

APPENDIX A. Search Strategy

Database: Ovid MEDLINE(R) <1996 to April Week 1 2007>

Search Strategy:

- 1 Analgesia/ or Analgesics, Opioid/ or Pain/ or Anti-Inflammatory Agents, Non-Steroidal/ or acute pain.mp. or Pain Measurement/ or Analgesics/ (89900)
 - 2 Meta-Analysis/ or "Review Literature"/ or systematic review.mp. (15321)
 - 3 1 and 2 (661)
 - 4 limit 3 to english language (596)
 - 5 from 4 keep 1-596 (596)
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Targeted search strategy for primary studies on KQ1:

Database: Ovid MEDLINE(R) <1950 to July Week 2 2007>

Search Strategy:

- 1 exp Pain/ (212174)
 - 2 exp Pain Measurement/ (31393)
 - 3 ((assess\$ or measur\$) adj3 pain\$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (37632)
 - 4 acute pain\$.mp. (2813)
 - 5 1 or 2 or 3 or 4 (226036)
 - 6 exp Hospitalization/ (104116)
 - 7 exp Inpatients/ (6381)
 - 8 exp patient admission/ (12978)
 - 9 exp Emergency Medical Services/ (60608)
 - 10 6 or 7 or 8 or 9 (163418)
 - 11 5 and 10 (5687)
 - 12 exp Time/ (845509)
 - 13 11 and 12 (778)
 - 14 limit 13 to (humans and english language) (657)
 - 15 from 14 keep 1-657 (657)
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Targeted search strategy for primary studies on the use of PCA in non-surgical settings, for KQ2:

Database: Ovid MEDLINE(R) <1950 to July Week 3 2007>

Search Strategy:

- 1 Analgesia, Patient-Controlled/ (2508)
- 2 limit 1 to english language (2205)
- 3 limit 2 to meta analysis (14)
- 4 exp Surgical Procedures, Operative/ (1661433)
- 5 su.fs. (1152982)

- 6 exp Postoperative Complications/ (307984)
- 7 4 or 5 or 6 (2196325)
- 8 2 not 7 (612)
- 9 from 8 keep 1-612 (612)

Initial exploratory search strategies for systematic reviews, conducted in January 2007 (postoperative pain was subsequently excluded from the scope):

Acute Pain Management: Postoperative and Inpatient Settings
January 23, 2007

Search strategy 1: PubMed Clinical Queries - Limits; human, English

(pain [mh] AND (drug therapy [sh] OR therapy [sh] OR psychology [sh] OR surgery [sh])) AND systematic[sb]:

((pain,postoperative [mh] OR acute disease [mh]) AND pain measurement [mh]) AND systematic[sb]))

Search strategy 2: PubMed

pain,postoperative [mh] AND evidence-based medicine [mh] AND acute [tw] = 17

Search strategy 3: Cochrane library

Pain management

Pain (and) evidence (and) assessment

Pain in Record Title and management in Record Title and evidence in Record Title in Database of Abstracts of Reviews of Effects

(1-23-07)

Search strategy 4: PubMed : Acute pain in patients with cognitive impairment or acute psychiatric illness

pain [mh] AND (drug therapy [sh] OR therapy [sh] OR psychology [sh]) AND mental disorders [mh]

Search Strategy 5 - PM Clinical Queries –

pain [mh] AND (drug therapy [sh] OR therapy [sh] OR psychology [sh]) AND mental disorders [mh]

Search strategy 6: PM Clin Quer

(Pain [mh] AND (delirium [tw] OR dementia [tw])) AND systematic[sb]

(1-29-07 – Pubmed)

pain, postoperative [mh] AND (timing [tw] OR assessment [tw]) AND evidence based medicine [mh] = 19

pain measurement [mh] AND evidence based medicine [mh] = 104

March 20, 2007

Ovid search 1

1.pain, postoperative.mp. or Pain, Postoperative/

OR acute disease.mp. or Acute Disease/

AND

patient satisfaction.mp. or Patient Satisfaction/ = 298

Ovid search 2

pain measurement.mp. [mp=title, original title, abstract, name of substance word, subject heading word]

OR

acute disease.mp. [mp=title, original title, abstract, name of substance word, subject heading word]

AND

"Outcome Assessment (Health Care)"/

Ovid search 3 =6

pain, postoperative.mp. or Pain, Postoperative/

AND

patient satisfaction.mp. or Patient Satisfaction/

AND

questionnaires.mp. or Questionnaires/

APPENDIX A, continued. Table of systematic reviews and studies cited, by key question

Title	Conditions	Special populations	KQ1	KQ2	KQ3	KQ4
Acute Pain Management: Scientific Evidence.(1)	Post-operative pain and acute pain in spinal cord injury, burns, cancer, acute zoster, neurological diseases, haematological disorders (e.g. sickle cell disease) HIV/AIDS, renal and biliary colic, musculoskeletal and orofacial pain and headache, phantom limb pain	Elderly, opioid-tolerant patients, patients with obstructive sleep apnea, renal or hepatic impairment or a substance abuse disorder	(2, 3)	(4-18)	(19, 20)	(21-28)
Tools for assessment of pain in nonverbal older adults with dementia: a state-of-the-science review (29)	Types of pain not specified. The assessment scales measured pain by observation of behavioral indicators.	Nonverbal elderly patients with cognitive impairment	--	--	(30-39)	--
Observation scales for pain assessment in older adults with cognitive impairments or communication difficulties (40)	Types of pain not specified. The assessment scales measured pain by observation of behavioral indicators.	Elderly patients with cognitive impairments, communication difficulties, or both.	--	--	(30, 31, 33-35, 37-39, 41-45)	--
Pain in elderly people with severe dementia: a systematic review of behavioural pain assessment tools (46)	Types of pain not specified. The assessment scales measured pain by patient self-report, or behavioral measures.	Elderly patients with cognitive impairment	--	--	(30-33, 37, 38, 47-52)	--
Institutional Approaches to Pain Assessment and Management (2003).(53)	Postoperative pain, non-surgical pain, cancer, HIV disease, sickle cell crisis	--	--	(54-62)	--	--
Do opiates affect the clinical evaluation of patients with acute	Acute abdomen	--	--	(64-72)	--	--

abdominal pain? (63)						
Nonsteroidal anti-inflammatory drugs (NSAIDs) versus opioids for acute renal colic (73)	Acute renal colic pain	--	--	(74-92)	--	--
Comparing analgesic efficacy of non-steroidal anti-inflammatory drugs given by different routes in acute and chronic pain: a qualitative systematic review (93)	Included 3 trials in renal colic	--	--	(94-96)	--	--
Hydromorphone for acute and chronic pain (97)	Included one trial in patients with renal colic, and one trial in patients with biliary stone pain.	--	--	(98, 99)	--	--
Pain management in hospitalized cancer patients: a systematic review (100)	Cancer	--	--	(101-105)	--	--
Evidence for the optimal management of acute and chronic phantom pain: a systematic review. (5)	Phantom limb pain after amputation	--	--	(11, 12, 18, 106-114)	--	--

References in Appendix A, Table of Systematic Reviews

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APPENDIX B. Inclusion/exclusion criteria

Code	Include / Exclude	Reason
I1	Include	<p>Published primary research, systematic review, or meta-analysis of studies that</p> <ol style="list-style-type: none"> a. Were conducted in inpatients with acute pain (including patients with impaired self-report; patients with preexisting opiate therapy; and patients with dependencies on tobacco, alcohol, opioids, or other substances) b. Report data on any of the following <ol style="list-style-type: none"> i. Association between timing and frequency of pain assessment, severity of pain, and choice of treatment (e.g. regional blocks, medications, or other therapies) ii. Method of pain assessment (e.g. 11-point pain scale, visual analog scale, verbal descriptor scale) iii. Timing and route of administration of pain interventions (e.g. oral intermittent pharmacotherapy, intravenous therapy, psychological interventions, positioning, neural blockade, and patient-controlled analgesia); timeliness of enactment of treatment plans, changes in treatment plans iv. Effect of coordination of care with the patient's primary care physician or with a pain consultation service on choice of treatment, clinical outcomes, and safety v. Patient outcomes, including degree of pain relief, pain intensity, emotional well-being, patient satisfaction, physical function, and fitness for rehabilitation of the underlying condition vi. Safety outcomes; severity and frequency of side effects (including somnolence, respiratory depression, confusion, constipation, ileus, vomiting, non-allergic itching, weakness/numbness, and use of naloxone) vii. Length of stay viii. Follow-up of pain
I3	Include	Unpublished research meeting I1 criteria
I4	Include	Non-systematic review or background article meeting I1 criteria
I5	Include	Other (specify)
X1	Exclude	Study outcome does not meet I1 criteria
X2	Exclude	Study population does not meet criteria (e.g. outpatients; inpatients hospitalized 10 days or longer)
X3	Exclude	Type of pain not within scope of review (e.g. post-operative pain, sickle cell disease, cancer pain, chronic pain in patients hospitalized 10 days or longer for whom pain is chronic or refractory)
X4	Exclude	Pain intervention studied is not routinely available in the VA health system
X5	Exclude	Non-English language, no abstract
X6	Exclude	Non-human, animal
X7	Exclude	Other (specify, e.g. off-topic)
X8	Exclude	Wrong study design; no data

APPENDIX C. USPSTF Quality Rating Criteria

Diagnostic Accuracy Studies

Criteria

- Screening test relevant, available for primary care, adequately described
- Study uses a credible reference standard, performed regardless of test results
- Reference standard interpreted independently of screening test
- Handles indeterminate results in a reasonable manner
- Spectrum of patients included in study
- Sample size
- Administration of reliable screening test

Definition of ratings based on above criteria

- Good:** Evaluates relevant available screening test; uses a credible reference standard; interprets reference standard independently of screening test; reliability of test assessed; has few or handles indeterminate results in a reasonable manner; includes large number (more than 100) broad-spectrum patients with and without disease.
- Fair:** Evaluates relevant available screening test; uses reasonable although not best standard; interprets reference standard independent of screening test; moderate sample size (50 to 100 subjects) and a “medium” spectrum of patients.
- Poor:** Has important limitations such as: uses inappropriate reference standard; screening test improperly administered; biased ascertainment of reference standard; very small sample size of very narrow selected spectrum of patients.

Randomized Controlled Trials (RCTs) and Cohort Studies

Criteria

- Initial assembly of comparable groups: RCTs—adequate randomization, including concealment and whether potential confounders were distributed equally among groups; cohort studies—consideration of potential confounders with either restriction or measurement for adjustment in the analysis; consideration of inception cohorts
- Maintenance of comparable groups (includes attrition, cross-overs, adherence, contamination)
- Important differential loss to follow-up or overall high loss to follow-up
- Measurements: equal, reliable, and valid (includes masking of outcome assessment)
- Clear definition of interventions
- Important outcomes considered
- Analysis: adjustment for potential confounders for cohort studies, or intention-to-treat analysis for RCTs (i.e. analysis in which all participants in a trial are analyzed according to the intervention to which they were allocated, regardless of whether or not they completed the intervention)

Definition of ratings based on above criteria

- Good:** Meets all criteria: Comparable groups are assembled initially and maintained throughout the study (follow-up at least 80 percent); reliable and valid measurement instruments are used and applied equally to the groups; interventions are spelled out clearly; important outcomes are considered; and appropriate attention to confounders in analysis.
- Fair:** Studies will be graded “fair” if any or all of the following problems occur, without the important limitations noted in the “poor” category below: Generally comparable groups are assembled initially but some question remains whether some (although not major) differences occurred in follow-up; measurement instruments are acceptable (although not the best) and generally applied equally; some but not all important outcomes are considered; and some but not all potential confounders are accounted for.
- Poor:** Studies will be graded “poor” if any of the following major limitations exists: Groups assembled initially are not close to being comparable or maintained throughout the study; unreliable or invalid measurement instruments are used or not applied at all equally among groups (including not masking outcome assessment); and key confounders are given little or no attention.

Case Control Studies

Criteria

- Accurate ascertainment of cases
- Nonbiased selection of cases/controls with exclusion criteria applied equally to both
- Response rate
- Diagnostic testing procedures applied equally to each group
- Measurement of exposure accurate and applied equally to each group
- Appropriate attention to potential confounding variable

Definition of ratings based on above criteria

- Good:** Appropriate ascertainment of cases and nonbiased selection of case and control participants; exclusion criteria applied equally to cases and controls; response rate equal to or greater than 80 percent; diagnostic procedures and measurements accurate and applied equally to cases and controls; and appropriate attention to confounding variables.
- Fair:** Recent, relevant, without major apparent selection or diagnostic work-up bias but with response rate less than 80 percent or attention to some but not all important confounding variables.
- Poor:** Major selection or diagnostic work-up biases, response rates less than 50 percent, or inattention to confounding variables

APPENDIX E. Evidence Summary Tables

Summary Table 1. Studies on methods of pain assessment (KQ1)

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/exposure of interest	Outcomes measured	Results
Carey, 1997 ¹	Prospective cohort	267	39.5% acute pain, 40.3% chronic pain. 20.9% reported no pain on admission. Mean for pain intensity ranged from 5.09-5.75.	Patients rated the intensity of pain using each of the 3 scales once over the next 24 hours were also asked which of the scales was easiest to use, whether the scale was helpful or needed further explanation, and employment and education data.	Use of 3 self-rated pain scales; questionnaire also collected demographic information and perceptions about scales.	Patients most frequently selected the VAS faces scale (48.6%), followed by the number scale (35.3%) and line scale (16.1%). None of the demographic variables were associated with preference. Reliability coefficient between scales (Chronbach's alpha) was 0.88. Most (85.8%) patients indicated that a pain rating scale helped them to describe their pain to the nursing staff.
Luger, 2003 ²	Single-site prospective study, convenience sample in Innsbruck, Austria	10 EMS technicians, 10 EMS drivers, 2 ER physicians; 15 trauma patients and 36 nontrauma patients (mostly cardiovascular disease).	15 trauma patients: 7 fractures or lacerations, 5 blunt injuries, 3 penetrating wounds.	Pain assessment was performed at the beginning of emergency care before analgesics, during transport, and upon arrival at the hospital immediately prior to hospitalization.	Severity of pain assessed by patient; EMS physician; EMS technician; EMS driver; at 3 time points (on the scene, during transport, and on arrival at hospital)	The EMS physician underestimate pain 47% of the time; the EMS technician underestimated pain 53% of the time; the EMS driver underestimated pain 57% of the time. The disparity was greatest (60-68%) among patients with severe pain, and lowest (28-36%) among patients with mild pain. The pain intensities on the VAS and VPS were highly correlated ($r^2=0.86$, $p=0.0001$).
Nelson, 2004 ³	Retrospective cohort study at a suburban university-based ED	521 before the mandatory pain scale; 479 after introducing the pain scale to the ED,	Renal colic, extremity trauma, headache, ophthalmologic trauma, or soft tissue injury. Pain varied from 0-10. 8% of patients who reported 0 received analgesia, compared with 74% who reported 9, and 69% who reported 10 as baseline pain.	The standard triage form was revised to include a pain scale in the vital signs section, and the pain assessment was made at triage at the same time as presentation vital signs were assessed. ED staff and patients were not made aware of the study or alerted to the intervention.	1) The proportion of patients who received oral or parenteral analgesia for their pain while in the ED; 2) the time to analgesia administration	The proportion of patients who received analgesia after introduction of the pain scale increased from 25% to 35% ($p<0.001$). The mean time from triage to analgesia administration was 152 minutes before the intervention, and 113 minutes after (mean difference 39 minutes, 95%CI -7 to 84) but the difference was not statistically significant. Patients with diagnostic uncertainty who received further evaluation were less likely to receive analgesia. 34% who received no workup received analgesia, while only 27% did who underwent a workup ($p=0.022$). In patients with headache, 23% who underwent CT were treated for pain, whereas 62% of those who did not undergo CT were treated ($p<0.001$)

APPENDIX E. Evidence Summary Tables

Summary Table 1. Studies on methods of pain assessment (KQ1), continued

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/exposure of interest	Outcomes measured	Results
Morrison, 2006 ⁴	Controlled clinical trial in an 1171-bed hospital in Mt. Sinai Hospital, New York.	3964 adults	9 medical/surgical units were selected for inclusion based on similar baseline patient demographics and pain scores (3 general medicine, 2 general surgery, 2 specialty surgery, 1 oncology, and 1 mixed oncology/general medicine). 32-38% surgical pts 10-16% cancer pts 1.5 - 4.8% AIDS pts 56% had moderate to complete relief from pain medication 29-32% had moderate to severe pain at study enrollment	Education in pain management (months 0-4) was followed by a series of additive 6 to 7-month intervention periods: 1) patient education and nursing pain assessment of current and worst pain, pain relief, and pain acceptability; 2) audit and feedback to nursing staff of patients' pain intensity and staff compliance; and 3) a computerized clinical decision support system (CDSS) to guide analgesic prescribing.	Patients were interviewed within 48 hrs of admission and then once daily. Patients were asked to rate current pain, worst pain over 24 hrs, their pain relief with analgesics, and whether their pain was acceptable to them. Pain and pain relief were rated on 4-pt scales. Outcomes included measures of pain assessment, pain severity, and analgesic prescribing. % of patients who had a daily pain assessment for each shift; % of pts with moderate to severe pain 72-96 hrs later, mean pain scores for the first 72 hrs or on postop days 1-3	Pain documentation was improved by >80% using an enhanced pain assessment instrument combined with either audit and feedback or a computerized decision support system. The enhanced pain scale was associated with increased analgesic prescribing. Patients on units using the enhanced pain scale were significantly more likely to have their pain assessed than those on units in which the 1-item pain scale was used (p<0.001). Audit and feedback of pain results was associated with significant increases in pain assessment rates compared with units without audit and feedback (p<0.001). Adding the CSS was associated with significant increases in pain assessment only when compared with units that lacked audit and feedback (p<0.001). Overall the % of pts who received at least 1 pain assessment per day increased from 32.1% with the standard pain assessment to 79.3% when the enhanced pain scale was combined with the CSS, and to more than 80% for interventions using audit and feedback.

APPENDIX E. Evidence Summary Tables

Summary Table 2. Studies on the timing and frequency of pain assessment, and timing of treatment (KQ1)

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/ exposure of interest	Outcomes measured	Results
Arendts, 2006 ⁵	Retrospective cohort study in an Australian ED	857	Thoracic, including cardiac 12.9%, abdominal 30.6%, urological 11.4%, gynecological 4%, trauma 31%, neurological 35%, and misc. 6.6%. 15% were admitted to critical care, 49% admitted to general ward, and 19% admitted to ED observation	Morphine was the drug used in 94% of cases.	Time from arrival to first dose of opiate. Patients were grouped in 2: time <60 minutes, and time >=60 minutes.	Median time to first dose of opiate = 53 min. 73.5% received no alternative analgesia prior to opiate. Patients with 60+ minute delay were more likely to be female, older, of lower triage acuity, seen by junior medical staff, suffering from nontrauma-related illness, and admitted to hospital rather than discharged. These predictors were significant in multivariate analysis.
Grant, 2006 ⁶	Retrospective review of patient records	473	Of 473 pain patients, 213 (45%) had severe pain and 105 (22%) had moderate pain. By type of pain: Chest pain: 14-17% Abdominal pain: 19-21% Headache/neuropathic: 8-11% Muscular: 29-32% Skeletal: 11-15% Ears, nose throat: 2-3% NOS 6-12%	Any form of analgesia	Time intervals between patient arrival, assessment, and delivery of analgesia.	For patients with moderate pain v. severe pain, mean time interval (min): Arrival to doctor assessment: 142 v 42 Arrival to prescription of analg: 168 v 58 Arrival and receipt of analg: 236 v 72 Delay btw prescription and administration of analgesia: 68 v 14. % of patients who received analgesia within time frame meeting BAEM guidelines: 24% in severe pain, 18% in moderate pain. 32% of patients were re-evaluated in terms of analgesia requirements.
Hwang, 2006 ⁷	Retrospective review of medical records from a prospective cohort study	158	Patients reporting complaint of pain: 81%	Transfer administrative data (ADT) on time of registration and discharge was used to determine ED crowding risk factors: ED census and mean ED length of stay (LOS) during the hour the index hip fracture patient arrived.	4 quality measures: 1) time to pain assessment by a physician; 2) documentation of administration of pain medication; 3) type of analgesic (opioid v nonopioid (NSAID, acetaminophen) if given; 4) time to pain treatment	Minutes to first documented pain assessment, mean (range): 40 (0-600) Minutes to first documented pain treatment: 141 (10-525) Delay in treatment, minutes: 122 (0-526) 64.1% received analgesia for pain (57% opioids, 7% nonopioids). 32.8% of patients for whom opioid was prescribed received meperidine. ED crowding at census levels greater than 120% bed capacity was significantly associated with a lower likelihood of documentation of pain assessment and longer times to pain assessment, in a multivariate analysis that adjusted for age, gender, RAND score, dementia, and mean ED LOS >100% annual.

APPENDIX E. Evidence Summary Tables

Summary Table 2. Studies on the timing and frequency of pain assessment, and timing of treatment (KQ1), continued

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/ exposure of interest	Outcomes measured	Results
Ranji, 2006 ⁸	Systematic Review of RCTs of opiate analgesia v placebo in acute abdomen	9 studies in 1062 adults, and 3 studies in 291 children.	3 studies enrolled only patients with right lower quadrant pain; all others enrolled patients with undifferentiated acute abdominal pain.	use of opiate analgesia in acute abdomen	Effect of opiates on patient history (potential to minimize previously concerning symptoms v. increasing its accuracy by calming the patient); on the physical examination; and on potential management errors	11 comparisons from 9 studies in adults showed a trend toward changes in the physical examination with opiate administration, with a summary RR of 1.51 (95%CI 0.85 - 2.69). There was significant heterogeneity among the studies; in 3 comparisons, pain relief reported by the opiate group did not significantly differ from placebo. Studies did not generally distinguish between potentially beneficial changes such as improved localization of tenderness and potentially harmful changes such as changes in peritoneal signs. In 2 studies, loss of peritoneal signs after analgesia occurred in 5.6% to 18.7% of patients with opiates, compared with 2.6% to 7.7% of those in the control group. Diagnostic accuracy: a meta-analysis of 4 adult studies indicated no significant change in the rate of incorrect management decisions with opiates vs. placebo. Analgesia was adequate in all these studies, and no significant heterogeneity was found. The frequency of possible unnecessary surgeries was similar between opiate and control groups (7.6% v 7.9%). Meta-analysis showed a non-significant trend toward fewer unnecessary surgeries among patients with opiates.
Shabbir, 2004 ⁹	Prospective study in a direct access A&E department where patients were immediately assessed by the surgical on-call service.	100	Acute abdominal pain. Clinical diagnoses included non-specific abdominal pain, PID, peptic ulcer disease, pancreatitis, appendicitis, renal, cholecystitis.	Most common drugs used:diclofenac 37%pethidine 26%Most common routes used:80% intramuscular route0% received intravenous analgesia.	Waiting time for analgesia and its relationship to subjective visual analogue pain scores and clinical diagnoses	Mean waiting time for analgesia was 1.4 hours (range 2 min to 14 hr).Female patients had a longer mean wait time than males (129 min v. 69 min, p=0.09). Patients admitted at nighttime received analgesia quicker (mean 76 min) than during the day time (mean 114 min). 77% were satisfied with the adequacy of analgesia once given; 23% thought the pain relief was not sufficient.Neither clinical diagnosis nor age influenced the timing of analgesia.

APPENDIX E. Evidence Summary Tables

Summary Table 2. Studies on the timing and frequency of pain assessment, and timing of treatment (KQ1), continued

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/ exposure of interest	Outcomes measured	Results
Vila, 2005 ¹⁰	Retrospective chart review, single hospital: H.Lee Moffitt Cancer Center and Research Institute	Pre-intervention: 79 opioid ADRs for 117,672 inpatient hospital days, Post-intervention: 67 opioid ADRs for 65,388 inpatient hospital days	Cancer patients	All nursing staff and support personnel were required beginning January 2001 to document each patient's rating of their pain intensity using a numerical scale, along with other vital signs with every routine patient assessment.	Change in patient satisfaction and opioid-related ADRs, including oversedation or respiratory depression requiring discontinuation of the opioid or reversal with naloxone, in the 4 years before and 2 years after implementation of new pain management standards.	Pre-intervention: 79 opioid ADRs for 117,672 inpatient hospital days, of these 13 involved oversedation. Post-intervention: 67 opioid ADRs for 65,388 inpatient hospital days; of these there were 16 oversedation events. There was a significant increase in the incidence of both events (opioid ADRs and cases of oversedation) post-NPTA ($p=0.01$ and $p=0.03$ respectively). The overall rate of ADRs increased by 49%, with a rate ratio of 1.49 (95%CI 1.08-2.07) 67% of patients received analgesia within 1 hour after presentation; approximately 25% waited over 2 hrs. Patient satisfaction ratings increased significantly before and after the NPTA period. ($p<0.00001$)

APPENDIX E. Evidence Summary Tables

Summary Table 3. Studies on the effectiveness and safety of patient-controlled analgesia for acute pain (KQ2)

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/exposure of interest	Results
Evans, 2005 ¹¹	RCT, not placebo-controlled, in an ED	86; 43 in each group	Trauma patients, mostly fracture: 53.4% control, 74% PCA	After baseline measures of VAS, BP, pulse, GCS, SaO ₂ , respiratory rate, an IV cannula was inserted. Controls were given 0-10 mg morphine by IV, titrated by a nurse. Morphine was given at a rate of 1-2 mg/min until by patient's responses pt was comfortable. Pts were then asked to call for further analgesia if needed, and nurse was expected to check pt periodically per ED guidelines. PCA group pts were instructed in the use of the PCA, which administered a 5 mg loading dose with a subsequent bolus dose of 1mg and a lockout interval of 5 minutes. Pain scores and physiological measurements were made at 0, 5, 15, 30, 45, 60, 90, and 120 minutes. Patients were also given 50 mg of cyclizine to minimize nausea and vomiting. Recording of AEs were made by observation. At least 12 hrs after admission to a ward or discharge, patients were contacted by the researcher to complete a satisfaction questionnaire.	The mean pain scores for PCA and controls were similar (4.8 and 4.8, p=0.578). Area under the curve analysis of VAS pain scores confirmed that there was no significant difference between the 2 groups (p=0.784) Twice as much morphine was given to the PCA group, despite the similarity in VAS scores: mean mg PCA v. control: 18.83 v. 7.65. Mean morphine amt delivered over mean time: 7.26 mg/h PCA, 4.03 mg/h control. AEs: PCA patients experienced more events (p ns), most commonly mild sedation. There were no significant differences in the satisfaction questionnaires between the 2 groups.
Fulda, 2005 ¹²	DB RCT, placebo-controlled	44; 22 in each group	All had thoracic fractures: Unilateral rib fractures = 59% Bilateral rib fractures: 27% The mean injury severity score was 10.5 in the NMS group, 9.8 in the PCA group.	Randomized to 2 groups: nebulized morphine (NMS) or control group (PCA morphine). The PCA group received nebulized saline every 4 hrs with PCA morphine; the NMS group received nebulized morphine every 4 hrs with PCA saline. Pain was considered controlled if VAS ≤4 and patient stated pain was well controlled. Patients with uncontrolled pain after 30 minutes Patients in NMS group received additional PRN doses of nebulized morphine every 30 minutes up to 2 treatments, and had the PCA pump adjusted to provide PCA doses of saline every 15 min. Patients in PCA group had PCA delivery adjusted to include addition of 1 mg of morphine every 15 minutes on demand, and received 2 additional PRN nebulized saline treatments every 30 minutes up to 2 treatments	The NMS group required more morphine than the PCA group: the average 4-hr morphine dose was 11.96 for the NMS group, and 6.22 for the PCA group (p<0.001). Although most (74.3%) of observations, patients were alert without evidence of increased sedation, those in the NMS group had lower sedation scores than the PCA group (0.33 v. 0.56, p=0.03). Only 1 patient in the NMS group exceeded sedation level of 1, whereas 5 in the PCA group exceeded this level. However, these 6 patients had less morphine on average than the group as a whole, so there was no correlation. Patients with NMS had a significantly lower mean heart rate, and a non-significantly higher respiratory rate compared with the PCA group. Effect on pain level was similar between NMS and PCA morphine Mean pain score for each group, baseline v. pretreatment v. posttreatment: NMS: 5.38 v. 3.52 v. 2.59, mean overall = 3.38 PCA: 5.73 v. 3.89 v. 2.64, mean overall = 3.84

APPENDIX E. Evidence Summary Tables

Summary Table 3. Studies on the effectiveness and safety of patient-controlled analgesia for acute pain (KQ2), continued

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/exposure of interest	Results
Moon, 1999 ¹³	Controlled CT at Univ Cincinnati	34 enrolled; 10 excluded from analysis	Significant thoracic traumatic injury	Epidural analgesia vs. PCA Patients randomized to PCA received a loading dose of IV morphine 0.1 mg/kg before establishment of PCA. The infusion was titrated by a member of the acute pain service to maximize pain relief before handing over the control of the system to the patient. The PCA regimen used morphine 1 mg/ml in bolus doses of 2 mg with a lockout duration of 10 minutes. There was no background infusion. Thoracic epidural catheters were placed by an anesthesiologist in the epidural space between T5 and T7. A 3-ml test dose of lidocaine 1.5% with epinephrine 1:200,000 was then administered through the epidural catheter to exclude subarachnoid or intravascular location of the catheter. Sensory testing of appropriate thoracic dermatomes was performed 10 minutes after to confirm epidural placement of the catheter. The catheter was further dosed with an injection of fentanyl (50 ug) and 3 mg preservative-free morphine. Within 1 hr of placement, a continuous infusion of bupivacaine 0.25% and morphine 0.005% was initiated at a rate of 4-6 ml/hr using an infusion pump. A member of the APS adjusted the infusion rates to optimize pain relief and minimize side effects.	During the first 24 hrs of study, the epidural group had a significant reduction in pain score with coughing, compared with PCA patients. After 48 hrs there was no difference in pain scores btw the 2 routes of opioid administration. On day 3, the epidural group had a 38.7% reduction in pain score compared with the PCA group, whose score was approximately 6.2, the same as for day 2. The epidural group's pain score on day 3 (3.8) was significantly lower than that of the PCA group (p<0.05). PCA patients had a gradual 15% decline in MIF during the study period, whereas the epidural group had a continual increase (23%) By day 3 the epidural group had a significant increase in MIF v. PCA. Tidal volume continually fell for the PCA group (56% on day 3 compared with day 1), but the epidural group had a continual improvement (45% increase from day 1)
Wu, 1999 ¹⁴	Retrospective cohort study	64, 32 in each group	Multiple (3+) rib fracture from motor vehicle crash N fractured ribs: 5.6 epidural vs 4.4 PCA (p=0.01) Injury severity score: 21.6 epidural vs 21.9 PCA (p=ns)	Patients who received IV PCA were able to obtain 1 mg of morphine every 6 minutes through the PCA pushbutton. The morphine could be increased by physician order. Epidural catheters were inserted in the thoracic region (T5-T9) with local analgesia (0.125 to 0.25% bupivacaine) and fentanyl (2.5 ug/mL), and the initial infusion rate was 5 to 8ml/h as adjusted by the Acute Pain Service.	There was no difference between PCA and epidural analgesia in duration of analgesia, length of ICU stay, or length of hospital stay. Patients with epidural analgesia had significantly lower pain ratings at all time intervals, with the exception of baseline scores (difference of 0.5 to 1 point higher in the PCA group, p-value ranging from 0.005 to p<0.001 at various time points). There were no differences between the groups with respect to pulmonary, cardiac, or neurologic complications.

APPENDIX E. Evidence Summary Tables

Summary Table 4. Studies on the management of acute pain in renal colic and biliary stone (KQ2)

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/ exposure of interest	Outcomes measured	Results
Holdgate, 2007 ¹⁵	Cochrane systematic review, NSAIDs	20 trials with 1613	Most studies included only participants with renal calculi confirmed on subsequent testing, and excluded patients with negative results on followup tests.	Trials compared one of 5 NSAIDs (diclofenac, indomethacin, indoprofen, ketorolac, tenoxicam), to 1 of 7 opioids (pethidine was used in 10 of the 20 trials). The intramuscular route was most commonly used for each drug type (10 trials), followed by the intravenous route (7 trials).	Patient-rated pain and/or time, time to pain relief, need for rescue medication, rate of pain recurrence, adverse events. Major events were defined as GI hemorrhage, renal failure, hypotension, and respiratory depression. Minor adverse events were defined as GI disturbance without bleeding, dizziness, sleepiness.	Patients receiving NSAIDs reported lower pain scores than patients receiving opioids in 10 of 13 studies, though the differences were small. No pooled results on efficacy due to heterogeneity. Use of rescue analgesia was significantly less likely with NSAIDs (RR 0.75, 95%CI 0.61-0.93). More AEs with NSAIDs in the majority of trials, especially vomiting with pethidine. The reviewers concluded that both NSAIDs and opioids provide effective analgesia in acute renal colic, but opioids, particularly pethidine, result in a higher incidence of vomiting and other adverse events.
Jasani, 1994 ¹⁶	Prospective DB RCT comparing hydromorphone v. meperidine in a tertiary care center with 93,000 annual ED visits.	36 hydromorphone, 37 meperidine.	Presumed ureteral colic	Comparable doses of the 2 medications were administered at t=0. The patients were randomized to receive either 50 mg meperidine (M) or 1 mg hydromorphone (H) IV in a double-blind manner.	Remedication interval for patients requiring additional analgesia; proportions of men and nonresponders	Baseline VAS pain scores were similar between treatment groups at t=0. The H group had significantly lower pain intensity levels at each timepoint. The M group had significantly more nonresponders than the H group. Significantly fewer patients required IV pyelograms in the H group (28% v 54%, p=0.05) and there were fewer admissions in the H group than the M group (25% v 49%, p=0.08). AEs: there were more patients with nausea and vomiting in the M group compared with H: 40% v 28%, p=0.31. More patients on H had dizziness than did M (22% v 11%, p=0.25. The two groups experienced similar rates of drowsiness (41% H v 46% M).

APPENDIX E. Evidence Summary Tables

Summary Table 4. Studies on the management of acute pain in renal colic and biliary stone (KQ2), continued

Author, Year	Study Design, setting	Sample size	Clinical condition/ baseline pain	Intervention/ exposure of interest	Outcomes measured	Results
Muriel-Villoria, 1995 ¹⁷	IM v. IV dipyron	Varied by intervention, 22-70	Renal colic	dipyron 1g IM + placebo IV dipyron 1g IV + placebo IM dipyron 2g + placebo IM dipyron 2g + placebo IV diclofenac 75mg IV + placebo IM	Proportion of patients with >50% improvement	Significant differences: dipyron 2g IV > 1g IV at 10' diclofenac 75 mg IV > IM at 20' dipyron 1g IV > 1g IM at 20'
Nelson, 1988 ¹⁸	Rectal v. IV indomethacin	Varied by intervention, 53-63	Renal colic	indomethacin 100mg PR indomethacin 50mg IV	VASPI at 10'	IV significantly lower than PR; at 30' no difference. Supplementary analgesics: pr 16/47; IV 8/37
Nissen, 1990 ¹⁹	Rectal v. IV indomethacin	Varied by intervention, 44-54	Renal colic	indomethacin 100mg PR indomethacin 50mg IV	VASPI at 10' and 20':	VASPI: IV significantly lower than PR; at 30' no difference. Use of supplementary analgesics: PR 17/63 v. IV 5/53 (p=0.03).
Uden, 1984 ²⁰	Single-blind, randomized trial Biliary stone: subcutaneous injection of dihydromorphinone v. IV indomethacin	42	Acute attacks of biliary stone pain	Group D received 1 mL of dihydromorphinone and patients in Group I received 50 mg of indomethacin intravenously. The surgeon on duty conducted patient exam and provided information about the ongoing study. (Subsequently?) the attendant nurse provided the drug injection, but the examiner was blinded to the treatment. Pain was evaluated at baseline and at 10 and 30 minutes after drug injection. In cases of insufficient pain relief, a second injection was given.	Pain (VAS) at 10 and 30 minutes after administering treatment	N/total free of pain at 10 minutes and 30 minutes: Group D: 2/21 at 10 min, 11/21 at 30 min Group I: 2/21 at 10 min, 10/21 at 30 min Mean scores at baseline, 10 minutes, and 30 minutes: Group D: 71.8, 44.1, 14.2 Group I: 68.5, 32.4, 15.8 Pain reduction within each group was statistically significant (p<0.01) whereas the difference between the two groups was not. AEs: 2 pts in each group felt nausea and vertigo. 1 in D developed a red, itching subcutaneous infiltration at injection site. 1 in Group I vomited during injection, another in Group I experienced nasal congestion.

APPENDIX E. Evidence Summary Tables

Summary Table 5. Studies on the effectiveness and safety of neural blockade for acute pain (KQ2)

Author, Year	Study Design, setting	Sample size	Clinical category; baseline pain	Intervention/exposure of interest	Outcomes measured	Results
Chudinov, 1999 ²¹	Randomized trial in orthopedic hospital, Israel	40	Hip fracture, undergoing surgery	Psoas compartment block using 2mg/kg/body weight of 0.25% bupivacaine with adrenaline (0.8 ml/kg) and supplementary doses as required via catheter vs. no block	Length of follow-up: perioperative period only (72 hours). Pain relief assessed by VAS. Adverse effects of the block	The psoas compartment block resulted in significantly less pain at 8 and 16 hours pre-operatively, and also at 16, 24, and 32 hours post-operatively. Proportionally more patients who received the psoas block were satisfied with pain control compared with controls.
Haddad, 1995 ²²	Randomised trial	50	Extracapsular hip fracture	Femoral nerve block inserted at time of admission using 0.3ml/kg of 0.25% bupivacaine vs. control group (no injection)	Mean pain score using VAS: pre-block and at 15 mins, 2 hrs and 8 hrs. Amount of analgesic administration within first 24 hrs of co-codamol, voltarol, pethidine. Incidence of respiratory infections, CVA, pulmonary embolism, deep vein thrombosis, urinary tract infection, skin breakdown, mortality, failed nerve block.	Femoral nerve block provided a greater reduction in the mean pain scores that was statistically significant at 15 minutes (mean change -2.6 v. -0.7) and at 2 hours (mean reduction -3.0 v. -1.2). The number of parenteral analgesic drugs administered in the 24 hrs from admission was reduced for the nerve block group. Local or systemic complications did not occur with the use of femoral nerve blocks.
Scheinin, 2000 ²³	Randomized trial, orthopedic hospital in Finland	59	Hip fracture, undergoing surgery	Lumbar epidural using bupivacaine and fentanyl inserted within 6 hrs of admission. Infusion rate adjusted according to patients requirements vs intramuscular opiate (oxycodone 0.1-0.15mg/kg) at 6 hourly intervals as necessary. All patients operated on using spinal anesthesia	Length of follow-up for clinical outcomes was 3 days. Mortality for 3 years was determined using central statistic register. Pain relief as assessed by VAS (scale 0-100). Ischemic episodes as determined by continuous electrocardiogram recording; nocturnal oxygen saturation; itching; nausea; quality of sleep; mortality.	Pre-operative pain scores did not significantly differ (p=0.42) continuous epidural infusion of bupivacaine plus fentanyl (mean value 34) vs controls who received parenteral opiates IM (mean 42), although post-operative pain scores were significantly (p=0.006) reduced in the epidural group (mean 22) compared with intramuscular opiates (mean 35). No mention of complications specific to the treatment.

APPENDIX E. Evidence Summary Tables

Summary Table 5. Studies on the effectiveness and safety of neural blockade for acute pain (KQ2), continued

Author, Year	Study Design, setting	Sample size	Clinical condition/baseline pain	Intervention/exposure of interest	Outcomes measured	Results
Halbert, 2002 #1428 ²⁴	SR of 12 controlled trials that reported phantom pain as an outcome	Included 12 trials, total 375 patients (both men and women), ages 47-75.	8 trials of treatment of acute phantom pain with preoperative, intra-operative, and early (<2 weeks) postoperative interventions	8 trials on phantom limb pain studied epidural treatments (3 trials); regional nerve blocks (3); calcitonin (1); and transcutaneous electrical nerve stimulation (1). 4 trials on late postoperative pain studied transcutaneous electrical nerve stimulation (2) and Farabloc (a metal threaded sock) and ketamine (1 trial each). In 8 preop/intraop/early post-op trials, the interventions included epidural anesthesia (3 trials), regional nerve blocks (3), intravenous calcitonin (1) and TENS. Controls received a placebo consisting of a saline infusion or epidural anesthesia consisting of on-demand opioid analgesia. 5 trials used opioid analgesia, and 1 trial used sham TENS with and without chlorpromazine. Trials that used epidural anesthesia commenced 18-72 hours before surgery. Blockade anesthesia commenced during the operation or postoperatively. 4 trials of late postop interventions included TENS, Farabloc, vibratory stimulation, and infused ketamine.	Effect on phantom limb pain at various time points up to 12 months post-amputation	Up to 70% of patients have phantom limb pain after amputation. There is little evidence from randomized trials to guide clinicians with treatment. Evidence on preemptive epidurals, early regional nerve blocks, and mechanical vibratory stimulation provides inconsistent support for these treatments.

APPENDIX E. Evidence Summary Tables

Summary Table 5. Studies on the effectiveness and safety of neural blockade for acute pain (KQ2), continued

Author, Year	Study Design, setting	Sample size	Clinical condition/baseline pain	Intervention/exposure of interest	Outcomes measured	Results
Knoop, 1994 ²⁵	Randomized prospective, nonblinded clinical study, convenience sample; inner-city and community hospital ER	30	Patients had 3rd or 4th finger injuries including and distal to the proximalinterphalangeal joint that required digital anesthesia. Injuries included lacerations (67%) and infections (27%).	Digital blocks and a metacarpal block were performed on each patient, in randomized order. Additional anesthesia was given and noted when required for all patients. After a period of no less than 10 minutes, the patient was treated in a manner consistent with the injury (ie, sutures, incision, and drainage).	Patients immediately rated pain associated with each technique on a nonsegmented VAS. Efficacy was assessed by requirement for additional anesthesia and anesthesia to pinprick. Time to anesthesia was assessed after each block in 23 patients. Patients were asked which technique they thought was more painful or if there was no difference between the 2 techniques. Responses were recorded for 10 minutes.	Digital block was less painful than metacarpal block by both VAS and by verbal comparison, but the differences did not reach statistical significance. There were no sig. Diff's in the VAS scores of the first block compared with the second block. Mean VAS scores were 2.53 cm for digital block, and 3.35 cm for metacarpal block (p=ns). 40% of patients rated the digital block as more painful, and 7% noted no difference in pain between the blocks (p=ns). Digital block was found to be more efficacious as metacarpal block failed anesthesia to pinprick in seven of 30 metacarpal blocks (23%) compared with one of 30 (3%) for digital block (p=0.02). When requirement for additional anesthesia was assessed, digital block was adequate 97% of the time (29 of 30 blocks), while metacarpal block was adequate 87% of the time (26 of 30 blocks, p=ns). Time to anesthesia available in 23 patients was found to be significantly shorter for digital block compared with metacarpal block, with a mean of 2.82 minutes vs. 6.35 minutes (p<0.0001).

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References in Appendix E, Evidence Summary Tables

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