Cureus
Part of SPRINGER NATURE

Open Access Original Article

Time to Specialist Pain Service Referral and Variation in Analgesic Management Among Patients With Rib Fractures: A One-Year Clinical Audit

Review began 11/03/2026
Review ended 11/12/2026
Published 11/18/2026

© **Copyright** 2026
Wood et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.119881

Katherine N. Wood [1], Jessica S. Hainsworth [2], Hayeon Lim [1]

1. General Medicine, Ashford and St Peter's Hospitals NHS Foundation Trust, Chertsey, GBR 2. General Medicine, South Warwickshire University NHS Foundation Trust, Warwick, GBR

Corresponding author: Katherine N. Wood, katie.wood0912@gmail.com

Abstract

Background

Rib fractures can compromise respiratory function, particularly in older adults. This audit examined assessment, risk documentation, analgesic prescribing, and specialist pain service referral in a surgical inpatient cohort.

Methods

A single-centre retrospective baseline audit included 52 surgical patients admitted with rib fractures to St Peter's Hospital in Chertsey, UK, between October 2024 and October 2025. Collected audit data were summarised descriptively for patient characteristics, documented risk assessment, prescribing, assessment and referral intervals, regional analgesia, and inpatient outcomes.

Results

The mean age was 75.3 years. The median hospital stay was six days (IQR: 3-10; n = 52). The median intervals from emergency department (ED) presentation to initial ED doctor assessment and general surgical assessment were 1.33 hours (IQR: 0.73-1.87; n = 52) and 7.07 hours (IQR: 4.65-11.57; n = 45), respectively. The median interval from initial ED doctor assessment to Inpatient Pain Service (IPS) referral was 18.28 hours (IQR: 11.63-35.60; n = 41). Study of the Management of Blunt chest wall trauma (STUMBL)/Battle scores were documented in 15 (28.8%) patients. Initial prescribing varied across analgesic and supportive medication categories, and IPS recommendations addressed several opportunities for optimisation. Regional analgesia catheters were inserted in 13 (25.0%) patients. Pneumonia was recorded in 16 (30.8%), oxygen requirement in 17 (32.7%), and delirium in nine (17.3%); no intensive care admissions were reported.

Conclusion

The audit identified incomplete risk and pain documentation, variable prescribing, and variation in time to specialist referral. These findings informed a multidisciplinary electronic pathway. Its effect on care processes and patient outcomes remains to be evaluated.

Categories: Trauma, Pain Management, General Surgery
Keywords: acute pain management, blunt trauma chest, clinical care outcomes, multimodal analgesia efficacy, quality improvement (qi), rib fractures

Introduction

Rib fractures are common injuries in the elderly (>60 years old) with significant consequences, such as severe pain, prolonged recovery, and disabilities [1]. Trauma to the thorax is the second most common site of injury in this population [1]. The optimal multimodal pain management technique remains uncertain [2,3]. Poor pain control can impair ventilation and coughing, contributing to complications such as pneumonia, atelectasis, and respiratory failure [1,3]. Appropriate management of rib fractures may reduce morbidity and mortality in older patients [1,4].

The published literature has not established a single optimal analgesic approach for rib fracture management [2,3]. Current analgesic regimens include systemic opioids, patient-controlled analgesia, epidural analgesia, and other regional techniques [2,3]. The adverse effects of systemic opioid analgesia, including sedation, vomiting, respiratory depression, and constipation, remain problematic [1-3]. Structured rib fracture management pathways and multidisciplinary approaches have been associated with improvements in analgesic provision and care processes, although improvements in patient-reported pain and clinical outcomes have not been consistent across studies [4].

This baseline audit aimed to describe local assessment and referral intervals, risk and pain documentation, analgesic prescribing, regional analgesia provision, and inpatient outcomes. A supporting narrative review was used to contextualise the findings within the discussion and inform subsequent service evaluation.

Materials And Methods

Study design and setting

This was a retrospective, single-centre baseline clinical audit of surgical inpatients with rib fractures at St Peter's Hospital, Ashford and St Peter's Hospitals NHS Foundation Trust, in Chertsey, UK. The reported admission period was one year from October 2024 to October 2025. It preceded evaluation of a locally developed Rib Fracture Power Plan.

Study population and eligibility criteria

The study cohort comprised 52 consecutive patients admitted with rib fractures to St Peter's Hospital between October 2024 and October 2025. Patients with single or multiple rib fractures were included, with no minimum age restriction. Rib fractures were confirmed by chest radiography. Readmissions and repeated episodes were excluded. Admissions were identified from data supplied by the clinical governance team and arranged chronologically by admission date. Patients who did not receive an Inpatient Pain Service (IPS) review at any point during admission were excluded. The final cohort comprised 52 consecutive eligible admissions, all of whom received an IPS review. No patient in this cohort underwent surgery for rib fracture management. Admission under a surgical team should therefore be distinguished from operative treatment.

Data collection and variable definitions

The audit extracted electronic data from October 2024 to October 2025 from Millennium electronic patient records (EPR) from the database of St Peter's Hospital. The following variables were extracted by two independent collectors: age, hospital length of stay, documented Bolton Pain Score, Clinical Frailty Scale, Study of the Management of Blunt chest wall trauma (STUMBL)/Battle score, Chest Injury Score, initial emergency department (ED) prescribing, general surgery (GS) prescribing, IPS recommendations and referral timing, regional analgesia, complications, and pain documentation. Timing measures included the interval from ED presentation to initial ED doctor assessment, from ED presentation to general surgical assessment, and from initial ED doctor assessment to IPS referral. Timestamps were recorded using the 24-hour clock. General surgical referral was treated as a distinct event from IPS specialist review or catheter insertion. Electronic data were collected into Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) and verified by two data collectors collaboratively for resolution of missing or conflicting entries. Chest Injury Score was defined as a points-based risk stratification tool for patients with blunt chest wall trauma. Complications were recorded in the following categories: pneumonia, delirium, supplemental oxygen requirement, and intensive care unit (ICU) admission. For this audit, pneumonia was operationally defined as consolidation identified on a chest radiograph during admission. Delirium was defined as a 4AT score of 4 or above on clinical assessment. Prescribing records were reviewed with attention to medication, dose, and timing, and documented omitted doses were acknowledged. A prescription timestamp was not treated as evidence that medication had been administered at that time; actual administered doses and administration times could not be reliably established from prescribing data alone.

Outcome measures

Care processes were described using assessment and referral intervals, prescribing categories, documented risk and pain assessments, and regional catheter insertion and duration. Inpatient outcomes comprised recorded pneumonia, supplemental oxygen requirement, delirium, intensive care admission, and hospital length of stay. Documentation of pain assessment before discharge and mortality were recorded. Adherence to St Peter's Hospital Trust clinical standards was assessed under the document on the Intranet published as "Guideline for the Management of Pain in Patients with Fractured Ribs". This online document under Clinical Guidelines was the only literature available within the Trust during the time of data extraction. This guideline stated that the IPS team must be contacted and a referral completed once a patient has been admitted with rib fractures. This guidance also stated that a Chest Injury Score and dynamic pain assessment must be recorded. Admission timestamps were not available for the referral analysis, and the Trust guidance did not specify a numerical time target. The ED-assessment-to-referral interval therefore cannot establish compliance with the requirement to refer on admission or quantify referral delay. These outcomes describe the baseline cohort and do not measure the effect of the subsequently developed pathway.

Statistical analysis

Data were summarised descriptively. Categorical variables were presented as patient counts and percentages of the full cohort (n = 52). Two-sided 95% confidence intervals (CIs) for proportions were calculated using the Wilson score method without continuity correction. Documentation percentages indicate the presence of a recorded measure; absence of documentation does not establish absence of assessment. Assessment and referral intervals, hospital length of stay, and catheter duration were summarised using medians and

interquartile ranges (IQRs). Timing completeness was reported as n/N (%) of the full cohort (n = 52); unavailable timings were excluded from the corresponding median and IQR. Hospital stay was available for all 52 patients, and catheter duration was summarised for the 13 catheter recipients. Quartiles for assessment and referral intervals, hospital length of stay, and catheter duration were calculated using inclusive linear interpolation, consistent with Microsoft Excel QUARTILE.INC. Other continuous measures were presented as means and, where available, ranges. ED prescribing and IPS recommendations were not analysed as paired before-and-after outcomes because they describe different activities and patient-level pairing was unavailable. The association between Chest Injury Score and regional analgesia catheter insertion was analysed using two-sided Fisher's exact test. This analysis included 37 (71.2%) patients with documented Chest Injury Scores and corresponding regional analgesia catheter data. The remaining 15 (28.8%) patients had no documented Chest Injury Score and were excluded from this analysis. Statistical significance was defined as $p < 0.05$.

Supporting narrative review methods

A literature search was performed on August 24, 2026, to compare local rib fracture management findings with existing literature. Embase, MEDLINE, Trip, Cochrane Library, and UpToDate were searched. The reported search terms were "Rib Fractures" OR "Rib Fracture Pathway" OR "Care Bundle" OR "Bundle of Care" OR "Chest Injury Bundle" OR "Chest Injury Pathway" OR "Referral and Consultation" OR "Analgesic management" OR "Pain management" OR "Inpatient Pain Service" OR "Specialist Pain Service". Eligible evidence types included systematic reviews, narrative reviews, randomised controlled trials, guidance, and conference abstracts; observational studies and clinical audit or quality improvement reports addressing non-operative management were also eligible, as reflected in the included publications. Studies focused on the surgical management of rib fractures, such as operative fixation, were excluded.

The search yielded 29 records. Seventeen were excluded because they focused on the surgical management of rib fractures, such as operative fixation, leaving 12 publications for narrative comparison with the local results. Study design, population, intervention, results, and limitations were extracted. Results were compared narratively because interventions, populations, thresholds, and outcome definitions differed. Quantitative comparisons retain each study's reported denominator and scale; differences between studies are descriptive and are not adjusted for case mix. No formal methodological quality assessment was undertaken, limiting the assessment of the reliability of the included evidence and confidence in the resulting comparisons.

Ethical and governance considerations

The audit was formally reviewed and registered within Ashford and St Peter's Hospitals NHS Foundation Trust as an audit/QI project (Clinical Audit Reg ID Audit 451), in accordance with the Trust's local governance requirements. The Research and Development (R&D) Department has received confirmation from the Clinical Effectiveness Team of the project's registration and classification. Based on this classification, the project is considered an audit/QI rather than research and therefore did not require review or approval by an NHS Research Ethics Committee (REC) under the Health Research Authority (HRA) framework.

Results

Cohort characteristics and documentation

The cohort comprised patients with a wide age range and a predominantly older population. The median hospital stay was six days (IQR: 3-10; n = 52). Documentation of structured risk assessment was inconsistent, with Chest Injury Scores recorded more frequently than Clinical Frailty Scale and STUMBL/Battle scores. Formal pain control and severity assessment documentation was particularly limited, demonstrated by documentation of the Bolton Pain Score in only one patient. These findings highlight variation in baseline assessment and documentation practices (Table *1*).

Measure	Reported result	95% CI (%)
Patients included	52	-
Age (mean in years)	75.3	-
Hospital stay, median (IQR), days	6 (3-10)	-
Hospital stay >10 days	10/52 (19.2%)	10.8-31.9%
Clinical Frailty Scale documented	27/52 (51.9%)	38.7-64.9%
Clinical Frailty Scale (mean)	3.58	-
STUMBL/Battle score documented	15/52 (28.8%)	18.3-42.3%
STUMBL/Battle score (mean)	20	-
Chest Injury Score documented	37/52 (71.2%)	57.7-81.7%
Chest Injury Score (range)	7-37	-
Bolton Pain Score documented	1/52 (1.9%)	0.3-10.1%
Pain assessment before discharge documented	29/52 (55.8%)	42.3-68.4%
Mortality	3/52 (5.8%)	2.0-15.6%

TABLE 1: Patient characteristics and documented assessment measures

Data are presented as counts, n/N (%), median (IQR), means, or ranges, as indicated. Percentages use the full cohort denominator (n = 52). Two-sided 95% CIs for proportions were calculated using the Wilson score method without continuity correction. CIs are not presented for continuous variables.

IQR: interquartile range; CIs: confidence intervals

Initial assessment and specialist referral

The median time from ED presentation to initial ED doctor assessment was 1.33 hours (IQR: 0.73-1.87), based on usable timings for all 52 patients. The median time from ED presentation to general surgical assessment was 7.07 hours (IQR: 4.65-11.57), based on 45 (86.5%) patients. The median interval from initial ED assessment to IPS referral was 18.28 hours (IQR: 11.63-35.60), based on 41 (78.8%) patients. General surgical assessment timings were unavailable in the electronic documentation for seven patients and IPS referral timings for 11 patients. Two of the 41 patients with usable IPS referral timings (4.9%) were initially reviewed out of hours by the on-call anaesthetic team and subsequently reviewed in hours by the IPS team. Electronic IPS referral time therefore did not necessarily represent first specialist pain-related assessment. Without admission timestamps or a numerical referral target, the reported interval does not establish delayed referral; the intervals have different starting points and available-case denominators and should not be interpreted as sequential components of a single timeline (Table *2*).

Event	Usable timings, n/N (%)	95% CI for percentage	Median time, hours	IQR, hours
ED assessment	52/52 (100.0%)	93.1-100.0%	1.33	0.73-1.87
GS assessment	45/52 (86.5%)	74.7-93.3%	7.07	4.65-11.57
IPS referral	41/52 (78.8%)	66.0-87.8%	18.28	11.63-35.60

TABLE 2: ED assessment, GS assessment, and IPS referral intervals: usable timings, medians, and interquartile ranges

ED and GS assessment intervals start at ED presentation; the IPS referral interval starts at initial ED doctor assessment. Times are reported in decimal hours as medians and IQRs among patients with usable timings. Percentages and their 95% CIs describe timing availability in the full cohort (n = 52), not uncertainty around the median times. IPS referral is distinct from IPS review or regional catheter insertion.

ED: emergency department; IPS: Inpatient Pain Service; IQR: interquartile range; CI: confidence interval; GS: general surgery

Analgesic prescribing and IPS recommendations

Paracetamol was the most frequently recorded initial ED medication among the reported categories. As-required opioids and lidocaine patches were also common, while laxatives and antiemetics were less frequently prescribed (Table 3). Following general surgical assessment, additional analgesic interventions were documented in some patients, although a proportion had no recorded changes to their multimodal analgesic regimen. IPS recommendations extended across analgesic and supportive medication categories, particularly opioid management and bowel care (Table 3). Recommendations concerning bowel care and antiemetics suggest a broader medication review.

Phase and category	Patients, n/N (%)	95% CI (%)
ED-paracetamol	39/52 (75.0%)	61.8-84.8%
ED-lidocaine patches	30/52 (57.7%)	44.2-70.1%
ED-as-required opioids	31/52 (59.6%)	46.1-71.8%
ED-laxatives	8/52 (15.4%)	8.0-27.5%
ED-antiemetics	11/52 (21.2%)	12.2-34.0%
GS-paracetamol	13/52 (25.0%)	15.2-38.2%
GS-lidocaine patches	16/52 (30.8%)	19.9-44.3%
GS-opioid management	13/52 (25.0%)	15.2-38.2%
GS-laxatives	10/52 (19.2%)	10.8-31.9%
GS-antiemetics	5/52 (9.6%)	4.2-20.6%
IPS-paracetamol	27/52 (51.9%)	38.7-64.9%
IPS-lidocaine patches	28/52 (53.8%)	40.5-66.7%
IPS-opioid management	39/52 (75.0%)	61.8-84.8%
IPS-laxatives	25/52 (48.1%)	35.1-61.3%
IPS-antiemetics	19/52 (36.5%)	24.8-50.1%

TABLE 3: Initial ED prescriptions and subsequent GS and IPS recommendation categories

Values are presented as n/N (%) with corresponding two-sided 95% CIs calculated using the Wilson score method without continuity correction. The full cohort (n = 52) was used as the denominator. Patients may appear in multiple categories. Prescriptions and recommendations represent different activities and were not analysed as paired outcomes.

ED: emergency department; GS: general surgery; IPS: Inpatient Pain Service; CI: confidence interval

Regional analgesia and inpatient outcomes

Regional analgesia catheters were inserted in 13 (25.0%) patients. Among these 13 patients, the median catheter duration was three days (IQR: 3-4). Chest Injury Score documentation was available for 37 (71.2%) patients, while the remaining 15 (28.8%) patients had no documented score and were excluded from the Chest Injury Score analysis. Serratus anterior blocks and erector spinae plane blocks were used in accordance with Trust guidelines: moderate-to-severe score (2-3) on dynamic pain assessment, limitation of function, or inability to comply with physiotherapy. The relationship between Chest Injury Score and regional analgesia catheter insertion was examined using two-sided Fisher's exact test (Table 4).

Chest Injury Score	RA used, n	No RA, n	Total, n	Test statistic	P-value
≥11	12	24	36	N/A	0.351
<11	1	0	1	N/A	N/A
Total	13	24	37	N/A	N/A

TABLE 4: Association between Chest Injury Score and RA catheter insertion

The two-sided Fisher's exact test compared RA catheter insertion between Chest Injury Score categories (p = 0.351); no conventional test statistic applies. The analysis included 37 patients with documented scores and excluded 15 without documented scores. Only one patient had a score <11, severely limiting interpretation.

RA: regional analgesia; N/A: not applicable

Only one patient had a Chest Injury Score below 11, leaving the comparison severely imbalanced. The absence of a statistically significant association therefore does not establish that Chest Injury Score is unrelated to catheter insertion, and no firm conclusion can be drawn from this small available-case analysis.

Pneumonia and supplemental oxygen requirement were among the more frequently recorded inpatient outcomes, while delirium was less common. No intensive care admissions were recorded in the cohort (Table *5*).

Measure	Reported result	95% CI (%)
Regional analgesia catheter inserted	13/52 (25.0%)	15.2-38.2%
Catheter duration, median (IQR), days	3 (3-4)	-
Pneumonia	16/52 (30.8%)	19.9-44.3%
Supplemental oxygen required	17/52 (32.7%)	21.5-46.2%
Delirium	9/52 (17.3%)	9.4-29.7%
Intensive care admission	0/52 (0.0%)	0.0-6.9%

TABLE 5: Regional analgesia and recorded inpatient outcomes

Values are presented as n/N (%) or median (IQR), as indicated. Catheter duration was available for all 13 catheter recipients. Percentages use the full cohort denominator (n = 52). Two-sided 95% CIs for proportions were calculated using the Wilson score method without continuity correction. Outcomes are not mutually exclusive. CIs are not presented for continuous variables.

IQR: interquartile range; CIs: confidence intervals

Discussion

Local audit baseline findings

This baseline audit identified variation in initial prescribing, incomplete risk and pain documentation, and a median interval of 18.28 hours (IQR: 11.63-35.60; n = 41) between initial ED doctor assessment and referral to the IPS. These findings support improved documentation and consistency in analgesic prescribing and provide a baseline referral interval. They do not establish delayed referral against the Trust's admission-based standard, because admission timestamps and a numerical referral target were unavailable. The results do not establish that referral timing caused complications or that IPS recommendations improved patient outcomes. The limited documentation of structured pain measures also restricts the assessment of treatment response.

Narrative review

The supporting narrative review contextualised the local audit findings. The search identified 29 records, of which 17 were excluded because they focused on the surgical management of rib fractures, such as operative fixation. Twelve publications addressing non-operative management were included in the narrative comparison (Figure *1*). Search methods, eligibility criteria, and synthesis methods are described in Materials

and methods.

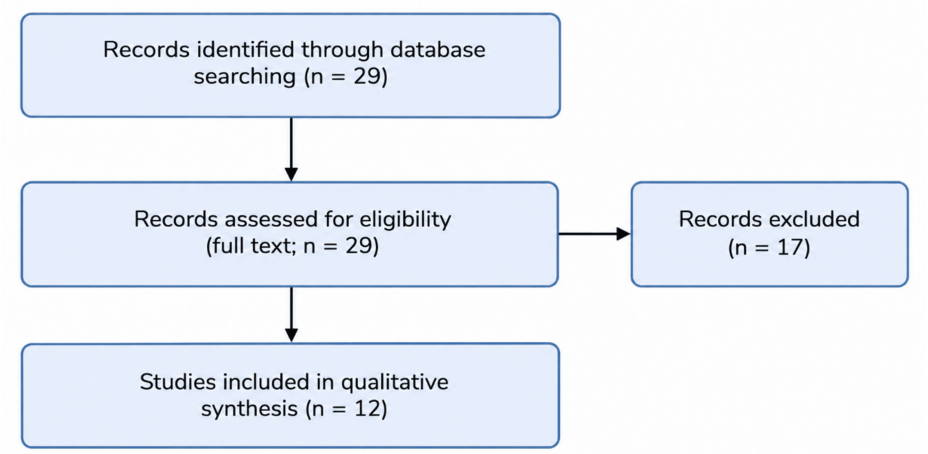


FIGURE 1: Literature selection flow diagram. The search identified 29 records; 17 were excluded, and 12 publications were included in the qualitative synthesis

Risk stratification analgesia and specialist escalation

Implementation of rib fracture management pathways was associated with improvements in analgesic prescribing and specialist pain service involvement across several studies. In a retrospective cohort of 2,488 patients aged ⩾65 years, O'Donohoe et al. reported an increase in adequate analgesia from 892 (76.4%) to 1,158 (87.7%) following pathway implementation ($p < 0.001$) [4]. Similarly, Dalla Vecchia et al. reported improvements in documented analgesia, regional anaesthetic block provision, and documented discharge advice following the implementation of a chest injury pathway [5]. Morrison et al. reported increased regional nerve block utilisation from 17 (10.4%) to 115 (56.7%) ($p < 0.001$), although patient-reported pain scores remained unchanged [6]. Improvements in regional analgesia provision were also reported by Karimi et al. and Chuahan and Yap, with the latter reporting erector spinae plane catheter utilisation in 16 (57.1%) of 28 eligible patients following pathway implementation [7,8]. Carrie et al. demonstrated a significant reduction in uncontrolled pain following the implementation of a multidisciplinary care bundle ($p < 0.001$) [9]. Regarding specialist escalation, Shearer et al. identified significant associations between STUMBL scores ⩾31 and Acute Pain Service referral (RR: 4.7; 95% CI: 2.7-8.1), regional analgesia insertion (RR: 29.3; 95% CI: 4.0-212.5), and patient-controlled analgesia prescription (RR: 5.0; 95% CI: 2.6-9.7) [10]. Delays in specialist intervention were highlighted by Hemmings et al., who reported a mean interval of 11 hours 48 minutes between surgical review and pain team referral, followed by a further 20 hours 23 minutes before regional block administration [11]. Following pathway implementation, Bethel et al. reported a reduction in mean admission-to-block time from 41.9 to 23.9 hours ($p = 0.03$), while Bhattacharyya et al. reported a reduction in mean booking-to-block time from 41 to 32 hours [12,13].

Pulmonary complications, intensive care, length of stay, and mortality

The impact of rib fracture management pathways on pulmonary complications and intensive care utilisation varied between studies (Table *6*).

Author	Design and population	Intervention	Principal findings	Interpretation and limitations	Test statistic	P-value
O'Donohoe et al., 2026 [4]	Retrospective cohort; 2,488 adults aged ≥65 years	Early blunt chest injury guideline	Adequate analgesia increased from 892 (76.4%) to 1,158 (87.7%); adequate analgesia was associated with lower in-hospital mortality (OR: 0.57; 95% CI: 0.36-0.91)	Observational association; guideline effect cannot be separated from case mix	NR in abstract	Adequate analgesia: $p < 0.001$; mortality association with adequate analgesia: $p = 0.019$
	ED quality			Process measures differ from local		

Dalla Vecchia et al., 2022 [5]	improvement study	Chest injury pathway	Better analgesia documentation, block provision, and discharge advice	drug-specific prescribing; before-after design	NR	NR
Morrison et al., 2026 [6]	Retrospective cohort; 367 patients, 164 before and 203 after	Rib fracture pathway	Regional block provision increased from 17 (10.4%) to 115 (56.7%); pain scores were unchanged. Hospital LOS increased from 8.1 to 8.9 days in the unadjusted comparison; the adjusted association was not statistically significant. APS follow-up increased from 3.0 to 3.8 days	Pain registry selection and temporal confounding limit generalisability	NR	Regional block provision: $p < 0.001$; LOS unadjusted: $p = 0.009$; LOS adjusted: $p = 0.46$; APS follow-up duration: $p < 0.001$; pain scores: exact values not reported in text
Karimi et al., 2024 [7]	District general hospital improvement report; two cohorts (total n = 118); conference abstract	Rib fracture care improvement	Increased regional analgesia; reduced critical care admissions; mean anaesthetist review: 11.6 hours	Limited abstract-level detail	NR	NR
Chuahan and Yap, 2025 [8]	Retrospective district general hospital audit; 48 before and 53 after; conference abstract	Multidisciplinary trauma pathway	Greater eligible-patient catheter use; deaths: six to four; stays >14 days: 13 to nine; ICU admissions: five to seven	Eligibility denominator differs from the full local cohort; abstract-level evidence	NR	NR
Carrie et al., 2018 [9]	Matched retrospective case-control study; 69 pairs	Multidisciplinary bundle	Uncontrolled pain decreased, while primary ICU transfer increased following bundle implementation. No reduction in secondary respiratory complications or LOS was reported. NSAID use was associated with fewer secondary respiratory complications (OR: 0.3; 95% CI: 0.1-0.9)	ICU use may reflect altered triage; nonrandomised comparison	NR in abstract	Uncontrolled pain: $p < 0.001$; primary ICU transfer: $p < 0.001$; NSAID use and secondary respiratory complications: $p = 0.03$; overall secondary respiratory complications and LOS: NR in abstract
Shearer et al., 2025 [10]	Retrospective rib fracture cohort; n = 344	STUMBL score and referral	Compared with STUMBL <11, STUMBL ≥31 was associated with PCA prescription (RR: 5.0; 95% CI: 2.6-9.7), APS referral (RR: 4.7; 95% CI: 2.7-8.1), and ICU admission (RR: 3.8; 95% CI: 2.0-6.9). Regional analgesia insertion was associated with STUMBL 26-30 (RR: 15.3; 95% CI: 1.8-130.3) and ≥31 (RR: 29.3; 95% CI: 4.0-212.5)	Association with escalation does not demonstrate treatment benefit; wide CI for regional analgesia	NR in abstract	STUMBL ≥31: PCA prescription, APS referral, and ICU admission: each $p < 0.001$; regional analgesia: 26-30 group ($p = 0.013$); ≥31 group ($p = 0.001$)
	Rib fracture			Timing starts at		

Hemmings et al., 2025 [11]	audit; n = 100; conference abstract	Referral and block delays	Surgical review to referral: 11 hours 48 minutes; further delay to block: 20 hours 23 minutes; mean stay: 10 days	surgical review, unlike the local ED-based interval	NR	NR
Bethel et al., 2023 [12]	Before-after pathway evaluation; 22 before and 47 after; conference abstract	Regional block delivery	Pre- versus post-pathway: admission-to-block time 41.9 ± 33.8 versus 23.9 ± 21.2 hours; LOS 21.6 ± 14.2 versus 19.9 ± 14.5 days; age 54.6 ± 15.0 versus 66.8 ± 17.4 years; rib fractures 5.4 ± 2.3 versus 7.4 ± 3.5; ISS 24.1 ± 10.3 versus 18.1 ± 8.5. Chest infection rates did not differ significantly	Abstract-level reporting; admission-to-block differs from referral time	NR in abstract	Admission-to-block time: p = 0.03; LOS: p = 0.3; age: p = 0.006; rib fracture count: p = 0.02; mean ISS: p = 0.02; chest infection: p = 0.4
Bhattacharyya et al., 2022 [13]	Quality improvement project; initial cohort 67; six block recipients in repeat cycle	Guideline, education, and electronic order set	Booking-to-block time: 41 to 32 hours; stay with versus without block: 16 versus 17.5 days	Small repeat sample; treatment selection; different comparison groups	NR	NR
Butts et al., 2021 [14]	Retrospective cohort; 648 patients	Risk-stratified triage	Following pathway implementation, ICU admission and pulmonary complications decreased, and hospital LOS decreased from 7.5 to 6.8 days. Mortality and readmission did not differ significantly	Composite pulmonary outcome differs from local pneumonia; before-after confounding	NR in abstract	ICU admission: p = 0.003; pulmonary complications: p = 0.01; hospital LOS: p = 0.001; mortality: p = 0.42; readmission: p = 0.4
Mai and Singh, 2021 [15]	Retrospective audit; 45 patients over 26 months	Battle score and escalation	Pneumonia: 9 (20.0%) overall, 4 (44.4%) in the highest-risk group; regional analgesia: 1 (2.2%); both deaths in the highest-risk group	Small audit; pathway proposed after baseline assessment	NR	NR

TABLE 6: Comparative analysis of the 12 publications included in the narrative review, summarising study designs, interventions, principal findings, and limitations

O'Donohoe et al. [4] used logistic regression for the association between adequate analgesia and mortality. Shearer et al. [10] used modified Poisson regression, with STUMBL <11 as the reference group. The specific tests underlying the remaining p-values were not verified from the available source text. Numerical test statistics were unavailable and are marked NR. ORs and RRs are effect estimates, not test statistics; p-values relate to the outcomes explicitly named in the final column. NR stands for not reported in the supplied extraction or accessible source text; missing values have not been reconstructed from rounded p-values or aggregate data.

CI: confidence interval; LOS: length of stay; ICU: intensive care unit; APS: Acute Pain Service; PCA: patient-controlled analgesia; ISS: Injury Severity Score; NSAID: non-steroidal anti-inflammatory drug; ED: emergency department; STUMBL: Study of the Management of Blunt chest wall trauma

Butts et al., in a retrospective cohort of 648 patients, reported significant reductions in pulmonary complications (p = 0.01) and ICU admissions (p = 0.003) following the implementation of a risk-stratified triage pathway [14]. Conversely, Carrie et al. observed a significant increase in primary ICU transfers (p < 0.001), without a corresponding reduction in secondary respiratory complications [9]. Chuahan and Yap similarly reported an increase in ICU admissions from five to seven patients following pathway implementation, whereas Karimi et al. reported a reduction in critical care admissions [7,8]. Shearer et al. identified a significant association between STUMBL scores ⩾31 and ICU admission (RR: 3.8; 95% CI: 2.0-6.9) [10]. In a retrospective audit of 45 patients, Mai and Singh reported an overall pneumonia incidence of nine (20.0%), with four (44.4%) patients in the highest-risk group developing pneumonia; both recorded deaths occurred within this highest-risk group [15].

Findings regarding hospital length of stay and mortality were inconsistent. Butts et al. reported a reduction in mean length of stay from 7.5 to 6.8 days following pathway implementation (p = 0.001), without a

significant difference in mortality (p = 0.42) [14]. In contrast, Morrison et al. observed an increase in mean hospital length of stay from 8.1 to 8.9 days in the unadjusted comparison (p = 0.009); however, the adjusted association was not statistically significant (p = 0.46). Acute Pain Service follow-up duration also increased from 3.0 to 3.8 days (p < 0.001) [6]. Carrie et al. found no significant reduction in ICU or hospital length of stay despite improvements in analgesic management [9]. Similarly, Bethel et al. found no significant difference in length of stay (21.6 versus 19.9 days; p = 0.3), despite shorter times to regional block administration [12]. Bhattacharyya et al. reported a mean length of stay of 16 days among patients receiving regional blocks compared with 17.5 days among those who did not [13].

Regarding mortality, O'Donohoe et al. identified an association between adequate analgesia and reduced in-hospital mortality (OR: 0.57; 95% CI: 0.36-0.91; p = 0.019). However, this association did not establish an independent mortality benefit attributable to pathway implementation [4].

The literature more consistently supports improvements in care processes than reductions in complications or hospital stay. Locally, individual prescribing categories cannot be equated with composite adequate-analgesia measures, and catheter insertion cannot be equated with all regional blocks. Likewise, the local interval from initial ED doctor assessment to IPS referral differs from admission-to-block or booking-to-block timing. These differences make the published studies useful for selecting improvement targets while limiting numerical comparisons [4-14]. Incomplete STUMBL/Battle documentation is relevant because risk stratification can inform escalation; however, the association between higher scores and referral in published observational work does not establish treatment benefit [10]. The local pneumonia frequency warrants review, but comparison with other cohorts is limited by case mix and differences between pneumonia and composite pulmonary outcomes [14,15].

This local audit identified three key areas for improvement: timely referrals to IPS services, consistency in analgesic prescribing across departments, and adherence to Trust guidelines. We can commend ED for early assessment timing; however, there is scope to improve the structure of analgesia provided. IPS review generated recommendations across several prescribing categories, indicating opportunities for analgesic optimisation. However, the median interval from initial ED doctor assessment to IPS referral was 18.28 hours (IQR: 11.63-35.60), based on 41 patients with usable timings. The IPS operates in hours, with the on-call anaesthetist providing out-of-hours cover. Two of the 41 patients with usable referral timings were reviewed initially by the out-of-hours anaesthetic team and subsequently by IPS in hours. The electronic referral interval may therefore overestimate time to first specialist assessment. Out-of-hours presentation is a potential contributor to the observed referral interval, but its effect was not quantified. Potential implementation barriers include awareness of Trust guidance and the organisation of out-of-hours escalation; these were not formally measured.

To improve these barriers, we developed a Rib Fracture Power Plan on Millennium EPR outlining a step-by-step pathway of rib fracture management accessible to all departments. The Rib Fracture Power Plan went live on Millennium EPR in Ashford and St Peter's Hospitals NHS Foundation Trust on April 27, 2026. In response to the identified gaps, a multidisciplinary electronic rib fracture pathway was developed to standardise risk assessment, multimodal analgesia, and escalation to specialist services. Rib fractures are confirmed by chest radiography or computed tomography. Patients aged >70 years or with two or more rib fractures are escalated to a consultant. The pathway also specifies discussion with cardiothoracic surgery when computed tomography findings are reported. Patients requiring admission proceed to risk assessment, while those managed as outpatients follow the discharge plan. Risk assessment involves documenting the STUMBL/Battle score, with a score greater than 10 prompting referral for inpatient management. Multimodal analgesia is selected according to the World Health Organisation analgesic ladder, taking frailty and renal function into account. Moderate-to-severe pain or an oxygen requirement prompts escalation of analgesia and discussion with anaesthesia in the ED. Subsequent specialist referral is guided by STUMBL score criteria and may involve surgery, intensive care, frailty services, or anaesthesia. IPS and physiotherapy support are available during working hours. The discharge plan advises paracetamol, with non-steroidal anti-inflammatory drugs where appropriate, and lists dihydrocodeine 30 mg four times daily for seven days or tramadol 50 mg three times daily for seven days, with a stated maximum tramadol dose of 300 mg/day. For patients with impaired renal function, the pathway lists tramadol 50 mg three times daily for a maximum of seven days.

Limitations

This retrospective, single-centre audit included a small cohort and depended on the completeness and accuracy of electronic records. Eligibility required an IPS review during admission, so patients who never received such a review were excluded. This selection limits generalisability and prevents estimation of referral or review coverage among all rib fracture admissions. The findings should not be interpreted as showing that every patient admitted with rib fractures received IPS review. Ethnicity and comorbidities were not accounted for, and differences in these characteristics may affect generalisability and comparisons with other cohorts. Outcomes were not adjusted for case mix.

Usable timings were available for 45 of 52 general surgical assessments and 41 of 52 IPS referrals. Missing timestamps may bias the medians if patients with missing data differed from those with complete records.

Timing measures had different starting points and did not measure time to IPS review or regional catheter insertion. The 18.28-hour interval began at initial ED doctor assessment, whereas Trust guidance required referral on admission. Admission timestamps and a numerical referral target were unavailable; consequently, this interval cannot establish a referral delay or quantify compliance with the admission-based standard.

Out-of-hours specialist care deserves particular consideration. A patient presenting overnight may have received assessment and analgesic management from the on-call anaesthetist before an electronic IPS referral was placed. This occurred in two of the 41 patients with usable referral timings, who were subsequently reviewed by IPS in hours. Electronic referral time is therefore an imperfect proxy for first specialist contact. The audit did not quantify the contribution of service hours to the referral interval; this should be explored explicitly in the second cycle.

Prescribing and recommendations do not establish medication administration. Although medication, dose, timing, and documented omitted doses were considered, an order's timestamp cannot be assumed to represent the time medication was given. The analysis did not establish actual administered doses, cumulative analgesic exposure, or the interval between prescription and administration. Unrecorded omissions or delays may therefore have affected pain control, and prescribing variation alone cannot determine the adequacy of delivered analgesia. Sparse structured pain documentation further limits the assessment of treatment response.

Pneumonia was defined by radiographic consolidation during admission, which may not distinguish infection from other causes of consolidation. Identification of delirium depended on a recorded 4AT assessment and may have missed cases without documented screening. These operational definitions and differences in outcome ascertainment limit comparisons with published cohorts.

The supporting narrative review included heterogeneous study designs and conference abstracts, which often provide limited methodological detail. No formal methodological quality assessment was undertaken, limiting the ability to judge the reliability of the included evidence and confidence in the comparisons. Narrative comparisons were descriptive, retained study-specific denominators and scales, and were not adjusted for case mix. They cannot establish the effectiveness of the local pathway. A controlled before-and-after study or interrupted time-series evaluation would strengthen future assessment.

Conclusions

In this local baseline audit of patients who received IPS review, risk and pain documentation was incomplete, and analgesic prescribing varied. The median interval from initial ED doctor assessment to electronic IPS referral was 18.28 hours among 41 patients with usable timings. This does not establish referral delay against the Trust's admission-based standard, and earlier out-of-hours anaesthetic care may not be captured by the referral timestamp. A multidisciplinary electronic rib fracture pathway was developed in response to the identified care-process gaps. Its effect on care processes and patient outcomes requires evaluation through a repeat audit.

We recommend a repeat audit using clearly defined outcomes to determine whether similar improvements can be achieved locally with a clear rib fracture pathway. The second audit cycle should include all eligible rib fracture admissions and report referral and review coverage explicitly. It should record admission time, first on-call anaesthetic contact and review, electronic IPS referral, in-hours IPS review, and regional analgesia timing. In-hours and out-of-hours presentations should be examined separately, including handover to IPS. Admission-to-referral time should assess the Trust's admission-based standard; a numerical target, if adopted locally, should be prespecified. The ED-assessment-to-referral interval may also be retained for comparison with baseline.

Additional predefined process measures should include documented STUMBL/Battle and Bolton Pain Scores, dynamic pain assessment, multimodal analgesic prescribing, actual medication administration and omitted doses, discharge pain assessment and analgesia planning, and Rib Fracture Power Plan use. Pneumonia, delirium, oxygen requirement, ICU admission, and length of stay should be reported as secondary outcomes, with case-mix differences considered. Educational posters and local presentations across departments have been created to raise awareness of the pathway. Future studies should prospectively evaluate implementation of the local rib fracture pathway using clearly defined eligibility criteria, audit standards, and outcome measures.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Katherine N. Wood, Jessica S. Hainsworth, Hayeon Lim

Acquisition, analysis, or interpretation of data: Katherine N. Wood, Hayeon Lim

Drafting of the manuscript: Katherine N. Wood, Jessica S. Hainsworth

Critical review of the manuscript for important intellectual content: Katherine N. Wood, Jessica S. Hainsworth, Hayeon Lim

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Coary R, Skerritt C, Carey A, Rudd S, Shipway D: New horizons in rib fracture management in the older adult. Age Ageing. 2020, 49:161-7. 10.1093/ageing/afz157
2. Hammal F, Chiu C, Kung JY, Bradley N, Dillane D: Pain management for hospitalized patients with rib fractures: a systematic review of randomized clinical trials. J Clin Anesth. 2024, 92:111276. 10.1016/j.jclinane.2023.111276
3. Peek J, Smeeing DP, Hietbrink F, Houwert RM, Marsman M, de Jong MB: Comparison of analgesic interventions for traumatic rib fractures: a systematic review and meta-analysis. Eur J Trauma Emerg Surg. 2019, 45:597-622. 10.1007/s00068-018-0918-7
4. O'Donohoe RB, Mathew J, Winter N, et al.: The effectiveness of an early management guideline for older patients following blunt thoracic injury. Injury. 2026, 57:113155. 10.1016/j.injury.2026.113155
5. Dalla Vecchia C, McDermott C, O'Keeffe F, Ramiah V, Breslin T: Implementation of a chest injury pathway in the emergency department. BMJ Open Qual. 2022, 11:e001989.
6. Morrison C, Song K, Cheok TS, et al.: Evaluation of a rib fracture management pathway in an Australian tertiary trauma hospital. J Int Med Res. 2026, 54:3000605261471253. 10.1177/03000605261471253
7. Karimi AM, Yan S, Imam M, Navarange S: Improving rib fracture care at a district general hospital . Reg Anesth Pain Med. 2024, 49:A197. 10.1136/rapm-2024-ESRA.275
8. Chuahan V, Yap WL: An audit of rib fracture management following the introduction of a multidisciplinary trauma pathway at a district general hospital. Reg Anesth Pain Med. 2025, 50:294.
9. Carrie C, Stecken L, Cayrol E, et al.: Bundle of care for blunt chest trauma patients improves analgesia but increases rates of intensive care unit admission: a retrospective case-control study. Anaesth Crit Care Pain Med. 2018, 37:211-5. 10.1016/j.accpm.2017.05.008
10. Shearer N, Blakey T, Wornham D, Taylor S, Lee CW: Guiding rib fracture care with the STUMBL score: acute pain management and intensive care unit referrals. Injury. 2025, 56:112525. 10.1016/j.injury.2025.112525
11. Hemmings VJ, Castro A, Fawcett WJ: Rib fracture audit - time for an ERAS® pathway? . Clin Nutr ESPEN. 2025, 65:520-1.
12. Bethel J, Christodoulou A, Smart YW, Emer N, Fernando K, Vasireddy A: The effect of a 'rib fracture pathway' on the efficiency of rib block delivery at a UK major trauma centre. BJS. 2023, 110:
13. Bhattacharyya S, Bethel J, Ikponmwosa B, Ali Y, Twohig C, Christodoulou A: Improving rib fracture management in a major trauma centre: a service and quality improvement project. Reg Anesth Pain Med. 2022, 47:A1-A315.
14. Butts CC, Miller P, Nunn A, Nelson A, Rosenberg M, Yanmis O, Avery M: RIB fracture triage pathway decreases ICU utilization, pulmonary complications and hospital length of stay. Injury. 2021, 52:231-4. 10.1016/j.injury.2020.10.008
15. Mai DV, Singh A: Rib fractures - an overlooked part of general surgical take? An audit and creation of a local pathway. BJS. 2021, 108:10.1093/bjs/znab312.055