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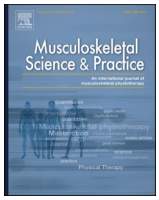

Review article

Utilisation and experience of emergency medical services by patients with back pain: A scoping review

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ABSTRACT

Background: Back pain is recognised as a common reason for people to access emergency medical services (EMS). EMS focus on identifying and treating serious and life-threatening conditions. Back pain frequently has a non-specific cause, however back pain is also a symptom for potentially serious pathology best suited for management by EMS.
Objectives: This scoping review explores how and why patients with back pain access EMS, the care provided, and patients' and clinicians' perceptions of EMS.
Methods: The established methodology advocated by the Joanna Briggs Institute was followed. Literature was identified via a comprehensive search of six databases as well as grey literature searching. Data was extracted to form a narrative review supported by summary tables and figures.
Results: The review included 144 papers across the last 36 years, with half the papers published since 2018, the majority from the USA and Australia. Rates of back pain presentation range from 1 to 9% depending on the definition used, with the rate of serious pathology higher than in primary care. Patients present due to concerns about their condition, positive perceptions of the care provided by EMS and difficulty in accessing primary care. Imaging and opioids are widely used, blood markers may aid diagnosis of serious pathology, whilst physiotherapists in Emergency Departments may support management of patients without serious pathology.
Conclusions: Back pain is a common reason for EMS presentation. Whilst non-specific back pain is the most common diagnosis further research to support the recognition and care of serious cases would be beneficial.

1. Introduction

Back pain is a common cause of pain and disability. It is estimated to affect about 80% of the population during their life, with a point prevalence rate of 12% (Hoy et al., 2010, 2012). Only a small minority (<1%) are believed to have a serious underlying pathology that requires emergency treatment (Henschke et al., 2009). Back pain has been identified as a common cause for emergency presentation, and patients presenting to emergency medical services (EMS) are more likely to receive imaging than those presenting elsewhere (Downie et al., 2020). EMS focuses on identifying and treating serious and life-threatening conditions. It has been argued that care provided by EMS to patients with back pain is of low value (Machado et al., 2017; Buchbinder et al., 2020) and, rather than providing unnecessary and expensive investigations and treatment, it would be more appropriate for these patients to be referred back to primary care. This is especially relevant as, although the exact reasons vary, it is recognised that demand on EMS has been rising globally (Lowthian et al., 2011; NHS England, 2019). However, more recently, it has been argued that those who present to EMS with back pain may be substantially different to those that present to primary care services and thus the assessment and treatment provided may be appropriate (Ferreira et al., 2018; Machado et al., 2020; Capsey et al., 2022a; Melman et al., 2022). There are guidelines specific to managing back pain in EMS; established guidelines focus on primary care and some studies have tried to enhance emergency care based on these (Potier et al., 2015).

To ensure limited resources are used effectively and appropriate treatment is provided in the most appropriate setting there may be a need to develop bespoke EMS guidelines for those presenting with back

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Abbreviations

APP	advanced practice physical therapist
BMI	body mass index
CES	cauda equina syndrome
CRP	C-reactive protein
CT	computer tomography
ED	emergency department
ESR	erythrocyte sedimentation rate
ICD-9-CM	International Classification of Diseases 9th edition Clinical Modification
LBP	low back pain
LOS	length of stay
MRI	magnetic resonance imaging
MSK	musculoskeletal
NSAID	non-steroidal anti-inflammatory drug
RCT	randomised control trial
SEA	spinal epidural abscess
SLR	straight leg raise

pain. However, this is difficult as there is a lack of evidence about EMS use by people with back pain, making it hard to plan care. Little is known about the extent and nature of use or the expectations and experiences of care of both the patients and clinicians. Such information would help develop an understanding of current practice and provide a foundation for guiding EMS practice relating to back pain and identify the key research needs in this area.

The aim of this scoping review was to explore the existing literature regarding use of EMS by patients with back pain, to examine and conceptually map the evidence, and to identify any gaps in the literature. Its primary aim was to explore how and why patients with back pain access EMS. A secondary aim was to explore the experiences of patients and clinicians, including the care provided and the perceptions of this care.

2. Methods

The scoping review was conducted following the Joanna Briggs Institute methodology (The Joanna Briggs Institute, 2015) and adhered to the PRISMA extension for scoping reviews (PRISMA-ScR). The review methodology developed a research question and inclusion criteria using a Participant, Concept and Context structure; search strategy; screening and selection; data extraction and data analysis. The study protocol has been published previously (Capsey et al., 2018).

2.1. Eligibility criteria

2.1.1. Participants

Studies that included adults with back pain were the focus of the review. The term back pain can be difficult to define and several variations on the term are used in the literature. Using too narrow a definition might exclude relevant studies, as such any study stating it was looking at back pain was considered. However, studies focusing solely on back pain following major trauma (such as road traffic accident) were excluded. Whilst back pain may be present following major trauma there will be additional signs and symptoms. There are separate well-established guidelines on the management of trauma (National Institute for Health and Care Excellence, 2016).

2.1.2. Concept

The concepts considered were health care utilization and patient experience. The two terms expressed the quantitative and qualitative aspects of patients' use of EMS. Utilization referred to the quantitative description of how people use EMS, this could include prevalence, diagnoses, use of investigations or treatments. Experience referred to the aspects explored through appropriate qualitative methodologies. The dual definition of concepts ensured that all methodologies (qualitative, quantitative, and mixed) were included.

2.1.3. Context

The context for this review was emergency medical services (EMS). The term encompassed care delivered in any setting that provides emergency or unscheduled care. EMS is widely used in the international literature applied to both hospital-based emergency department care, ambulatory care, and ambulance services. Services characteristically do not require an appointment and are usually accessible 24 h a day. The review considered any studies that were conducted in emergency medical settings including hospital emergency departments, ambulance services, out of hours primary care, and associated telephone services.

The review considered studies published after 1987 when Waddell's landmark paper (Waddell, 1987) marked a change in approach towards a biopsychosocial understanding of back pain management. All geographical contexts were considered however due to a lack of suitable translation services only papers with an English language version were included.

2.2. Information sources

Medline, CINAHL, EMBASE, PsychINFO, AMED and TRIP databases were searched for published peer-reviewed papers. The ISRCTN Registry and EU Clinical Trials Register were searched to identify potential trials. Websites of relevant clinical guidelines from the UK, Australia (GAC, 2016), USA and Canada were searched along with any relevant reference lists and development notes. OpenGrey was searched for grey literature in Europe. Where protocols were identified publications of results were searched for. If results were identified the protocol was then removed from the review, if no results could be identified then the protocol was retained. Once papers were identified for inclusion in the final review their reference lists were searched for further relevant papers.

2.3. Search

An initial limited keyword search of EMBASE, Medline and CINAHL was undertaken to identify subject index terms used to describe articles. In consultation with an academic librarian this informed the development of a detailed search strategy which was tailored for each information source. A full search strategy for Medline (and other EBSCOhost databases) and EMBASE are detailed in Tables A and B in the supplementary file. The final search was updated 28th August 2023.

2.4. Study selection

Sources identified during the search were collated and duplicates removed. Titles and abstracts were screened by two independent reviewers against the inclusion criteria. Those that were retained following the initial screening were retrieved and following a full text read were retained or excluded with reasons. Any disagreements that arose between reviewers were resolved through discussion. The reference lists of all included sources were screened for additional relevant papers.

2.5. Data charting process and data items

Once the list of included papers was agreed data items were extracted and summarised by two independent reviewers using a data charting table (Table C in supplementary file). Reviewers completed the table independently and then results were collated and agreed. Scoping reviews map what evidence has been produced regardless of quality

therefore a formal assessment of methodological quality is not advocated (The Joanna Briggs Institute, 2015). Despite there being no quality assessment, designs and methodologies of included papers were extracted and charted.

2.6. Synthesis of results

Data charting tables were reviewed and collated into an overall summary table. The results of individual data items were assessed for the most suitable method of presentation. Publication dates, study design and geographical location have been presented in table or diagrammatic form. Results related to methods of defining back pain and the five initial review questions are presented narratively.

3. Results

The search strategy initially identified 5223 records. After screening 144 papers were included in the review. The process is summarised in the PRISMA diagram (Fig. 1). Papers excluded at full-text read, with reasons, are summarised in Table D and incidences of multiple papers from the same underlying study are summarised in Table E, both in the supplementary file. Table 1 summarises each of the included studies.

3.1. Frequency, methods and geographical distribution

Methods used across the papers were varied (table F in the supplementary file). There were 11 discussion papers, presenting either expert opinion on how to approach the assessment of back pain or the challenges of this patient group; six case studies or case series, (including one focusing on guideline development and one on a service improvement project). Of the 14 literature reviews four included a meta-analysis and two were shortcut or rapid reviews. Two protocols were included: one for an RTC and one for a qualitative study. Of the papers following an experimental or quasi-experimental method, 49 were retrospective studies of existing data. The 44 prospective studies used a range of designs, including cross-sectional or before and after studies. Only 17 studies used randomised designs reflecting the challenges of research in the emergency medicine setting. Six studies, and one protocol, used qualitative methods.

Between 1988 and 2009 the cumulative total of publications was 15 papers. The total when the search was updated on 28th August 2023 was 144, with 19 papers published in 2020, 21 in 2021 and 21 since the start of 2022. This growth in research in the area of back pain in EMS is illustrated in Fig. 2.

Most studies originated in the United States of America (n = 61) followed by Australia (n = 33). Further detail of the geographical distribution of papers is shown in Fig. 3. Work published in the USA was spread across the 36 years of the review, in comparison with 26 of the 33 papers from Australia being published after 2017.

Twenty-one papers of the 144 studies provided figures for the frequency of back pain as a percentage of overall presentations, these varied from 1% (Thiruganasambandamoorthy et al., 2014) to 9.3% (Mullins et al., 2021). An area that was addressed by very few papers (n = 7) was the prevalence of serious pathology in those presenting with back pain. Many papers specifically excluded serious diagnoses when analysing back pain patients. The findings from those papers that did look at serious pathology are summarised in table E in the supplementary file.

3.2. Reasons for accessing emergency medical services

In relation to why patients access emergency medical services five papers explored patients' reasons (Stafford et al., 2014; Saggers et al., 2021; Kawchuk et al., 2022; Oshima et al., 2022; Kim et al., 2023). They identified that patients' decisions were influenced by concerns that their condition was serious, lack of access to primary care, and perceptions of the resources available in the Emergency Department (ED). Supporting this Oliveira et al. (2022) highlighted that patients with LBP attending

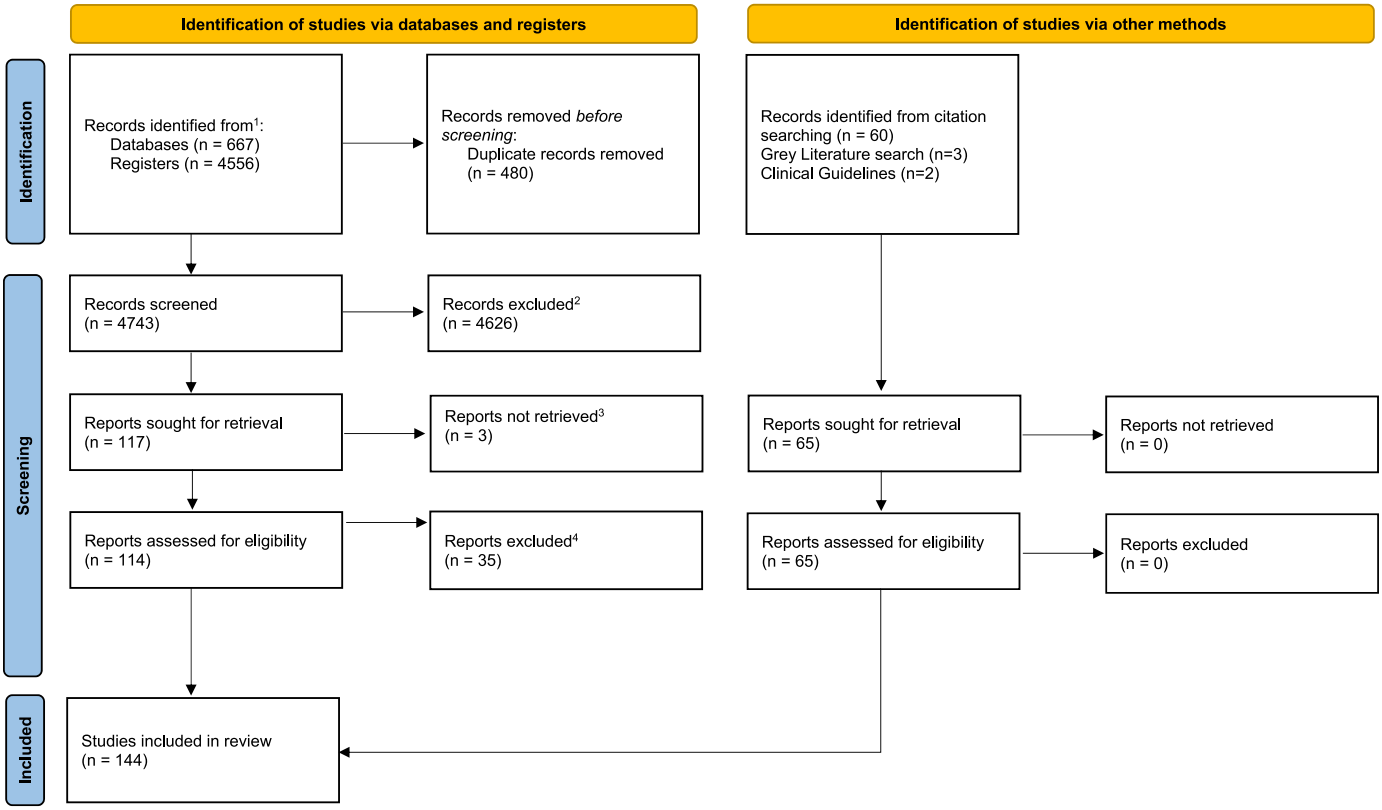

Fig. 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources (Page et al., 2021).

Table 1
Summary of included papers.

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
Association of Ambulance Chief Executives (AACE) (2022)	Clinical Guideline	Ambulance Service	UK	Clinician defined		Summarises incidence, severity and outcome, differential diagnoses, serious pathologies, urgent conditions, assessment and management, pain management, simple exercises, and safety netting. Cited references are mostly based in primary care or orthopaedic practice
Aaronson et al. (2017)	Retrospective Cohort Study	ED	USA	Clinician defined. ICD-9	44% female. Mean age 46 (±17)	Impact of MRI imaging on the rate of return visits. 6094 patients with back pain were evaluated in c.30 months 13% of back pain patients (n = 797) received an MRI. 4.5% of all back pain patients returned within 7 days (n = 277). MRI increased mean length of stay but had no impact on return visits.
Akbas et al. (2020)	Prospective Parallel RCT	ED	Turkey	Clinician defined. Acute low back pain (LBP) related to lumbar disk herniation	4.2% of adult patients admitted to ED had acute LBP	Randomised participants n = 120 Use of intradermal mesotherapy for analgesia Pain intensity decrease was higher for mesotherapy group versus systemic therapy ($p < 0.001$)
Alerhand et al. (2017)	Systematic Literature Review	ED	USA	Not specified	Spinal epidural abscess (SEA) incidence is estimated at 2.5–3 patients per 10,000 admissions.	Critique of red flags related to spinal epidural abscess The "classic triad" (Spinal pain, fever and neurological deficits) presents infrequently. MRI is the best diagnostic imaging tool for SEA and early diagnosis is the major prognostic factor for favourable outcome
Ali et al. (2021)	Retrospective secondary data analysis	ED	USA	Clinician defined, suspected spinal infection	960 MRIs examinations for suspected spinal infection were conducted in a 75-month period. Median age 54.5 (IQR:37-66), 52.5% male	To investigate predicative value of raised CRP for spinal infection. 13.6% of patients receiving an MRI for suspected spinal infection had a positive finding. Raised CRP level (>10 mg/L) showed 100% sensitivity, 100% negative predictive value and 35% specificity. Abnormal CRP, although extremely sensitive, lacks specificity in predicting a positive MRI for spinal infection unless highly elevated. A normal CRP makes spinal infection unlikely, and its routine use as a screening test can help reducing utilization of emergent MRI for this purpose.
Anderson et al. (2020)	Retrospective Secondary Data Analysis	ED	USA	Clinician defined. ICD-9-CM and documented reason for visit	Estimated 8.6million ED visits for LBP (2014 and 2015), 3% of estimated total. 59.1% female. Average age 45	LBP subgroup (n = 1363) of nationally representative sample (n = 44,905) Exploration of opioid therapy 60.1% of patients received opioids, 39.9% received non-opioids only. Use of opioids

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						increases ED length of stay (LOS).
Angus and Horner (2019)	Shortcut Literature Review	ED	UK	Not specified		The role of sexual dysfunction as a red flag in cauda equina syndrome Whilst clinician recording appears to be poor between 12% and 96% of patients with confirmed CES will report the presence of new-onset sexual dysfunction at presentation when asked.
Angus et al. (2020)	Service Improvement Study	ED and Emergency Assessment Unit	UK	Clinician defined		Pathway development using consultant physiotherapists for complex back pain patients presenting to ED. The new model reduced admissions, length of stay and return visits. It improved staff and patient satisfaction.
Australian Commission on Safety and Quality in Healthcare (ACSQ) (2022)	Clinical care standard	Various settings including ED	Australia	Clinician defined		To improve the early assessment, management, review, and appropriate referral of patients with low back pain. To reduce the use of investigations and treatments that may be ineffective or unnecessary in managing low back pain. It specifically does not cover the diagnosis and treatment of specific causes of low back pain.
Bailes et al. (2021)	Retrospective Observational Study of Electronic Health Record Data	Patients recruited in outpatient offices	USA	Clinician defined. ICD-9, ICD-10	39.4% of patients presenting to outpatient offices for LBP presented to ED in the following 365 days. 58.0% female. Average age 52.6 ± 19.5	An exploration of resource use for patients with back pain including, but not exclusively, ED. Participants (n = 513,088) with a diagnosis of LBP over a 10.5 year period. Comorbid depression or anxiety was present in 21.4% of patients, differences in pain scores were not clinically significant but they were more likely to present to ED
Bailey et al. (2013)	Longitudinal Data Analysis	ED	USA	Clinician defined. ICD-9-CM		Exploration of the use of health information exchange to reduce diagnostic imaging in emergency back pain. Participants: all repeated ED patient visits for back pain with previous ED diagnostic imaging over a two-year period (n = 800). Health information exchange use was low, it's use was associated with reduced radiographic and MRI imaging but increased CT-scans
Balakrishnamoorthy et al. (2015)	Double Blind RCT	ED	Australia	Clinician defined. "Low back pain with radiculopathy"		Use of dexamethasone in addition to routine treatment. Participants n = 58. The addition of dexamethasone improved pain scores at 24 h and reduced LOS. It had no significant effect on 6-week pain score or functional scores.
Behrbalk et al. (2014)	Prospective Single-blind RCT	ED	Israel	Clinician defined. "Severe acute LBP"	59.3% female. Average age 43 ± 11	Use of promethazine (anxiolytic) adjunct therapy with morphine versus

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						morphine alone. Participants n = 59 The addition of promethazine had no advantage on pain scores and increased LOS
Bertalanffy et al. (2005)	Prospective, Randomized control study	Ambulance Service	Romania	Clinician defined		To evaluate the efficacy of paramedic-administered TENS in patients with acute low back pain during emergency transport. TENS was found to be effective in reducing pain and anxiety in patients with acute LBP during emergency transport.
Blokzijl et al. (2021)	Qualitive Interviews using framework analysis	ED	Australia	Not specified		Investigation of the overuse of imaging for patients with LBP in the ED. Focus groups and/or interviews with 14 patients and 12 clinicians. Patients reported that decisions were made by the clinician, these might be driven by expectations of imaging, reluctance to delay receiving a diagnosis or requirements from third parties. Clinicians identified lack of ongoing therapeutic relations and manging patient pressure as drivers if imaging use.
Borczuk (2013)	Literature review and discussion	ED	USA	Search used a glossary of common terms		Advocating an evidence-based approach to evaluation and treatment. The review advocates a red flag approach to management pre-hospitally; in ED a detailed history and use of risk stratification to inform laboratory assessment and imaging.
Borges et al. (2020)	Retrospective cross-sectional study	ED	Brazil	Clinician defined. Patients triaged with low back pain symptoms via the Manchester Triage System (MTS) into non-traumatic, traumatic and non-spinal related.	2016 patients presented in 2013. 50.4% female. Mean age 40.5 (SD 15.7) 50.4% non-traumatic, 31.7% traumatic, 17.9% non-spinal	Description of patient profile and management. Patients n = 2016. Non-traumatic back pain was the most common reason for patients presenting with low back pain.
Buchbinder (2017)	Qualitative element of a mixed-methods study	ED	USA	Patient defined. Those who reported back pain as their primary complaint		Study of patient/provider communication related to gatekeeping. Based on audio recordings of 74 ED encounters. ED clinicians perform a gate-keeping role in identifying patients unsuitable for management in ED alongside signposting to more appropriate care. There is an element of managing scarce resources but also of addressing the vulnerabilities of disadvantaged patients in accessing healthcare.
Capsey et al. (2022a)	Retrospective secondary data analysis	ED	UK	Patient defined	2% of patients presented complaining of back pain. Median age for all patients was 46 (IQR 30–62), 55% female.	To quantify the prevalence of people attending ED with back pain, to describe their characteristics and the characteristics of their attendance. 36% had no official diagnosis recorded, 5% were categorised as potentially serious spinal pathology,

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						22% non-spinal pathology and 23% simple backache. 56% had no recorded investigations, 19% received plain radiography, 5% received either CT/MRI, 18% had blood investigations, 17% had cardiac monitoring or electrocardiogram.
Capsey et al. (2022b)	Retrospective secondary data analysis	Ambulance Service	UK	Patient defined	0.7% of calls were categorised as LBP. 59% female.	To investigate the extent and nature of ambulance services utilization by patients presenting with LBP. Almost half of patients (48%) initially presenting with LBP were later categorised with a problem elsewhere. Of the patients, 49% received analgesia, including Entonox (24%) and morphine (13%). Most patients (69%) were transported to an emergency department while 28% remained at home.
Cetin et al. (2021)	Multicentre cross-sectional observational study	ED	Turkey	Patient defined, admitted to the ED with a primary complaint of pain	Of patients presenting with a primary complaint of pain 18.8% reported lower back pain and 4.3% reported back pain.	To evaluate pain management practices in EDs in Turkey and to evaluate the prevalence and aetiologies of oligoanalgesia to identify possible improvement strategies. Lower back pain was the second most common pain presentation after headache. Patients were not separated by examination for the further analysis in this study.
Chandra et al. (2019)	Two-centre before and after practice evaluation	ED	Canada	Clinician defined. Canadian Emergency Department Information System (CEDIS)		Impact of Choosing Wisely Canada-Emergency Medicine (CWC-EM) recommendation on imaging rates. Participants (n = 37) were ED physicians. The intervention increased physicians' awareness and knowledge of the CWC-EM recommendations however lumbar x-ray imaging rates increased.
Chronister et al. (2020)	Retrospective secondary data analysis (Conference Abstract)	ED	USA	Clinician defined, ICD 10 codes for back pain	2.9% of ED visits recorded an ICD 10 code indicative of back pain.	To investigate if legislation resulting in a decrease in opiate prescribing led to a decrease in patient satisfaction. There was no change in ED back pain patient satisfaction scores after legislation, despite a marked decrease in ED opiate prescriptions.
Cofano et al. (2020)	Expert opinion (letter) discussing routinely collected data.	ED	Italy	Clinician defined		Back pain presentations to ED decreased after the Covid lockdown. Post lockdown patients were more likely to have a traumatic history and require tests
Cohen et al. (2017)	Multi-site RCT	ED	Australia	Clinician defined. Acute/ acute-on-chronic LBP		An investigation into the effectiveness of acupuncture compared to pharmacological management. Patients with acute LBP (n = 270) over a two-year period. There was no difference in pain management between acupuncture and pharmacological approaches.

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
Coombs et al. (2021)	Prospective Multi-centre pragmatic stepped-wedge, cluster-randomised trial of a service improvement intervention	ED	Australia	Clinician defined. Systematized Nomenclature of Medicine- Clinical Terms- Australian Version- Emergency Department Reference Set		Evaluation of an intervention to improve LBP care in ED by reducing imaging and opioid use. The intervention did not reduce imaging rates but did reduce opioid use. It also increased clinicians' beliefs and knowledge about low back pain
Coombs et al. (2021)	Systematic Review and meta-analysis	ED	Australia	Various diagnoses based on "non-specific low back pain"		Charting the clinical course of patients with non-specific LBP after an ED visit Mean pain scores were: 71.0% at presentation; 47.7% at 4 h; 46.1% at 1 day; 31.8% at 1 week; 24.8% at 6 weeks; 13.5% at 26 weeks.
Corwell (2010)	Expert opinion	ED	USA	Patient defined.		Discussion of the evaluation, management and treatment of back pain in the emergency department. Focused on red flags in the clinical history, physical assessment and treatment. Diagnostic testing is advocated if it will help guide patient management. Tests include routine blood, urinalysis. Imaging is only advocated if red flags are present and patient education is encouraged. Non-opioid analgesics are advocated over opioids. Also discusses potential serious pathologies.
Davidson et al. (2022)	Qualitative exploratory study	ED	Australia	Not specified		Identifying and exploring clinicians' perceptions of why patients with LBP present; to ED barriers and enablers to care; and strategies to improve care Participants felt ease of access and advanced care drive presentations; patient, clinician and service level factors are both barriers and enablers; an ED pathway, better resources and follow-up options could improve care.
Davidson et al. (2022)	Retrospective observational study	ED	Australia	Clinician defined.ICD-10	LBP accounted for 1.3% of all ED presentations. 51.7% female. Mean age 49.2 (20.0). Annual presentations grew at 3.2% per year between 2015 and 2019.	Describing the context of LBP presentations to EDs by remoteness, hospital delineation and staffing profiles. Length of stay decreased but re-presentation rates increased with increasingly remote departments, admission rates were lowest for "inner regional" EDs.
Davis et al. (2004)	Retrospective case-control study	ED	USA	Clinician defined. ICD-9 discharge code for intra-spinal abscess		Clinical presentation and impact of delays on SEA. Red flags in the diagnosis of spinal epidural abscess- "classic triad" present in only 13% of cases. Prognosis for full recovery was worse once all three deficits are present. 75% of SEA patients had diagnostic delays. ESR was more sensitive and specific than total white blood cell count (WBC) but had not

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						been recorded until the diagnosis had been suspected.
Davis et al. (2011)	Prospective cohort analysis	ED	USA	Study included patients diagnosed with SEA in ED. Also, all patients with a chief complaint of "neck pain" or "back pain"		Exploring the use of clinical decision guidelines in the assessment of spinal epidural abscess. The implementation of guidelines incorporating risk factor assessment followed by ESR and CRP testing reduced diagnostic delays (83.6%–9.7%) and motor deficits at time of diagnosis.
de Gruchy et al., 2015	Prospective observational cohort analysis	ED	Australia	Clinician defined	44.6% female. Median age 34.1 (IQR 25.0–52.0)	Analysis of physiotherapists as primary practitioners. Comparison with ED clinicians looked specifically at hand fracture, ankle sprain as well as lumbar pain. 95% of patients met a 4-h LOS target, 46% required no further medical support, most were referred back to primary care or outpatient clinic. APPs were more time efficient than ED clinicians for similar diagnostic groups.
de Jesús et al. (2022)	Retrospective Analysis	ED	USA (Puerto Rico)	Clinician defined.ICD-10-CM		ED utilization by older patients with musculoskeletal conditions Low back pain was the most commonly recognised MSK condition in patients aged 60–69, second most common in 70–79, 80-89, 100+ groups and third in those over 90-99.
de Luca et al. (2023)	Retrospective secondary data analysis	ED	Australia	Clinician defined, study looked at patients aged ≥65 years	Of 4093 presentations to ED over three years 82.0% were non-specific low back pain. 58.3% female	39.9% had lumbar imaging, 34.1% were admitted. 67.1% received opioid analgesics, 63.9% paracetamol, 33.0% NSAIDs.
Della-Giustina (2015)	Discussion Article	ED	USA	Not specified		Evaluation and treatment of acute back pain. Emphasis on red flag focused history and physical examination. MRI advocated for suspected spinal infection and epidural compression syndromes.
Downie et al. (2020)	Systematic review and meta-analysis	ED and primary care	Australia	Not specified		Estimating the proportion of patients seeking care for LBP in primary care and ED receiving imaging, along with trends over time. For ED: simple imaging proportion 26.1%, complex imaging proportion 8.2%, any imaging 35.6%. These figures are higher than in primary care. Complex imaging requests increased between 1995 and 2015 by 53.5%.
Drazin et al. (2016)	Retrospective multivariate analysis of Nationwide Inpatient Sample	ED admitted to hospital	USA	Clinician defined.ICD-9-CM		ED utilization by patients with LBP, specifically admission following assessment. An increasing proportion of patients discharged from hospital with a diagnosis of LBP were admitted via ED (n = 118,962 over 10 years, 1998–2007). Socioeconomic factors may play a role in ED

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						utilization by patients with LBP.
Dubosh et al. (2019)	Retrospective analysis of population-based data	ED	USA	Clinician defined.ICD-9-CM	57% female. Mean age 44 (IQR 33-55)	Incidence of serious neurologic conditions in patients initially discharged from ED with non-specific diagnosis of back pain or headache and associated risk factors. Patients discharged from ED with a diagnosis of back pain (n = 1,381,614) over seven years. 0.2% of those discharged with a non-specific diagnosis of back pain had a primary outcome. Of these 41% had an intraspinal abscess. Risk factors were advanced age, male, non-Hispanic white, and comorbidities.
Dutch et al. (2008)	Retrospective multi-centre analytical observational study	ED	Australia	Patient defined. Triage description related to back pain.		Impact of "liked" and "disliked" presentations on waiting times. Data: 28,566 case-control pairs of ten complaints, of which back pain was one. Back pain had been identified as a disliked category in a previous pilot study, it had significantly longer waiting times than a matched control in this study (+25.5%, $p < 0.05$).
Edlow (2015)	Expert opinion	ED	USA	Patient defined	States 2-3% of emergency visits are non-traumatic back pain.	Expert opinion on diagnosis and management of back pain (divided into simple, serious and non-spinal causes of back pain) in ED. Recognises that the ED population is "acuity-skewed" and suggests ED will likely encounter more patients with serious causes.
Edwards (2016)	Systematic review and retrospective cross-sectional analysis	ED	Canada	Various, study included ICD-9 & ICD-10	Pooled prevalence in literature review = 4.39% Back pain prevalence in Canadian ED 3.17%. 60.8% Non-specific LBP (prevalence 1.93%)	To gather a comprehensive and global perspective about the prevalence of low back pain in emergency settings and analyse six years of data from a local emergency setting (Masters Dissertation)
Edwards et al. (2017)	Systematic review and meta-analysis	Various emergency settings	Canada	Various, separated into "broad" or "narrow"	Pooled prevalence 4.39%. Defined by presenting complaint 5.5%, by diagnostic coding 3.4%	Review of the literature on the prevalence of low back pain in emergency settings and the impact of study characteristics Low back pain is consistently a top presenting complaint in ED, the reported prevalence of low back pain varies with definition of low back pain and emergency setting.
Eken et al. (2014)	Randomised double-blind study	ED	Turkey	Clinician defined. Acute mechanical low back pain. Defined using a 4-point verbal rating scale, and having started in the last week.	Mean age 31.5 ± 9.5. 60.6% male	Comparison of the effectiveness of IV paracetamol vs dexketoprofen vs morphine in acute mechanical LBP. Participants, n = 137. Neither paracetamol, dexketoprofen nor morphine is superior to the others in treating acute LBP.
Elam et al. (1995)	Questionnaire	ED	USA	Three illustrative clinical vignettes of LBP: severe acute pain (with and		Determining ED physicians' approach to diagnosis and treatment of LBP. 114

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
				without radiculopathy) and chronic LBP		respondents from 283 surveyed. For acute pain 22% of consultants recommended CT, 36% recommended MRI; referrals to surgical specialists (orthopaedics or neurosurgery) for treatment were 81% for acute sciatica, 52% for chronic LBP and 41% for acute non-sciatic LBP; 87% of consultants recommended bed rest for acute sciatica, 75% for acute non-sciatic LBP, and 57% for chronic LBP. These recommendations were expensive and deemed to be of limited use.
Engel-Rebitzer et al. (2021)	Secondary analysis of RCT data	ED	Australia	Not specified		Exploration of racial disparities in opioid prescribing after accounting for patient preference. 1302 participants who presented to ED with ureter colic, MSK back and neck pain. Back pain was not separated in the analysis. Overall Black patients were less likely than White patients to receive a prescription for opioids, regardless of their treatment preference, even when clinicians were provided with additional data about their patients' preferences and risks.
Eskin et al. (2014)	Prospective randomised, double-blind, placebo-controlled trial	ED	USA	Clinician defined		To determine if a short course of oral corticosteroids benefits LBP ED patients. The study detected no benefit from oral corticosteroids in ED patients with Musculoskeletal LBP.
Fadel et al. (2020)	Retrospective secondary data analysis and provider survey (Conference Abstract)	ED	USA	Clinician defined, ICD-9 and ICD-10		Evidence based guidelines made no impact on CT imaging rates, lumbar MRI rates went up post introduction. 97.8% of providers agreed with the use of guidelines to make clinical decisions and 51.1% believed imaging is overused for LBP patients. However, 52.2% of providers were unaware of the guideline, 73.3% felt pressure from patients to obtain imaging, even if the guideline deemed unnecessary, 42.2% believed that denying patients imaging would lead to lower patient-satisfaction scores, and 15.6% felt that compliance with the guideline increased risk of litigation.
Ferreira et al. (2019)	Retrospective analysis of routinely collected data	ED	Australia	Patient defined. Key word search of reasons for visit	3.4% of presentations had a presenting complaint of 'back pain'. 45.6% of patients diagnosed with lumbar spine condition, 54.4%	Description of diagnoses of people with LBP and the proportion who arrived by ambulance, received imaging, opioids and were admitted to hospital.

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
					diagnosis beyond the lumbar spine	Presentations (n = 14, 024) over 30 months. 23.6% received lumbar imaging, 69.6% received opioids and 17.6% were admitted to hospital. Of the non-spinal diagnoses renal disorders was the most common (18.8%); 0.2% received a cancer diagnosis, and 0.2% vascular diagnosis. Of the spinal diagnoses 85.4% were non-specific LBP, 10.1% radicular LBP, and 4.5% serious spinal pathology. Ambulance arrival was associated with older age, higher socio-economic status but not seriousness of pathology.
Ferreira et al. (2021)	Retrospective secondary analysis	ED	Australia	Clinician defined. ICD-9, ICD-10, Systematized Nomenclature of Medicine Clinical Terms (SNOMED)	LBP prevalence 1.6%. Mean age 51.3 (SD 20.0). 51.9% female	To determine if rates of LBP presentation have changed between 2016 and 2019 (n = 188,275 across the five years). 88.6% of presentations were non-specific LBP, 7.0% radicular LBP, 4.3% serious LBP. Of the serious LBP, 52% were vertebral fractures, 27.4% infections and 9.9% CES. Presentation rates had increased and there was 20-fold difference in presentation rates between regions with the higher rates in rural and regional areas, and lower in metropolitan areas.
Forseen and Corey (2012)	Discussion Article	Ambulatory Care settings	USA	Descriptive		Presentation of templates for evidence-based decision making Description of the process of developing clinical decision support from national guidelines to address a perceived variance between clinical practice and the best available evidence. There is no assessment of the effectiveness of the proposals.
Friedman et al. (2006)	Randomised, double-blind, placebo-controlled trial	ED	USA	Clinician defined. "Originating below the tips of the scapulae and above the buttocks" with a negative SLR		Intramuscular corticosteroids compared to placebo as an adjunct to normal care. Participants (n = 87) with non-traumatic low back pain and -ve SLR. Systemic corticosteroids had no statistically or clinically significant impact on patient pain at 1-month
Friedman et al. (2010)	Retrospective secondary analysis	ED	USA	Clinician defined. Primary reason for visit and discharge code (ICD-9) related to back pain	LBP prevalence at ED 2.3%.	Exploration of prevalence, analgesia and imaging practices. Participants (n = 4097) from a representative national sample (n = 183,633) over five years. 30.5% received a plain radiograph, 9.6% had CT or MRI in 2006, compared to 3.2% in 2002. 61.0% received opioids, 49.9%

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						NSAIDs, 43.1% muscle relaxants.
Friedman et al. (2012)	Prospective observational cohort study	ED	USA	Clinician defined. "Originating below the tips of the scapulae and above the buttocks" sub-divided into chronic, episodic and rarely/ never	Median age 45 (IQR 35-53). 61% female	Risk factors for 7-day and 3-month functional disability. Participants n = 556. Higher baseline functional limitation and history of chronic LBP were both predictors of increased functional disability at 7-days and 3-months. Radicular signs, depression and work-related injury were not predictive.
Friedman et al. (2012)[4]	Prospective observational cohort study	ED	USA	Clinician defined. "Originating below the tips of the scapulae and above the buttocks" sub-divided into chronic, episodic and rarely/ never	Median age 45 (IQR 35-53). 61% female	Description of 7-day and 3-month pain and functional outcomes. Participants n = 556. At 7-days 70% had functional impairment, 59% had moderate or severe LBP, 69% had used analgesics in the previous 24-h. At 3-months 48% had functional impairment, 42% had moderate or severe LBP, 46% had used analgesics in the previous 24-h.
Friedman et al. (2020)	Randomised double blind study	ED	USA	Clinician defined. "Originating between the lower border of the scapulae and the upper gluteal folds" and discharge diagnosis consistent with acute nontraumatic, non-radicular, MSK LBP		Assessment of ibuprofen plus acetaminophen versus ibuprofen alone on pain and functional impairment. Participants n = 120 There was no significant difference in outcomes for the two groups at 48-h and 7-days. In both groups ~25% of patients reported moderate or severe pain or functional impairment at 7-days.
Galliker et al. (2020)	Systematic literature review	ED	Switzerland	Various reported	Review found a higher prevalence of serious spinal pathologies in ED compared reported prevalence in primary care	Exploration of the diagnostic accuracy of red flags, and the prevalence of serious spinal pathology. Prevalence LBP presentations requiring immediate/urgent treatment 2.5%–5.1% in prospective, 0.7%–7.4% in retrospective studies. Suspicion or history of cancer was a red flag for spinal cancer diagnosis; Intravenous drug use, indwelling vascular catheter and another infection site were red flags for epidural abscess. Decreased likelihood was associated with no risk factor, normal ESR and no suspicion or history of cancer. Of 84 red flags only two were investigated n more than one study.
Gotfryd et al. (2015)	Prospective Observational cross-sectional study	Orthopaedic ED	Brazil	Clinician defined. Pain in the dorsal and/or lumbar region	3% of orthopaedic cases met the inclusion criteria for the study. Mean age 39.3. No gender predominance	Predictive value of epidemiological data, lifestyle and psychosocial factors in clinical manifestations of back pain. Participants (n = 210) with major complaint of back pain. Majority of participants worked in administrative roles (65.2%); mean BMI was 26.0 indicating overweight; 83.3% had low physical

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						disability. Increasing number of medical visits in the previous six months and depression independently correlated with physical disability.
Hänninen et al. (2020)	Pilot service improvement programme evaluation	Community Paramedic Unit	Finland	Clinician defined. International Classification of Primary Care (ICPC-2)		Rate of recontacting ED following community paramedic (CP) assessment. Participants: CP unit patients seeking retreatment (n = 229) after a CP unit visit. The study was not back pain focused but LBP (27%) and nausea (42%) were the main problems that led to recontact within 96 h.
Harwood et al. (2022)	Retrospective secondary data analysis	Various providers including ED	USA	Clinician defined		To examine how the first provider seen by an individual at initial diagnosis of LBP influences downstream utilization and costs. Patients who were first seen by an emergency medicine providers had higher rates of early opioid prescription but lower rates of long-tern opioid prescriptions, Rates of imaging were similar to other providers, as was the rate of serious illness.
Havel et al. (2001)	Protocol-Randomised Controlled Factorial Trial	ED	Austria	Clinician defined. "localised between 12th rib and gluteal fold"		Effectiveness of intravenous analgesics vs oral NSAIDs in the ED and centrally acting muscle relaxant vs placebo over the following three days. No paper reporting the results of the proposed trial were located.
Hayes (1999)	Retrospective descriptive review of records with telephone follow-up	ED	USA	Not specified		Description of repeat users of a rural ED. 28 patients presenting in one-week period who had previously presented within the preceding three months. A wider review which included descriptions of repeat users, back pain was cited as a more frequent complaint- 2 patients out of 28 repeat users (7.1%) identified in the one-week study period.
Irizarry et al. (2021)	Randomised Controlled trial	ED	USA	Clinician defined		To compare ibuprofen, ketorolac, and diclofenac for the treatment of acute, Non-radicular LBP. There were no important differences between groups with regard to the primary outcome. These data do not rule out that possibility that ketorolac results in better pain relief and less stomach irritation than ibuprofen.
Isenberger and Salzman (2013)	Retrospective observational study	ED	USA	Not specified		Satisfaction of patients with limited treatment options: abdominal pain, dental pain, low back pain and headache. 14,051 participants from 28,021 eligible. The conference abstract reported that the patient satisfaction scores of LBP patients was not different

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						from the combined score of all other chief complaints.
Jones et al. (2023)	Triple-blinded randomised placebo-controlled trial	Primary care and ED	Australia	Clinician defined		To investigate the efficacy and safety of a judicious short course (up to six weeks) of an opioid analgesic for acute low back pain and neck pain. There was no significant difference between the opioid and placebo groups for pain severity at six weeks, there were similar rates of adverse events although the opioid group were more likely to report opioid-related adverse events (e.g. constipation).
Jorgensen (2007)	Retrospective descriptive study	ED	USA	Clinician defined. ICD-9-CM	Acute exacerbation of chronic back pain accounted for ~2.1% of admissions to the ED during the study period. 74% were assigned to the top three (of five) codes for severity	Documentation of the cost of ED presentations (n = 1397) for acute exacerbation of chronic non-malignant back pain. Of 1397 visits in the 12-month study 30% were multiple visits; 3% of the patients were seen 3 or more times but accounted for 12.4% of charges. ED may be a costly venue for management of chronic back pain.
Kawchuk et al. (2022)	Prospective observational study	ED	Canada	Patient defined		To understand why persons with low back pain choose to attend the emergency department. 17.7% received at least one consultation, 89.0% of participants were discharged home, 9.6% were admitted and 1.4% were transferred. Median pain intensity was 8/10 and a median daily functioning of 3/10. When asked, 64.6% attended for pain control; 44.5% stated ease of access. Most participants expected to obtain pain medication (67%) and advice (56%). Few attended because of cost savings (3.8%). After adjustment, only advanced age and ambulance arrival were significantly associated with admission.
Kim et al. (2018)	Discussion Article	ED	USA	Not specified		Description of scope and potential impact of physical therapists in ED. The article sets out the case for ED, LBP is cited as a typical consultation where a physical therapist may aid the ED physician in providing more appropriate care.
Kim et al. (2019)	Retrospective cohort study	ED	USA	Clinician defined. ICD-10		Comparing analgesic prescribing between physical therapists and usual care. Physical therapists prescribed opioids at a similar rate, and benzodiazepines at a higher rate, to usual care.
Kim et al. (2020)	Prospective feasibility study	ED	USA	Clinician defined. <2 weeks duration, localised between 12th rib and buttocks		Feasibility of initiating a physical therapy intervention in ED

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						The majority of patients were able to retain instructions after a brief physical therapist intervention in ED, however they rarely used an online educational resource provided at ED discharge. No outcomes related to pain or function were reported.
Kim et al. (2021)	Prospective observational study	ED	USA	Clinician defined. <2 weeks duration, localised between 12th rib and buttocks	Median age 40.5. 59% female	Comparison of patient-reported outcomes between physical therapy (n = 74) and usual care (n = 370) over a 17-month period. The ED-initiated physical-therapy group had higher baseline scores for functioning, had greater improvements at 3-month follow up and lower use of high-risk medications (opioids, benzodiazepines and skeletal muscle relaxants).
Kim et al. (2023)	Qualitative study, focus group and individual interviews	ED	USA	Clinician defined		To explore patient perspectives on visiting the ED for low back pain to inform a more patient-centred approach to emergency care. identified 5 summary themes: (1) the decision to seek emergency care for low back pain is motivated by severe pain, resulting disability, and fears about a catastrophic diagnosis, (2) participants sought various goals from their ED visit but emphasized the primacy of pain control, (3) participants were reluctant to use pain medications but also acknowledged their benefit, (4) participants perceived a number of benefits from direct access to an ED physical therapist in the ED, and (5) participation in physical therapy ultimately facilitated recovery, but the pain was a barrier to performing exercises.
Kocak et al. (2019)	Prospective randomised trial	ED	Turkey	Clinician defined. <48hrs LBP with an identified trigger point cause		Intravenous NSAIDs versus trigger point injection of local anaesthetic. Sample (n = 54) of patients presenting to ED with complaint of LBP. Across the 60-min follow-up period those in the trigger point injection (n = 22) appear to have had a greater decrease in their pain than those receiving NSAIDs (n = 32) at all time points.
Kohns et al. (2018)	Prospective observational study	ED	USA	Clinician defined. ICD-9	Mean age 43.8. 56.2% female.	Relating the ordering of advanced imaging and opioid prescriptions with the presentation of LBP in ED. Sample n = 600. 63.5% had warning signs of a potentially serious condition, 83.9% had psychosocial factors. 16.6% received CT or MRI, 52.6% were prescribed opioids and 4.5% were

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						admitted to hospital. Ina one-year follow-up sample 40.8% received subsequent spine care and 5.1% had a medically serious condition.
Lau et al. (2008)	Assessor-blinded randomised trial	ED	Hong Kong	Clinician defined. <24hrs		Assess the effect of ED initiated physiotherapy on pain and patient satisfaction. Sample n = 110. Those in the intervention group (n = 55) had an average of 1.6 points (out of 10) less pain at ED discharge and 0.9 less on admission to the outpatient physiotherapy department, but this had disappeared by one month. They were 2.1 points (out of 20) more satisfied with their care.
Liu et al. (2018)	Systematic review	ED or other acute care setting	Canada	Not specified		Review of the effectiveness of interventions to reduce image ordering. Of five papers included in the review, four reported a decrease in their specific imaging modality following an intervention, one reported a 35% increase in referrals following intervention. One study that decreased referrals for simple radiography reported a subsequent 15.4% increase in referrals to CT and myelography.
Liu et al. (2019)	Before and after observational study of a service improvement project	ED	Sweden	Patient defined. "Main complaint was back pain"		Service improvement redesign of ED, interprofessional teams (n = 21,738) versus fast-track streaming (n = 22,593). Comparison periods both one year. Looked at differences in time to physician and LOS for limb injuries and back pain. Looking at back pain patients in the analysis, results showed time to physician was shorter in the teamwork period, but length of stay was on average slightly increased. CT requests were higher in the teamwork period, but other types of imaging were lower- separate figures for back pain patients were not given in the imaging analysis.
Liu (2022)	Longitudinal evaluation of a service improvement.	ED	Sweden	Not specified		Evaluation of a service improvement redesign of ED, interprofessional teams versus fast-track streaming, including impact on patient flow and team behaviour. Thesis that includes more detailed findings from Liu et al. (2019) study II of the project. Conventional radiographs were requested for 51.4% of patients in the teamwork period compared to 52.8% in the fast-track period; CT was requested for 5.9% in the teamwork period compared to 4.8% in the fast track; the time from request of CT to result was longer in the teamwork period mostly

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						attributed to delays prior to imaging start. Separate figures for back pain patients were still not provided.
Logan et al. (2019)	Systematic review	ED and Primary care	Canada	Not specified	Only two of six included studies were set solely in ED	To determine the pooled proportion of CT and x-ray imaging of the lumbar spine that were considered appropriate in primary and emergency care. The pooled estimate for appropriateness of x-rays was 43% and the pooled estimate for appropriateness of CTs was 54%. Risk of bias was high in 4 studies, moderate in one, and low in one. GRADE for X-ray appropriateness was low quality and for CT appropriateness was very-low-quality.
Loh et al. (2022)	Case report	ED	Australia	Not specified		Report on "surfer's myelopathy" following presentation that included low back pain. Presenting symptoms were similar to cauda equina syndrome: lower limb weakness, sensory loss, urinary retention, and perineal paraesthesia 1 h after her first surf lesson. She was diagnosed with complete T7 spinal cord injury secondary to surfer's myelopathy.
Long et al. (2020)	Narrative literature review	ED	USA	Not specified		Evaluation of risk factors, signs and symptoms associated with CES Diagnosis is often delayed, red flags include bilateral sciatica, reduced perineal sensation, altered bladder function leading to painless urinary retention, loss of anal tone and loss of sexual function. In isolation history and physical examination have poor sensitivity. Diagnosis typically involves MRI or CT.
Long et al. (2022)	Expert opinion	ED	USA	Not specified		Evaluation of risk factors, signs and symptoms associated with SEA A challenging diagnosis with up to 90% misdiagnosed on their first ED visit. Risk factors include immunocompromise, bacteraemia, contiguous infection and spinal instrumentation. Absence of these does not preclude SEA. Whilst back pain is a common presenting symptom the "classic triad" (back pain, fever, and neurologic deficit occurs) is only present in 8% of cases. Diagnosis includes MRI and blood cultures.
Lovegrove et al. (2011)	Retrospective secondary data analysis	ED	Australia	Patient defined. "Back pain" as primary complaint	Prevalence 1.9%, of which 43.8% were simple low back pain. 51.4% female. Mean age 46.2, modal group 35-44	Examination of characteristics of those presenting to ED with a complaint of back pain including the prevalence of non-muscular causes for back

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						pain (n = 22,655 over five years). 15-years and >75-years were more likely to have non-muscular causes of their back pain. Presentations were mostly between 0800 and 1600 (35.8%) and higher at weekends (30.2%). Mean LOS was 4.4 h 88.9% presented only once, 3% three or more times. 25.4% of patients were admitted. Of the non-muscular group, the most common diagnoses were renal colic, sciatica/ radiculopathy, UTI or pyelonephritis. Other diagnoses included angina, myocardial infraction, pulmonary emboli and pancreatitis.
Ly et al. (2021)	Pre-post implementation service improvement study	ED	Australia	Clinician defined. ICD-10-AM		Introduction of a modified analgesic ladder and targeted education on oxycodone use. Sample n = 107 pre-intervention, n = 107 post-intervention. Patients receiving oxycodone dropped from 72.9% to 51.4% following the implementation, mean dose dropped from 14 mg to 5 mg and patients receiving a discharge prescription dropped from 33.6% to 24.3%. Post implementation paracetamol, NSAID and tramadol use increased.
Machado et al. (2017)	Discussion article	ED	Australia	Not specified		Description of usual care with discussion of potential strategies for restructuring ED practice and changing clinician and patient behaviour Most presentations in ED are similar to primary care and guidelines recommendations will help avoid low value care.
Machado et al. (2020)	Discussion article	ED	Australia	Not specified		Should primary care guidelines for LBP be adopted in ED ED sees a different spectrum of low back pain presentations, likely including a larger proportion of patients with an underlying serious pathology or non-spinal diseases than in primary care. Current low back pain guidelines do not adequately cover screening for these conditions.
Magnusson et al. (2021)	Retrospective secondary data analysis	Ambulance Service	Sweden	Clinician defined	Back pain was the presenting complaint for 2.5% of patients assessed by EMS, 1.2% of those hospitalised and 3.8% of those discharged from ED.	To describe the patients who are brought to hospital by the EMS, with particular emphasis on those that were discharged from the ED, and to assess the proportion of these patients who did not require hospital resources, which could mean that they were candidates for primary care.

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						Pre-hospital triage did not have the option of using the lowest code (alternative other than ED may be suitable). Back pain was the second most common complaint amongst patients who were transported to hospital by EMS but did not require hospital resources.
McCarthy et al. (2021)	Sub-analysis of RCT results	ED	USA	Not specified		Study on promoting safe opioid use after ED discharge. 267 completed diaries, back pain n = 45. Study was widely focused on oral opioid use after ED visits, it identified back pain patients as having the highest use, median of 12 tablets, median morphine milligram equivalents 65. Compared to all case values of 8 and 45 respectively. On the day of discharge 88.9% back pain patients consumed an opioid at home, increasing to 91.1% on day 1 after discharge, decreasing after that but remaining above the all case rate to day 9.
McCaughey et al. (2016)	Retrospective cohort study	ED	Australia	Patient defined. “Back pain” with triage categories 3, 4 and 5.	2.2% prevalence for "back pain". Mean age 49.1 (SD 21.0), modal category 26-35 years. 52.3% female	Quantifying imaging utilization for patients presenting to ED with back pain, characteristics and disposition. n = 1132 over one-year. Imaging was requested for 29.5% of presentations: 26.2% radiography, 5.6% CT or MRI. Rates were higher for older patients. Imaging was not associated with time of presentation and did not predict admission or re-presentation. Of those patients admitted 68.5% were diagnosed with an MSK disorder, the next most common was 6.3% with disorders of the kidney and urinary tract.
Medeiros et al. (2018)	Prospective inception cohort study	ED	Brazil	Clinician defined. >24hrs, <6 weeks		Utility of STarT Back Screening Tool to predict long term clinical outcomes and the best time for its use. Sample n = 200, presenting to ED with new episode of acute nonspecific LBP. 45% of patients were classified as high risk at baseline; most patients with medium or high classification changed their subgroup at 6 weeks usually improving. STarT improved 6-month prediction when administered at week 6 rather than baseline.
Meisel et al. (2022)	Parallel, multicentre RCT	ED	USA			Compare effectiveness of 3 approaches for communicating opioid risk. Sample, patients with chief complaint suggestive of kidney stone or musculoskeletal back pain (n

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						= 1301) recruited over 22 months. The study focused on back and kidney stone pain, the two groups were not separated in the analysis. The narrative enhanced probabilistic risk tool group had better risk recall at 14 days and a lower preference for an opioid medication at discharge. There was no significant difference in opioid use at 14 days between the three intervention groups.
Melman et al. (2022)	Retrospective secondary database analysis	ED	Australia	Clinician defined. Systematized Nomenclature of Medicine- Clinical Terms- Australian Version- Emergency Department Reference Set		Determine the proportion of patients admitted to hospital for back pain who have nonserious back pain, serious spinal or serious other pathology as their final diagnosis. n = 1982 across 57 months. Of patients admitted with an initial diagnosis of non-serious back pain, subsequent diagnoses identified a serious spinal pathology in 14.2% of patients and 23.9% a serious pathology beyond the lumbar spine.
Mills et al. (2011)	Retrospective cohort study	ED	USA	Not specified		Determination of the association between age and analgesia. Subjects n = 24,752. The study looked at back (n = 5948) and abdominal pain (n = 18,804), the conditions were not separated in the results. General results were that older adults who present to the ED are less likely to receive analgesia and wait significantly longer for it compared to younger adults.
Min et al. (2017)	Prospective single centre before and after study	ED	Canada	Clinician defined. Those with specific diagnoses were excluded	LBP prevalence 2% LBP was fifth most common discharge diagnosis	Determine whether point of care decision support can reduce inappropriate imaging of patients presenting to ED with LBP. Data collected on LBP patients seen by 46 physicians across 15 months (n = 1996). Imaging rates dropped after implementation, median 22%–17%, mean 23%–18%. There was no impact on patients later imaged at an outpatient clinic. No serious diagnoses were missed.
Morgan et al. (2013)	Retrospective observational study	ED	USA	Not specified		Determine which factors influence patient satisfaction in chief complaints with treatment options limited to symptomatic care. 2718 respondents from 5479 surveyed. Research forum abstract. Study looked at dental pain, low back pain and headache. Conditions were not separated in the results. Lower satisfaction was associated with longer wait

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						times, patient's self-assessment remaining the same or worsening after discharge. Patients who received more imaging reported higher satisfaction.
Mullins et al. (2021)	Retrospective secondary data analysis	ED	USA	Clinician defined	Proportion of overall ED presentations was stable. 9.1% in 2007, 9.3% in 2016.	Investigation of the trends in the evaluation and management of back pain in U.S. EDs from 2007 to 2016. Admission rates declined from 6.4% to 5.0%; imaging increased from 51.7% to 57.6% (with a 58.3% increase in CT use); Overall opioid use declined from 53.5% to 46.5%; tramadol use increased 4.1%–8.4%
Ngo et al. (2016)	Retrospective secondary data analysis	ED	Singapore	Not specified		Pilot study of the impact of physiotherapy services in ED. Data of 317 patients seen by on-site physiotherapist over 10 months. Conference abstract. Study focused on MSK conditions including back pain, but not separated in the analysis. ED physiotherapist patients started physiotherapy sooner and saw symptom resolution in fewer sessions than pre-implementation. Function and pain outcomes improved significantly. 91.3% of patients were satisfied with the service.
Nuhr et al. (2004)	Prospective randomized blinded trial	Ambulance Service	Austria	Clinician defined		Active warming reduces acute low back pain during rescue transport.
Nunn et al. (2017)	Retrospective cross-sectional analysis of clinical data	ED	Canada	Clinician defined. ICD-9	Median age 43% (IQR 30-57). 55% female.	Description of demographic and clinical characteristics of patients presenting to ED with non-urgent LBP. Simple random sample (n = 325) from patients presenting with non-urgent LBP over six years. Most patients did not have neurological symptoms (81%), or sciatica (68%). 22.5% had laboratory investigations, 29.5% received imaging (27.4% plain radiograph, 4.6% CT, 0.6% MRI), 59.4% received medication in ED, 20.8% of patients arrived by ambulance, 97.2% were discharged home
O'Cathain et al. (2022)	Cross-sectional survey	ED and primary care	UK	Clinician defined (with PPI input) vignettes representing minor or non-urgent problems		To identify the characteristics of the British population with a tendency to contact emergency medical services and EDs for minor or non-urgent problems. When asked how they would manage back pain that was unresolved after two weeks 0.9% would call 999 for an ambulance, 6.4% would go to ED
Oliveira et al. (2020)	Prospective cross-sectional study	ED	Brazil	Clinician defined	Patients were 58% female; median pain score 8/11; median disability score 17/24.	To describe the profile of patients with acute LBP who accessed EDs in Brazilian public hospitals; and also to describe the profile of these

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						patients according to the STarT Back Screening Tool (SBST). 49.2% were classified as at high risk of developing an unfavourable prognosis via SBST. 74% of patients reported continuing to work normally without interference from LBP.
Oliveira et al. (2021)	Inception cohort study	ED	Brazil	Clinician Defined		To describe the prognosis in people with recent-onset LBP presenting to emergency departments (EDs) and to identify prognostic factors for nonrecovery. Within 12 months 73% of participants had recovered from pain, 86% recovered from disability, 79% returned to previous work hours and 70% were completely recovered. The median recovery times were 67 days to recover from pain, 37 days to recover from disability, 37 days to return to previous work hours and duties, and 70 days to recover completely. Higher pain levels, a higher perceived risk of persistent LBP, more days of reduced activity due to LBP, more pain sites, and higher duration of LBP were associated with complete nonrecovery within 6 months.
Oliveira et al. (2022)	Systematic Review with Meta-Analysis	ED and primary care	Brazil	Patient defined		To compare pain and disability levels of patients with acute low back pain presenting to general practice vs those presenting to emergency departments. The review included 12 records reporting results for 10 unique studies. The review found low-quality evidence that patients presenting to emergency departments had higher pain scores than those in general practice (mean difference of 17.3 points) and low-quality evidence that patients presenting to emergency departments had higher disability scores than those in general practice (mean difference: 21.7).
Oshima et al. (2022)	Cross-sectional survey	ED	Brazil	Patient defined	Participants were majority female (68%)	To describe the demographic, physical, and psychological characteristics, and reasons for seeking care at emergency departments due to an episode of low back pain. Most patients went to the emergency department because they were worried about their pain (78%) and because they could not control their pain (73%). Patients also choose the emergency department because it is always available,

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						it is free, and provided them good care.
Overman et al. (1988)	Service evaluation with randomisation	ED	USA	Not stated	Average age 48. 59% male	Evaluation of physical therapist first contact care programme in ED. 174 study subjects managed by physical therapist (n = 107) or physician (n = 67). Compared again standard care by physicians. 76.4% of patients received a diagnosis of LBP. Physical therapists made more referrals to physical therapy department and recommended muscle relaxants, prescription analgesics and best rest less frequently. Patients were more satisfied with their care from physical therapists. Overall outcomes were similar between the two groups at one-month however highly dysfunctional patients had better outcomes with physical therapists.
Owens et al. (2011)	Statistical brief	ED and inpatient departments	USA	Clinician defined. ICD-9-CM	5.8% of ED patients had back problems, 2.7% had back problems as their first listed diagnosis. Mean ages were 47 and 43.6 respectively.	Statistical brief with information on prevalence and cost of ED visits and inpatient stays related to back problems. 7,294,280 ED visits and 2,368,148 inpatient stays related to back problems in 2008. The rate of ED visits was highest for the 18 to 44-year-old group and for those from rural areas.
Pakpoor et al. (2020)	Retrospective database analysis	ED	USA	Clinician defined. ICD-9-CM, ICD-10	Mean age 41.2. 53.9% female.	Investigation of the use of imaging for patients with LBP. Included 134,624 patient encounters over 6 years. Images were obtained in 33.7% of visits, decreasing over the study period. 30.9% radiography, 2.7% CT, 0.8% MRI.
Paul and Buser (1996)	Discussion article	ED	USA	Not specified		Discussion of osteopathic approaches to low back pain, chest pain, torticollis, asthma and sinusitis. For LBP clinical history is emphasized. The article presents a long list of potential differential diagnoses, including vascular, visceral, mass effect and neoplastic origins.
Potier et al. (2015)	Retrospective, service improvement pilot study and audit	ED	UK	Clinician defined "musculoskeletal lower back pain"	Mean age 43.5	Evaluation of patient experience for an intervention for the assessment and treatment of MSK LBP. Initial review of case notes (n = 75); baseline audit (n = 100); and post-implements (n = 100) Following staff education and the introduction of an evidence-based LBP pathway, documentation of history and examination improved and there was an increased rate of both diagnosis and diagnostic

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						accuracy. Post implementation investigation rates dropped except for x-ray which increased.
Pugh et al. (2020)	Prospective longitudinal study (Conference abstract)	ED	USA	Clinician defined		To assesses the impact of ED-initiated Physical Therapy (PT) on ED resource utilization and return rates in patients with atraumatic low back pain. Patients with low back pain who received ED PT were less likely to have imaging studies in the ED and had lower ED return rates within the year following the initial ED visit. ED PT may not only offer therapeutic benefits to ED patients but may also positively impact ED resource utilization while not increasing ED length of stay.
Rao et al. (2015)	Retrospective sample data analysis	ED	USA	Patient defined. Chief complaint of LBP	Mean age 48	Prevalence of appropriate imaging based on the American College of Radiology Appropriateness Criteria. Random sample (n = 100) of patients with chief complaint of LBP (n = 624) over a four month period. 50% of patients had a precipitating event, 28% underwent imaging in ED, 24% in outpatient imaging, 54% had no imaging. 96% of imaging referrals were considered appropriate, 96% of those not imaged were considered appropriate.
Reito et al. (2015)	Retrospective secondary data analysis	ED	Finland	Clinician defined ICD-10		To investigate the population-based incidence of specific spinal pathologies as a cause of atraumatic acute or subacute LBP. Of 900 ED attendances diagnosed as atraumatic back pain 31.6% were nonspecific LBP, 64.8% were radicular pain suggestive of nerve root compression, 3.7% of cases has a specific spinal pathology. Red flag accuracy was poor and the authors advocate a low threshold for referral and advanced imaging in cases where a specific spinal pathology is suspected.
Rizzardo et al. (2016)	Retrospective observational study	ED	Italy	Clinician defined. ICD-10	Mean age 63.6. Male 51%	Description of patient demographics and care provided. Patients admitted to the ED with diagnosis codes for sciatica, lumbosciatica and lumbago (n = 1298) over one-year. Mean LOS, 4h14m, 62.0% received NSAIDs, 40.4% received opioids, 44.1% received imaging
Ryan (2022)	Protocol-Observational qualitative study	ED	UK	Patient defined.		To understand why people attend ED with LBP Protocol published and data collection completed at the time of writing, no results published yet.

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Table 1 (*continued*)

Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
Saggers et al. (2021)	Qualitive interview study	ED	Australia	Clinician defined. Included patients that had been triaged as non-specific LBP		Investigation of factors contributing to the decision by patients with non-specific LBP to seek care in ED. Sample, 21 patients attending ED with non-specific LBP Patients' perception and interpretation of their symptoms (including worry or the desire for pain relief) was the most important factor, convenience was important, patients expected high quality care. Few were advised to attend by GPs or physiotherapists, but if advised this was a critical factor.
Sayer et al. (2018)	Retrospective audit	ED	Australia	Clinician defined. ICD-10	50.3% female	Comparison of key performance indicators between advanced MSK physiotherapists and other clinicians. Audit of 1089 patients. Patients seen by physiotherapists (n = 360) had shorter waiting times and LOS, as well as lower admission rates.
Schlemmer et al. (2015)	Retrospective analysis of patient data	ED	USA	Clinician defined. ICD-9-CM	52.8% female. Median age 46	To determine frequency and type of non-indicated imaging, and characteristic of patients. Analysis of 14,838 ED events. 51.9% did not have indications for imaging, among these 30.1% received imaging (15.6% of the total), and of those 26.2% received advanced imaging (4.1% of total presentations).
Schulz et al. (2016)	Prospective study	ED	Australia	Clinician defined. Acute MSK LBP	Mean age 36, 45% female	Comparison of advanced MSK physiotherapist with other health professionals. Study looked at lower limb soft tissue injuries (n = 88) and acute LBP (n = 29). For LBP physiotherapists were less likely to order imaging or use anxiolytics. Patients' satisfaction was equal or higher than other clinicians at discharge although this effect disappeared at 2-week and 6-week follow up. There was no significance in other reported variables.
Shani et al. (2020)	Prospective randomised case series	ED	Israel	Clinician defined. Non-radicular, lumber spine pain, <1 month		Effectiveness of analgesia when administrative route preference (PO versus IM) is matched to patient choice. 38 patients with acute LBP presenting to ED. Overall, patients had similar pain reduction regardless of route, however pain reduction was greater when analgesia was administered via their preferred route.
Sharma et al. (2021)	Prospective, replicated time series controlled experimental study	ED	Australia	Patient defined.	Mean age 47. 62.5% female	Impact of waiting room communication strategy on imaging rates. 337 people presenting to ED with LBP over 4-month period

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						(intervention n = 99; control n = 238). A waiting room patient information strategy of digital posters and a leaflet. Imaging rates across the study were 28%, there was no evidence of a significant change in imaging rates between the intervention and control. Differences in patient awareness and satisfaction were not significant.
Sharma et al. (2022)	Retrospective data analysis	ED	Australia	Clinician defined. Sydney Local Heath District Targeted Activity and Reporting System (STARS) diagnosed with "spinal conditions"	2019 mean age 51. 52% female. 2020 mean age 52, 51% female. Majority higher socio-economic status.	Impact of Covid-19 on presentation and patterns of care for LBP in ED over comparable 3-month periods. Presentations to ED dropped by 31% between pre-covid (n = 694) and covid (n = 475) periods. Diagnoses of serious spinal pathology were 4% and 6% in the respective periods. Admission rates, imaging, laboratory tests and pain medication use were similar between the two periods. Arrival by ambulance was higher in the covid period.
Shaw et al. (2020)	Retrospective observational study	ED	Australia	Patient defined. Triaged as describing their primary problem as "back pain"	Mean age 52.6 (SD 20.1). 46.9% male	Determine the frequency of red flags and association with serious pathologies and investigations. 1346 consecutive patients with back pain as presenting complaint at triage, 1000 eligible for inclusion. A list of 39 red flags were searched for in medical records, 25 based on primary care studies, 14 additional ED relevant categories. Flags were compared to primary ED diagnosis or, if admitted, discharge diagnosis. 3.3% received a serious spinal diagnosis, 14.6% received a serious non-spinal diagnosis, 73.7% were not diagnosed with a serious underlying pathology. The seven criteria most positively indicative of serious pathology were fever on examination, history of tuberculosis, known nephrolithiasis/abdominal aortic aneurysm, unexplained weight loss, writhing in pain, urinary symptoms, and flank pain. For serious spinal pathology saddle anaesthesia, history of tuberculosis, intravenous drug use, acute onset urinary retention and loss of anal sphincter tone had the highest positive likelihood ratios.
Smith and Siket (2020)	Expert opinion	ED	USA	Patient defined		To discuss tools to aid the frontline provider in accurate diagnosis of the neurologic emergencies and tips to improve timely treatment decisions in hopes of

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						reducing diagnostic error and medicolegal risk and optimizing care delivery for patients. Most patients presenting with back pain do not require emergent imaging, but those with new neurologic deficits or signs/symptoms concerning for acute infection or cord compression warrant MRI.
Sohil et al. (2017)	Retrospective observational study	ED	Singapore	Clinician defined. Non-traumatic neck and back pain		Evaluation of the impact of early physiotherapy evaluation and treatment pathway versus standard care. 125 patients presenting to ED with non-traumatic neck and back pain over eight months, pathway n = 62, standard care n = 63. Use of the pathway reduced waiting time for outpatient physiotherapy, from a mean wait of 34 days–4 days. Disability and pain scores were significantly different at 34 days for the pathway group.
Stafford et al. (2014)	Qualitative exploratory inquiry based on grounded theory	Urgent care (ED, walk-in centre, out of hours service)	UK	Clinician defined as simple mechanical back pain		Exploration of why patients with simple mechanical back pain seek urgent care. 11 patients presenting to urgent care with back pain. Eight key motivators were identified: GP access; Pain & Analgesia; Function; Different; Something Wrong; Investigation; Third Party; Repeat Visits.
Staiger et al. (2010)	Service improvement study	ED and community healthcare	Australia	Clinician defined. Acute LBP <3 months		Report on the development of a care pathway to improve service linkages across the healthcare system for the treatment of LBP, one aim being to reduce ED presentations. The proposed pathway introduced a referral route from ED to community health services for next day follow-up and then onto appropriate services. No results are reported, and no follow-up papers were identified.
Stewart et al. (2015)	Component analysis of healthcare records	Primary Care	USA	Clinician defined. ICD-9		Focus on healthcare use by a primary care defined group of LBP patients (n = 33,577), including ED presentations, over a five-year period. The study identified that patients with three or more opioid prescriptions in the study period or two or more surgeries were the highest users of ED in the period following a primary care encounter for LBP.
Strudwick et al. (2018)	Rapid literature review	ED	Australia	Not specified		Review focused on identifying current best practice for managing LBP in ED. Review included 'red flag' conditions that can mimic MSK LBP, recommended that imaging should only be used

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						in the presence of red flags, opioids should be used judiciously, psychosocial risk factors should be identified, and early return to work and function should be promoted.
Suslavich et al.(2020)	Prospective longitudinal study (Conference abstract)	ED	USA	Clinician defined	Of those patients referred average age was 42 years (range 13–88), 53% were female	To describe the types of patients seen, interventions performed, and follow up associated with an academic ED's PT program. Lumbar back pain was the most common reason for referral to physiotherapy (43.6%). The availability of PT in the ED may provide an adjunct to traditional musculoskeletal diagnostic and pain management approaches while also connecting patients to outpatient PT resources.
Tacy et al. (2017)	Service improvement study	ED	USA	Clinician defined. ICD-10 diagnosis of chronic LBP	2013 prevalence 1.8%. 0.4% Chronic LBP. Study period prevalence 3.7%, 0.2% Chronic LBP.	Application of primary care guidelines for chronic LBP in a nurse-initiated initiative in ED. 277 patients presented to Ed with chief complaint of back pain over a 75-day period. Of patients presenting with back pain, 33% had objective red flags, a majority presented with chronic rather than acute back pain. During the pilot pain reduction at discharge improved, compliance with evidence-based guidance improved, and re-presentation rate dropped. Patient satisfaction also improved.
Tan et al. (2018)	Prospective observational cohort study	ED	Singapore	Clinician defined. ICD-9		Investigate STarT Back Pain Screening Tool to provide prognostic information. 177 patients presenting to ED for acute LBP and completing 6-month follow-up. STarT Back Pain total score and 6-week pain score were significantly associated with 6-month pain score, more than the STarT psychosocial score. High, low and medium risk patients all had a significant drop in pain score between baseline and 6-weeks.
Tekin et al. (2021)	Prospective single centre unblinded RCT	ED	Turkey	Clinician defined. Acute non-specific back pain		Effectiveness of intradermal sterile water injection as an adjunct to systemic treatment. 112 patients admitted t ED for LBP of unclear chronicity. The intervention (n = 56) was found to be more effective than systemic treatment alone (n = 56) in reducing pain. Opioid consumption in the following 24 h was reduced and patient satisfaction was increased.
Thiruganasambandamoorthy et al. (2014)	Retrospective health records review	ED	Canada	Clinician defined. Non-traumatic LBP, below the costal margins and above the buttocks.	Prevalence of non-traumatic LBP 1%. Mean age 49.3. 50.8% female.	To identify risk factors associated with serious pathology in patients (n = 329) with non-traumatic LBP presenting to ED LBP over

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						three months. Identified risk factors were anticoagulant use, decreased sensation in physical examination, pain that is worse at night, pain that persists despite appropriate treatment- 91% sensitivity, 55% specificity.
Tracey et al. (1994)	Case study of guideline development	ED	UK	Not specified		Development and introduction of guidelines for imaging referral for patients with acute LBP. 445 patients presented with back pain during baseline period, 312 during the study period. Following introduction of the guidelines referral for radiography was reduced from 48.4% to 27.2%, although it is noted that by the last month of the study the referral rate had risen to close to the pre-protocol rate.
Traeger et al. (2021)	Retrospective data analysis	ED	Australia	Patient defined		To estimate the prevalence of the overuse and underuse of lumbar imaging in patients presenting with low back pain to the emergency department (ED). Of those patients reviewed 12.2% had features suggesting lumbar imaging was indicated. Prevalence of overuse of imaging was 8.8%, underuse was 4.3%. nearly half of the underuse cases were due to referral for uninformative imaging modalities.
Tsai et al. (2021)	Retrospective observational study of existing data	ED	USA	Clinician defined. ICD-10		Study focus was to determine common ED presentations of homeless veterans. For homeless veterans LBP comprised 3.1%–3.8% of presentations across the four years studied (4th to 7th most common). For non-homeless veterans LBP comprised 4.0% (2nd to 4thmost common). In 2019 it was in the top ten for all sub-groups of homeless veterans (race, sex and age) except for those aged over 75.
Veenema et al. (2000)	Prospective double-blind randomised comparative clinical trial	ED	USA	Not specified		Effectiveness of Ketorolac versus meperidine to treat severe MSK LBP in ED. Convenience sample of 155 patients over 19-month period. Ketorolac (n = 80) reduced pain less than meperidine (n = 75) at 60 min but had less sedative or adverse effects.
Vella et al. (2022)	Scoping review	Ambulance Service	Australia	Various		The scoping review of paramedic management of back pain included 26 articles. 16% of calls for back pain received transport to hospital. Pharmacological management of back pain includes benzodiazepines, NSAIDs, opioids, nitrous oxide, and paracetamol. Non-pharmacological care is poorly reported and includes

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						referral to alternate health service, counselling and behavioural interventions and self-care advice.
Washington et al. (2002)	Prospective RCT	ED	USA	Not specified		To determine the effects of next-day primary care for nonacute conditions. 156 patients presenting to ED meeting the inclusion criteria. LBP was one of the conditions considered suitable for referral to next-day primary care. LBP patients were not separated in the analysis but there were no significant clinical differences reported between those patients treated in ED and those referred to next-day care.
Waterman et al. (2012)	Retrospective cross-sectional study	ED	USA	Clinician defined. Consumer Product Safety Commission's National Electronic Injury Surveillance System	LBP prevalence 3.15%. 51.5% male	Characterise incidence of LBP presentation to ED and associated risk factors. Analysis of a probability sample in a government database. Most people presented following injuries sustained at home. There was a bi-modal distribution with peaks at 25-29 and 95-99 years of age. Rates of back pain were higher for Black and White patients compared to Asian patients.
Westgard et al. (2020)	Before-and-after observational study	ED	USA	Clinician defined - "back pain"	Back pain prevalence 5.3% prior to Covid, 3.5% after emergency declaration.	Analysis of changes in ED use during a state declared emergency due Covid After emergency declaration there was a 35.2% decline in ED visits overall from the previous year, with a disproportionate decline in visits for back pain (50.7%)
Wu and Davis (2019)	Case report	ED	USA	Clinician defined		The study presented an unusual presentation of spinal cord infarct. In this case spinal cord infarct presented with chest pain and neurogenic shock rather than back pain, the paper identifies infarct as an important differential for patients with back pain.
Xantus et al. (2021)	Case series and validating retrospective audit	ED	Hungary	Clinician defined. MSK chest pain, with or without costovertebral involvement.		Case study of a previously undiagnosed scoliosis. Cohort of five patients over one month. The study included patients with low-risk chest pain, including pain on palpation of the costovertebral junction which was hypothesised as being due to undiagnosed scoliosis. A six-month retrospective case review of patient records identified that 35.7% of patients with a similar presentation had obvious radiological evidence of scoliosis.
Yau et al. (2012)	RCT feasibility pilot	Emergency medicine ward	Hong Kong	Not specified		Feasibility of a nurse-initiated early pain management program. 13 participants with acute LBP

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Author	Design	Setting	Country	Pain definition[a]	Prevalence data[b]	Aims and key findings[c]
						in the Emergency Medicine Ward. Conference abstract. Use of heat therapy and a health education booklet intervention in ED. While there was no significant difference between the intervention and control groups at baseline and end of their ED treatment the intervention group had greater decreasing trend in disability, pain and anxiety scores across 1-week, 1-month and 3-month follow-ups.

4 Friedman, Mulvey et al. (2012) and Friedman, O'Mahoney et al. (2012) both report results from the same study.

[a] Who defined pain and how this was done. Where a definition is drawn from medical management systems these are provided. Whether clinicians defined the patients, or patients' self-description were used, plus any further terms provided are included.

[b] Prevalence data is included where this was provided in the paper.

[c] Aims of the paper and key findings that are relevant to this review not covered in the other columns.

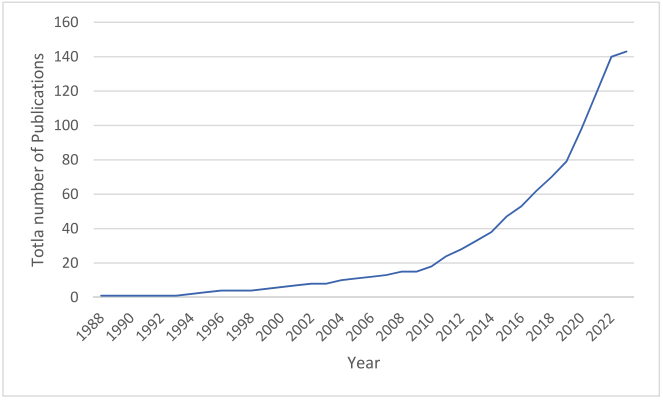

Fig. 2. Graph showing the cumulative number of papers over the period covered by the review.

ED had higher levels of pain and disability than those presenting to primary care. Two papers also highlighted that some patients were advised to attend by other healthcare professionals (Stafford et al., 2014; Saggers et al., 2021). Davidson et al. (2022) asked clinicians why they thought patients with LBP presented to EMS, the main reasons given were problems accessing GP appointments and a belief that EMS offered better and faster care.

3.3. Care received when accessing emergency medical services

There were few papers that explored the care that patients received. When discussed it was most often from the perspective of improving the efficiency of EMS. Either through reduction of the use of imaging (n = 14), implementation of clinical support guidelines (n = 14) or novel approaches to analgesia, usually to reduce opioid prescribing (n = 29). An additional four studies discussed initiatives in the organisation of EMS and 14 looked specifically at the introduction of physiotherapists or physical therapists in emergency care.

Those papers that looked at the use of imaging reported between 19% (Capsey et al., 2022a) and 52.8% (Liu, 2022) of patients with LBP received plain X-rays; rates of MRI or other advanced imaging ranged from 2.7% (Pakpoor et al., 2020) to 26.6% (Mullins et al., 2021). Some of the variation can be attributed to how studies defined their population, for example older patients are more likely to have imaging. Imaging rates were often presented in comparison with primary care, a minority of studies explored the appropriateness of imaging requests based on initial assessment. Rao et al. (2015) suggested that 96% of imaging referrals in their study were considered appropriate; however Schlemmer et al. (2015) looked at non-indicated imaging and identified that 51.9% of patients did not have indications, but of these 30.1% received imaging. The opinion papers included in the review highlight that MRI scan is appropriate for patients with suspected spinal epidural abscess (Della-Giustina, 2015; Smith and Siket, 2020; Long et al., 2022). Dubosh et al. (2019) reported that intraspinal abscess was the most commonly missed serious diagnosis (41%) in patients discharged with a

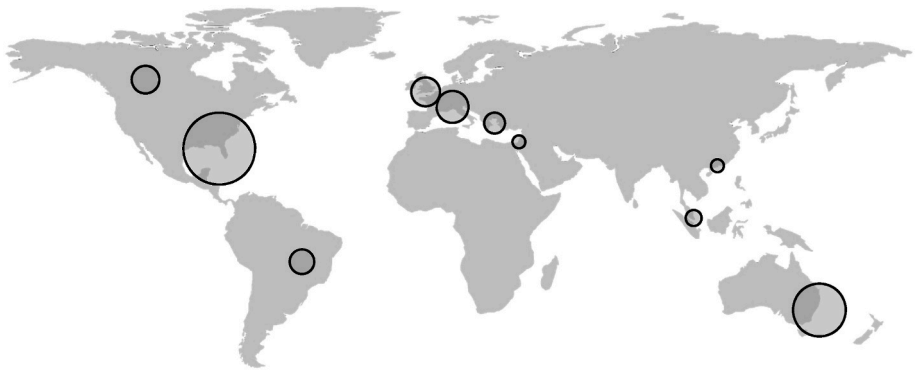

Fig. 3. Map showing geographical distribution of papers included in the review.

diagnosis of non-specific low back pain, and Long et al. (2022) reported that 90% of spinal epidural abscesses are misdiagnosed on their first visit.

Four papers reported studies into the diagnostic value of blood markers suggesting that both C-Reactive Protein (CRP) and Erythrocyte Sedimentation Rate (ESR) can be indicative of serious pathology (Davis et al., 2004, 2011; Galliker et al., 2020; Ali et al., 2021). However, of the retrospective data analyses, only two (Nunn et al., 2017; Capsey et al., 2022a) reported on the frequency of blood testing, 22.5% and 19% respectively.

The majority of papers focusing on analgesia concentrated on opioid use and its reduction. Reported rates of opioid use varied between 13% (Capsey, 2022b) and 72.9% (Ly et al., 2021; de Luca et al., 2023) with most studies citing figures of around half of patients receiving an opioid. Various studies explored reducing opioid use or alternative analgesics. There was little evidence that adjunct therapies aided pain reduction in the ED (Friedman et al., 2006, 2020; Behrbalk et al., 2014). There was little reported difference in the effectiveness of opioids and alternative analgesics in the ED (Veenema et al., 2000; Eken et al., 2014; Irizarry et al., 2021). Two alternative therapies that showed preliminary evidence of being effective in the pre-hospital phase were TENS (Bertalanffy et al., 2005) and active warming (Nuhr et al., 2004).

The other treatment option explored by many papers is the use of physiotherapists/physical therapists to assess patients and, where appropriate, initiate non-pharmacological treatments. Their use in ED was found to be effective with reduced length of stay, imaging and opioid use reported (Overman et al., 1988; de Gruchy et al., 2015; Schulz et al., 2016; Sohil et al., 2017; Sayer et al., 2018; Kim et al., 2019; Pugh et al., 2020). Patient satisfaction was equal or better than standard care. It should be noted that in many studies physiotherapy management was targeted at patients assessed as low risk.

Eleven papers focused specifically on low frequency but high consequence conditions. Due to these presentations being relatively low frequency these were mostly discussion papers, case studies/case series or literature reviews. However, there are some retrospective data analyses (Davis et al., 2004; Dubosh et al., 2019; Melman et al., 2022) with a focus on red flags and risk factors for serious conditions. Additional papers explored risk factors for poor outcomes in patients with non-specific back pain (Thiruganasambandamoorthy et al., 2014; Galliker et al., 2020). A total of 22 papers explored red flags or risk factors, and there were two sets of clinical guidelines in the review. Both guidelines have been published recently and mostly present the guidelines established in primary care and orthopaedic practice (ACSQ, 2022; AACE, 2022).

3.4. *Patient experiences and clinicians' perceptions of emergency medical service care*

There were 17 papers that considered the patient experience, their context when presenting to EMS and expectations. Data on patient experience included some retrospective data from patient surveys although these were often collected alongside data on other conditions and frequently subsumed in a general analysis. Patient waiting time and overall time in the department were reported for some service improvement projects and were reported as improving the patient experience.

Data on clinician perceptions of dealing with back pain were also sparse. Corwell (2010) summarised the emergency clinician's focus succinctly as, "to rule out significant pathology and obtain a correct diagnosis while avoiding excessive investigation" further stating that, "the clinical pitfall to avoid is diagnosing an emergent back pain episode as just a back strain." Expert opinion papers presented serious but infrequent presentations as examples of the challenges associated with managed back pain presentations (Loh et al., 2022; Long et al., 2022). Edlow (2015) suggested that the ED population skews towards higher acuity cases and as such clinicians are more likely to see serious cases. Dutch et al. (2008) explored how clinicians managed "liked" and "disliked" patient presentations. Back pain was identified as an exemplar of the "disliked" patient presentation and these patients had the longest wait times, however there was no further detail given on why back pain was disliked. In the qualitative study by Davidson et al. (2022) clinicians described challenges around confidence in patients being safe for discharge, management of chronic presentations in comparison to acute patients with comorbidities, and addressing patients emotions and expectations. The limited information identified in the review suggests that back pain is often viewed as a complex and challenging presentation in EMS.

4. Discussion

Patients accessed EMS due to concerns over the severity of their condition, perceptions of the services available at EDs, and difficulty in accessing primary care services. Whilst reported imaging rates vary from 19% to 52.8%, papers that explored the appropriateness of imaging decisions identified that many patients presenting to EMS have clinical indicators that suggest imaging is justified. In addition to imaging blood tests, specifically ESR and CRP, were found to be useful in identifying serious pathology. Opioid analgesics are the most commonly used in EMS however discharging patients with a short course of opioids has been shown to have little effect on the progression of their back pain. A small group of papers focused on low frequency but high consequence conditions which reflects emergency clinicians' own perceptions of the purpose of emergency care.

5. Strengths and limitations

A key strength of this review has been both the broad definitions used to identify papers and the timescale covered. Whilst it meant many papers were included this allowed the papers focused on low frequency but high consequence conditions to contextualise the wider challenges of emergency medicine. It also revealed the recent change in research focus from trying to apply primary care guidelines to emergency care to exploring the underpinning assumptions and relevance of those guidelines to an EMS setting. In doing so it attempts to define the emergency care population in its own terms. Limitations included: the heterogenous approach to defining back pain makes drawing strong conclusions difficult; many papers grouped back pain in with other presentations (e.g. ankle sprain (de Gruchy et al., 2015), headache or dental pain (Isenberger and Salzman, 2013)); the number of papers that do not include a definition suggests there may be assumptions by some writers that clinicians share an understanding of what is meant by "back pain", but it is not clear if that assumption is correct or what the shared definition of back pain is.

6. Implications for clinical practice and research

The outcomes from this review provide areas for future research. Prospective studies following patients from presentation with a complaint of back pain through to diagnosis and discharge to identify final diagnoses; exploration of how emergency clinicians understand back pain and their diagnostic accuracy; and the role and long-term impact of imaging and opioid use in managing patients with back pain who present to EMS. Of note, there is little or no research on pre-hospital ambulance care. This is an area where guidelines could lead to the safe referral of low-risk patients to primary care and those with potentially serious pathology are transported to a hospital for further investigation and management. Our review indicates a growing awareness that guidelines cannot be simply transferred from primary care to emergency departments. Furthermore, if guidelines are developed for pre-hospital care this should include establishing if that population reflects emergency departments, primary care groups or is different again.

7. Conclusions

Back pain is a relatively common reason for patients to access EMS and as such remains a focus for research. Patients find back pain concerning and access EMS due to the perceived quality of care available. The care provided by EMS differs from that provided in primary care, notably a higher rate of imaging and opioid use however some of this is explained by the higher rates of serious cases presenting. Non-specific back pain remains the most common final diagnosis. Research that focuses on reliably identifying serious cases, through clinical red flags, appropriate imaging, and blood tests, would support EMS specific guidelines to give patients and clinicians confidence in the assessment and care provided to patients who access care complaining of back pain.

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Matt Capsey: Conceptualization, Methodology, Project administration, Writing – original draft. **Cormac Ryan:** Supervision, Writing – review & editing. **Jagjit Mankelow:** Supervision, Writing – review & editing. **Denis Martin:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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Appendix A. Supplementary data

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