O_2 etc.)	1)	2)	3)	
PSA INTERVENTION GROUP 2				
PSA Drug Used:		Method of Administration: (e.g, IV bolus, titration)	Dosage:	
Co-interventions:	1)	2)	3)	
CONVENTIONAL COMPARATOR ☐ (check if yes; not applicable for all study designs)				
Comparator Drug Used:		Method of Administration: (e.g, IV bolus, titration)	Dosage:	
Co-interventions:	1)	2)	3)	
ED Staff Involved: (if specified: # present and time)	Physician Nursing Staff Other:	Medical Student/Intern etc. Orthopedic Technician	EMS/EMT staff Respiratory Therapist	

		Tool to determine sedation	**Description of how "time" was defined**
Waiting Time: (triage to first	Group 1 (PSA)		
	Group 2 (PSA 2*)		

treatment)	Group 3 (Comparator)		
Procedural Time: (duration of procedure)	Group 1 (PSA)		
	Group 2 (PSA 2*)		
	Group 3 (Comparator)		
Recovery Time: (time until PSA agents wear off)	Group 1 (PSA)		
	Group 2 (PSA 2*)		
	Group 3 (Comparator)		
Total Time in ED:	Group 1 (PSA)		
	Group 2 (PSA 2*)		
	Group 3 (Comparator)		

Q1. DATA EXTRACTION: Practice Patterns of PSA use in Canadian EDs

1. ED CHARACTERISTICS

Name of institution: _____
City/province: _____
Annual ED volume: _____
Primary ED physician training: ☐ emergency medicine ☐ family medicine ☐ other: _____
ED Nurse PSA training:

2. PATIENT CHARACTERISTICS

	No. patients N=	**% of patients**	**Mean age**
Adult			
Pediatric			
Sex Male/Average Patient Age (if reported)			
Sex Female/Average Patient Age (if reported)			
Patients admitted to hospital due to PSA complications			

3. PSA MANAGEMENT

Procedure		
Protocol in use	yes☐ no☐	
Standardized form	yes☐ no☐	
Supplemental O_2 used	yes☐ no☐	
During research study	yes☐ no☐	
Staffing (needed for PSA)		
Procedural physician	yes☐ no☐	
Sedation physician	yes☐ no☐	
Anesthesiologist	yes☐ no☐	
Nurse(s)	yes☐ no☐	If "yes", total no. of nurses required for procedure _____
Orthopedic technician	yes☐ no☐	
Other physician		

4. PSA PRACTICE PATTERNS

A. SEDATIVE REGIMES

Medication/Combination	**No. patients N=**	**% of patients**	
Propofol + Fentanyl			
Midazolam + Fentanyl			
Propofol + Midazolam + Fentanyl			
Propofol			
Ketamine			
Ketamine + Propofol			
Etomidate			
Fentanyl			
Midazolam			

Morphine			
Other: _____			

B. PROCEDURES

Indications	**No. patients N=**	**% of patients**	
Cardioversion			
Chest tube placement			
Lumber puncture			
Imaging sedation			
Orthopedic – fractures			
Orthopedic – dislocations			
Orthopedic – combined procedures*			
Incisions and drainage			
Foreign body removal			
Intubation/Endoscopy			
Wound care			
Other: _____			
Other:_____			
Other: _____			
Other: _____			

* Please complete "combined procedures" only when not individually specified.

Q2. EFFICACY AND SAFETY OF ETOMIDATE, KETAMINE, AND PROPOFOL DATA EXTRACTION FORM

Number of patients recruited: _____

	Enrolled (or randomized, if applicable):	Analyzed	Losses to follow up
Group 1 (PSA):			
Group 2 (PSA 2):			
Group 3 (Comparator):			
TOTAL:			

Characteristics of participants

	GROUP 1 (n =)		GROUP 2 (n =)		TOTAL (N =)	
Gender	Female n =	Male n =	Female n =	Male n =	Female n =	Male n =
Age	Mean =	SD =	Mean =	SD =	Mean =	SD =
Other relevant health problem/s (specify)						
Other relevant demographic info						

Monitoring of PSA and procedure

PSA Monitoring (check if "yes")	Time points assessed		Time points assessed
Standardized PSA form ☐		Blood pressure ☐	
Bispectral EEG (BIS) ☐		Respiratory rate ☐	
O_2 desaturation (pulse oximeter) ☐		Pulse: _____	
End tidal CO_2 ($ETCO_2$) ☐		Other: _____	
Supplemental O_2? ☐ Specify n:	Pre-procedure:_____	During procedure:_____	Recovery (period):____
Discharge Assessment			
Visual Analogue Scale (VAS) Specify:_____		Level of Consciousness (LOC, eg., Aldrete PAR) Specify:_____	
Post Anesthetic Recovery Score (PAR) Min discharge score/Max:__/__ Reference:_____		Discharge criteria:	
Follow-up: (check all that apply)			
Phone (specify who calls: _____)	☐	Return to ED	☐
Clinic/office visit (with: _____)	☐	Interview	☐
Questionnaire	☐	Other:_____ _____	☐

EFFICACY OUTCOME MEASURES

Categorical Outcomes	**Measured by:** (judged by physician, RN, EEG etc.)	**Intervention (PSA Group 1)**		**Intervention (PSA Group 2)**		**Control (Conventional)**		**Statistical Significance (p-value, 95% CI etc.)**
		Final		**Final**		**Final**		
		n	**N**	**n**	**N**	**n**	**N**	
Procedural Success • Fractures • Dislocations • Cardioversion • Other: _____								
Adequate Sedation • Fractures • Dislocations • Cardioversion • Other: _____								

Continuous Outcomes	**Scale of Measure** (VAS etc.)	**Intervention (PSA Group 1)**		**Intervention (PSA Group 2)**		**Control (Conventional)**		**Statistical Significance (p-value, 95% CI etc.)**
		Score		**Score**		**Score**		
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Pain (scale etc.) or Unpleasant Emergence • Fractures • Dislocations • Cardioversion • Other: _____								
Patient Recall • Fractures • Dislocations • Cardioversion Other: _____								
Patient Satisfaction • Fractures • Dislocations								

• Cardioversion • Other: _____								
Physician Satisfaction • Fractures • Dislocations • Cardioversion • Other: _____								

Record of any Additional Sedation Required

Specify Drug Supplemented: (may be additional dose of original drug, or new drug)	**Supplemental Drug Added**				**Statistical Significance (p-value, 95% CI etc.)**
	Time into procedure	**Reason**	**Mean Dose**	**SD**	
Intervention (PSA Group 1): _____					
Intervention (PSA Group 2): _____					
Control (Conventional): _____					

ADVERSE EVENTS

Adverse Events	Instrument/ units/ definition	Point(s) of analysis	Proportion/incidence/mean measure (include SD and 95% CI if provided)		
			Group 1	Group 2	Overall
1. Apnea/Capnometry					
2. Hypotension • O_2 desaturation • Hypercabia (>CO_2) • Hypoxia • Bradycardia					
3. GI Complaints: • Nausea • Emesis • Vomiting • Other:_____					
4. Myoclonus • General myoclonus • Bronchiospasm /laryngospasm					
5. Anxiety/Emergence Phenomeon					
6. Seizure					
7. Transfer to higher level care (specify): _____					

8. Other (specify):					
9. Unsucessful procedure					
10. Inadequate sedation					
Total adverse event rate					
Interventions					
1. Bag-valve-mask ventilation					
2. Intubation					
3. Other assisted ventiliation: _____					
4. Reversal agents (specify): _____					

Q3. BARRIERS TO THE USE OF ETOMIDATE, KETAMINE, AND PROPOFOL FOR PROCEDURAL SEDATION IN CANADIAN EDs

Description of Barriers (please provide quote or direct reference to paper)	**Level of barrier:** (check all that apply)	
Turf/Anesthesiologist Role pg number___ (ED vs. OR etc.)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Human Resources pg number ___ (staffing issues, coordination etc.)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Skills/Training pg number ___ (ED physician and staff education for PSA)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Billings pg number ___ (insured procedure, physician compensated etc.)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Costs pg number ___ (admission relative to conventional, drug price etc.)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Time pg number ___ (average time to complete)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Adverse Event pg number ___ (relative admission rates, opinion of freq. in practice etc.)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Legal issues pg number ___ (malpractice fear etc.)	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	
Other pg number ___	Individual ☐ Departmental ☐ Institutional ☐ Government ☐ Professional assoc ☐ Other:_____	

QUALITY ASSESSMENT FORMS

Reviewer ID:	**Date: / /2007**	**Record ID:**

Quality Assessment for RCTs/CCTs

Jadad scale

	YES	**NO**
1. Was the study described as randomized (this includes the use of words such as randomly, random and randomization)?	1	0
2. Was the study described as double-blind?	1	0
3. Was there a description of withdrawals and drop-outs?	1	0
4. Method to generate the sequence of randomization was described and was appropriate (e.g., table of random numbers, computer generated, coin tossing, etc.)	1	0
5. Method of double-blinding described and appropriate (identical placebo, active placebo, dummy)	1	0
6. Method of randomization described and it was **in**appropriate (allocated alternately, according to date of birth, hospital number, etc.)	-1	0
7. Method of double-blinding described but it was **in**appropriate (comparison of tablet vs. injection with no double dummy)	-1	0
OVERALL SCORE (Maximum 5)		

Concealment of treatment allocation – Schulz

Concealment of treatment allocation	☐ Adequate ☐ Inadequate ☐ Unclear

Adequate:	e.g. central randomization; numbered/coded containers; drugs prepared by pharmacy; serially numbered, opaque, sealed envelopes
Inadequate:	e.g. alternation, use of case record numbers, dates of birth or day of week; open lists
Unclear:	Allocation concealment approach not reported or fits neither above category

New Castle-Ottawa for Cohort Studies

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability

Selection

1) Representativeness of the exposed cohort
    a) truly representative of the average _____ (describe) in the community * (1)
    b) somewhat representative of the average _____ in the community * (1)
    c) selected group of users e.g. nurses, volunteers
    d) no description of the derivation of the cohort
2) Selection of the non exposed cohort
    a) drawn from the same community as the exposed cohort * (1)
    b) drawn from a different source
    c) no description of the derivation of the non exposed cohort
3) Ascertainment of exposure
    a) secure record (e.g., surgical records) * (1)
    b) structured interview
    c) written self report
    d) no description
4) Demonstration that outcome of interest was not present at start of study
    a) yes * (1)
    b) no

Comparability

5) Comparability of cohorts on the basis of the design or analysis
    a) study controls for _____ (select the most important factor) * (1)
    b) study controls for any additional factor * (This criteria could be modified to indicate specific control for a second important factor) (1)

Outcome

6) Assessment of outcome
    a) independent blind assessment * (1)
    b) record linkage * (1)
    c) self report
    d) no description
7) Was follow-up long enough for outcomes to occur
    a) yes (select an adequate follow-up period for outcome of interest) * (1)
    b) no
8) Adequacy of follow-up of cohorts
    a) complete follow-up - all subjects accounted for * (1)
    b) subjects lost to follow-up unlikely to introduce bias - small number lost - > ____ % (select an adequate %) follow-up, or description provided of those lost * (1)
    c) follow-up rate < ____% (select an adequate %) and no description of those lost
    d) no statement

Checklist for Methodological Quality of Case Series Studies

Source of potential bias	Yes	No	Not stated
Selection bias			
• Informed consent obtained from all patients	☐	☐	☐
• Source of case series (patients) was reported (e.g., database, charts, EDs involved)	☐	☐	☐
• Results are from a consecutive series of patients	☐	☐	☐
• Clear indications of patient characteristics:			
ASA scoring	☐	☐	☐
Age (mean, SD or by category)	☐	☐	☐
Indications/procedures identified	☐	☐	☐
Attrition bias			
• Losses to follow-up with respect to outcomes of interest were <10%	☐	☐	☐
Detection bias			
• Study was clearly conducted prospectively (not just reported as prospective)	☐	☐	☐
• Outcomes of interest were measured using predefined criteria (clear definition of clinical outcomes)	☐	☐	☐
• Adverse events of treatment were recorded	☐	☐	☐
• Prospective data collection through patient interview in ED	☐	☐	☐
Assessment bias			
• Treatment protocol were clearly described (drugs, doses, route, administration times)	☐	☐	☐
• Adjunctive therapies were clearly described (drugs, doses, route, administration times)	☐	☐	☐
• Assessment of outcomes undertaken by independent observers	☐	☐	☐
• Assessment of outcomes by attending staff	☐	☐	☐

APPENDIX 5: PSA PRACTICE PATTERNS IN CANADIAN EMERGENCY DEPARTMENTS

Procedural sedation and analgesia (PSA) for painful and complex procedures within the emergency setting are now widely accepted as the standard of care. Despite this, little is known about how it is delivered in Canadian Emergency Departments (ED). For example, the PSA agents used, the procedures selected for PSA, and the outcomes of these patients have been infrequently reported in the published literature.

OBJECTIVES

(a) For adult patients who present to Canadian EDs (population), how are these common procedures (i.e., bone fractures, major joint dislocations, cardioversion) managed (interventions)?
(b) For adult patients who present to Canadian EDs (population), what techniques and pharmacological agents (interventions) are currently utilized?

METHODS

Information to address this question was obtained from three sources: a systematic review of prospective observational studies of procedural sedation and analgesia for adults in Canadian EDs, data provided by emergency medicine researchers at hospitals across Canada, and data collected from ED directors across the province of Alberta on PSA management.

Systematic Review

Study identification and retrieval strategies

A research librarian, in collaboration with the HTA team, developed and implemented search strategies for six electronic databases: Cochrane Central Register of Controlled Trials (1900 to present), Cochrane Database of Systematic Reviews (2007 Issue 2), DARE (1995 to present), HTA (2007 Issue 2), EMBASE (1988 to present) and MEDLINE (1950 to present). Appendix A provides a detailed description of the search strategies. Hand searches of abstracts from the Canadian Association of Emergency Physicians (CAEP) Annual Scientific Meetings for 2003 to 2007 were also conducted.

Study selection procedures

Two reviewers applied broad screening criteria to the search results to exclude “clearly irrelevant studies.” The full text of potentially relevant citations was retrieved and reviewed independently by two reviewers using detailed inclusion criteria. Inclusion required a study to be a prospective Canadian ED study that reported which PSA agents were used and which procedures were preformed. See section 1.1 of the main report for a detailed description of study selection.

Strategy for validity assessment

The studies were used for a description of current practice patterns not a comparison of treatment effects; therefore, no methodological quality assessment was conducted.

Data handling

Data were extracted by one reviewer into a detailed, pre-tested form and verified by a second reviewer. Extracted data included details of study design, population, procedures, agents used, success rates, patient disposition, adverse events and complications. Reviewers resolved discrepancies by consensus or consultation with the principal investigator (BHR).

Survey of Emergency Medicine Researchers

Because of the paucity of published data on PSA in Canadian EDs, we contacted 23 researchers from the CAEP Research Consortium (RC), which is a network representing well-known research hospitals across Canada. These research directors were asked to provide information on the collection of PSA data and practice patterns in their respective institutions. Since Consortium members are located predominantly in large urban teaching hospitals it was assumed that the greatest likelihood of innovative PSA practices, use of a standardized forms, and data collection would be in these centres and that they would provide a best-case of current Canadian practice patterns.

An E-mail was sent to all CAEP RC site researchers briefly describing the project and requesting the following data:

1. Drug(s) given (data by drug or all PSA welcome);
2. General indication for procedure (e.g., orthopaedic reduction, cardioversion, etc.);
3. Time from study drug administration to adequate sedation (mean or median minutes; SD; 95% CI or IQR);
4. Length of procedure (mean or median minutes; SD; 95% CI or IQR);
5. Recovery time (from end of procedure to discharge readiness; mean or median minutes; SD; 95% CI or IQR);
6. Number and qualifications of staff present during procedure (mean time spent, if available).

Non-responders were sent up to three E-mails.

Survey of Alberta Emergency Department Directors

A survey questionnaire was developed by modifying one that had been approved and employed in the 2006 CADTH report on ED overcrowding[98] conducted by the Department of Emergency Medicine at the University of Alberta and commissioned by the Health Quality Council of Alberta (HQCA). The survey, designed to determine the perceived determinants of ED overcrowding in Alberta, also collected data on the drugs used for PSA.

Study design

This paper-based survey targeted ED medical directors from all 102 Alberta hospital EDs between September 29, 2006 and December 19, 2006. The survey was accompanied by a letter that provided an introduction, reassurances regarding ethics approval and confidentiality. To improve responses, there were two additional mail-outs followed by E-mail encouragement from the President of the Alberta Medical Association (AMA) Section of Emergency Medicine.

Survey participants

A list of hospitals providing either direct or indirect ED services through referral hospitals from urban and rural areas in Alberta was established using a database from Alberta Health and Wellness (personal communication, Dr. Habib Fattoo, September 2006). A list of associated medical directors was established from an Alberta Centre for Injury Control and Research list, plus telephone contact. Of the Alberta hospitals providing ED services, 102 were identified. Six facilities had either no medical director or no designated medical staff to respond to the survey.

Data analysis

The survey data were entered into an Excel spreadsheet and imported into SPSS (SPSS, Inc.; Chicago, USA) for analysis. Categorical variables were summarized as percentages or proportions; continuous variables as means with standard deviations (SD) or medians with interquartile ranges (IQR), when appropriate. Comparisons of data were performed using chi-square, Fisher's Exact Test, and Mann-Whitney tests.

Ethics

The survey study methodology was approved by the Health Research Ethics Board at the University of Alberta. Informed consent was assumed upon completion of the surveys.

RESULTS

Canadian Practice Patterns

Studies on procedural sedation in Canadian Emergency Departments

Of the 268 potentially relevant studies, 5 provided evidence on the management and use of procedural sedation in Canadian EDs. All were consecutive case series designs. An additional study[99] was identified by contact with Canadian ED researchers. Two examined general PSA practices while a third examined the use of Bier block for lower extremity fractures.[11]The regional anaesthesia paper was included since it provided a picture of how these injuries were managed in non-urban EDs that may not have the staffing or training needed for using intravenous PSA agents for minor procedures. Two observational studies[51,71] and one randomized controlled trial[5] examined the use of single agents. Because they examined only single agents and provided no estimates of what proportion of the total number of PSA procedures they represented they were not considered to provide data that accurately represented

the practice patterns of their respective departments. The main characteristics of these three studies are reported below

a) Queen Elizabeth II Health Sciences Centre, Halifax

Campbell et al.[72] reviewed data collected on a standard PSA patient care record for 1,334 patients presenting to this major urban tertiary care referral centre ED (approximately 70,000 annual ED visits) from August 2004 to February 2006. Twenty-three per cent were older than 65 years. PSA was administered and monitored by trained Advanced Care Paramedics (ACP) under the authorization of an emergency physician.

Indications

The majority of procedures were fractures and/or dislocations (1,070; 80.2%), followed by incision and drainage (124; 9.3%), cardioversion (57; 4.3%), other (41; 3.1%), wound care (15; 1.1%), chest tube placement (15; 1.1%), lumbar puncture (8; 0.6%), behaviour control (3; 0.2%), and endoscopy (1; 0.1%).

Agents

Fentanyl was the most commonly used agent (1255; 94.1%), followed by propofol (874; 65.5%), midazolam (490; 36.7%), and ketamine (31; 2.3%). A combination of drugs was used 92.6% of the time with the most common combinations being propofol and fentanyl (62.4%) and midazolam and fentanyl (34.9%). (Percentages sum to greater than 100 because the agents are often combined.)

b) Kingston General Hospital/Hotel Dieu Hospital, Kingston, ON

Tranmer[99] (unpublished manuscript) reviewed data collected on all PSA patients who were not subsequently admitted to two university teaching hospital EDs (approximately 36,000 and 47,000 annual ED visits, respectively). Data for 923 patients seen between January 2001 and December 2004 was captured on a standard PSA form. (Data was unavailable for the period January 2002 to March 2002 due to a change in PSA coding.) The average patient age was 39 years. Sixty-one per cent were 19 years of age or older. Forty-nine per cent of cases were Amercian Society of Anesthesiology (ASA) Classification I. The Kingston General Hospital/Hotel Dieu Hospital PSA guidelines recommend that one physician plus a second trained health care professional be present for all ED PSA procedures.

Indications

The majority of procedures were orthopedic reductions (663; 71.8%), followed by abscess incision and drainage (111; 12.0%), cardioversion (54; 5.9%), suturing (18; 2.0%), chest tube insertion (11; 1.2%), foreign body removal (6; 0.7%), and other (5; 0.5%).

Agents

Ketamine was the agent in 32% of cases, fentanyl in 63%, midazolam in 20%, and propofol in 53%.

c) Huntsville District Memorial Hospital, Hunstville, ON

Mensour et al.[12] prospectively collected PSA data using a standard PSA form on 160 consecutive patients presenting to a rural ED (approximately 30,000 annual ED visits) in northern Ontario

from February 2004 to May 2005. The ED is staffed primarily by family physicians without specialty training in emergency medicine or anesthesiology. PSA was performed according to the hospital protocol. The mean age of patients was 33.6 years (SD 23.6). Almost one-third of the patients (52; 32.5%) were less than 18 years of age and almost one quarter of the patients (35; 22.0%) were older than 65 years. A single physician and nurse attended one third (54; 33.8%) of the patients.

Indications

The majority of procedures were orthopedic (124; 78.5%), followed by other (19; 10.8%), incision and drainage (11; 6.9%), and cardioversion (6; 3.8%).

Agents

Propofol was the agent in 83.3% (134) of cases followed by fentanyl (82; 51.3%), propofol and fentanyl (69; 43.1%), midazolam (24; 15.0%), ketamine (8; 5.0%), and etomidate (1; 0.6%).

d) St. Paul's Hospital, Vancouver

Information on PSA practice at St. Paul's Hospital, a large urban university-affiliated tertiary care hospital (approximately 54,000 annual ED visits), comprised data on 564 ED patients between August 1, 2006 and July 31, 2007. The median patient age was 42 (IQR: 31, 58).

Indications

The majority of procedures were orthopedic (213; 37.7%), followed by incision and drainage (176; 31.2%), cardioversion (91; 16.1%), other (59; 10.4%), lumbar puncture (12; 2.1%), lacerations (9; 1.6%), and foreign body removal (4; 0.7%).

Agents

Ketamine was the agent most frequently used (229; 40.6%), followed by fentanyl/morphine (189; 33.4%), midazolam (169; 29.9%), propofol (167; 29.6%), and etomidate (151; 26.7%).

e) Lion's Gate Hospital, North Vancouver

Willman and Andolfatto[70] prospectively collected data using a special study data form on 114 patients presenting to a 250-bed community teaching hospital (approximately 45,000 annual ED visits) from July 2005 to February 2006. The study was limited to patients who received the combination of ketamine and propofol ("ketafol") for PSA. The mean age was 36 years (range 4 to 88). Twenty-five patients (22%) were 15 years or younger, while 23 (20%) were 61 years of age or older.

Indications

The majority of procedures were orthopedic (79; 69%), followed by abscess incision and drainage (13; 11%), cardioversion (9; 8%), laceration (5; 4%), tube thoracostomy (4; 3.5%) and foreign body removal and hernia reduction (2; 2% each).

Agents

Though not described in detail, propofol and ketamine were used alone, in addition to ketafol. The study's authors estimate that patients receiving ketafol represent a majority (75%) of PSA patients, with the remainder receiving either drug alone.

f) Whistler Health Care Centre, Whistler, BC

Mohr[11] reviewed data collected using a standard patient care form on 1,816 Bier blocks performed to manage fractures in the forearm, wrist or hand in this small diagnostic and treatment facility (approximately 23,000 annual visits) from September 2000 to March 2005. The facility lacks surgical or specialist support and is staffed by family physicians, two of whom have emergency medicine certification. The mean age of patients was 25 years (range 4 to 70 years).

Indications

The majority of indications were wrist injuries (1,768; 97.3%), followed by hand (38; 2.1%), and forearm injuries (10; 0.6%).

Agents

Lidocaine was used for all procedures.

CAEP researcher survey

Twenty-two of the 23 (96% response rate) CAEP RC researchers responded. Thirteen institutions in 12 urban centres (Halifax, Quebec City, Kingston, Sudbury, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, North Vancouver, Surrey, Nanaimo) reported the use of a specialized PSA form and the collection of the relevant data (Table 1); however, only eight reported the data was accessible, and seven were willing to provide data to the project (Table 2). Three institutions provided data by the project deadline (Queen Elizabeth II Health Sciences Centre [Halifax], Kingston General Hospital/Hotel Dieu Hospital [Kingston, ON], and St. Paul's Hospital [Vancouver]). Only St. Paul's had not previously published at least some of the data provided.

There was insufficient data on practice patterns to determine regional differences in management and practice and variation in PSA use by type and size of institution.

Table 1: Summary of Availability and Collection of PSA Data from 23 Canadian Hospitals

	City	Site	Standard PSA Form†	Response
1.	Halifax	Queen Elizabeth II Health Sciences Centre*	Y	Published study/provided data on practice patterns
2.	Montreal	Sir Morimer B. Davis–Jewish General Hospital	N	Data not routinely collected
3.	Kingston	Kingston General Hospital*	Y	Published study/provided data on practice patterns
4.	Quebec City	Infant Jesus Hospital	Y	Data unavailable (procedure times and staffing not routinely collected)
5.	Ste. Foy	Hôpital CHUL (Centre hospitalier universitaire de Québec)	N	Data not routinely collected
6.	Ottawa	Ottawa General Hospital/Ottawa Civic Hospital	N	Data not routinely collected
7.	Toronto	Mt. Sinai Hospital	Y	Data unavailable (part of patient health record)
8.		Sunnybrook Hospital	N	Data not routinely collected
9.	Mississauga	Credit Valley Hospital	---	No reply
10.	Sudbury	Sudbury General Hospital*	Y	Data not provided by deadline
11.	Thunder Bay	Thunder Bay Regional Hospital	N	Data not routinely collected
12.	Hamilton	Hamilton Health Sciences Centre*	Y	Data not provided by deadline
13.	London	London Health Sciences Centre	N	Data not routinely collected Data available from 1 RCT (ketamine vs. ketafol) and 1 observational study (propofol vs. midazolam) but not representative of general PSA practice.
14.	Winnipeg	Winnipeg Health Sciences Centre	Y	Data unavailable (paper record only)
15.	Saskatoon	Royal University Hospital	Y	Data unavailable (paper record only)
16.	Lethbridge	Lethbridge Regional Hospital	---	No details about collection
17.	Calgary	Foothills Hospital	N	Data not routinely collected
18.	Edmonton	University of Alberta Hospital	N	Data not routinely collected
19.	Vancouver	St. Paul's Hospital*	Y	Provided data on practice patterns
20.		Vancouver General Hospital*	Y	Published study
21.	North Vancouver	Lion's Gate Hospital*	Y	Published study
22.	Surrey	Surrey Memorial Hospital	Y	Data unavailable (paper record only)
23.	Nanaimo	Nanaimo*	Y	Data unavailable (lost)

*Willing to provide data; † "Standard PSA form" refers to a procedural record designed specifically to document PSA

Table 2: Summary of Canadian Practice Patterns for Emergency Department Procedural Sedation and Analgesia Based on Six Institutions (identified through literature review and CAEP RC contact)

		Indications (%)					PSA Agents (%)					
Institution (Location)	**Annual ED Volume Length of Data Collection**	**Fractures**	**Dislocations**	**Cardioversion**	**Abscess**	**Other**	**Etomidate**	**Ketamine**	**Ketafol**	**Propofol**	**Midazolam/Fentanyl**	**Procedure Times (min)***
QE II Health Sciences Centre (Halifax)	70,000 18 mo.	80.2		4.3	9.3	6.2	NR	2.3	NR	65.5	36.7/ 94.1	12.1
Kingston General Hospital/Hotel Dieu (Kingston, ON)	47,000/36,000 45 mo.	71.8		5.9	12.0	4.4	NR	32	NR	63	20/63	16.9
Huntsville District Memorial Hospital (Huntsville, ON)	30,000 15 mo.	78.5		3.8	6.9	10.8	0.6	5.0	NR	83.8	NR/ 51.3	NR
St. Paul's (Vancouver)	54,000 12 mo.	15.0	22.7	16.1	31.2	14.8	26.7	40.6	NR	29.6	53.3	29
Lion's Gate (North Vancouver)	45,000 7 mo.	69		8	11	11	NR	NR	100	NR	NR	NR
Whistler Health Centre† (Whistler, BC)	23,000 54 mo.	100	---	---	---	---	---	---	---	---	---	NR

*Procedure time = administration of first drug to no monitoring

†All procedures (forearm injuries [i.e., forearm, wrist, hand]) performed with lidocaine

Alberta Emergency Department Director Survey[100]

Overall, 88 (86.3%) ED medical directors responded to the survey through either mail or fax. Among the respondents, 16 and 72 were from urban and rural EDs, giving 100.0% and 83.7% response rates, respectively. Among the responding EDs, the median number of ED visits was higher in urban (58,474; IQR: 47,547; 69471) than rural (11,818; IQR: 5892; 18,000) hospitals ($p < 0.001$). The median population of the communities served by the urban EDs (556,196; IQR: 84,035; 984,461) was significantly higher than the rural EDs (5,800; IQR: 3,000; 11,000) ($p < 0.001$).

Rural EDs experienced less difficulty with anesthesia turf battles and credentialing (69.4% vs. 37.5% never; $p = 0.01$). However, more urban ED Directors reported routine use of PSA for cardioversion (81.3% vs. 43%; $p = 0.01$) and "other" painful procedures (75.0% vs. 31.9%; $p = 0.004$) than did rural ED Directors. Both groups had relatively similar rates of PSA use for fractures and dislocations (Table 3).

Rural sites use more opioid and benzodiazepine combinations for PSA for fractures and dislocations than do urban sites (81.9% vs. 50.0%; $p = 0.02$), while urban sites tend to use more propofol (93.8% vs. 33.3%; $p < 0.001$) and ketamine (81.3% vs. 22.2%; $p < 0.001$) than rural EDs. For cardioversion, a similar profile was observed. In terms of staffing, more urban centres "always" used 2 ED physicians to perform PSA (37.5% vs. 4%; $p = 0.001$), with a majority of rural EDs (57.4%) reporting "rarely" or "never" using two ED physicians (Table 4).

Whether these differences between urban and rural EDs reflects regional differences or the make up of health care services in a specific province (Alberta) and the generalizability of these results to Canada as a whole is unclear at this time. Many of the differences in the use of PSA identified here may be explained by staffing differences. For example, rural sites are smaller, provide single 24-hour coverage by local physicians, infrequently have learners (medical students, interns and/or residents) and quite frequently have non-specialized staff supporting them. Conversely, urban and regional EDs have overlap coverage (median 40 hours of coverage per day), availability of consultants and other support staff (e.g., respiratory and orthopedic technicians). This arrangement permits procedural and sedation responsibilities to be shared by two physicians with other staff available to assist.

Table 3: PSA practices and procedures in urban and rural emergency departments in Alberta

	Urban sites N = 16		Rural sites N = 72		P-value
Difficulty in credentialing from anesthesia consultants	**n**	**%**	**n**	**%**	
Never	6	37.5	50	69.4	0.510
Rarely	7	43.8	13	18.1	
Sometimes	2	12.5	2	2.9	
½ the time	0	0.0	0	0.0	
Often	1	6.3	0	0.0	
Very Often	0	0.0	1	1.5	
Always	0	0.0	1	1.5	
N/A	0		4		
Procedures routinely required sedation and/or analgesia	**n**	**%**	**n**	**%**	
Electrical cardioversion for atrial fibrillation/flutter	13	81.3	31	43.1	0.011[a]
Closed reduction of simple fractures	16	100	60	87.0	0.113[a]
Closed reduction of simple dislocation	16	100	65	94.2	0.342[a]
Other	12	75	23	31.9	0.004[a]
None	0	0	3	4.3	1[a]
Two ED physicians for the above procedures	**n**	**%**	**n**	**%**	
Never	0	0.0	13	19.2	<0.001 [a]
Rarely	0	0.0	26	38.2	
Sometimes	2	12.5	9	13.2	
½ the time	1	6.2	5	7.4	
Often	1	6.2	3	4.4	
Very Often	6	37.5	9	12.5	
Always	6	37.5	3	4.2	

Table 4: Procedures and sedation agents used in urban and rural emergency departments in Alberta

	Urban sites N = 16		Rural sites N = 72		P-value
Procedural sedation agents for fracture/dislocation	**n**	**%**	**n**	**%**	
IV propofol	15	93.8	24	33.3	<0.001*
IV ketamine	13	81.3	16	22.2	<0.001*
IV narcotic + benzodiazepine	8	50.0	59	81.9	0.019*
Regional anesthesia	4	25.0	25	36.8	0.564*
Other	3	18.8	4	5.9	0.110*
IV etomidate	0	0.0	0	0.0	1
Procedural sedation agents for cardioversion					
IV propofol	13	81.3	19	26.4	<0.001*
IV narcotic + benzodiazepine	7	43.8	39	61.9	0.451
Other	3	18.8	1	1.6	0.018*
IV ketamine	1	6.3	2	3.2	0.457*
IV etomidate	1	6.3	2	3.2	0.457*
Not applicable	1	6.3	23	36.5	N/A
N/A	0		9		

N/A = not available; LWBS = left without being seen
*Fisher's Exact Test for 2x2 tables with cell counts less than five

Discussion

Overall, little is know about the variation in practice patterns of ED PSA in Canada. Based on the responses of CAEP RC members, it is reasonable to assume that few sites routinely collect the data necessary to determine practice patterns and to accurately ascertain regional variation in practice. From the small sample of hospitals with PSA data, however, some patterns emerged. Orthopedic reductions (of dislocations or fractures) are the most common procedures for which PSA is employed. PSA is also frequently employed for abscess incision and drainage, and cardioversion. A variety of other painful procedures (e.g., foreign body removal, hernia reduction, wound debridement, chest tube placement) performed less frequently in the ED also employ PSA approaches. The proportions appear to vary among sites for reasons which are unclear; however, the location and acuity of the ED clearly influence this. For example, abscess incision and drainage is highest in an inner city ED and lowest in a non-urban community ED. In addition, practice variation within and among EDs may also influence the use of PSA for some procedures where evidence provides less guidance to practicing clinicians (e.g., cardioversion for atrial arrhythmias such as fibrillation).

In terms of PSA agents, propofol is generally the main PSA agent employed in Canada. Etomidate, though available under Health Canada's Special Access Program, was used in a relatively large number of cases by one of the responding institutions (St. Paul's). The use of ketamine for adults, either alone or combined with low-dose propofol (as "ketafol"), remains uncommon in Canada, except in some regional preferences (e.g.,

Kingston General Hospital and North Vancouver's Lion's Gate Hospital). Finally, midazolam and fentanyl also make up a large percentage of the agents used, but likely because they are not only frequently used together as the main PSA agents, but also used additionally with one of the other agents (e.g., with propofol).

The role of location is a clear contributor to PSA use—urban EDs deal with some procedures in a dramatically different way than do their rural counterparts. For example, urban hospitals tend to use PSA more often for cardioversion and "other" painful procedures than do ED in rural hospitals, yet hospitals in both locations deal with fractures and dislocation in similar ways. In addition, urban hospital EDs tend to use PSA agents such as propofol as their primary treatment options, whereas rural ED sites prefer opioid and benzodiazepine combination treatment. In terms of staffing, the use of 2 ED physicians is rarely seen in rural areas; however, even in urban hospitals a second physician is routine only a third of the time. Some of these differences can be explained by differences in staffing. For example, rural sites are smaller, provide single 24-hour coverage by local physicians, infrequently have learners (medical students, interns and/or residents) and quite frequently have non-specialized support staff. Conversely, urban and regional EDs have overlap coverage (median 40 hours of coverage per day), availability of consultants and other support staff (e.g., respiratory and orthopedic technicians).

APPENDIX 6: METHODOLOGICAL QUALITY OF STUDIES INCLUDED FOR CLINICAL REVIEW

Table 1: Methodological quality of observational studies

Author, Year	Quality Components																	
	Informed consent	Source of case series reported	Results from consecutive series of patients	Indication of ASA scoring	Indication of age (mean, SD or category)	Indications/procedures identified	Losses to follow-up <10%	Study was clearly conducted prospectively	Outcomes of interest were measured using predefined criteria	Adverse events of treatment were recorded	Prospective data collection through patient interview in ED	Treatment protocol clearly described	Adjunctive therapies were clearly described	Assessment of outcomes undertaken by independent observers	Assessment of outcomes by attending staff	Total number "Yes"	Total number "No"	Total number "Unclear"
Arora S, 2007[43]	Yes	Yes	UC	Yes	No	Yes	Yes	Yes	Yes	Yes	UC	Yes	Yes	UC	UC	10	1	4
Bell A, 2007[29,32]	Yes	Yes	UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	11	3	1
Burton JH, 2006[45]	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	10	5	0
Burton JH, 2001[44]	UC	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	No	No	No	UC	UC	6	6	3
Campbell SG, 2007 (publication in progrees)	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	UC	No	No	UC	UC	7	5	3
Caro DB, 1974[46]	UC	No	No	No	Yes	Yes	Yes	UC	No	No	Yes	Yes	Yes	UC	UC	6	5	4
Charles M, 2005[30,33]	UC	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	No	UC	Yes	9	4	2

Table 1: Methodological quality of observational studies (continued)

	Quality Components s																	
Author, Year	**Informed consent**	**Source of case series reported**	**Results from consecutive series of patients**	**Indication of ASA scoring**	**Indication of age (mean, SD or category)**	**Indications/procedures identified**	**Losses to follow-up <10%**	**Study was clearly conducted prospectively**	**Outcomes of interest were measured using predefined criteria**	**Adverse events of treatment were recorded**	**Prospective data collection through patient interview in ED**	**Treatment protocol clearly described**	**Adjunctive therapies were clearly described**	**Assessment of outcomes undertaken by independent observers**	**Assessment of outcomes by attending staff**	**Total number "Yes"**	**Total number "No"**	**Total number "Unclear"**
Charles M, 2003[47]	UC	Yes	Yes	UC	UC	Yes	Yes	Yes	Yes	Yes	No	No	No	UC	Yes	8	3	4
Cheng L, 2004[48]	UC	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	UC	UC	8	4	3
Chudnofsky, 2000[49]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	12	3	0
Dunn MJG, 2006[50]	UC	Yes	UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	UC	Yes	11	1	3
Dunn T, 2007[51]	Yes	Yes	UC	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	UC	UC	10	2	3
Engel J, 2007[52]	UC	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	8	6	1
Frank LR, 2006[53]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	UC	Yes	12	2	1
Frazee BW, 2005[54]	UC	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	UC	Yes	11	2	2
Green SM, 2005[55]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	UC	UC	12	1	2

Table 1: Methodological quality of observational studies (continued)

Author, Year	Quality Components																	
	Informed consent	Source of case series reported	Results from consecutive series of patients	Indication of ASA scoring	Indication of age (mean, SD or category)	Indications/procedures identified	Losses to follow-up <10%	Study was clearly conducted prospectively	Outcomes of interest were measured using predefined criteria	Adverse events of treatment were recorded	Prospective data collection through patient interview in ED	Treatment protocol clearly described	Adjunctive therapies were clearly described	Assessment of outcomes undertaken by independent observers	Assessment of outcomes by attending staff	Total number "Yes"	Total number "No"	Total number "Unclear"
Hogan K, 2006[31,34]	UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	UC	UC	9	3	3
Keim SM, 2002[56]	No	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	UC	Yes	No	UC	Yes	8	5	2
Lee CC, 2001[57]	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	UC	8	6	1
Mace SE, 2006[58]	UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	UC	9	4	2
Manoocha A, 2003[59]	UC	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	UC	UC	7	5	3
Mensour M, 2006[12]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	14	1	0
Miner JR, 2005[62]	No	Yes	UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	UC	10	3	2

Table 1: Methodological quality of observational studies (continued)

Author, Year	Quality Components																	
	Informed consent	Source of case series reported	Results from consecutive series of patients	Indication of ASA scoring	Indication of age (mean, SD or category)	Indications/procedures identified	Losses to follow-up <10%	Study was clearly conducted prospectively	Outcomes of interest were measured using predefined criteria	Adverse events of treatment were recorded	Prospective data collection through patient interview in ED	Treatment protocol clearly described	Adjunctive therapies were clearly described	Assessment of outcomes undertaken by independent observers	Assessment of outcomes by attending staff	Total number "Yes"	Total number "No"	Total number "Unclear"
Miner JR, 2007[61]	Yes	Yes	No	UC	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	UC	10	3	2
Miner JR, 2005[60]	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	12	3	0
Peddle M, 2007[63]	UC	Yes	UC	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	UC	Yes	10	2	3
Reid DK, 2004[64]	UC	Yes	Yes	Yes	UC	Yes	UC	Yes	No	Yes	No	Yes	UC	UC	UC	7	2	6
Ruth WJ, 2001[65]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	13	2	0
Ruth WJ, 1999[101]	UC	Yes	Yes	UC	UC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	UC	Yes	10	1	4
Swann A, 2007[66]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	UC	Yes	11	3	1

Table 1: Methodological quality of observational studies (continued)

Author, Year	Quality Components																	
	Informed consent	Source of case series reported	Results from consecutive series of patients	Indication of ASA scoring	Indication of age (mean, SD or category)	Indications/procedures identified	Losses to follow-up <10%	Study was clearly conducted prospectively	Outcomes of interest were measured using predefined criteria	Adverse events of treatment were recorded	Prospective data collection through patient interview in ED	Treatment protocol clearly described	Adjunctive therapies were clearly described	Assessment of outcomes undertaken by independent observers	Assessment of outcomes by attending staff	Total number "Yes"	Total number "No"	Total number "Unclear"
Swanson ER, 1996[67]	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	12	3	0
Vinson DR, 2002[68]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	UC	Yes	10	4	1
Weaver CS, 2007[69]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	UC	Yes	No	11	3	1
Willman, 2007[70]	UC	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	12	2	1
Zed PJ, 2007[71]	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	13	2	0

Table 2: Methodological quality of randomized controlled trials

Author, Year	Quality Components								
	Randomized (0, +1)	**Double-blind (0, +1)**	**Description of withdrawals/dropouts (0, +1)**	**Method of randomization appropriate (0, +1)**	**Method of double-blinding appropriate (0, +1)**	**Method of randomization inappropriate (0, -1)**	**Method of double-blinding inappropriate (0, -1)**	**Overall (0-5)**	**Concealment of allocation**
Burton JH, 2002[35]	1	1	1	1	1	0	0	5	adequate
Coll-Vinent, 2003[36]	1	0	1	1	0	0	0	3	adequate
Holger JS, 2005[37]	1	0	1	0	0	0	0	2	unclear
Hunt GS, 2005[38]	1	1	1	0	1	0	0	4	adequate
Messenger DW, 2007[5]	1	1	1	1	1	0	0	5	adequate
Miner JR, 2007[40]	1	0	1	0	0	0	0	2	unclear
Miner JR, 2007[15]	1	0	1	1	0	0	0	3	adequate
Miner JR, 2003[39]	1	0	1	0	0	0	0	2	unclear
Taylor DMcD, 2005[41]	1	0	1	1	0	0	0	3	adequate

Table 3: Methodological quality of cohort study

Quality components	Author, Year
Selection	Bigelow S, 2005[42]
Truly representative of the average ---- (describe) in the community(*1)	
Somewhat representative of the average ---- in the community(*1)	Yes
Selected group of users e.g., nurses, volunteers	
No description of the derivation of the cohort	
Drawn from the same community as the exposed cohort(*1)	Yes
Drawn from a different source	
No description of the derivation of the non-exposed cohort	
Secure record (e.g., surgical record)(*1)	Yes
Structured interview	
Written self report	
No description	
Demonstration that outcome of interest(*1) was not present at the start of study	Yes
Comparability	
Study controls for --- (select the most important factors)(*1)	Yes
Study control for any additional factor(*1)	Yes
Outcome	
Independent blind assessment(*1)	
Record linkage(*1)	
Self report	
No description	Yes
Was follow-up long enough for outcome to occur?(*1)	Yes
Complete follow-up all subjects accounted for?(*1)	
Subject lost to follow-up unlikely to introduce bias-small number lost >----% (select an adequate %) follow-up or description provided to those lost)(*1)	
Follow-up rate <---% (select an adequate %) and no description of those lost	
No statement	
Total number components fulfilled	7 of 12

APPENDIX 7: GENERAL CHARACTERISTICS OF EFFICACY AND SAFETY STUDIES

Author, Year Country	No. participants analyzed Mean age (SD) No. males (%)	Study design Site No. annual ED visits No. centres	Drug comparison	No. procedures (% of total)
Randomized controlled trials				
Burton JH, 2002[35] USA	No. participants: 41 Age: NR Male: 32 (78)	RCT University/teaching hospital 50,000 Single centre centre	Etomidate vs. midazolam	Dislocation E: 19, Mi: 22 (100)
Coll-Vincent B, 2003[36] Spain	No. participants: 32 Age: 62.5 (15-81) Male: 26 (81)	RCT University/teaching hospital 50,000 Single centre	Etomidate vs. propofol vs. midazolam (with and without flumazenil)	Cardioversion E: 9, P: 9, Mi + Fl: 8, Mi: 6 (100)
Holger JS, 2005[37] USA	No. participants: 32 Age: NR Male: NR	RCT University/teaching hospital 65,000 Single centre	Propofol vs. midazolam	NR
Hunt GS, 2005[38] USA	No. participants: 45 Age: NR Male: 32 (73)	RCT University/teaching hospital 88,000 Single centre	Etomidate vs. midazolam	Fracture: 6 (13) Dislocation: 39 (87) Groups not reported
Messenger DW, 2007[5] Canada	No. participants: 63 Age: NR Male: 31 (49)	RCT University/teaching hospital NR Single centre	Ketofol vs. propofol + fentanyl	Combined ortho P: 31, P + F: 27 (92) Abscess P: 1, P + F: 4 (8)
Miner JR, 2007[40] USA	No. participants: 80 Age: 37.8 (range=18-83)(14.3) Male: 43 (54)	RCT Other NR Single centre	Propofol vs. propofol + alfentanyl	Fracture : 26 (32) Dislocation: 15 (19) Cardioversion: 3 (4) Abcess: 4 (5) Other: 32 (40) Results combined
Miner JR, 2007[15] USA	No. participants: 214 Age: NR Male: NR	RCT Urban setting 97,000 Single centre	Etomidate vs. propofol	Fracture E: 47. P: 38 (40) Dislocation E: 17, P: 26 (20)

Author, Year Country	No. participants analyzed Mean age (SD) No. males (%)	Study design Site No. annual ED visits No. centres	Drug comparison	No. procedures (% of total)
				Abscess E: 40, P: 40 (38) Other E: 1, P: 4 (2)
Miner JR, 2003[39] USA	No. participants: 103 Age: NR Male: NR	RCT Urban setting 93,000 Single centre	Propofol vs. methohexital	Fracture: 48 (47) Dislocation: 55 (53) Groups not reported
Taylor DMcD, 2005[41] Australia	No. participants: 86 Age: NR Male: 64 (74)	RCT University/teaching hospital 40,000 - 50,000 Multicenter	Propofol vs. midazolam	Dislocation P: 48, Mi: 38 (100)
Observational/case series studies				
Arora S, 2007[43] USA	No. participants: 10 Age: NR Male: NR	Case series Urban setting NR Single centre	Ketofol	Combined ortho: 9 (90) Abscess: 1 (10)
Bell A, 2007 [29,32] Australia	No. participants: 400 Age: NR Male: 212 (53)	Case series Urban setting 42,000 Single centre	Propofol	Fracture: 203 (50.75) Dislocation: 132 (33) Cardioversion: 6 (1.5) Abscess: 39 (9.75) Other: 20 (5)
Bigelow S, 2005[42] USA	No. participants: 24 Age: NR Male: NR	Prospective cohort University/teaching hospital NR Single centre	Propofol vs. midazolam + fentanyl	NR
Burton JH, 2006[45] USA	No. participants: 792 Age: NR Male: NR	Case series University/teaching hospital >209,000 Multicenter	Propofol	Fracture: 277 (35) Dislocation: 302 (38) Cardioversion: 77 (10) Other: 136 (17)
Burton JH, 2001[44] USA	No. participants: 27 Age: NR Male: NR	Case series Rural setting NR Single centre centre	Etomidate vs. midazolam	Dislocation E: 12, M: 26 (100) Groups not reported
Campbell SG,	No. participants: 1334	Case series	Fentanyl, ketamine,	Combined ortho: 1070

Author, Year Country	No. participants analyzed Mean age (SD) No. males (%)	Study design Site No. annual ED visits No. centres	Drug comparison	No. procedures (% of total)
2007[72] Canada	Age: NR Male: NR	University/teaching hospital 65,000 Single centre	midazolam, propofol or combinations	(80.2) Cardioversion: 57 (4.3) Abcess: 124 (9.3) Other: 83 (6.2) Groups not reported
Caro DB, 1974[46] UK	No. participants: 52 Age: NR Male: NR	Case series Urban setting NR Single centre	Ketamine	Combined ortho: 23 (44) Abcess: 23 (44) Other: 6 (12)
Charles M, 2005[30,33] USA	No. participants: 4500 Age: NR Male: NR	Case series University/teaching hospital NR Single centre	Propofol	Combined ortho: 1800 (40) Other: 2700 (60)
Charles M, 2003[47] USA	No. participants: 200 Age: NR Male: NR	Case series Urban setting NR Single centre	Propofol	Combined ortho: 60 (30) Other: 140 (70)
Cheng L, 2004[48] Canada	No. participants: 47 Age: NR Male: NR	Case series Urban setting NR Single centre	Propofol	Cardioversion: 27 (57) Other: 20 (43)
Chudnofsky CR, 2000[49] USA	No. participants: 70 Age: NR Male: NR	Case series University/teaching hospital NR Single centre	Ketamine	Combined ortho: 18 (26) Other: 52 (74)
Dunn MJG, 2006[50] UK	No. participants: 11 Age: NR Male: NR	Case series Urban setting NR Single centre	Propofol	Dislocation: 11 (100)
Dunn T, 2007[51] UK	No. participants: 48 Age: 39.5 (IQR: 27-58) Male: (65)	Case series Urban setting 75,000 Single centre	Propofol vs. midazolam	Dislocation: 44 (92) Other: 3 (6)
Engel J, 2007[52] USA	No. participants: 308 Age: 39.5 (IQR: 27-58) Male: (65)	Case series Rural community hospital NR	Propofol	Dislocation: 246 (78) Abscess: 22 (7) Other: 46 (15)

Author, Year Country	No. participants analyzed Mean age (SD) No. males (%)	Study design Site No. annual ED visits No. centres	Drug comparison	No. procedures (% of total)
		Single centre		
Frank LR, 2006[53] USA	No. participants: 50 Age: NR Male: NR	Case series University/teaching hospital 35,000 Single centre	Propofol	Combined ortho: 22 (45) Cardioversion: 7 (15) Other: 19 (40)
Frazee BW, 2005[54] USA	No. participants: 136 Age: NR Male: NR	Case series Urban setting 85,000 Single centre	Propofol	Combined ortho: 47 (35) Other: 89 (65)
Green SM, 2005[55] USA	No. participants: 26 Age: 17.3(16.0-19-2) Male: 17 (65)	Case series University/teaching hospital 55,000 Single centre	Ketamine	Fracture: 13 (50) Dislocation: 4 (15) Other: 9 (35)
Hogan K, 2006[31,34] USA	No. participants: 980 Age: NR Male: NR	Case series Other NR Multicenter	Etomidate, fentanyl, hydromorphone, ketamine, meperidine, midazolam, moprhine, propofol and others.	Fracture: 136 (13) Dislocation: 632 (61) Cardioversion: 8 (1) Other: 252 (25)
Keim SM, 2002[56] USA	No. participants: 48 Age: 34 (18) Male: 38 (79)	Case series University/teaching hospital 55,000 Single centre	Etomidate	Fracture: 4 (8) Dislocation: 37 (77) Other: 7 (15)
Lee CC, 2001[57] Korea	No. participants: 40 Age: NR Male: NR	Case series University/teaching hospital NR Single centre	Etomidate	Dislocation: 40 (100)
Mace SE, 2006[58] USA	No. participants: 640 Age: NR Male: NR	Case series Urban setting NR Single centre	Etomidate, ketamine, methohexitol, midazolam, propofol	Fracture: 172 (24) Dislocation: 213 (29) Cardioversion: 88 (12) Other: 255 (35)
Manoocha A, 2003[59] Canada	No. participants: 763 Age: 40.3 Male: 420 (55)	Case series University/teaching hospital NR	Fentanyl, ketamine, midazolam, propofol	Combined ortho F + Mi: 143, G2: 30 Abscess

Author, Year Country	No. participants analyzed Mean age (SD) No. males (%)	Study design Site No. annual ED visits No. centres	Drug comparison	No. procedures (% of total)
		Single centre		G1: 72, G2: 185
Mensour M, 2006[12] Canada	No. participants: 160 Age: NR Male: NR	Case series Rural setting 30,000 Single centre	Etomidate, fentanyl, ketamine, midazolam, propofol or combinations	Combined ortho: 124 (77) Cardioversion: 6 (4) Other: 30 (19)
Miner JR, 2005[62] USA	No. participants: 62 Age: 34(30.4-37.7) Male: NR	Case series Urban setting 93,000 Single centre	Etomidate, propofol	Combined ortho: 36 (57) Cardioversion: 12 (19) Other: 15 (24)
Miner JR, 2005[60] USA	No. participants: 74 Age: NR Male: NR	Case series Urban setting 97,000 Single centre	Propofol	Fracture: 17 (23) Dislocation: 44 (59) Other: 13 (18)
Miner JR, 2007[61] USA	No. participants: 75 Age: NR Male: NR	Case series Urban setting NR Single centre	Propofol (low dose vs. high dose)	NR
Peddle M, 2007[63] Canada	No. participants: 54 Age: NR Male: 28 (52)	Case series University/teaching hospital 80,000 Multicenter	Propofol vs. midazolam + fentanyl	Combined ortho P: 37, Mi + F: 3 (74) Cardioversion P: 3, Mi + F: 0 (5.5) Abscess P: 6, Mi + F: 2 (15) Other P: 1, Mi + F: 2 (5.5)
Reid DK, 2004[64] Canada	No. participants: 105 Age: NR Male: NR	Case series Rural setting 30,000 Single centre	Propofol	NR
Ruth WJ, 2001[65] USA	No. participants: 48 Age: NR Male: NR	Case series University/teaching hospital 48,000	Etomidate	Fracture: 20 (39) Dislocation: 19 (37) Cardioversion: 6 (12)

Author, Year Country	No. participants analyzed Mean age (SD) No. males (%)	Study design Site No. annual ED visits No. centres	Drug comparison	No. procedures (% of total)
		Single centre		Abscess: 3 (6) Other: 3 (6)
Swann A, 2007[66] Australia	No. participants: 125 Age: NR Male: NR	Case series University/teaching hospital 53,000 Single centre	Propofol	Combined ortho: 84 (67) Cardioversion: 41 (33)
Swanson ER, 1996[67] USA	No. participants: 20 Age: NR Male: NR	Case series University/teaching hospital 42,500 Single centre	Propofol + 4 others	Combined ortho: 8 (40) Abcess: 10 (50) Other: 2 (10)
Vinson DR, 2002[68] USA	No. participants: 134 Age: NR Male: NR	Case series Urban setting 33,000 - 49,000 Multicenter	Etomidate	Fracture: 17 (11) Dislocation: 52 (35) Cardioversion: 75 (50) Abcess: 4 (2.7) Other: 2 (1.3)
Weaver CS, 2007[69] USA	No. participants: 82 Age: 38 (14) Male: 39 (48)	Case series University/teaching hospital 100,000 (mean of centres) Multicenter	Propofol	Combined ortho: 24 (29) Abscess: 40 (49) Other: 18 (21)
Willman EV, 2007[70] Canada	No. participants: 114 Age: 36 (median) range: 20-58 Male: 77 (68)	Case series University/teaching hospital 45,000 Single centre	Ketofol	Combined ortho: 79 (69) Cardioversion: 9 (8) Abcess: 13 (11) Other: 13 (11)
Zed PJ, 2007[71] Canada	No. participants: 113 Age: 50 (19) Male: 70 (62)	Case series University/teaching hospital 62,000 Single centre	Propofol	Combined ortho: 50 (44) Cardioversion: 42 (37) Abscess: 15 (13) Other: 6 (5)

E = etomidate, F = fentanyl, Fl = flumazenil, K = ketamine, Me = methohexital, Mi = midazolam, P = propofol
Other = chest tube placement, dilatation and curettage, endoscopy, hernia reduction, laceration repair, lumbar puncture, foley catheter, foreign body removal, rectal prolaps reduction, wound debridement; *results combined

APPENDIX 8: PARTICIPANTS, DOSAGE, AND SUCCESS RATES OF PSA

Author, Year, Study Design	G1 No Enrolled / G2 No Enrolled	G1 No Analyzed / G2 No Analyzed	G1 No Withdrawals / G2 No Withdrawals	G1 Drug used / G2 Drug used	G1 Injection / G2 Injection	G1 Dosage / G2 Dosage	G1 Co-intervention / G2 Co-intervention	G1 Reported Success Rate PSA in % / G2 Reported Success Rate PSA in %
Burton JH, 2002[35] RCT	22	19	3	Etomidate	IV bolus	0.1 mg/kg initial dose, repeatable up to three times if necessary, mean dose=1.6	Fentanyl 1.5-2.0 µg/kg IV pre sedation for all patients, morphine to maximun 0.2 mg/kg for analgesia at discretion of ED physician	90%
	24	22	2	Midazolam	IV bolus	0.033 mg/kg bolus, mean dose=2.1	Same as Etomidate group	91%
Coll-Vinent B, 2003[36] RCT	9	9	0	Etomidate	IV bolus	0.2 mg/kg	NR	100%
	14	14	0	Midazolam	IV bolus	0.2 mg/kg & 0.5 mg/kg, 20 second initial dose. Supplemental doses given at 1-min. intervals until desired sedation achieved	NR	100%
	9	9	0	Propofol	IV bolus	1.5 mg/kg	Midazolam 0.2 mg/kg, Flumanezil 0.5 mg/kg,	100%
Holger JS, 2005[37] RCT	16	15	1	Propofol	IV bolus	0.5 mg/kg, followed by 0.25 mg/kg IV every 30-45 seconds until Ramsay Sedation Scale (RSS) of 3, additional dose of 0.25 mg/kg IV as needed, mean dose= 0.96 mg/kg	Fentanyl 2 µg/kg IV given before sedation	*100%
	24	17	7	Midazolam	IV bolus	1 mg IV followed by 1 mg every 2-min until RSS score of 3, additional dose were given if the RSS< 3 during the procedure per physician judgment, mean dose=5.4 mg.	Fentanyl 2 µg/kg IV given before sedation	*100%

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Hunt GS, 2005[38] RCT	24	24	1	Etomidate	NR	0.1 mg/kg per dose with a maximum 3 doses (mean dose =2.04 median=2.0)	Morphine sulfate (0.1-0.15 mg/kg) pre-procedure and fantanyl 50 µg increments during the procedure, (mean fentanyl dose µg =87.5 ± 71)	100%
	21	21	0	Midazolam	NR	0.035 mg/kg per dose with a maximum 3 doses, (mean dose =2.14 median=2.0)	Morphine sulfate (0.1-0.15 mg/kg) pre-procedure and fantanyl 50 µg increments during the procedure, (mean fentanyl dose µg =102.4 ±4)	86%
Messenger DW, 2007[5] RCT	32	32	1	Ketofol	IV bolus	0.3 mg/kg IV ketamine, after 2 min 0.4 mg/kg propofol IV followed by additional 0.1 mg/kg boluses every 30 seconds until adequate sedation, additional 0.1 mg/kg IV propofol at 30-second intervals as required	NR	96.9%
	31	31	0	Propofol + fentanyl	IV bolus	1.5 µg/kg fentanyl, after 2 min 0.4 mg/kg propofol IV followed by additional 0.1 mg/kg boluses every 30 seconds until adequate sedation, additional 0.1 mg/kg IV propofol at 30-second intervals as required	NR	100%
Miner JR, 2007[40] RCT,	39	39	0	Propofol	IV bolus	1 mg/kg initially, 0.5 mg/kg every 3 min as needed, mean total dose=1.8 mg/kg (95% CI: 1.5 to 2.1)	NR	100%
	41	41	0	Propofol + alfentanyl	IV bolus	10 µg/kg alfentanyl, mean total dose c propofol=1.6 mg/kg (95% CI: 1.4 to 1.	NR	100%

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Miner JR, 2007[15] RCT	110	105	5	Etomidate	IV bolus	0.1 mg/kg followed by 0.05 mg/kg every 3 to 5 min as needed	Standard for fractures or dislocation: morphine 0.1 mg/kg IV followed by 0.05 mg/kg every 10 min as needed	90%
	110	109	1	Propofol	IV bolus	1 mg/kg followed by 0.5 mg/kg eve 3 min as needed	Same as etomidate group	97%
Miner JR, 2003[39] RCT	55	51	4	Propofol	IV bolus	1.0 mg/kg bolus followed by 0.5 mg/kg every 3 to 5 min as needed	Morphine IV 0.1 mg/kg bolus followed by 0.05 mg/kg every 15 min as needed/tolerated	98%
	54	52	2	Methohexital	IV bolus	1 mg/kg followed by 0.5 mg/kg every 3 to 5 min as needed	The same as propofol group	94%
Taylor DMcD, 2005[41] RCT	48	48	0	Propofol	IV bolus	1.5 mg/kg (95% CI: 1.3 to 1.7) initial dose, mean total dose=142.3 mg/kg (95% CI: 124.7 to 159.9)	Morphine IV (dose not reported), metoclopramide 10 mg if required	98%
	38	38	0	Midazolam/fe ntanyl	IV bolus	Fentanyl 1.25 mg/kg IV, followed by a bolus midazolam 0.06 mg/kg (95% CI: 0.04 to 0.07) 2 min later, mean initial does= 4.1 mg/kg (95% CI: 3.2 to 5.0), mean total dose of midazolam= 7.3 mg (95% CI: 5.4 to 9.2)	Morphine in propofol group	92%
Arora S, 2007[43] case series	0	10	0	Ketofol	IV bolus	Initial dose 0.5 mg/kg followed by 0.5 mg/kg at the physician discretion	Ketamine (initial dose 0.5 mg/kg followed by 0.5 mg/kg at physician discretion)	100%

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Bell A, 2007[29,32] case series	400	400	4	Propofol	IV bolus	0.5-1 mg/kg bolus followed by 10-40 mg titrated until enough sedation. Median initial propofol was 0.82 mg/kg (IQR=0.47-1.0 mg/kg), total propofol dose was 1.78 mg/kg (IQR=1.0-2.3 mg/kg)	No specific guidelines for analgesic was given but 62.5% of cases (n=252) were given opiates at the discretion of physician	99%
Bigelow S, 2005[42] prospective cohort	12	12	0	Propofol	NR	NR	NR	92%
	12	12	0	Midazolam/ fentanyl	NR	NR	NR	83%
Burton JH, 2006[45] case series	792	792	0	Propofol	IV bolus	Mean dose 1.2 mg/kg ± 0.4 mg; range 0.3-3.8	526 Analgesic, 107 Antiemetic,	100%
Burton JH, 2001[44] case series	8	NR	NR	Etomidate	IV bolus	NR	NR	92%
	19	NR	NR	Midazolam	IV bolus	NR	NR	92%
Campbell SG, 2007[72] case series	1334	1334	0	Fentanyl Ketamine Midazolam Propofol	NR	NR	NR	100%
Caro DB, 1974[46] case series	52	52	0	Ketamine	IV bolus	2 mg/kg	Diazepam, 10-20 mg IV	100%
Charles M, 2005[33] case series	4500	4500	0	Propofol	Titration	Mean total dose=183 mg (range=20-600 mg)	NR	100 %

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Charles M, 2003[47] case series	200	200	0	Propofol	Titration	Mean total dose=150 mg (range 20-600 mg)	NR	*100%
Cheng L, 2004[48] case series	47	47	0	Propofol	IV bolus	0.5 mg/kg bolus, 10-20 mg IV every 30 to 60 sec as needed, average total dose= 90.3 mg (± 53.1 mg) and average number of doses=3.6 (± 2.1)	NR	*100%
Chudnofsky CR, 2000[49] case series	77	70	7	Ketamine + midazolam	IV bolus	Ketamine 2 mg/kg IV over 2 min , midazolam 0.07 mg/kg	NR	100%
Dunn MJG, 2006[50] case series	11	11	0	Propofol	IV bolus	0.5 mg/kg over 90 seconds, followed by 0.25 mg/kg if needed, mean (range) total dose=47 (30-80) mg	Remifentanyl, 0.5 µg/kg and 0.25 µg/kg if needed, mean (range) total dose=48 (30-80) µg	100%
Dunn T, 2007[51] case series	32	32	0	Propofol	IV bolus	Initial bolus 0.5 mg/kg (up to max=50 mg) followed by, if required, up to a max 1 mg/kg	All but three received morphine before andministration of sedation agent. One received no analgesia, one received oral tramadol, and one a combination of oral ibuprofen and co-codamol.	97%
	16	16	0	Midazolam	IV bolus	1 mg bolus IV titrated to achieve desired level of sedation	Same as first group	100%
Engel J, 2007[52] case series	308	308	0	Propofol	IV bolus (titration at the discretion of ED Physician)	Average total dose was 111 mg (range 10-600)	NR	96%

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Frank LR, 2006[53] case series,	50	50	0	Propofol	Titration	Loading dose 0.21 mg/kg/h, maintenance: 3-6 mg/kg/h	All patients received Fentanyl	100%
Frazee BW, 2005[54] case series	136	136	0	Propofol	IV bolus	Initial dose 0.5-1.0 mg/kg followed by 0.1-0.2 mg/kg every 30-60 min as needed, mean initial dose=0.98 mg/kg, mean infusion rate after initial=0.22 mg/kg/min, mean total dose=168.6 mg	Fentanyl 1-1.5 µg/kg bolus one min before Propofol and repeating dose at the discretion of the provider, mean initial dose=1.2 µg/kg, mean total dose=2.0 µg/kg	100%
Green SM, 2005[55] case series	26	26	0	Ketamine	IV bolus	Mean 1.3, range 1.0-1.9	Atropine	*100%
Hogan K, 2006[15,34] case series	980	980	0	Etomidate Fentanyl Hydromorphon e Ketamine Meperidine Midazolam Moprhine Propofol others	NR	NR	NR	96%
Keim SM, 2002[56] case series,	48	48	0	Etomidate	IV bolus	0.1mg/kg in 1 min	Midazolam (9), fentanyl (7), fentanyl + midazolam (7), morphine (4), lorazepam (1), morphine + midazolam (1)	94%

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Lee CC, 2001[57] case series	40	40	0	Etomidate	NR	0.3 mg/kg (20 mg) followed by 0.15 mg/kg (10 mg) if needed	NR	100%
Mace SE, 2006[58] case series	640	640	0	Etomidate Ketamine Methohexital Midazolam Propofol	NR	NR	NR	96%
Manoocha A, 2003[59] case series	516	516	0	Fentanyl Ketamine Midazolam Propofol	NR	Mean midazolam dose=3.4 mg, mean fentanyl dose =201 µg, mean ketamine does=75 mg, mean propofol dose=120 mg	NR	100%
	247	247	0	Fentanyl Ketamine Midazolam Propofol	NR	Mean midazolam dose= 4.7 mg, mean fentanyl dose= 313 mg, mean ketamine does=87 mg, mean propofol dose=140	NR	100%
Mensour M, 2006[12] case series,	160	160	0	Etomidate Fentanyl Ketamine Midazolam Propofol combinations	IV bolus	1 mg/kg initial dose, further propofol in aliquotes of 20-40 mg in adults or if there is withdrawal to pain 0.5 mg/kg	NR	96%
Miner JR, 2005[62] case series	31	31	0	Etomidate	IV bolus	Mean initial dose 0.25 mg/kg ((95% CI: 0.17 to 0.34), mean total dose =0.40 (95% CI: 0.26 to 0.53)	Fentanyl 1 µg/kg IV followed by 0.5 µg/kg every 5 min as needed/tolerated	87%
	31	31	0	Propofol	IV bolus	Mean initial dose=0.96 mg/kg (95% CI: 0.84 to 1.10), mean total dose =1.80 (95% CI: 1.41 to 2.19),	The same as etomidate	100%
Miner JR, 2005[60] case series	75	74	1	Propofol	IV bolus	1 mg/kg followed by 0.5 mg/kg bolus every 3 min as needed	Standard for fractures or dislocation, morphine 0.1 mg/kg IV followed by 0.05 mg/kg every 10 min as needed/tolerated.	100%

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Miner JR, 2007[61] **RCT	NR	39	NR	Propofol (low dose)	IV bolus	0.88 mg/kg (0.83-0.93)	NA	100%
	NR	36	NR	Propofol (high dose)	IV bolus	0.98 mg/kg (0.88-1.09)	NA	97%
Peddle M, 2007[63] case series	56	47	2	Propofol	NR	Mean total=124.15 mg (SD=70.4)	Fantanyl (n=23), mean total=101.67 ± 56.8 , lidocaine (n=3), mean total=83.3 ± 102.1, morphine (n=3), mean total=4 ± 1.73	100%
	NR	7	0	Midazolam + fentanyl	NR	Mean total=4 mg (SD=1.83)	The same as propofol group	100%
Reid DK, 2004[64] case series	105	105	0	Propofol	IV bolus	1 mg/kg bolus followed by titration to effect	NR	*100%
Ruth WJ, 2001[65] case series	51	48	10	Etomidate	IV bolus	0.1 mg/kg IV bolus 1-3 times during the procedure, mean=1.6 dose (SD=0.7)	36/38 patients with complete vital sign assessment received analgesics: fentanyl (31/38) mean=95 µg (range 30-300 µg) , morphine (5/38) mean=13 mg (range 4-30 mg)	92%
Swann A, 2007[66] case series	125	125	15	Fentanyl, midazolam, morphine, propofol	NR	Fentanyl 1.0 (0.2-2.6) µg/kg, midazolam 0.06 (0.01-0.24) mg/kg, morphine 0.1 (0.03-3.0) mg/kg, propofol 1.3 (0.4-3.0) mg/kg	NR	87%
Swanson ER, 1996[67] case series	20	20	0	Propofol	Titration	0.21/mg/kg/min as start, then maintenance infusion of 3-6 mg/kg/hour, maximum 6 mg/kg/hr	Fentanyl 2 µg/kg IV bolus	100%

Author, Year, Study Design	Enrolled	Analyzed	Withdrawals	Drug used	Injection	Dosage	Co-intervention	Reported Success Rate PSA in %
Vinson DR, 2002[68] administrative data	134	134	0	Etomidate	IV bolus	0.19 mg/kg (0.15-0.23) median 0.17	Opioides 17, benzodiazepines 15, Both 2	90%
Weaver CS, 2007[69] cases series	82	82	0	Propofol	IV bolus	Initial dose of 0.5 (SD= 0.2) mg/kg, mean cumulative dose of 1.5 (SD=0.6) mg/kg for patients with complication and 1.4 (SD=0.6) mg/kg without complication	Benzodiazepin, fentanyl, morphine, vicodin	100%
Willman EV, 2007[70] case series	114	114	0	Ketofol	Titration	Mixture (1:1) of 10mg/mL ketamine and 10mg/mL propofol	Opiods administered pre-sedation at discretion of physician	99%
Zed PJ, 2007[71] case series	113	113	0	Propofol	IV bolus	Initial dose of 0.25-0.5 mg/kg followed by 10-20 mg/min until sedation, mean total dose required was 1.6 ± 0.9 mg/kg. Mean propofol dose=113 ± 62	Lidocaine without epinephrine (10 mg of 1% or 2%) 30 seconds prior to propofol	90%

G1,2=group 1,2, PSA=procedural sedation and analgesia, RCT=randomized clinical trial, IV=intravenous, NR=not reported, * assumed; ** treated as case series. Mean ± SD.

APPENDIX 9: ADVERSE OUTCOMES FOR ED PSA

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Randomized controlled trials							
Burton JH, 2002[35]	Etomidate Midazolam	E: 17/19 (89.5) Mi: 20/22 (90.9) Overall: 37/41 (90.2) 3 subsequently reduced in ED	E: 1 (5.3) (to OR) Mi: 0	E: 10 (52.6) Mi: 4 (18.2) Overall: 15 complications	E: 0 Mi: 0	Apnea E: 1 (5.3) Mi: 1 (4.5) SaO_2 < 90% E: 3 (15.8) Mi: 3 (13.6) Respiratory event E: 3 (15.8) P: 3 (13.6) SAM required E: 1 (5.3) Mi: 1 (4.5)	Bradycardia E: 0 Mi: 0 Emesis E: 1 (5.3) Mi: 0 Myoclonus E: 4 (21.1) Mi: 0 Intubation E: 0 P: 0 "No patient described side effects or complications at follow-up."

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Coll-Vinent B, 2003[36]	Etomidate Propofol Midazolam	E: 9/9 (100) P: 9/9 (100) Mi: 14/14 (100) Overall: 32/32 (100)	E: 0 P: 0 Mi: 0	E: 9 (100) P: 7 (77.8) Mi: 9 (64.3)	NR	Apnea ≥20 seconds E: 2 (22.2) P: 2 (22.2) Mi: 4 (28.6) SaO_2 < 90% E: 1 (11.1) P: 4 (44.4) Mi: 2 (14.3) Bronchospasm/ cough E: 3 (33.3) P: 1 (11.1) Mi: 0 SAM required E: 3 (33.3) P: 6 (66.7) Mi: 6 (42.9)	Myoclonus E: 4 (44.4) P: 0 Mi: 0 Intubation E: 0 P: 0 Mi: 0 "None of the AEs led to any clinical consequence"
Holger JS, 2005[37]	Propofol Midazolam	P: 15/15 (*100) Mi: 17/17 (*100) Overall: 32/32 (100)	P: 0 Mi: 0	P: 1 (6.7) Mi: 1 (5.9)	P: 0 Mi: 0	Decreased SaO_2 P: 0 Mi: 0 SAM required NR	Bradycardia P: 0 Mi: 0 Emesis P: 1 (6.7) Mi: 1 (5.9) 'No other AEs noted and none reported at follow-up"
Hunt GS, 2005[38]	Etomidate Midazolam	E: 24/24 (100) Mi: 18/21 (85.7) Overall: 42/45 (93.3)	E: 0 due to complications Mi: 3 (14.3) (to OR)	E: 6 (25.0) Mi: 5 (23.8)	E: 0 Mi: 1 (4.8)	Apnea E: 0 Mi: 1 (4.8) Decreased SaO_2 E: 2 (8.3) Mi: 5 (23.8) SAM required E: 1 (4.2) Mi: 1 (4.8)	Myoclonus E: 4 (16.7) Mi: 0 Emergence phenomenon E: 1 (4.2) Mi: 0

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Messenger DW, 2007[5]	Ketofol Propofol + fentanyl	Kfl: 31/32 (96.9) PF: 31/31 (100) Overall: 62/63 (98.4) 1 subsequently successful in ED with other drugs	Kfl: 0 PF: 0	Kfl: 15 (46.9) PF: 26 (83.9)	SBP <100mmHg Kfl: 0 PF: 3 (9.7)	SaO_2 < 92% Kfl: 12 (37.5) PF: 24 (77.4) Increased $EtCO_2$ > 10mmHg Kfl: 3 (9.4) PF: 4 (12.9) SAM required Kfl: 8 (25.0) PF: 24 (77.4)	Emesis Kflfl: 0 PF: 0 Emergence phenomenon K: 0 PF: 0 Intubation Kfl: 0 PF: 0 "All AEs were transient"
Miner JR, 2007[40]	Propofol Propofol + alfentanyl Results combined	P+PA: 80/80 (100)	P+PA: NR	P+PA: 11(13.8)	P+PA: NR	SaO_2 < 92% P+PA: 11 (13.8) SAM required P+PA: 19 (23.8)	"No significant adverse events were noted."
Miner JR, 2007[15]	Etomidate Propofol	E: 94/105 (89.5) P: 106/109 (97.2 Overall: 210/214 (98.1)	E: 0 P: 0	E: 60 events P: 56 events	SBP <100 mmHg E: 1 (1.0) P: 4 (3.7)	SaO_2 < 92% E:10 (9.5) P: 10 (9.1) Change $EtCO_2$ >10 mmHg E: 28 (26.7) P: 40 (37.6) Respiratory depression (SaO_2 < 90%, change $EtCO_2$ ≥10 torr, or airway obstruction) E: 36 (34.3) P: 46 (42.2) SAM required E: 30 (28.6) P: 30 (27.5)	Emesis E: 0 P: 0 Myoclonus E:21 (20.0) P: 2 (1.8) Intubation E: 0 P: 0 "No clinically significant complications were noted"

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Miner JR, 2003[39]	Propofol Methohexital	P: 50/51 (98.0) Me: 49/52 (94.2) Overall 99/103 (96.1)	P: 0 Me: 0	P: 13 (25.0) Me: 13 (25.0)	Decrease SBP >20% P: 0 Me: 0	SaO_2 < 90% Overall: 11 (10.7) Change $EtCO_2$ ≥10 torr Overall: 48 (46.6) Respiratory depression (SaO_2 < 92%, change $EtCO_2$ ≥10 torr, or airway obstruction) P: 25 (49.0) Me: 25 (48.0) SAM required P: 2 (58.8) Me: 4 (7.7)	Emesis P: 0 Me: 0 Intubation P: 0 Me: 0
Taylor DMcD, 2005[41]	Propofol Midazolam/ fentanyl	P: 47/48 (97.9) MiF: 35/38 (92.1) Overall: 82/86 (95.3) (4/86 subsequent success in ED with other drugs)	*0	P: 11 (22.9) MiF: 7 (18.4)	SBP < 94mmHg P: 0 MiF: 1 (2.6)	SaO_2 < 90% P: 4 (8.3) MiF: 2 (5.3) Partial obstruction P: 6 (12.5) MiF: 5 (13.2) Respiratory depression (decreased rate or SaO_2 or partial obstruction) P: 11 (22.9) MiF: 6 (15.8) SAM required P: 11 (22.9) MiF: 6 (15.8)	Emesis P: 1 (2.1) MiF: 0 Intubation P: 0 MiF: 0 "AEs were uncommon, transient and easily managed."

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Observational studies							
Arora S, 2007[43]	Ketofol	10/10 (100)	NR	1/10 (10.0)	Decrease > 10% MAP 0	SaO_2 < 99% 0 Respiratory depression 0 SAM required 0	Emesis 0 Emergence reaction 1 (10.0)
Bell A, 2007[32]	Propofol	402/404 (99.5) (400 patients)	0 unplanned admissions	86 (22.0)	NR	Apnea 19 (4.7) SaO_2 < 95% 11 (1.7) Change $EtCO_2$ ≥10 mmHg 4 (1.0) Laryngospasm 1 (0.2) Any respiratory event 86 (21.5) SAM required: 123 (31.0)	Emesis 2 (0.5) Intubation 0
Bigelow S, 2005[42]	Propofol Midazolam/ fentanyl	P: 11/12 (91.7) MiF: 10/12 (83.3) Overall 21/24 (87.5) (3/24 success in ED with other drugs)	*0	P: 3 (25.0) MiF: 0	P: 1 (8.3) MiF: 0	Respiratory depression P: 2 (16.7) MiF: 0 SAM required NR	"The three AEs were quickly and easily reversed."

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Burton JH, 2006[45]	Propofol	792/792 (100)	0 (for PSA complications)	Approximately 75 (9.5) (some had ≥ 1 event)	SBP <100 mmHg or required intervention 28 (3.5)	SaO_2 < 90% 61 (7.7) SAM required 33 (4.2)	Bradycardia (PR <60 bpm or required intervention) 3 (0.4) Emesis 1 (0.1) Intubation 0 "All AE's resolved with brief, supportive interventions."
Burton JH, 2001[44]	Etomidate Midazolam	E: 11/12 (91.7) (8 patients) Mi: 24/26 (92.3) (19 patients) Overall: 35/38 (92.1)	NR	E: 2 (16.7) Mi: 2 (7.7)	NR	Apnea E: 1 (8.3) Mi: 1 (3.8) SAM required E: 1 (8.3) Mi: 1 (3.8)	Emesis E: 0 Mi: 1 (3.8) Myoclonus E:1 (8.3) Mi: 0
Campbell SG, 2007[72]	Fentanyl, Midazolam, Propofol, Ketamine or combinations	1334/1334 (100)	1 (0.07)	12 (0.9)	SBP < 85mmHg 8 (0.6)	SaO_2 < 90% 11 (0.9) SAM required 1 (0.7)	Aspiration and intubation 1 (0.07)
Caro DB, 1974[46]	Ketamine	52/52 (100)	0	2 (3.8)	NR	NR	Emergence phenomenon 2 (3.8)
Charles M, 2005[30,33]	Propofol - 1 physician present Propofol - 2 physicians present	P-1: *4000/4000 P-2: *500/500 Overall 4500/4500 (100)	P-1: *0 P-2: *0 Overall 0	P-1:240 (6.0) P-2: 35 (7.0) Overall 275 (6.1)	SBP <90 mmHg P-1: 120 (3.0) P-2: 20 (4.0) Overall 140 (3.1)	SaO_2 < 90% P-1: 120 (3.0) P-2: 15 (3.0) Overall 135 (3.0) Airway obstruction 0 SAM required P-1: 24 (0.6) P-2: 15 (3.0) Overall 39 (8.7)	Intubation 0

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Charles M, 2003[47]	Propofol	*200/200 (100)	*0	7 (3.5)	SBP <90 mmHg 4 (2.0)	SaO_2 < 90% 3 (1.5) SAM required 0	Intubation 0 No others observed
Cheng L, 2004[48]	Propofol	*47/47 (100)	0	10 (21.0)	NR	NR	NR
Chudnofsky CR, 2000[49]	Ketamine + midazolam	70/70 (100)	0	12 (17.1)	0	Apnea 3 (4.3) Laryngospasm 1 (1.4) SAM required 4 (5.7)	Emesis 2 (2.9) Myoclonus 1 (1.4) Emergence phenomenon 7 (2.9) Intubation 0
Dunn MJG, 2006[50]	Propofol	11/11 (100)	0	None	1 (9.0)	Apnea 0 SAM required: 0	"There were no circulatory or respiratory AEs that required treatment."
Dunn T, 2007[51]	Propofol Midazolam	P: 31/32 (97) Mi: 16/16 (100) Overall: 47/48 (97.9)	P: 1 (3.1) (to OR) Mi: 0	P: 0 Mi: 0	SBP <90mmHg P: 0 Mi: 0	Apnea P: 0 Mi: 0 SaO_2 <90% P: 0 Mi: 0	None observed
Engel J, 2007[52]	Propofol	300/314 (95.5) (308 patients)	0	6 (1.9)	SBP <90mmHg 1 (0.3)	SaO2 <90% 5 (1.6) SAM required 5 (1.6)	Intubation 0 No others reported

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Frank LR, 2006[53]	Propofol	50/50 (100)	*0	17 (34.0)	SBP <100 mmHg 6 (12.0)	Apnea 2 (4.0) SaO2 <90% 4 (8.0) $EtCO_2$ >50 mmHg or increase >10 mmHg 2 (4.0) Respiratory depression (SaO_2 < 90%, $EtCO_2$ >50 mmHg or increase >10 mmHg or apnea) 8 (16.0) SAM required 4 (8.0)	Emergence phenomenon 2 (4.0) Intubation 0
Frazee BW, 2005[54]	Propofol	136/136 (100)	0	14 (10.3)	SBP <90 mmHg 5 (3.7)	Apnea ≥ 30 sec. 5 (3.7) SaO_2 < 90% 7 (5.1) SAM required 8 (5.9)	Emesis 1 (0.7) Intubation 1 (0.7)
Green SM, 2005[55]	Ketamine	26/26 (100)	0	4 (15.4)	0	No respiratory complications	Emesis/nausea 3 (11.5) Emergence phenomenon 2 (7.7)

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Hogan K, 2006[31,34]	Etomidate, fentanyl, hydromorphone, ketamine, meperidine, midazolam, moprhine, propofol and others.	982/1028 (95.5) (980 patients) 4 stopped due to complication (none were admitted)	0 unplanned admissions	42 (4.1)	SBP <90mmHg ≥ 60 s 3 (0.29)	Apnea 11 (1.1) Airway obstruction 1 (0.10) SaO_2 < 93% ≥ 60 s 26 (2.6) SAM required 26 (2.6)	Emergence phenomenon 1 (0.10)
Keim SM, 2002[56]	Etomidate	45/48 (93.8) (2 subsequent successes with other drugs)	2 (4.2) (to OR)	6 (12.5)	0	Apnea >30 sec 1 (2.1) SaO_2 < 90% 1 (2.1) SAM required 2 (4.2)	Emesis 2 (4.2) Myoclonus 0 Emergence phenomenon 2 (4.2) Intubation 0 "No AE resulted in a poor outcome."
Lee CC, 2001[57]	Etomidate	40/40 (100)	0	7 (17.5)	0	Respiratory depression 0	Emesis 0 Myoclonus 7 (17.5)
Mace SE, 2006[58]	Propofol, Ketamine, Methohexitol Midazolam, or Etomidate	613/640 (95.8)	*0	79 (12.3)	Occurred but no data	Apnea, SaO_2 < 90%, occurred but no data SAM required used but no data	Bradycardia, nausea/vomiting, cough, hypertension, chest pain, myoclonus/seizure, hiccups, hives/itching occurred but no data. Intubation 0 "There were no serious complications."

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Manoocha A, 2003[59]	Midazolam, Fentanyl, Ketamine, Propofol	*763/763 (100)	*0	81 (10.6)	SBP <90 mmHg 22 (2.9)	SaO_2 < 90% 27 (3.5)	Bradycardia <50 bpm 12 (1.6) "No significant morbidity occurred."
Mensour M, 2006[12]	Etomidate, fentanyl, ketamine, midazolam, propofol and combinations	153/160 (95.6)	0	29 (18.0)	SBP <90 mmHg 2 (1.3)	Apnea >20 sec. 16 (10.0) SaO_2 < 90% 2 (1.3) SAM required 36 (22.5)	Bradycardia <50 bpm 3 (1.9) Emesis 0 Intubation 0 "All AEs were minor."
Miner JR, 2005[62]	Etomidate Propofol	E: 27/31 (87.0) P: 31/31 (100) Overall 58/62 (93.5)	E: NR P: NR	E: 19 (61.3) P: 27 (87.1)	Decrease SBP >20% E: I (3.2) P: 8 (25.8)	SaO_2 < 90% E:1(3.2) P: 2 (6.4) Change $EtCO_2$ >10mmHg E: 18 (58.1) P: 19 (61.3) Respiratory depression (SaO_2 < 90%, change $EtCO_2$ >10mmHg or airway obstruction) E: 18 (58.1) P: 19 (61.3) SAM required E: 4 (12.9) P: 1 (3.2)	Emesis 0 Intubation 0

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Miner JR, 2005[60]	Propofol	74/74 (100)	0	14 (18.9)	SBP <90 mmHg 0	SaO_2 < 90% 2 (2.7) change $EtCO_2$ >10 torr 10 (13.5) SAM required 0	Sinus tachycardia >120 bpm 2 (2.7) Emesis 0 Intubation 0 "No serious AEs were noted"
Miner JR, 2007[61]	Propofol	74/75 (98.7)	NR	40 events	0	SaO_2 < 90% 5 (6.7) Change $EtCO_2$ >10mmHg P: 35 (46.7) Respiratory depression (SaO_2 < 90%, change $EtCO_2$ >10mmHg, or airway obstruction) P: 37 (49.3) SAM required P: 3 (4.0)	Emesis 0 Intubation 0 "No significant AEs were noted."
Peddle M, 2007[63]	Propofol Midazolam + fentanyl	P: 47/47 (100) MiF: 7/7 (100) Overall 54/54 (100)	P: 5 (10.6) MiF: 1 (14.3)	P: 7 (14.9) MiF: 2 (28.6)	P: 1 (2.1) MiF: 1 (14.3)	Apnea and/or Hypoxia P: 4 (8.5) MiF: 0 SAM required NR	Nausea P: 1 (2.1) MiF: 1 (14.3)
Reid DK, 2004[64]	Propofol	*105/105 (100)	*0	5 (4.8)	3 (2.9)	Apnea 0 Decreased SaO_2 1 (1.0) SAM required NR	Bradycardia 0

Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Ruth WJ, 2001[65]	Etomidate	47/51 (92.2) (48 patients)	2 (4.2)	12 events in 9 patients 9 (17.6)	0	Apnea 0 SaO_2 < 90% 5 (9.8) SAM required 5 (9.8)	Bradycardia 1 (1.96) Emesis 1 (1.96) Myoclonus 4 (7.8) Intubation 0
Swann A, 2007[66]	PSA in general Propofol + 4 others	109/125 (87.2)	NR	2 (1.6)	1 (0.8)	SaO_2 < 90% 0 SAM required None	Emergence phenomenon 1 (0.8)
Swanson ER, 1996[67]	Propofol	20/20 (100)	*0	6 (15.0)	SBP <90mmHg 1 (5.0)	Apnea <30 sec 2 (10.0) SaO_2 < 90% 1 (5.0)	Emesis 0 No others reported
Vinson DR, 2002[68]	Etomidate	135/150 (90.0) (134 patients)	1 (0.7) due to heart block	7 (4.7)	Decrease SBP ≥ 20mmHg 13 (8.7)	SaO_2 < 94% 5 (3.3) SAM required 5 (3.3)	Emesis 1 (0.7) Intubation 0
Weaver CS, 2007[69]	Propofol	*82/82 (100)	0	17 (21.0) experienced 28 events	0	Apnea (no effort to breath) 2 (2.4) SaO_2 < 90% > 90 s 9 (11.0) Obstruction/ partial obstruction 7 (8.5) SAM required 10 (12.2)	Intubation 0 No others reported

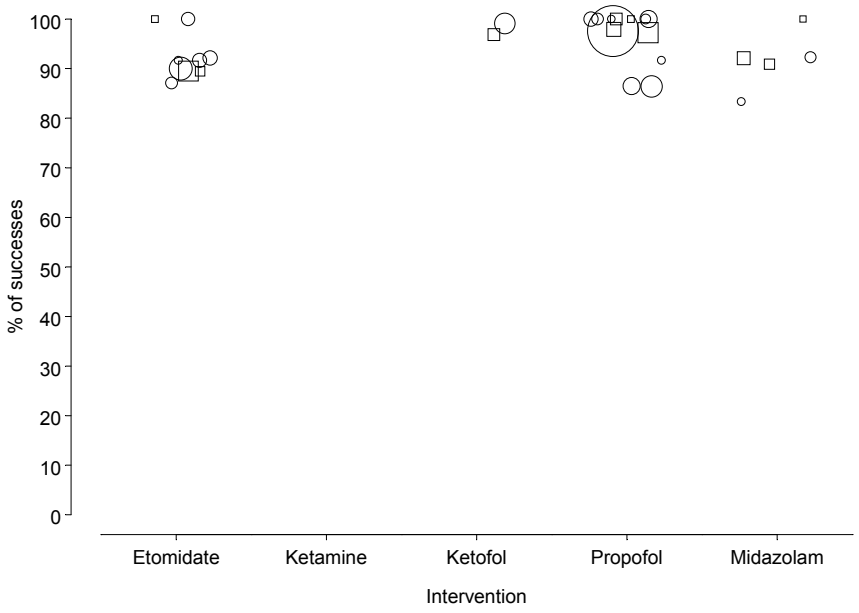
Author, Year	Comparison	Procedural success n/N (%)	Hospitalized or transferred from ED n (%)	Total adverse events n (%)	Observed hypotension n (%)	Observed airway issues n (%)	Other adverse events observed n (%)
Willman EV, 2007[70]	Ketofol	113/114 (99.1) 1 subsequent success with different drug	0	8 (7.0)	Decrease SBP ≥20% 0	Apnea ≥20 sec 2 (2.7) SaO_2 < 90% 3 (2.6) Airway malalignment 3 (2.6) SAM required 6 (5.2)	Bradycardia 0 Emesis 0 Intubation 0 Emergence phenomenon 3 (2.6)
Zed PJ, 2007[71]	Propofol	102/113 (90.3)	0 uplanned admissions	10 (8.8)	Decrease SBP >20% or <90mmHg 9 (8.0)	Apnea ≥ 30 sec. 0 SaO_2 < 90% 1 (0.9) SAM required 1 (0.9)	Emesis 1 (0.9) Intubation 0 "No patient experienced a major complication."

AE = adverse event; bpm=beats per minute; E = etomidate; $EtCO_2$ = end-tidal carbon dioxide; Kfl = ketofol; MAP = mean atrerial pressure; Me = methohexital; Mi = midazolam MiF = midazolam with/without fentanyl; P = propofol; PA = propofol + alfentanyl; PF = propofol + fentanyl; P-1 = propofol with 1 physician present; P-2 = propofol with 2 physicians present; SAM = supportive airway measures (any combination of supplemental O_2, stimulation, repositioning, bag-valve-mask); SaO_2 = oxygen saturation; SBP = systolic blood pressure;
*assumed because all successful and no significant AE's;

NOTE: The airway events are not necessarily mutually exclusive. It was not always clear if the AEs reported were the total number of events or the total number of patients experiencing an AE.

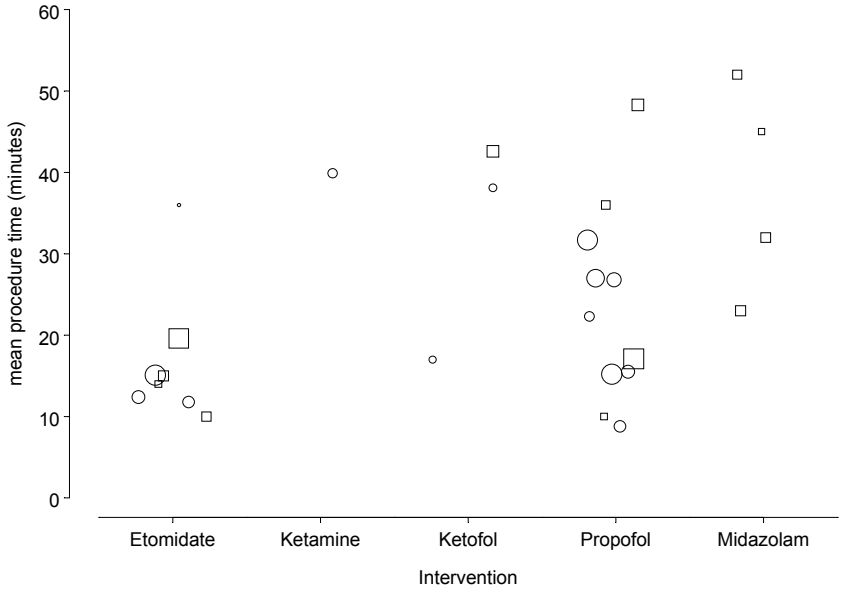
APPENDIX 10: EFFICACY SCATTER PLOTS

Figure 1: Procedural success by PSA agent



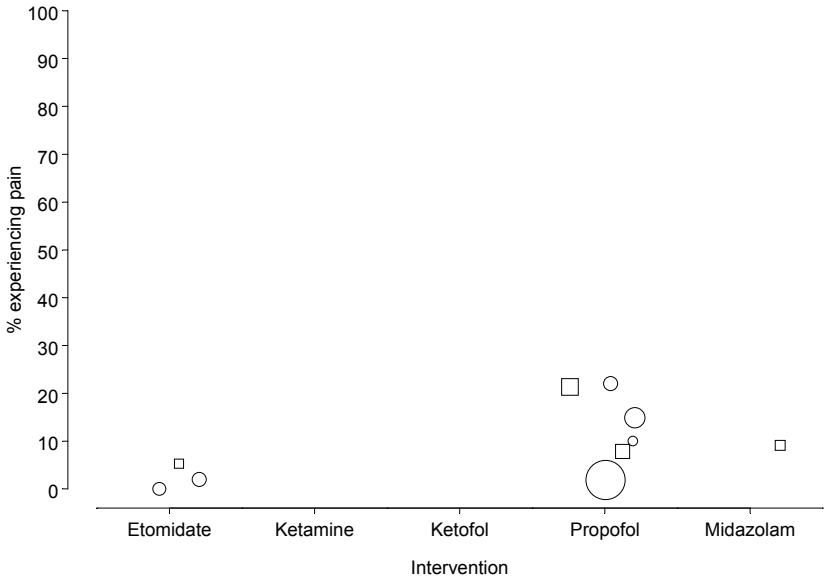
Legend: square = RCT, circle = observational study
Shapes are proportional in size to the number of patients in the estimate.

Figure 2: Procedure time (administration to recovery/no monitoring) by PSA agent



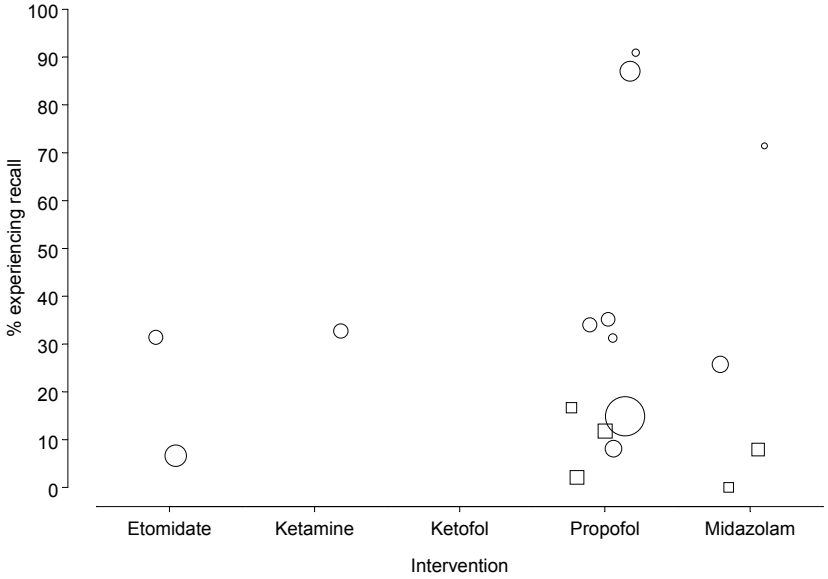
Legend: square = RCT, circle = observational study
Shapes are proportional in size to the number of patients in the estimate.

Figure 3: Patient pain by PSA agent



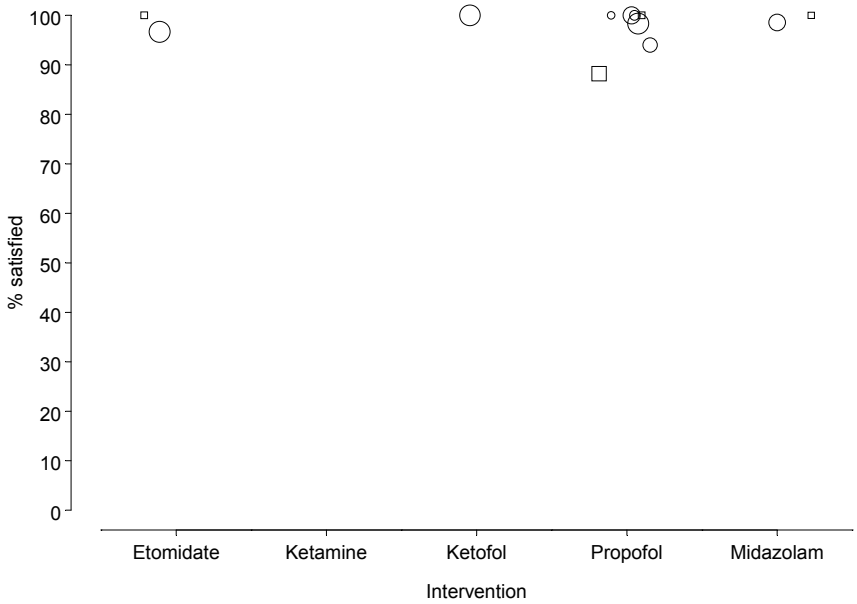
Legend: square = RCT, circle = observational study
Shapes are proportional in size to the number of patients in the estimate.

Figure 4: Patient recall by PSA agent



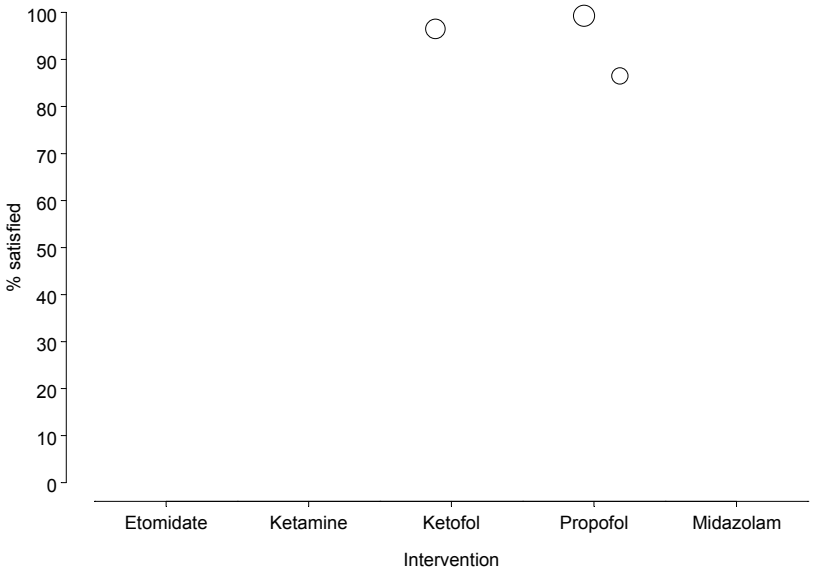
Legend: square = RCT, circle = observational study
Shapes are proportional in size to the number of patients in the estimate.

Figure 5: Patient satisfaction by PSA agent



Legend: square = RCT, circle = observational study
Shapes are proportional in size to the number of patients in the estimate.

Figure 6: Physician satisfaction by PSA agent



Legend: square = RCT, circle = observational study
Shapes are proportional in size to the number of patients in the estimate.

APPENDIX 11: POOLED RESULTS FOR PSA ADVERSE EVENTS

Table 1: Etomidate

Etomidate Author Year	Proportion with event n/N	Absolute risk (95%CI)
Hospitalized: RCT		
Burton 2002[35]	1/19	5.3 (0.9, 24.6)
Coll-Vinent 2003[36]	0/9	0.0 (0.0, 23.1)
Hunt 2005[38]	0/24	0.0 (0.0, 10.1)
Miner 2007[15]	0/105	0.0 (0.0, 2.5)
Sub-total	**1/157**	**0.6 (0.1, 3.5)**
Hospitalized: Observational studies		
Kiem 2002[56]	2/48	4.2(1.2, 14.0)
Lee 2001[57]	0/40	0.0 (0.0, 6.3)
Ruth 2001[65]	2/51	3.9 (1.1, 13.2)
Vinson 2002[68]	1/150	0.7 (0.1, 3.7)
Sub-total	**5/289**	**1.7 (0.7, 4.0)**
Total	**6/446**	**1.3 (0.6, 2.9)**
Total adverse events: RCT		
Burton 2002[35]	10/19	52.6 (31.7, 72.7)
Coll-Vinent 2003[36]	7/9	77.8 (45.3, 93.7)
Hunt 2005[38]	6/24	25.0 (12.0, 44.9)
Miner 2007[15]	60/105	57.1 (47.6, 66.2)
Sub-total	**83/157**	**52.9 (45.1, 60.5)**
Total adverse events: Observational studies		
Burton 2001[44]	2/12	16.7 (4.7, 44.8)
Kiem 2002[56]	6/48	12.5 (5.9, 24.7)
Lee 2001[57]	7/40	17.5 (8.7, 31.9)
Miner 2005[62]	19/31	61.3 (43.8, 76.3)
Ruth 2001[65]	9/51	17.6 (9.6, 30.3)
Vinson 2002[68]	7/150	4.7 (2.3, 9.3)
Sub-total	**50/332**	**15.1 (11.6, 19.3)**
Total	**133/489**	**27.2 (23.4, 31.3)**
Hypotension: RCT		
Burton 2002[35]	0/19	0.0 (0.0, 12.5)
Hunt 2005[38]	0/24	0.0 (0.0, 10.1)
Miner 2007[15]	1/105	1.0 (0.2, 5.2)
Sub-total	**1/148**	**0.7 (0.1, 3.7)**
Hypotension: Observational studies		
Kiem 2002[56]	0/48	0.0 (0.0, 5.3)
Lee 2001[57]	0/40	0.0 (0.0, 6.3)
Miner 2005[62]	1/31	3.2 (0.6, 16.2)
Ruth 2001[65]	0/51	0.0 (0.0, 5.0)
Vinson 2002[68]	13/150	8.7 (5.1, 14.3)
Sub-total	**14/320**	**4.4 (2.6, 7.2)**
Total	**15/468**	**3.2 (2.0, 5.2)**

Etomidate Author Year	Proportion with event n/N	Absolute risk (95%CI)
Apnea: RCT		
Burton 2002[35]	1/19	5.3 (0.9, 24.6)
Coll-Vinent 2003[36]	2/9	22.2 (6.3, 54.7)
Hunt 2005[38]	0/24	0.0 (0.0, 10.1)
Sub-total	**3/52**	5.8 (2.0, 15.6)
Apnea: Observational studies		
Burton 2001[44]	1/12	8.3 (1.5, 35.4)
Kiem 2002[56]	1/48	2.1 (0.4, 10.9)
Ruth 2001[65]	0/51	0.0 (0.0, 5.0)
Sub-total	**2/111**	**1.8 (0.5, 6.3)**
Total	**5/163**	3.1 (1.3, 7.0)
SaO2 <90-92%: RCT		
Burton 2002[35]	3/19	15.8 (5.5, 37.6)
Coll-Vinent 2003[36]	1/9	11.1 (2.0, 43.5)
Hunt 2005[38]	2/24	8.3 (2.3, 25.8)
Miner 2007[15]	10/105	9.5 (5.3, 16.6)
Sub-total	**16/157**	**10.2 (6.4, 15.9)**
SaO2 <90-92%: Observational studies		
Kiem 2002[56]	1/48	2.1 (0.4, 10.9)
Miner 2005[62]	1/31	3.2 (0.6, 16.2)
Ruth 2001[65]	5/51	9.8 (4.3, 21.0)
Vinson 2002[68]	5/150	3.3 (1.4, 7.6)
Sub-total	**12/280**	**4.3 (2.5, 7.3)**
Total	**28/437**	**6.4 (4.5, 9.1)**
Change in ETCO2 >10: RCT		
Miner 2007[15]	28/105	26.7 (19.1, 35.8)
Sub-total	**28/105**	**26.7 (19.1, 35.8)**
Change in ETCO2 >10: Observational studies		
Miner 2005[62]	18/31	58.1 (40.8, 73.6)
Sub-total	**18/31**	**58.1 (40.8, 73.6)**
Total	**46/136**	**33.8 (26.4, 42.1)**
Bronchospasm/cough: RCT		
Coll-Vinent 2003[36]	3/9	33.3 (12.1, 64.6)
Sub-total	**3/9**	**33.3 (12.1, 64.6)**
Bronchospasm/cough: Observational studies		
No data		
Total	**3/9**	**33.3 (12.1, 64.6)**

Etomidate Author Year	Proportion with event n/N	Absolute risk (95%CI)
Respiratory depression: RCT		
Burton 2002[35]	3/19	15.8 (5.5, 37.6)
Miner 2007[15]	36/105	34.3 (25.9, 43.8)
Sub-total	**39/124**	**31.5 (23.9,40.1)**
Respiratory depression: Observational studies		
Lee 2001[57]	0/40	0.0 (0.0, 6.3)
Miner 2005[62]	18/31	58.1 (40.8, 73.6)
Sub-total	**18/71**	25.4 (16.7, 36.6)
Total	**57/195**	**29.2 (23.3, 36.0)**
SAM required: RCT		
Burton 2002[35]	1/19	5.3 (0.9, 24.6)
Coll-Vinent 2003[36]	3/9	33.3 (12.1, 64.6)
Hunt 2005[38]	1/24	4.2 (0.7, 20.2)
Miner 2007[15]	30/105	28.6 (20.8, 37.8)
Sub-total	**35/157**	**22.3 (16.5, 29.4)**
SAM required: Observational studies		
Burton 2001[44]	1/12	8.3 (1.5, 35.4)
Kiem 2002[56]	2/48	4.2 (1.2, 14.0)
Miner 2005[62]	4/31	12.9 (5.1, 28.9)
Ruth 2001[65]	5/51	9.8 (4.3, 21.0)
Vinson 2002[68]	5/150	3.3 (1.4, 7.6)
Sub-total	**17/292**	**5.8 (3.7, 9.1)**
Total	**52/449**	**11.6 (8.9, 14.9)**
Bradycardia: RCT		
Burton 2002[35]	0/19	10 (0.0, 12.5)
Sub-total	**0/19**	**10 (0.0, 12.5)**
Bradycardia: Observational studies		
Ruth 2001[65]	1/51	2.0 (0.3, 10.3)
Sub-total	**1/51**	**2.0 (0.3, 10.3)**
Total	**1/70**	**1.4 (0.3, 7.7)**
Emesis: RCT		
Burton 2002[35]	1/19	5.3 (0.9, 24.6)
Miner 2007[15]	0/105	0.0 (0.0, 2.5)
Sub-total	**1/124**	**0.8 (0.1, 4.4)**
Emesis: Observational studies		
Burton 2001[44]	0/12	0.0 (0.0, 18.4)
Kiem 2002[56]	2/48	4.2 (1.2, 14.0)
Lee 2001[57]	0/40	0.0 (0.0, 6.3)
Miner 2005[62]	0/31	0.0 (0.0, 8.0)
Ruth 2001[65]	1/51	2.0 (0.3, 10.3)
Vinson 2002[68]	1/150	0.7 (0.1, 3.7)
Sub-total	**4/332**	**1.2 (0.5, 3.1)**
Total	**5/456**	**1.1 (0.5, 2.5)**

Etomidate Author Year	Proportion with event n/N	Absolute risk (95%CI)
Myoclonus: RCT		
Burton 2002[35]	4/19	21.1 (8.5, 43.3)
Coll-Vinent 2003[36]	4/9	44.4 (18.9, 73.3)
Hunt 2005[38]	4/24	16.7 (6.7, 35.9)
Miner 2007[15]	21/105	20.0 (13.5, 28.6)
Sub-total	**33/157**	**21.0 (15.4, 28.0)**
Myoclonus: Observational studies		
Burton 2001[44]	1/12	8.3 (1.5, 35.4)
Kiem 2002[56]	0/48	0.0 (0.0, 5.3)
Lee 2001[57]	7/40	17.5 (8.7, 31.9)
Ruth 2001[65]	4/51	7.8 (3.1, 18.5)
Sub-total	**12/151**	**7.9 (4.6, 13.4)**
Total	**45/308**	**14.6 (11.1, 19.0)**
Emergence phenomenon: RCT		
Hunt 2005[38]	1/24	4.2 (0.7, 20.2)
Sub-total	**1/24**	**4.2 (0.7, 20.2)**
Emergence phenomenon: Observational studies		
Kiem 2002[56]	2/48	4.2 (1.2, 14.0)
Sub-total	**2/48**	**4.2 (1.2, 14.0)**
Total	**3/72**	**4.2 (1.4, 11.5)**

Table 2: Ketamine

Ketamine Author Year	Proportion with event (n/N)	Absolute risk (95%CI)
Hospitalized: RCT		
No data		
Hospitalized: Observational studies		
Caro 1974[46]	0/52	0.0 (0.0, 4.9)
Chudnofsky 2000[49]	0/70	0.0 (0.0, 3.7)
Green 2005[55]	0/26	0.0 (0.0, 9.4)
Sub-total	**0/148**	**0.0 (0.0, 1.8)**
Total	**0/148**	**0.0 (0.0, 1.8)**
Total adverse events: RCT		
No data		
Total adverse events: Observational studies		
Caro 1974[46]	2/52	3.8 (1.1, 13.0)
Chudnofsky 2000[49]	12/70	17.1 (10.1, 27.6)
Green 2005[55]	4/26	15.4 (6.2, 33.5)
Sub-total	**18/148**	**12.2 (7.8, 18.4)**
Total	**18/148**	**12.2 (7.8, 18.4)**
Hypotension: RCT		
No data		
Hypotension: Observational studies		
Chudnofsky 2000[49]	0/70	0.0 (0.0, 3.7)
Green 2005[55]	0/26	0.0 (0.0, 9.4)
Sub-total	**0/96**	**0.0 (0.0, 2.7)**
Total	**0/96**	**0.0 (0.0, 2.7)**
Apnea: RCT		
No data		
Apnea: Observational studies		
Chudnofsky 2000[49]	3/70	4.3 (1.5, 11.9)
Sub-total	**3/70**	**4.3 (1.5, 11.9)**
Total	**3/70**	**4.3 (1.5, 11.9)**
Bronchospasm/cough/laryngospasm: RCT		
No data		
Bronchospasm/cough/laryngospasm: Observational studies		
Chudnofsky 2000[49]	1/70	1.4 (0.3, 7.7)
Sub-total	**1/70**	**1.4 (0.3, 7.7)**
Total	**1/70**	**1.4 (0.3, 7.7)**
Respiratory depression: RCT		
No data		
Respiratory depression: Observational studies		
Chudnofsky 2000[49]	4/70	5.7 (2.2, 13.8)
Green 2005[55]	0/26	0.0 (0.0, 9.4)
Sub-total	**4/96**	**4.2 (1.6, 10.2)**
Total	**4/96**	**4.2 (1.6, 10.2)**

Ketamine Author Year	Proportion with event n/N	Absolute risk (95%CI)
SAM required: RCT		
No data		
SAM required: Observational studies		
Chudnofsky 2000[49]	4/70	5.7 (2.2, 13.8)
Sub-total	**4/70**	**5.7 (2.2, 13.8)**
Total	**4/70**	**5.7 (2.2, 13.8)**
Emesis: RCT		
No data		
Emesis: Observational studies		
Chudnofsky 2000[49]	2/70	2.9 (0.8, 9.8)
Green 2005[55]	3/26	11.5 (4.0, 29.0)
Sub-total	**5/96**	**5.2 (2.2, 11.6)**
Total	**5/96**	**5.2 (2.2, 11.6)**
Myoclonus: RCT		
No data		
Myoclonus: Observational studies		
Chudnofsky 2000[49]	1/70	1.4 (0.3, 7.7)
Sub-total	**1/70**	**1.4 (0.3, 7.7)**
Total	**1/70**	**1.4 (0.3, 7.7)**
Emergence phenomenon: RCT		
No data		
Emergence phenomenon: Observational studies		
Caro 1974[46]	1/52	1.9 (0.3, 10.1)
Chudnofsky 2000[49]	7/70	10.0 (4.9, 19.2)
Green 2005[55]	2/26	7.7 (2.1, 24.1)
Sub-total	**11/148**	**7.4 (4.2, 12.8)**
Total	**11/148**	**7.4 (4.2, 12.8)**

Table 3: Ketofol

Ketofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
Hospitalized: RCT		
Messenger 2007[5]	0/32	0.0 (0.0, 7.8)
Sub-total	**0/32**	**0.0 (0.0, 7.8)**
Hospitalized: Observational studies		
Arora 2007[43]	0/10	0.0 (0.0, 21.3)
Willman 2007[70]	0/114	0.0 (0.0, 2.3)
Sub-total	**0/114**	**0.0 (0.0, 2.1)**
Total	**0/156**	**0.0 (0.0, 1.7)**
Total adverse events: RCT		
Messenger 2007[5]	15/32	46.9 (30.9, 63.6)
Sub-total	**15/32**	**46.9 (30.9, 63.6)**
Total adverse events: Observational studies		
Arora 2007[43]	1/10	10.0 (1.8, 40.4)
Willman 2007[70]	8/114	7.0 (3.6, 13.2)
Sub-total	**9/124**	7.3 (3.9, 13.2)
Total	**24/156**	**15.4 (10.6, 21.9)**
Hypotension: RCT		
Messenger 2007[5]	0/32	0.0 (0.0, 7.8)
Sub-total	**0/32**	**0.0 (0.0, 7.8)**
Hypotension: Observational studies		
Arora 2007[43]	0/10	0.0 (0.0, 21.3)
Willman 2007[70]	0/114	0.0 (0.0, 2.3)
Sub-total	**0/124**	**0.0 (0.0, 2.1)**
Total	**0/156**	**0.0 (0.0, 1.7)**
Apnea: RCT		
No data		
Apnea: Observational studies		
Willman 2007[70]	2/114	1.8 (0.5, 6.2)
Sub-total	**2/114**	**1.8 (0.5, 6.2)**
Total	**2/114**	**1.8 (0.5, 6.2)**
Airway obstruction: RCT		
No data		
Airway obstruction: Observational studies		
Willman 2007 [70]	3/114	2.6 (0.9, 7.5)
Sub-total	**3/114**	**2.6 (0.9, 7.5)**
Total	**3/114**	**2.6 (0.9, 7.5)**
SaO_2 <90-92%: RCT		
Messenger 2007[5]	12/32	37.5 (22.9, 54.7)
Sub-total	**12/32**	**37.5 (22.9, 54.7)**
SaO_2 <90-92%: Observational studies		
Arora 2007[43]	0/10	0.0 (0.0, 21.3)
Willman 2007 [70]	3/114	2.6 (0.9, 7.5)
Sub-total	**3/124**	**2.4 (0.8, 6.9)**
Total	**15/156**	**9.6 (5.9, 15.3)**
Change $EtCO_2$>10: RCT		

Ketofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
Messenger 2007[5]	3/32	9.4 (3.2, 24.2)
Sub-total	**3/32**	**9.4 (3.2, 24.2)**
Change $EtCO_2$>10: Observational studies		
No data		
Total	**3/32**	**9.4 (3.2, 24.2)**
SAM required: RCT		
Messenger 2007[5]	8/32	25.0 (13.3, 42.1)
Sub-total	**8/32**	**25.0 (13.3, 42.1)**
SAM required: Observational studies		
Arora 2007[43]	0/10	0.0 (0.0, 21.3)
Willman 2007 [70]	6/114	5.3 (2.4, 11.0)
Sub-total	**6/124**	**4.8 (2.2, 10.2)**
Total	**14/156**	**9.0 (5.4, 14.5)**
Bradycardia: RCT		
No data		
Bradycardia: Observational studies		
Willman 2007[70]	0/114	0.0 (0.0, 2.3)
Sub-total	**0/114**	**0.0 (0.0, 2.3)**
Total	**0/114**	**0.0 (0.0, 2.3)**
Emesis: RCT		
Messenger 2007[5]	0/32	0.0 (0.0, 7.8)
Sub-total	**0/32**	**0.0 (0.0, 7.8)**
Emesis: Observational studies		
Arora 2007[43]	0/10	0.0 (0.0, 21.3)
Willman 2007[70]	0/114	0.0 (0.0, 2.3)
Sub-total	**0/124**	**0.0 (0.0, 2.1)**
Total	**0/156**	**0.0 (0.0, 1.7)**
Emergence phenomenon: RCT		
Messenger 2007[5]	0/32	0.0 (0.0, 7.8)
Sub-total	**0/32**	**0.0 (0.0, 7.8)**
Emergence phenomenon: Observational studies		
Arora 2007[43]	1/10	10.0 (1.8, 40.4)
Willman 2007[70]	3/114	2.6 (0.9, 7.5)
Sub-total	**4/124**	**3.2 (1.3, 8.0)**
Total	**4/156**	**2.6 (1.0, 6.4)**

Table 4: Propofol

Propofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
Hospitalized: RCT		
Coll-Vinent 2003[36]	0/9	0.0 (0.0, 23.1)
Holger 2005[37]	0/15	0.0 (0.0, 15.3)
Miner 2007[40]	0/80	0.0 (0.0, 3.3)
Miner 2007[15]	0/109	0.0 (0.0, 2.4)
Miner 2003[39]	0/51	0.0 (0.0, 5.0)
Taylor 2005[41]	0/48	0.0 (0.0, 5.3)
Sub-total	**0/343**	**0.0 (0.0, 0.8)**
Hospitalized: Observational studies		
Bigelow 2005[42]	0/12	0.0 (0.0, 18.4)
Bell 2007[32]	0/400	0.0 (0.0, 0.7)
Burton 2006[45]	0/792	0.0 (0.0, 0.3)
Charles 2005[30,33]	0/4500	0.0(0.0, 0.1)
Charles 2003[47]	0/200	0.0 (0.0, 1.3)
Cheng 2004[48]	0/47	0.0 (0.0, 5.4)
Dunn 2006[50]	0/11	0.0 (0.0, 19.7)
Dunn 2007[51]	1/32	3.1 (0.6, 15.7)
Engel 2007[52]	0/308	0.0 (0.0, 0.9)
Frank 2006[53]	0/50	0.0 (0.0, 5.1)
Frazee 2005[54]	0/136	0.0 (0.0, 2.0)
Miner 2005[62]	0/31	0.0 (0.0, 8.0)
Miner 2005[60]	0/74	0.0 (0.0, 3.5)
Peddle 2007[63]	5/47	10.6 (4.6, 22.6)
Reid 2004[64]	0/105	0.0 (0.0, 2.5)
Swanson 1996[67]	0/20	0.0 (0.0, 11.9)
Weaver 2007[69]	0/82	0.0 (0.0, 3.2)
Zed 2005[71]	0/113	0.0 (0.0, 2.3)
Sub-total	**6/6929**	**0.1 (0.0, 0.2)**
Total	**6/6929**	**0.1 (0.0, 0.2)**

Propofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
Total adverse events: RCT		
Coll-Vinent 2003[36]	7/9	77.8 (45.3, 93.7)
Holger 2005[37]	1/15	6.7 (1.2, 29.8)
Messenger 2779[5]	26/31	83.9 (67.4, 92.9)
Miner 2007[40]	11/80	13.8 (7.9, 23.0)
Miner 2007[15]	56/109	51.4 (42.1, 60.6)
Miner 2003[39]	13/51	25.5 (15.5, 38.9)
Taylor 2005[41]	11/48	22.9 (13.3, 36.5)
Sub-total	**125/343**	**36.4 (31.5, 41.7)**
Total adverse events: Observational studies		
Bigelow 2005[42]	3/12	25.0 (8.9, 53.2)
Bell 2007[32]	86/400	21.5 (17.8, 25.8)
Burton 2006[45]	75/792	9.5 (7.6, 11.7)
Charles 2005 [30,33]	275/4500	6.1(5.4, 6.8)
Charles 2003[47]	7/200	3.5 (1.7, 7.0)
Cheng 2004[48]	10/47	21.3 (12.0, 34.9)
Dunn 2006[50]	0/11	0.0 (0.0, 19.7)
Dunn 2007[51]	0/32	0.0 (0.0, 7.8)
Engel 2007[52]	6/314	1.9 (0.9, 4.1)
Frank 2006[53]	17/50	34.0 (22.4, 47.8)
Frazee 2005[54]	14/136	10.3 (6.2, 16.5)
Miner 2005[62]	27/31	87.1 (71.1, 94.9)
Miner 2005[60]	14/74	18.9 (11.6, 29.3)
Miner 2007[61]	40/75	53.3 (42.2, 64.2)
Peddle 2007[63]	7/47	14.9 (7.4, 27.7)
Reid 2004[64]	5/105	4.8 (2.1, 10.7)
Swanson 1996[67]	3/20	15.0 (5.2, 36.0)
Weaver 2007[69]	17/82	20.7 (13.4, 30.7)
Zed 2005[71]	10/113	8.8 (4.9, 15.5)
Sub-total	**616/7041**	**8.7 (8.1, 9.4)**
Total	**741/7384**	**10.0 (9.4, 10.7)**

Propofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
Hypotension: RCT		
Holger 2005[37]	0/15	0.0 (0.0, 15.3)
Messenger 2007[5]	3/31	9.7 (3.3, 24.9)
Miner 2007[15]	4/109	3.7 (1.4, 9.1)
Miner 2003[39]	0/51	0.0 (0.0, 5.0)
Taylor 2005[41]	0/48	0.0 (0.0, 5.3)
Sub-total	**7/254**	**2.8 (1.3, 5.6)**
Hypotension: Observational studies		
Bigelow 2005[42]	1/12	8.3 (1.5, 35.4)
Burton 2006[45]	28/792	3.5 (2.5, 5.1)
Charles 2005 [30,33]	140/4500	3.1 (2.6, 3.7)
Charles 2003[47]	4/200	2.0 (0.8, 5.0)
Dunn 2006[50]	1/11	9.1 (1.6, 37.7)
Dunn 2007[51]	0/32	0.0 (0.0, 7.8)
Engel 2007[52]	1/314	0.3 (0.1, 1.8
Frank 2006[53]	6/50	12.0 (5.6, 23.8)
Frazee 2005[54]	5/136	3.7 (1.6, 8.3)
Miner 2005[62]	8/31	25.8 (13.7, 43.2)
Miner 2005[60]	0/74	0.0 (0.0, 3.5)
Miner 2007[61]	0/75	0.0 (0.0, 3.5)
Peddle 2007[63]	1/47	2.1 (0.4, 11.1)
Reid 2004[64]	3/105	2.9 (1.0, 8.1)
Swanson 1996[67]	1/20	5.0 (0.9, 23.6)
Weaver 2007[69]	0/82	0.0 (0.0, 3.2)
Zed 2005[71]	9/113	8.0 (4.2, 14.4)
Sub-total	**208/6594**	**3.2 (2.8, 3.6)**
Total	**215/6848**	**3.1 (2.8, 3.6)**
Apnea: RCT		
Coll-Vinent 2003[36]	2/9	22.2 (6.3, 54.7)
Sub-total	**2/9**	**22.2 (6.3, 54.7)**
Apnea: Observational studies		
Bell 2007[32]	19/400	4.8 (3.1, 7.3)
Dunn 2006[50]	0/11	0.0 (0.0, 19.7)
Dunn 2007[51]	0/32	0.0 (0.0, 7.8)
Frank 2006[53]	2/50	4.0 (1.1, 13.5)
Frazee 2005[54]	5/136	3.7 (1.6, 8.3)
Peddle 2007[63]	4/47	8.5 (3.4, 19.9)
Reid 2004[64]	0/105	0.0 (0.0, 2.5)
Swanson 1996[67]	2/20	10.0 (2.8, 30.1)
Weaver 2007[69]	2/82	2.4 (0.7, 8.5)
Zed 2005[71]	0/113	0.0 (0.0, 2.3)
Sub-total	**34/996**	**3.4 (2.5, 4.7)**
Total	**36/1005**	**3.6 (2.6, 4.9)**

Propofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
SaO2 <90-92%: RCT		
Coll-Vinent 2003[36]	4/9	44.4 (18.9, 73.3)
Holger 2005[37]	0/15	0.0 (0.0, 15.3)
Messenger 2007[5]	24/31	77.4 (60.2, 88.6)
Miner 2007[40]	11/80	13.8 (7.9, 23.0)
Miner 2007[15]	10/109	9.2 (5.1, 16.1)
Taylor 2005[41]	4/48	8.3 (3.3, 19.6)
Sub-total	**53/292**	**18.2 (14.2, 23.0)**
SaO2 <90-92%: Observational studies		
Bell 2007[32]	11/400	2.8 (1.5, 4.9)
Burton 2006[45]	61/792	7.7 (6.0, 9.8)
Charles 2005 [30,33]	135/4500	3.0 (2.5, 3.5)
Charles 2003[47]	3/200	1.5 (05, 4.3)
Dunn 2007[51]	0/32	0.0 (0.0, 7.8)
Engel 2007[52]	5/314	1.6 (0.7, 3.7)
Frank 2006[53]	4/50	8.0 (3.2, 18.8)
Frazee 2005[54]	7/136	5.1 (2.5, 10.2)
Miner 2005[62]	2/31	6.5 (1.8, 20.7)
Miner 2005[60]	2/74	2.7 (0.7, 9.3)
Miner 2007[61]	5/75	6.7 (2.9, 14.7)
Reid 2004[64]	1/105	1.0 (0.2, 5.2)
Swanson 1996[67]	1/20	5.0 (0.9, 23.6)
Weaver 2007[69]	9/82	11.0 (5.9, 19.6)
Zed 2005[71]	1/113	0.9 (0.2, 4.8)
Sub-total	**247/6924**	**3.6 (3.2, 4.0)**
Total	**300/7216**	**4.2 (3.7, 4.6)**
Change in ETCO2 >10: RCT		
Messenger 2007[5]	4/31	12.9 (5.1, 28.9)
Miner 2007[15]	40/109	36.7 (28.2, 46.1)
Miner 2003[39]	25/51	49.0 (35.9, 62.3)
Sub-total	69/191	36.1(29.6, 43.1)
Change in ETCO2 >10: Observational studies		
Bell 2007[32]	4/400	1.0 (0.4, 2.5)
Frank 2006[53]	2/50	4.0 (1.1, 13.5)
Miner 2005[62]	19/31	61.3 (43.8, 76.3)
Miner 2005[60]	10/74	13.5 (7.5, 23.1)
Miner 2007[61]	35/75	46.7 (35.8, 57.8)
Weaver 2007[69]	0/82	0.0 (0.0, 3.2)
Sub-total	**70/712**	**9.8 (7.9, 12.2)**
Total	**139/903**	**15.4 (13.2, 17.9)**

Propofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
Bronchospasm/cough: RCT		
Coll-Vinent 2003[36]	1/9	11.1 (2.0, 43.5)
Sub-total	**1/9**	**11.1 (2.0, 43.5)**
Bronchospasm/cough: Observational studies		
Bell 2007[32]	1/400	0.3 (0.0, 1.4)
Sub-total	**1/400**	**0.3 (0.0, 1.4)**
Total	**1/409**	**0.5 (0.1, 1.8)**
Airway obstruction: RCT		
Taylor 2005[41]	6/48	12.5 (5.9, 24.7)
Sub-total	**6/48**	**12.5 (5.9, 24.7)**
Airway obstruction: Observational studies		
Charles 2005 [30,33]	0/4500	0.0 (0.0, 0.1)
Weaver 2007[69]	7/82	8.5 (4.2, 16.6)
Sub-total	**7/4582**	**0.2 (0.1, 0.3)**
Total	**13/4630**	**0.3 (0.2, 0.5)**
Respiratory depression: RCT		
Miner 2003[39]	25/51	49.0 (35.9, 62.3)
Miner 2007[15]	46/109	42.2 (33.4, 51.6)
Taylor 2005[41]	11/48	22.9 (13.3, 36.5)
Sub-total	**82/208**	**39.4(33.0, 46.2)**
Respiratory depression: Observational studies		
Bigelow 2005[42]	2/12	16.7(4.7, 44.8)
Bell 2007[32]	86/400	21.5 (17.8, 25.8)
Dunn 2006[50]	0/11	0.0 (0.0, 19.7)
Miner 2005[62]	19/31	61.3 (43.8, 76.3)
Frank 2006[53]	8/50	16.0 (8.3, 28.5)
Miner 2007[61]	37/75	49.3 (38.3, 60.4)
Sub-total	**152/579**	**26.3(22.8, 30.0)**
Total	**234/787**	**29.7(26.6, 33.0)**

Propofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
SAM required: RCT		
Coll-Vinent 2003[36]	6/9	66.7 (35.4, 87.9)
Messenger 2007[5]	24/31	77.4 (60.2, 88.6)
Miner 2007[40]	19/80	23.8 (15.8, 34.1)
Miner 2007[15]	30/109	27.5 (20.0, 36.6)
Miner 2003[39]	30/51	58.8 (45.2, 71.2)
Taylor 2005[41]	11/48	22.9 (13.3, 36.5)
Sub-total	**120/328**	**36.6 (31.6, 41.9)**
SAM required: Observational studies		
Bell 2007[32]	123/400	30.8 (26.4, 35.4)
Burton 2006[45]	33/792	4.2 (3.0, 5.8)
Charles 2005 [30,33]	27/4500	0.6(0.4, 0.9)
Charles 2003[47]	0/200	0.0 (0.0, 1.3)
Dunn 2006[50]	0/11	0.0 (0.0, 19.7)
Engel 2007[52]	5/314	1.6 (0.7, 3.7)
Frank 2006[53]	4/50	8.0 (3.2, 18.8)
Frazee 2005[54]	8/136	5.9 (3.0, 11.2)
Green 2005[55]	0/26	0.0 (0.0, 9.4)
Miner 2005[62]	1/31	3.2 (0.6, 16.2)
Miner 2005[60]	0/74	0.0 (0.0, 3.5)
Miner 2007[61]	3/75	4.0 (1.4, 11.1)
Weaver 2007[69]	10/82	12.2 (6.8, 21.0)
Zed 2007[71]	1/113	0.9 (0.2, 4.8)
Sub-total	**215/6804**	**3.2 (2.8, 3.6)**
Total	**335/7132**	**4.7 (4.2, 5.2)**
Bradycardia: RCT		
Holger 2005[37]	0/15	0.0 (0.0, 15.3)
Sub-total	**0/15**	**0.0 (0.0, 15.3)**
Bradycardia: Observational studies		
Burton 2006[45]	3/792	0.4 (0.1, 1.1)
Sub-total	**3/792**	**0.4 (0.1, 1.1)**
Total	**3/807**	**0.4 (0.1, 1.1)**

Propofol Author Year	Proportion with event n/N	Absolute risk (95%CI)
Emesis: RCT		
Holger 2005[37]	1/15	6.7 (1.2, 29.8)
Messenger 2007[5]	0/31	0.0 (0.0, 8.0)
Miner 2003[39]	0/51	0.0 (0.0, 5.0)
Taylor 2005[41]	1/48	2.1 (0.4,10.9)
Sub-total	**2/145**	**1.4 (0.4, 4.9)**
Emesis: Observational studies		
Bell 2007[32]	2/400	0.5 (0.1, 1.8)
Burton 2006[45]	1/792	0.1 (0.0, 0.7)
Frazee 2005[54]	1/136	0.7 (0.1, 4.0)
Miner 2005[62]	0/31	0.0 (0.0, 8.0)
Miner 2005 [60]	0/74	0.0 (0.0, 3.5)
Miner 2007[61]	0/75	0.0 (0.0, 3.5)
Peddle 2007[63]	1/47	2.1 (0.4, 11.1)
Swanson 1996[67]	0/20	0.0 (0.0, 11.9)
Zed 2005[71]	1/113	0.9 (0.2, 4.8)
Sub-total	**6/1688**	**0.4 (0.2, 0.8)**
Total	**8/1833**	**0.4 (0.2, 0.9)**
Myoclonus: RCT		
Coll-Vinent 2003[36]	0/9	0.0 (0.0, 23.1)
Miner 2007[15]	2/109	1.8 (0.5, 6.4)
Sub-total	**2/118**	**1.7 (0.5, 6.0)**
Myoclonus: Observational studies		
No data		
Total	**2/118**	**1.7 (0.5, 6.0)**
Emergence phenomenon: RCT		
Messenger 2007[5]	0/31	0.0 (0.0, 8.0)
Sub-total	**0/31**	**0.0 (0.0, 8.0)**
Emergence phenomenon: Observational studies		
Frank 2006[53]	2/50	4.0 (1.1, 13.5)
Green 2005[55]	2/26	7.7 (2.1, 24.1)
Subtotal	**4/50**	**8.0 (3.2, 18.8)**
Total	4/81	**5.0 (1.9, 12.0)**

Table 5: Standard care

Standard Care Author Year	Proportion with event n/N	Absolute risk (95%CI)
Hospitalized: RCT		
Burton 2002[35]	0/22	0.0 (0.0, 11.0)
Coll-Vinent 2003[36]	0/14	0.0 (0.0, 16.2)
Holger 2005[37]	0/17	0.0 (0.0, 13.7)
Hunt 2005[38]	3/21	14.3 (5.0, 34.6)
Taylor 2005[41]	0/38	0.0 (0.0, 6.6)
Sub-total	**3/112**	**2.7 (0.9, 7.6)**
Hospitalized: Observational studies		
Bigelow 2005[42]	0/12	0.0 (0.0, 18.4)
Dunn 2007[51]	0/16	0.0 (0.0, 14.5)
Peddle 2007[63]	1/7	14.3 (2.6, 51.3)
Sub-total	**1/35**	**2.9 (0.5, 14.5)**
Total	**4/147**	**2.7 (1.1, 6.8)**
Total Adverse Events: RCT		
Burton 2002[35]	4/22	18.2 (7.3, 38.5)
Coll-Vinent 2003[36]	9/14	64.3 (38.8, 83.7)
Holger 2005[37]	1/17	5.9 (1.0, 27.0)
Hunt 2005[38]	5/21	23.8 (10.6, 45.1)
Taylor 2005[41]	7/38	18.4 (9.2, 33.4)
Sub-total	**26/112**	**23.2 (16.4, 31.8)**
Total Adverse Events: Observational studies		
Bigelow 2005[42]	0/12	0.0 (0.0, 18.4)
Burton 2001[44]	2/26	7.7 (2.1, 24.1)
Dunn 2007[51]	0/16	0.0 (0.0, 14.5)
Peddle 2007[63]	2/7	28.6 (8.2, 64.1)
Sub-total	**4/61**	**6.6 (2.6, 15.7)**
Total	**30/173**	**17.3 (12.4, 23.7)**
Hypotension: RCT		
Burton 2002[35]	0/22	0.0 (0.0, 11.0)
Holger 2005[37]	0/17	0.0 (0.0, 13.7)
Hunt 2005[38]	1/21	4.8 (0.8, 22.7)
Taylor 2005[41]	1/38	2.6 (0.5, 13.5)
Sub-total	**2/98**	**2.0 (0.6, 7.1)**
Hypotension: Observational studies		
Bigelow 2005[42]	0/12	0.0 (0.0, 18.4)
Dunn 2007[51]	0/16	0.0 (0.0, 14.5)
Peddle 2007[63]	1/7	14.3 (2.6, 51.3)
Sub-total	**1/35**	**2.9 (0.5, 14.5)**
Total	**3/133**	**2.3 (0.8, 6.4)**

Standard Care Author Year	Proportion with event n/N	Absolute risk (95%CI)
Apnea: RCT		
Burton 2002[35]	1/22	4.5 (0.8, 21.8)
Coll-Vinent 2003[36]	4/14	28.6 (11.7, 54.6)
Hunt 2005[38]	1/21	4.8 (0.8, 22.7)
Sub-total	**6/57**	**10.5 (4.9, 21.1)**
Apnea: Observational studies		
Burton 2001[44]	1/26	3.8 (0.7, 18.9)
Dunn 2007[51]	0/16	0.0 (0.0, 14.5)
Peddle 2007[63]	0/7	0.0 (0.0, 27.9)
Sub-total	**1/49**	**2.0 (0.4, 10.7)**
Total	**7/106**	**6.6 (3.2, 13.0)**
SaO_2 < 90-92%: RCT		
Burton 2002[35]	3/22	13.6 (4.7, 33.3)
Coll-Vinent 2003[36]	2/14	14.3 (4.0, 39.9)
Holger 2005[37]	0/17	0.0 (0.0, 13.7)
Hunt 2005[38]	5/21	23.8 (10.6, 45.1)
Taylor 2005[41]	2/38	5.3 (1.5, 17.3)
Sub-total	**12/112**	**10.7 (6.2, 17.8)**
SaO_2 < 90-92%: Observational studies		
Dunn 2007[51]	0/16	0.0 (0.0, 14.5)
Sub-total	**0/16**	**0.0 (0.0, 14.5)**
Total	**12/128**	**9.4 (5.4, 15.7)**
Bronchospasm-Cough: RCT		
Coll-Vinent 2003[36]	0/14	0.0 (0.0, 16.2)
Sub-total	**0/14**	**0.0 (0.0, 16.2)**
Bronchospasm-Cough: Observational studies		
No data		
Total	**0/14**	**0.0 (0.0, 16.2)**
Airway obstruction: RCT		
Taylor 2005[41]	5/38	13.2 (5.8, 27.3)
Sub-total	**5/38**	**13.2 (5.8, 27.3)**
Airway obstruction: Observational studies		
No data		
Total	**5/38**	**13.2 (5.8, 27.3)**
Respiratory Depression: RCT		
Burton 2002[35]	3/22	13.6 (4.7, 33.3)
Taylor 2005[41]	6/38	15.8 (7.4, 30.4)
Sub-total	**9/60**	**15.0 (8.1, 26.1)**
Respiratory Depression: Observational studies		
Bigelow 2005[42]	0/12	0.0 (0.0, 18.4)
Sub-total	**0/12**	**0.0 (0.0, 18.4)**
Total	**9/72**	**12.5 (6.7, 22.1)**

Standard Care Author Year	Proportion with event n/N	Absolute risk (95%CI)
SAM required: RCT		
Burton 2002[35]	1/22	4.5 (0.8, 21.8)
Coll-Vinent 2003[36]	6/14	42.9 (21.4, 67.4)
Hunt 2005[38]	1/21	4.8 (0.8, 22.7)
Taylor 2005[41]	6/38	15.8 (7.4, 30.4)
Sub-total	**14/95**	**14.7 (9.0, 23.2)**
SAM required: Observational studies		
Burton 2001[44]	1/26	3.8 (0.7, 18.9)
Sub-total	**1/26**	**3.8 (0.7, 18.9)**
Total	**15/121**	**12.4 (7.7, 19.4)**
Bradycardia: RCT		
Burton 2002[35]	0/22	0.0 (0.0, 11.0)
Holger 2005[37]	0/17	0.0 (0.0, 13.7)
Sub-total	**0/39**	**0.0 (0.0, 6.5)**
Bradycardia: Observational studies		
No data		
Total	**0/39**	**0.0 (0.0, 6.5)**
Emesis: RCT		
Burton 2002[35]	0/22	0.0 (0.0, 11.0)
Holger 2005[37]	1/17	5.9 (1.0, 27.0)
Taylor 2005[41]	0/38	0.0 (0.0, 6.6)
Sub-total	**1/77**	**1.3 (0.2, 7.0)**
Emesis: Observational studies		
Burton 2001[44]	1/26	3.8 (0.7, 18.9)
Peddle 2007[63]	1/7	14.3 (2.6, 51.3)
Sub-total	**2/33**	**6.1 (1.7, 19.6)**
Total	**3/110**	**2.7 (0.9, 7.7)**
Myoclonus: RCT		
Burton 2002[35]	0/22	0.0 (0.0, 11.0)
Coll-Vinent 2003[36]	0/14	0.0 (0.0, 16.2)
Hunt 2005[38]	0/21	0.0 (0.0, 11.4)
Sub-total	**0/57**	**0.0 (0.0, 4.5)**
Myoclonus: Observational studies		
Burton 2001[44]	0/26	0.0 (0.0, 9.4)
Sub-total	0/26	0.0 (0.0, 9.4)
Total	**0/83**	**0.0 (0.0, 3.2)**
Emergence phenomenon: RCT		
Hunt 2005[38]	0/21	0.0 (0.0, 11.4)
Sub-total	**0/21**	**0.0 (0.0, 11.4)**
Emergence phenomenon: Observational studies		
No data		
Total	**0/21**	**0.0 (0.0, 11.4)**

Table 6: All PSA

All PSA Author Year	Proportion with event n/N	Absolute risk (95%CI)
Hospitalized: RCT		
No data		
Hospitalized: Observational studies		
Campbell 2007[72]	1/1334	0.1 (0.0, 0.4)
Hogan 2006[31,34]	0/980	0.0 (0.0, 0.3)
Manoocha 2003[59]	0/763	0.0 (0.0, 0.4)
Sub-total	**1/3077**	**0.0 (0.0, 0.2)**
Total	**1/3077**	**0.0 (0.0, 0.2)**
Total Adverse Events: RCT		
No data		
Total Adverse Events: Observational studies		
Campbell 2007[72]	12/1334	0.9 (0.5, 1.6)
Hogan 2006[31,34]	42/1028	4.1 (3.0, 5.5)
Mace 2006[58]	79/640	12.3 (10.0, 15.1)
Manoocha 2003[59]	81/763	10.6 (8.6, 13.0)
Mensour 2006[12]	29/160	18.1 (12.9, 24.8)
Swann 2007[66]	2/125	1.6 (0.4, 5.6)
Sub-total	**245/4050**	**6.0 (5.4, 6.8)**
Total	**245/4050**	**6.0 (5.4, 6.8)**
Hypotension: RCT		
No data		
Hypotension: Observational studies		
Campbell 2007[72]	8/1334	0.6 (0.3, 1.2)
Hogan 2006[31,34]	3/1028	0.3 (0.1, 0.9)
Manoocha 2003[59]	22/763	2.9 (1.9, 4.3)
Mensour 2006[12]	2/160	1.3 (0.3, 4.4)
Swann 2007[66]	1/125	0.8 (0.1, 4.4)
Sub-total	**36/3410**	**1.1 (0.8, 1.5)**
Total	**36/3410**	**1.1 (0.8, 1.5)**
Apnea: RCT		
No data		
Apnea: Observational studies		
Hogan 2006[31,34]	11/1028	1.1 (0.6, 1.9)
Mensour 2006[12]	16/160	10.0 (6.2, 15.6)
Sub-total	**27/1188**	**2.3 (1.6, 3.3)**
Total	**27/1188**	**2.3 (1.6, 3.3)**

All PSA Author Year	Proportion with event n/N	Absolute risk (95%CI)
SaO_2 < 90-92%: RCT		
No data		
SaO_2 < 90-92%: Observational studies		
Campbell 2007[72]	11/1334	0.8 (0.5, 1.5)
Duncan 2006	1/101	1.0 (0.2, 5.4)
Hogan 2006[31,34]	26/1028	2.5(1.7, 3.7)
Manoocha 2003[59]	27/763	3.5 (2.4, 5.1)
Mensour 2006[12]	2/160	1.3 (0.3, 4.4)
Swann 2007[66]	0/125	0.0 (0.0, 2.1)
Sub-total	**67/3511**	**1.9 (1.5, 2.4)**
Total	**67/3511**	**1.9 (1.5, 2.4)**
Airway obstruction: RCT		
No data		
Airway obstruction: Observational studies		
Hogan 2006[31,34]	1/1028	0.1 (0.0, 0.5)
Mensour 2006[12]	16/160	10.0 (6.2, 15.6)
Sub-total	**27/1188**	**2.3 (1.6, 3.3)**
Total	**27/1188**	**2.3 (1.6, 3.3)**
SAM required: RCT		
No data		
SAM required: Observational studies		
Campbell 2007[72]	1/1334	0.1 (0.0, 0.4)
Hogan 2007[31,34]	11/1028	1.1 (0.6, 1.9)
Mensour 2006[12]	38/160	23.8 (17.8, 30.9)
Swann 2007[66]	0/125	0.0 (0.0, 2.1)
Sub-total	**50/2647**	**1.9 (1.4, 2.5)**
Total	**50/2647**	**1.9 (1.4, 2.5)**
Bradycardia: RCT		
No data		
Bradycardia: Observational studies		
Manoocha 2003[59]	12/763	1.6 (0.0, 2.7)
Mensour 2006[12]	3/160	1.9 (0.6, 5.4)
Sub-total	**15/923**	**1.6 (1.0, 2.7)**
Total	**15/923**	**1.6 (1.0, 2.7)**
Emesis: RCT		
No data		
Emesis: Observational studies		
Mensour 2006[12]	0/160	0.0 (0.0, 1.0)
Sub-total	**0/160**	**0.0 (0.0, 1.0)**
Total	**0/160**	**0.0 (0.0, 1.0)**

All PSA Author Year	Proportion with event n/N	Absolute risk (95%CI)
Emergence phenomenon: RCT		
No data		
Emergence phenomenon: Observational studies		
Hogan 2006[31,34]	1/1028	0.1 (0.0, 0.5)
Swann 2007[66]	1/125	0.8 (0.1, 4.4)
Sub-total	**2/1153**	**0.2 (0.0, 0.6)**
Total	**2/1153**	**0.2 (0.0, 0.6)**

APPENDIX 12: BARRIERS TO THE USE OF SHORT-ACTING AGENTS FOR ED PSA

OBJECTIVE
To identify barriers to use of short-acting and dissociative agents (e.g., etomidate, ketamine, propofol) for adult patients who present to Canadian EDs requiring brief painful procedures.

METHODS

Literature search strategy

The search for literature to identify barriers or issues that affected PSA use began by identifying Canadian or international guidelines pertaining to PSA in the ED. The most relevant sources were the Canadian Association of Emergency Physicians (CAEP), the American College of Emergency Physicians (ACEP), the Australasian Association of Emergency Medicine (AAEM), the British Association of Emergency Medicine (BAEM), the National Emergency Nurses Affiliation (NENA), the Canadian Anesthesiologists' Society (CAS), and the American Society of Anesthesiologists (ASA).

Online databases of clinical practice guidelines were also searched - Canadian Medical Association CPG Infobase, National Guidelines Clearinghouse, National Library of Guidelines (UK and International), National Health, and Medical Research Council Clinical Practice Guidelines (Australia). Search results were downloaded to a Reference Manager™ bibliographic database version 11 (ISI ResearchSoft, 2003).

Literature selection

The search strategy and screening methods used were the same as those described for the Efficacy Review (section 4 of the main report). Briefly, two reviewers independently used predetermined inclusion and exclusion criteria to identify reports of barriers to use. To be included, a guideline or article must meet all of the eligibility criteria. Disagreements were resolved by consensus.

Quality assessment

In addition to refereed Association guidelines, which had already met rigorous methodological standards, the electronic searches contained terms to capture commentaries, editorials, opinion papers and subjective reviews of PSA use in the ED. Because of the particular nature of this range of literature and the data being sought, no methodological assessments were performed.

Data extraction and analysis

Data on potential barriers to PSA use was extracted by one reviewer (CS) into an Excel™ spreadsheet (Microsoft Corp. 2003), classified and then verified by an Emergency Medicine

researcher (BHR). The term “barrier” was not found in the literature, but several issues or difficulties were reported that the reviewers considered to be barriers. The barriers were categorized first, dependant on whether they pertained to a specific drug or to PSA in general. Second, they were sorted by themes to capture the primary source of the issue (e.g., turf/anesthesiologist role, human resource/staffing, skills/training, etc.). Potential barriers were extracted verbatim from the guidelines and other literature and given a general categorical title reflecting the main issue affecting PSA use or not (e.g., lack of evidence, training, resources, etc.), followed by the recommendations or conclusions reached. Finally, the reviewers tried to identify who or what level of authority would have a responsibility to manage the issue (individual doctor, department, institution, government or professional association). The categories, themes, and levels were developed by the research team and vetted by the technical expert panel. All decisions were made independently by two reviewers and disagreements discussed.

Results

The 19 articles identified cover a range of evidence including editorials, clinical practice guidelines, reviews, and individual studies. The potential barriers and issues regarding PSA use fell into nine themes (themes were not mutually exclusive) that were developed iteratively by the HTA team: (1) adverse events, (2) billing (compensation, insurance), (3) costs (drug, hospital admission costs), (4) human resources/staffing, (5) legal issues, (6) practicality/pragmatic considerations, (7) skills/training, (8) turf/anesthesiologist role, and (9) other. Skill training was the most frequent theme of concern, followed closely by adverse events. Human resources and staffing was shared equally by a miscellaneous group of “other” themes, including concerns regarding the lack of universal definitions of adverse events and procedural success, and the use of sedation scales. Concerns about turf boundaries, legal issues, and costs were rarely reported and no concerns were found regarding billing.

Issues and Barriers (Table 1)

Barriers identified that might prevent the widespread use of PSA and specifically the short-acting agents included concerns about the risk and management of adverse events, qualifications and training of staff requirements (need for or availability of specialists), , the proper evaluation of patients prior to sedation, lack of appropriate protocols and clinical guidelines, and lack of equipment. “Lack of evidence” surrounding some aspect of PSA was the most common barrier, be it concerning the use of an particular agent, dosing, adverse events, or the adequate number of attending staff. Finally, the lack of uniform definitions of adverse events and what are a clinically significantly events were reported as a potential barriers and a challenge to PSA research identified by this review.

Drugs (Table 2)

The barriers predominantly concerned “PSA in general” (approximately 78% of issues). Concerns about particular drugs were relatively few and were shared almost equally by etomidate, ketamine, and propofol (7%-9% of issues each).

Responsibility (Table 3)

The responsibility to address and resolve the specific concerns expressed in the papers were broadly categorized as being the domain of the "individual doctor", "department", "institution", "government", and/or "professional association". Since individual doctors work within the rules and regulations of their emergency departments and institutions often have influence over these policies, it is not surprising that all three play an almost equal role in resolving many of the perceived barriers. Professional associations play a lesser role, albeit more than governments. This broad distribution of responsibility reflects the fact that the resolution of issues such as training and certification, determining the ideal number of PSA staff present, and the specific level and frequency of patient monitoring are often the result of collaborative efforts among emergency physicians, their group governance, institutional consultants, and the institutional approval processes. None of these levels of responsibility works in isolation because the way in which evidence on particular practices is transmitted and taken up by individual clinicians, disseminated in guidelines, and institutionalized in protocols necessitates shared accountability.

The role of the professional associations as outlined by this categorization appears to be to develop scope of practice, clinical guidelines and protocols for the professional group. Government responsibility is primarily to determine what drugs will be made available to the emergency physician (e.g., etomidate is currently only available through Health Canada's Special Access Program). However, once the government has made this decision, it is still up to the institution and department to decide what drugs will be available and what restrictions will be placed on their use.

Limitations

The appropriateness of the categorization of the domains was not formally assessed, apart from agreement within the project TEP; however, the descriptors have some face validity and are based on significant clinical and administrative experience. In addition, some barriers (e.g., disagreements between emergency nurses and anesthesiologists regarding their respective roles), are currently not a part of the Canadian context. At least one hospital in Canada, however, is currently allowing paramedics to perform PSA,[72] reflecting the constantly changing pressures and needs of emergency care facilities. It was difficult to identify a *primary* barrier for each issue, as the list was not mutually exclusive. Finally, the ultimate decisions were based on independent assessment and reaching consensus; no formal reliability assessment was performed.

Table 1: Summary of results of barriers to PSA use with short-acting agents

Theme	No. of times theme mentioned	Example issue(s)	Example barrier(s)
Skills/training	19	Pre-sedation patient preparation and assessment	Lack of evidence on the relationship between PSA outcomes and specific pre-procedural history and assessment (e.g. essential lab work, co-morbidity) ED physician must be knowledgeable and experienced with agents being used. Lack of evidence to support evaluation beyond vital signs, mental status, and cardio-respiratory assessment.
		PSA underutilized	Old paradigms: in general, pain is still inadequately addressed by health-care workers.
Adverse events	16	Safety concerns: No uniform definition of adverse events caused by PSA	Lack of clarity on what is a clinically significant adverse event. There are no evidence-based fasting guidelines, but also no evidence that recent oral intake has any relationship to outcomes of PSA
		Misperception of risks	Old paradigms: ignoring existing evidence of safety.
Human resources/staffing	11	Personnel requirements: Qualifications	Lack of evidence on number of qualified personnel necessary to safely provide PSA.
		Monitoring	No clear evidence on what physiological monitoring is necessary or for how long.
Other	11	Few PSA drug-specific guidelines	Lack of guidelines to address specifics of each PSA agent – most involve general principles.
		PSA guidelines not implemented	The PSA guidelines that are available are not being universally implemented by professional organizations or institutions.
		Definition of procedural success	There is no standard definition of success encompassing pain, recall, lack of adverse events, or completion of procedure.
Turf/anesthesiologist role	7	Scope of practice and hospital privileges	Safety concerns: Availability of specialist backup. Old paradigms: ED physicians limited by opposition from other disciplines.
Practicality/pragmatic considerations	6	How to assess respiratory status	Pulse oximetry and capnometry useful but not a substitute for clinical assessment during PSA.
		Subset of patients are high risk	Patient condition may influence decision to not perform PSA in the ED.

Theme	No. of times theme mentioned	Example issue(s)	Example barrier(s)
Costs (drug, hosptial admission costs)	6	Equipment and supplies required	Hospital size and budget: Each ED permitting PSA must have appropriate, readily available drugs and equipment to monitor the patient during PSA and to manage cardio-respiratory events, allergic reactions, and over sedation.
Legal issues	3	Discharge criteria	Lack of standardized discharge criteria and follow-up instructions.
Billing (compensation, insurance)	0	No issues	No barriers identified.

Table 2: Frequency of Themes per PSA agent

Agent	Frequency of themes	Main barrier sited
PSA in general	61	No ideal agent available, ED physicians must choose from or combine agents with diverse properties
PSA specific agent	17	
Etomidate	5	Few specific guidelines for etomidate Risk of myoclonus, adrenal suppression
Ketamine	7	Few studies in adults Risk of emergence reactions (sympathomimetic effects)
Ketofol	1	Pre-assess patient carefully
Propofol	4	Pre-assess patient carefully Lack of data but safety evidence is accumulating

Table 3: Responsibilities

Individual doctor	Department	Institution	Government	Professional association
65	66	65	5	29

APPENDIX 13: ECONOMIC MODEL SUB-STUDY—ASSUMPTIONS QUESTIONNAIRE

Introduction

The use of rapid-acting, effective and safe pharmacological agents for procedural sedation and analgesia (PSA) is an important management advance in many Canadian Emergency Departments (ED). In completing the Canadian Agency for Drugs and Technologies in Health (CADTH) PSA health technology assessment (HTA), certain assumptions were proposed for the health economic component of the report. This brief study was designed to test the validity of these assumptions among practicing clinicians.

Methods

Survey Site

The University of Alberta Hospital (UAH) ED is a full-service department staffed 24 hours a day, every day of the year, with full time certified emergency physicians. The total volume for the last fiscal year (2007) was 73,000 patients and the site operates as a trauma, orthopedic, transplant, critical care, cardiology and burn centre.

Survey Sample

The PSA PI approached clinicians working in the UAH ED during the period December 2007-January 2008 based on clinical shift availability. Physicians were unaware of the CADTH project at the time of survey response.

Questionnaire

The physicians were asked to respond to the following questions:

Do the side effects of agents used in PSA lead to hospitalization?

Do PSA agents or the severity of the presenting problem lead to hospital admission?

Do the side effects of agents used in PSA vary based on the success or failure of the procedures (assuming the same duration of the two procedures)?

Have you ever admitted someone due to side effects of the newer PSA agents?

Statistics

Simple descriptive statistics are provided.

Results

Sample

All physicians (100%) who were approached (n = 25) agreed to answer the brief in-person survey. The respondents represent a spectrum of experience, ages, and training levels. The group consisted of 5 (20%) females and 20 (80%) males, ranging in ED experience from 1 year to 30 years. All work at least part time in an adult ED that services adult patients with injury and trauma.

Questionnaire: See results below.

Do the side effects of agents used in PSA lead to hospitalization?	
Numbers	**Responses**
n = 25	***No***
Do PSA agents or the severity of the presenting problem lead to hospital admission?	
Numbers	**Responses**
n =25	***Severity of disease***
n = 0	***PSA Agents***
Do the side effects of agents used in PSA vary based on the success or failure of the procedures (assuming the same duration of the two procedures)?	
Numbers	**Responses**
n =25	***No***
Have you ever admitted someone due to side effects of the newer PSA agents?	
Numbers	**Responses**
n =23	***No***
n = 2 (Two isolated cases were the result of non-ED physicians providing PSA in the ED.)	***Yes***

Comments	
Some patients in whom the procedure fails require more medications, and even then, the complications/SEs are not a problem.	***n = 3***
Operator experience is associated with S/Es – with more training and experience, MDs use safer dosing approaches/take more time.	***n = 2***
The underlying co-morbidities predict S/Es, therefore, it is critically important to select ***only*** ASA Class I and II patients.	***n =2***
Degree of sedation is not similar across all patient groups; it varies with each patient.	***n =1***
If we compare the newer PSA agents with old approach (versed and fentanyl), the frequency of S/Es ***did*** vary based on the drugs.	***n =1***
Remember, these are not "elective" procedures (*"everyone has just finished a beer and a hoagie"*) so the low complication rate is incredibly reassuring	***n =1***

Discussion

Overall, clinical emergency physicians working at a large, academic, tertiary-care ED in a western Canadian urban centre where PSA with propofol is a routine procedure, believe that side effects of PSA agents are predictable and transient. Moreover, the side effects are dictated by patient pre-existing co-morbidities (ASA classification). Most ED physicians (23/25; 92%) had not encountered complications associated with any PSA agent(s) that resulted in hospitalization. The two who had, however, both recalled that the PSA was administered by a non-ED physician unfamiliar with the techniques of PSA.

An important qualitative feature of this survey was the consistent declaration that the patient's co-morbid condition (e.g., ASA class) was the most important factor associated with side effects. Universally, all emergency physicians believed that the severity of the presenting disease dictated the need for hospitalization, not the PSA agent used or side effects associated with the medication. For example, a fracture-dislocation of the ankle can be reduced successfully with PSA without complications; however, the patient will still require hospitalization for stabilization of the fracture (severity of presenting disease).

In addition, these physicians believe that PSA agents rarely (if ever) lead to side effects and never to hospitalization when performed by a qualified physician experienced with PSA drug delivery. This belief is not influenced by the success or failure of the procedure. For example, all (100%) surveyed physicians believed that the failure of the procedure did not increase the side effects associated with the PSA agents used.

Limitations

This is a single-site survey using a convenience sample; however, we have confidence that these results would be reproduced elsewhere in sites with experience using PSA and rapid-acting, effective and safe PSA agents. Moreover, the 100% completion (no refusals) and consistent responses suggest a degree of unanimity that is hard to find in clinical medicine.

Conclusions

This survey of emergency physicians in clinical practice suggests that side effects of PSA agents are predictable and transient, are related to the underlying condition (ASA classification) and hospitalization after PSA drug delivery is universally associated with the underlying condition and not side effects from the medications.

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APPENDIX 14: UNIVERSITY OF ALBERTA HOSPITAL TIME-IN-MOTION STUDY OF ED PSA

Objectives

A time study was conducted in the University of Alberta Hospital Emergency Department (ED) to collect more detailed data on the resources used in the treatment of fractures, dislocations, and cardioversion.The purpose of this study was to determine the time and costs associated with the administration of fast-acting PSA to patients in the ED.

Methods

Survey site: The University of Alberta Hospital (UAH) ED is a full-service department staffed 24 hours a day, every day of the year, with full time certified emergency physicians. The total volume for the last fiscal year (2007) was 73,000 patients and the site operates as a trauma, orthopedic, transplant, critical care, cardiology and burn centre.

Sample

A convenience sample of patients admitted the the UAH ED for procedural sedation for fracture and dislocation reduction or cardioversion between July and December 2007.

Data collection

A paging-system was used to alert a research assistant (RA) when a patient requiring PSA was admitted to the ED. Oral consent was obtained from both the patient and the attending staff, prior to the RA entering the treatment area. In addition, all participants were offered an information sheet detailing the rationale and scope of the study. If any difficulties or objections were by either the attending staff or patient at anytime during a procedure, the “time-in-motion” record will be terminated.
RAs remained present for the duration of the procedure and used stop-watches to record the time investment of the respiratory therapist, orthopedics technician, physicians, and nursing staff attending the patient. A standardized data collection form was used to record data (see form below). The type of injury or medical condition requiring PSA was documented, and was restricted to bone fractures, major joint dislocation, or cardioversion. The dosage of PSA drugs administered, the occurrence of adverse events, and the length of the patient’s ED stay were also recorded.

No personal information of the patients or staff was recorded, and RAs were instructed as to the confidential nature of the procedures observed.

Patients for whom PSA care times were collected were presumed to be in otherwise good health. It was presumed that higher risk patients (those with potentially complicating comorbidities) would not undergo PSA in the ED. Typically, such patients would be referred to an anaesthesiologist or other specialist(s) as required, rather than undergoing PSA in the ED.

Statistics

Staff involvement and time investments were summarized as means and standard deviation or means and interquartile ranges, when appropriate.

Ethics

The study was approved by the University of Alberta Health Research Ethics Board.

Results

Table 1: Patients involved in the procedural sedation study at the University of Alberta Hospital (n=41)

Variables	Number (%), Mean (± SD), or Median (IQR)
Demographics	
Age (years)	55.4 (± 20.3)
Female sex	24 (58.5)
Causes of attention/procedures	
Dislocation	15 (36.6)
DC Cardioversion	14 (34.1)
Fractures	12 (29.3
ASA classification $_{(n=33)}$	
I	11 (33.3)
II	19 (57.5)
III	3 (9.0)
Medication	
Propofol or Propofol + fentanyl	38 (92.6)
Ketamine alone	1 (2.9)
Ketafol	1 (2.9)
Fentanyl + Midazolam	1 (2.9)
Outcomes	
Successful procedures	24/30 (80)
Adverse events	9/40 (22.5)
Timing	
Procedure physician time (n= 41; min)	14.5 (± 5.5)
Sedation physician time (n= 41; min)	16.9 (± 5.9)
Nursing time (n = 22; min)	14.2 (± 6.9)
Respiratory therapist time (n= 34; min)	18.3 (± 5.7)
Orthopedic technician time (n= 18; min)	13.3 (± 6.1)
Time triage - start meds (hours)	3.1 (1.9, 4.6)
Admitted (n=18, hours)	2.9 (1.7, 3.9)
Discharged (n=23, hours)	3.2 (2.0, 4.7)
Time start meds – start procedure (min)	4.5 (± 2.5)
Time involving procedure and end monitoring (min)	11.0 (± 4.5)
Time start meds - end monitoring (min)	15.5 (± 4.6)
Time end monitoring - Discharge (hours)	3.4 (1.9, 5.5)
Admitted (n=18, hours)	5.1 (3.9, 5.8)
Discharged (n=23, hours)	2.0 (1.7, 3.4)

Table 1: Patients involved in the procedural sedation study at the University of Alberta Hospital (n=41) (continued)

Variables	Number (%), Mean (± SD), or Median (IQR)
Timing	
Time start meds - discharge/admitted (hours)	3.6 (2.1, 5.9)
Admitted (n=18, hours)	5.4 (4.2, 6.1)
Discharged (n=23, hours)	2.3 (1.9, 3.6)
Total ED length of stay (hours)	8.3 (5.4, 9.3)
Admitted (n=18, hours)	8.7 (7.2, 9.9)
Discharged (n=23, hours)	6.1 (4.7, 8.6)

Time-in-motion study of ED Procedural Sedation: Data Collection Form

Date: _____/_____/_____ Location (POD): _____ Data Collector: _____

dd mm yyyy

INJURY & TREATMENT PROTOCOL

Complaint Requiring PSA: _____

Fracture: ☐ Dislocation: ☐ Cardioversion: ☐ Specify Type (e.g. wrist, shoulder):_____

ASA Class: _____ Last solid intake: ___ ___ ___ mins Last liquid intake: ___ ___ ___ mins

PSA TREATMENT

Method of Administration: ☐ IV ☐ IM ☐ PO ☐ Other

SEDATION (to be completed after procedure using chart data)

Time(00:00-23:59)	Drugs	Dosage
_____:_____		
_____:_____		
_____:_____		
_____:_____		
_____:_____		
_____:_____		
_____:_____		
_____:_____		
_____:_____		

ADVERSE EVENTS & COMPLICATIONS:

Did any adverse event occur: ☐ Yes (if yes, see below) ☐ No (if no, go to next page)

Event:

Complication 1: _____ Time complication noted: ____: ____

Complication 2: _____ Time complication noted: ____: ____

Complication 3: _____ Time complication noted: ____: ____

Complication 4: _____ Time complication noted: ____: ____

Complication 5: _____ Time complication noted: ____: ____

☐ Hospitalization Time complication noted: ____: ____

ED HEALTH PROFESSIONALS: TIME-IN-MOTION

Senior Procedural Physician

Time In (00:00-23:59)	Time Away	Total
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:____
_____:_____	_____:_____	_____:_____
Total Time	--------	_____:_____

Senior Sedation Physician

Time In (00:00-23:59)	Time Away	Total
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:____
_____:_____	_____:_____	_____:_____
Total Time	--------	_____:_____

Nurse - Specify Role (if applicable):_____

Time In (00:00-23:59)	Time Away	Total
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
Total Time	--------	_____:_____

Respiratory Technician (RT)

Time In (00:00-23:59)	Time Away	Total
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:____
_____:_____	_____:_____	_____:_____
Total Time	--------	_____:_____

Orthopedic Technician (fracture/dislocation only)

Time In (00:00-23:59)	Time Away	Total
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:_____
_____:_____	_____:_____	_____:____
_____:_____	_____:_____	_____:_____
Total Time	--------	_____:_____

PSA TREATMENT

Action	**Time (00:00-23:49)**	**Total Time (cumulative from the start of 1st drug administered)**
Triage time	_____:_____	
Start of 1st drug administered	_____:_____	
Last drug administered	_____:_____	_____:_____
Physician begins reduction/cardioversion	_____:_____	_____:_____
Patient no longer requires monitoring	_____:_____	_____:_____
Patient discharged (to floor or home)	_____:_____	_____:_____