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LOW-VALUE CLINICAL PRACTICES IN INJURY CARE: A SCOPING REVIEW AND EXPERT CONSULTATION SURVEY

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The results of this study were presented at the 77th Annual Meeting of AAST and Clinical Congress of Acute Care Surgery and 4th World Trauma Congress, September 26th-29th, 2018 in San Diego, California

ABSTRACT

Background: Tests and treatments that are not supported by evidence and could expose patients to unnecessary harm, referred to here as low-value clinical practices, consume up to 30% of healthcare resources. Choosing Wisely and other organisations have published lists of clinical practices to be avoided. However, few apply to injury and most are based uniquely on expert consensus. We aimed to identify low-value clinical practices in acute injury care.

Methods: We conducted a scoping review targeting articles, reviews and guidelines that identified low-value clinical practices specific to injury populations. Thirty-six experts rated clinical practices on a 5-point Likert scale from clearly low-value to clearly beneficial. Clinical practices reported as low-value by at least one level I, II or III study and considered clearly or potentially low-value by at least 75% of experts were retained as candidates for low-value injury care.

Results: Of 50,695 citations, 815 studies were included and led to the identification of 150 clinical practices. Of these 63 were considered candidates for low-value injury care; 33 in the emergency room, 9 in trauma surgery, 15 in the intensive care unit and 5 in orthopaedics. We also identified 87 'grey zone' practices, which did not meet our criteria for low-value care.

Conclusions: We identified 63 low-value clinical practices in acute injury care that are supported by empirical evidence and expert opinion. Conditional on future research, they represent potential targets for guidelines, overuse metrics and de-implementation interventions. We also identified 87 'grey zone' practices, which may be interesting targets for value-based decision-making. Our study represents an important step towards the de-implementation of low-value clinical practices in injury care.

Level of evidence: III

Keywords: Low-value care, trauma systems, scoping review, expert survey

BACKGROUND

Injuries led to 192,000 deaths, 3 million hospitalizations and 27 million emergency department visits in the USA in 2013 and generated medical and work loss costs of $671 billion USD.[1] In Canada, injury deaths increased by 23% from 13,000 in 2004 to 16,000 in 2010 while costs increased by 35% and are projected to reach $75 billion CAN by 2035.[2] Given the huge burden of injury and evidence of unwarranted variation in injury outcomes across healthcare providers,[3-5] efforts to optimize care has the potential to yield major dividends.

Rapid innovation in imaging and therapeutic techniques has led to an exponential rise in the use of tests and treatments that are not supported by evidence and could expose patients to unnecessary harm,[6, 7] referred to here as low-value clinical practices.[8-15] Low-value clinical practices have been estimated to consume up to 30% of healthcare resources[10, 12, 14, 16] but little is known about this issue in the context of injury care. Low-value clinical practices have multiple negative consequences. From a healthcare system perspective, they strain healthcare budgets and decrease the availability of resources. From a patient and caregiver perspective, they expose patients to physical and psychological harm, delay effective treatment, and increase direct and indirect expenses.[8-10, 12, 14] Finally, from a societal perspective, low-value clinical practices threaten the sustainability of affordable, accessible healthcare. Interventions targeting the de-implementation of low-value clinical practices therefore have the potential to reduce waste and improve patient outcomes.[15, 17]

Physicians report overusing resources for fear of legal actions but also because of lack of guidelines on low-value clinical practices.[12-14, 18] Choosing Wisely has developed lists of commonly used tests or procedures whose necessity should be questioned including top five lists for emergency medicine,

radiology, pediatric orthopaedics, neurology, and surgery.[11] However, few apply to injury care and most are based solely on expert consensus. Previous systematic reviews aiming to identify low-value clinical practices have not been specific to injury but have underlined the importance of targeting diagnostic groups to improve feasibility and subsequent knowledge transfer.[15, 19-22] We aimed to identify low-value clinical practices in acute, intrahospital injury care.

METHODS

Our study was conducted in 6 stages following published guidelines for scoping reviews and comprised a literature review followed by a web-based survey consultation with clinical experts.[23, 24] The protocol has been published previously.[25] Ethics approval was obtained from the institutional research ethics committee.

1. Identify research questions and develop definitions

First, using an iterative approach, the interdisciplinary and intersectorial project steering committee comprising clinicians, allied health professionals and policy and decision-makers identified the following research question for our review: Which clinical practices are considered low-value in acute injury care? Second, the committee used highly-cited literature on healthcare overuse[7, 13, 14, 17] to establish the following working definition of low-value clinical practices: A test or treatment (i.e. admission, monitoring, diagnostic interventions, therapeutic interventions, consultation) that is used in practice but is ineffective or its harm/cost outweighs its benefits. Third, the committee consulted UCLA/RAND recommendations to establish the following criteria for identifying candidates for low-value injury care: clinical practices identified as low-value in at least one level I, II or III study AND

considered to be clearly/potentially low-value by at least 75% of experts and not considered clearly beneficial by any expert.

2. Identify relevant studies

Eligibility criteria

We included original research, literature reviews, recommendations and guidelines that identified at least one low-value clinical practice specific to injury populations according to the definition given above.[11] We included studies on clinical practices specific to intrahospital acute care (in the emergency department or following hospital admission). We excluded: i) studies with no clear indication for the low-value practice (e.g. based on physician gestalt), ii) studies based exclusively on populations with combat injuries, osteoporotic fractures, burns, bites, or foreign bodies, iii) case reports, animal and cadaver studies, iv) studies on pre-hospital or post-acute clinical practices.

Information sources

We systematically searched MEDLINE, EMBASE, Cochrane CENTRAL, BIOSIS/Web of Science, ClinicalTrials and ISRCTN; Thesis repositories (Thesis portal Canada, EtHOS, DART-Europe E-Theses Portal, the National Library of Australia's Trove and ProQuest Dissertations & Theses Global); Websites of healthcare quality organizations (Agency for Healthcare Research and Quality, Australasian Association for Quality in Healthcare, Canadian Institutes for Health Information, Choosing Wisely, Lown Institute, National Association for Healthcare Quality, National Institute of Health and Care Excellence, National Quality Forum, and World Health Organization) and injury organisations (American Association for the Surgery of Trauma, American Association of Orthopaedic Surgeons, American College of Surgeons, American Trauma Society, Australasian Trauma Society, Brain Trauma

Foundation, British Trauma Society, Eastern Association for the Surgery of Trauma, International Association for Trauma Surgery and Intensive Care, International Trauma Anesthesia and Critical Care Society, Orthopaedic Trauma Association, The Society of Trauma Nurses, Trauma Association of Canada, Trauma Audit Research Network, Trauma.org, and Western Trauma Association.); and patient advocacy organizations including Safer Healthcare Now!

Search strategy

We developed a systematic search strategy with an information specialist.[26] The strategy was developed for MEDLINE and EMBASE using keywords covering combinations of search terms under the themes injury and low-value clinical practices (Supplemental Digital Content 3, Table 1, http://links.lww.com/TA/B326). This search strategy was then adapted for the other databases.

3. Select studies

Data management

Citations were managed using EndNote software (version X7.0.1, New York City: Thomson Reuters, 2011). Duplicates were identified and eliminated using electronic and manual screening. Multiple publications based on the same dataset were identified by crosschecking authors, dates and settings. In the case of replication, we identified only one publication for analyses using criteria based on study dates (most recent) and sample size (largest).

Selection process

Pairs of reviewers with methodological and content expertise (two of four reviewers LM, KMB, PAT, IF) independently evaluated all citations for eligibility. Consecutive samples of 500 citations were

independently assessed by each reviewer until high agreement was achieved on study inclusion (3 samples for kappa>0.8). Any further disagreement on study eligibility was resolved by consensus and a fifth reviewer adjudicated when necessary (FL).

4. Chart material

A standard electronic data abstraction form and a detailed instruction manual were developed and piloted independently by all reviewers on a representative sample of five publications. Pairs of reviewers (LM, KMB, PAT, IF) independently extracted information on the study design, setting (country, year, language, funding), study objective, study population, low-value clinical practices, and primary outcomes when appropriate. Any discrepancies between reviewers was resolved by consensus and a fifth reviewer adjudicated when necessary (FL).

5. Collate, summarize, and report on results

Clinical practices were classified according to the type of practice and the clinical speciality.[19] Classifications were conducted independently by two reviewers (KMB, PAT) and then checked independently by a third reviewer (LM). Any disagreements were adjudicated by a fourth reviewer (FL). As is common in scoping reviews, the methodological quality of included studies was not evaluated.[27] We summarized the level of evidence for each practice by calculating the number of studies by type using an adaptation of Oxford Center for Evidence-based Medicine classifications:[28] randomized controlled trials (RCTs) or systematic review of RCTs (I), prospective cohort studies or systematic review of RCTs and prospective cohort studies (II), retrospective cohort, case-control, cross sectional and case series studies or systematic review of any of the former (III), expert consensus and other (IV).

6. Consultation

We recruited four groups of experts for the consultation phase using a snowball technique based on the following criteria: representation of clinical expertise involved in acute intrahospital injury care, actively involved in injury research (knowledge of the evidence base for clinical practices) and geographical diversity.[29] Recruitment was independent of scoping review results and authorship status to minimize the influence of intellectual or academic biases. Groups were formed according to clinical specialty: emergency physicians, critical care physicians/neurosurgeons, trauma surgeons and orthopaedic/spine surgeons. Each group reviewed clinical practices within their area of expertise. For the main objective, we used two phases of consultation. First, we consulted a subgroup of 8 experts (two from each specialty) to regroup overlapping clinical practices, harmonize terminology and develop and test our survey. Second, we administered a web-based survey[30] asking experts to rate each clinical practice on a 5-point Likert scale from clearly low-value to clearly beneficial (see Supplemental Digital Content 1, Figure 2, http://links.lww.com/TA/B324). These categories mirror the 'clearly ineffective, grey zone, and clearly effective' classifications described in the Lancet Right Care series.[14, 31]

After the consultation phase, we applied the a priori criteria described above to identify candidate low-value clinical practices for injury care, i.e. practices reported as low-value in at least one level I, II or III study AND considered to be clearly/potentially low-value by at least 75% of experts and not considered clearly beneficial by any expert.

RESULTS

Of 77,733 citations, 1,593 studies were retained for full text review and 815 were included (Supplemental Digital Content 2, Figure 1, http://links.lww.com/TA/B325). Data extraction led to the

identification of 965 clinical practices (Table 1). Over one half were prospective or retrospective cohort studies, 22% were reviews (one third of these systematic), 5% were based on expert opinion and less than 5% were RCTs. The majority of studies aimed to evaluate the effectiveness of the clinical practice (55%) whereas one quarter aimed to develop guidelines or derive/validate a clinical decision rule. Seventeen percent aimed to evaluate the prevalence of overuse or the efficacy of a de-implementation intervention. Less than 1% aimed to derive or validate quality indicators. More than one third of low-value practices pertained to the treatment of head injury and most were specific to adult (37%) or pediatric (12%) populations. One half of clinical practices targeted diagnostic interventions, 40% targeted therapeutic interventions and 5% targeted ICU or hospital admission.

We approached 39 experts of whom 36 (92%) agreed to participate and completed the survey including 8/9 emergency physicians, 9/9 critical care physicians, 1/1 neurosurgeon, 10/12 trauma surgeons and 8/8 orthopaedic/spine surgeons from Canada, US, Australia and the UK. After the first consultation phase, we identified 150 clinical practices (Tables 2-5 and Supplemental Digital Content 4, Table 2, http://links.lww.com/TA/B327). In the web-based survey, 66 clinical practices were considered clearly or potentially low-value by at least 75% of respondents. Thereafter, we identified 63 clinical practices that met our criteria as candidates for low-value injury care, i.e. they were reported as low-value in at least one level I, II or III study, considered clearly or potentially low-value by at least 75% of respondents and not considered clearly beneficial by any of the experts (Tables 2-5). Among these clinical practices, 13 were supported by do-not-do recommendations in internationally recognized clinical practice guidelines (i.e. indications were the same or very similar). Nine practices included as do-not-do recommendations in clinical guidelines were not selected by our criteria (Supplemental Digital Content 4, Table 2, http://links.lww.com/TA/B327).

We identified 33 candidates for low-value injury care in the emergency room of which five were related to hospital admission for abdominal trauma or mild TBI and 20 were related to imaging including CT or X-ray for mild TBI, ankle, knee, chest and cervical spine injuries (Table 2). We also identified 15 ED practices in the grey zone including repeat head CT in adult mild complicated TBI and hospital admission in pediatric isolated skull fracture (Supplemental Digital Content 4, Table 2, http://links.lww.com/TA/B327). Nine low-value practices were selected for general trauma surgery, 6 of which were related to operative management of liver, renal, splenic, and neck injuries (Table 3). In addition, we identified 15 practices in the grey zone including follow-up imaging for nonoperative blunt renal injury and surgical management of high-grade pancreatic or renal injuries (Supplemental Digital Content 4, Table 2, http://links.lww.com/TA/B327). We identified 15 low-value practices in the intensive care unit of which 8 targeted TBI (Table 4). Four were related to medications (corticosteroids, antibiotics and antiseizure prophylaxis) and four were related to fluids and blood products (albumin, colloids, platelet and red blood cell transfusion). Twenty-six (63%) of ICU clinical practices were in the grey zone (Supplemental Digital Content 4, Table 2, http://links.lww.com/TA/B327) including neurosurgical consultation in acute mild complicated TBI, decompressive craniotomy and hourly neurological assessments >24h for stable TBI. Five low-value practices were identified in orthopaedics targeting follow-up consultation, spine service consultation, repeat X-ray, orthosis for thoracolumbar burst fractures and pre-operative blood tests (Table 5). Thirty-one (86%) orthopaedic practices in acute injury care were classed in the grey zone of which 6 targeted follow-up consultation, 9 imaging and 5 immobilization (Supplemental Digital Content 4, Table 2, http://links.lww.com/TA/B327).

DISCUSSION

We identified 63 clinical practices that met criteria for low-value intrahospital injury care. These potential low-value practices are supported by empirical evidence and expert opinion. Conditional on the results of future research, they represent potential targets for guidelines, overuse metrics and de-implementation interventions. We also identified 87 clinical practices in the grey zone, which are not consistently supported by empirical studies and expert opinion. While these practices require more evidence before being labelled low-value, they may be interesting targets for value-based decision-making.

The literature on low-value clinical practices in injury care is scarce. Internationally recognized medical associations publish guidelines on injury care.[32-35] However, few pertain to clinical practices that should be avoided. Healthcare quality organisations including Choosing Wisely and the National Institute for Health and Care Excellence publish recommendations specific to low-value practices but few target injury care.[36, 37] In addition, these recommendations are often based only on expert consensus.[20] Three previous literature reviews on low-value care across a range of diagnostic groups identified 9 low-value practices specific to injury care.[14, 19, 20, 38] We were able to identify many more practices because targeting a specific diagnostic group allows for a much more sensitive review strategy.[31] With over 50,000 citations to screen and more than 1400 documents to extract in our study, a similar search strategy with no restrictions on diagnosis would have been unfeasible.

Twenty-six percent of low-value practices identified in our review were related to imaging. This is consistent with a previous review of low-value care measures[20] and may be because the value of imaging is relatively easy to evaluate retrospectively. Unnecessary imaging generates important costs[14,

[39] and may expose patients to high doses of radiation with non-negligible long term risks of cancer.[40-42] We retained 12 low-value practices on imaging which are already supported by guidelines and/or widely used clinical decision rules and 8 additional clinical practices which are potential targets for low-value imaging. We identified 21 low-value practices related to operative (versus non operative) management of which two are included in EAST guidelines.[32] A recent review found 71 low-value practices in general surgery representing an estimated annual cost of 153 million euros per year in the UK.[43] However, none of these practices pertained to injury. Seventeen practices identified in our review pertained to medications of which five were supported by do-not-do recommendations in clinical guidelines.[32, 34, 36, 37] There is a large body of literature on overprescribing in primary care.[14, 44-46] However, an important knowledge gap on in-hospital medication exists, probably in part due to the fact that hospital prescriptions are not recorded in administrative databases. Other low-value practices identified in our review were hospital and ICU admission (n=11) and follow-up consultation (n=7). Literature on overuse in these areas is sparse, possibly because they are very context-specific. Nine practices included in internationally-recognised guidelines as practices to avoid were not retained in our study, all because less than 75% of experts identified them as clearly or potentially low-value. This discordance could be due to our strict selection criteria based on literature evidence and agreement of more than 75% of experts. Guidelines are often based on few, low-quality studies or expert consensus, but rarely both.[47] It may also be explained by differing influences of local context, industry pressure or single highly-mediatized studies.[13, 15, 21, 48, 49] It does suggest that moving forward, guidelines/metrics on low-value injury care should be based both on evidence from high-quality experimental or observational studies AND expert opinion and should account for the possible influence of local context. Also, the consensus process should strive to minimize intellectual, academic and financial biases.

Strengths and limitations

This study represents a rigorous, exhaustive review of the literature on low-value clinical practices in injury care. Results from our scoping review are supported by a consultation study with 36 experts representing the clinical specialties involved in trauma care on three continents. The participation rate of over 90% demonstrates the high level of knowledge-user interest in this topic. In addition, experts are all involved in clinical research in acute injury care so are likely to have good knowledge of the evidence-base on clinical practices for injury admissions.

This study does have limitations that should be considered in the interpretation of results. First, for feasibility reasons, our search strategy was based on key words related to low-value care and was therefore dependent on authors' judgement of the value of clinical practices. This may have led us to miss some low-value practices. For example, authors of the Randomised Evaluation of Surgery with Craniectomy of Uncontrollable Elevation of Intracranial Pressure (RESCUEicp) trial that observed lower mortality but worse functional outcomes in the intervention group did not clearly identify decompressive craniectomy as a low-value practice.[50] However, by thoroughly screening article references, grey literature including injury organisations and healthcare quality websites, and consulting experts for further references, we are confident that we captured a large proportion of potentially low-value clinical practices that have been reported in the literature. Second, for feasibility reasons, we restricted the review to studies published since 2006. We may therefore have missed some important RCTs published earlier, for example the National Acute Spinal Cord Injury Studies I on high-dose steroids for spinal cord injury [51] and the Harborview trial on antiseizure prophylaxis in traumatic brain injury.[52] However, both these practices were captured through review of guidelines. Fourth, due to the scoping design of our review, we did not evaluate methodological quality. Strength of evidence was only

based on study design. Fifth, the last phase of the review was based on a single web survey therefore represents the results of a consultation rather than expert consensus. In addition, we used a convenience sample and only one neurosurgeon was surveyed. Finally, to identify targets for de-implementation we will need data on frequency (how frequently is the clinical practice actually used?), inter-provider variations (is there evidence of practice variation?) and economic impact (would de-adoption lead to important savings?).[53, 54] These aspects will be incorporated into the following subsequent phases of the Canadian Program for Monitoring Overuse in Injury Care; a systematic review to GRADE evidence for low-value clinical practices identified in this review,[55] a RAND-UCLA expert consensus study to develop a set of quality indicators targeting low-value practices, a multicenter retrospective cohort study to derive and validate metrics for the quality indicators and a cluster randomized controlled trial to evaluate the effectiveness of quality indicators in an audit-feedback intervention. The research program will also allow us to take into account the specificities of low-frequency, high-risk injuries.

CONCLUSIONS

This study fills a major knowledge gap on medical procedure overuse in acute injury care. Results will inform research priorities and the development of metrics to measure overuse. This knowledge will provide a solid basis for the development of interventions targeting de-implementation, such as clinical decision rules and shared decision-making tools. This has the potential to decrease costs, increase resource availability, reduce mortality and morbidity due to unnecessary tests and treatments and reduce patient stress and physicians' workload.

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Authorship statement

Lynne Moore led the conception and design of the study, acquisition of data, analysis and interpretation of data, and drafted the article.

François Lauzier made substantial contributions to the conception and design, the acquisition of the data, the analysis and the interpretation of data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Pier-Alexandre Tardif made substantial contributions to the acquisition of the data, the analysis and the interpretation of data. He participated in drafting the article and gave final approval of the version to be published

Khadidja Malloum Boukar made substantial contributions to the acquisition of the data. She revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Imen Farhat made substantial contributions to the acquisition of the data. She revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Patrick Archambault made substantial contributions to the conception and design, the acquisition of the data, the analysis and the interpretation of data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Éric Mercier made substantial contributions to the conception and design and the acquisition of the data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

François Lamontagne made substantial contributions to the acquisition of the data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Michael Chassé made substantial contributions to the acquisition of the data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Henry T Stelfox made substantial contributions to the conception and design and the acquisition of the data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Simon Berthelot made substantial contributions to the conception and design and the acquisition of the data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Belinda Gabbe made substantial contributions to conception and design. She revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Fiona Lecky made substantial contributions to the acquisition of the data. She revised the manuscript critically for important intellectual content and gave final approval of the version to be published

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Peter Cameron made substantial contributions to the the acquisition of the data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Paule Lessard Bonaventure made substantial contributions to the acquisition of the data and the analysis and the interpretation of data. Shee revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Jérôme Paquet made substantial contributions to the acquisition of the data and the analysis and the interpretation of data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Catherine Truchon made substantial contributions to the acquisition of the data. She revised the manuscript critically for important intellectual content and gave final approval of the version to be published

Alexis F Turgeon made substantial contributions to the conception and design, the acquisition of the data, the analysis and the interpretation of data. He revised the manuscript critically for important intellectual content and gave final approval of the version to be published

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Table 1. Overview of included studies (n=815)

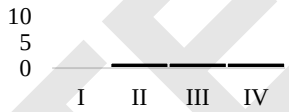
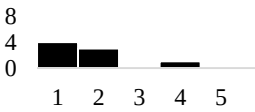
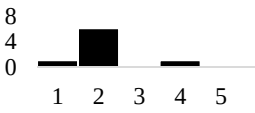
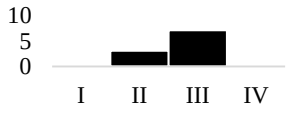
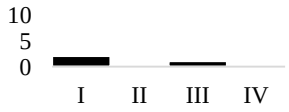
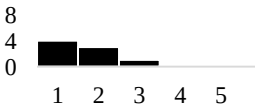
Country		N (%)
USA		397 (48.7)
UK		86 (10.6)
Canada		61 (7.5)
Australia		39 (4.8)
Netherlands		23 (2.8)
Turkey		19 (2.3)
Other		190 (23.3)
Year of publication		
2006-2007		105 (12.9)
2008-2009		119 (14.6)
2010-2011		121 (14.9)
2012-2013		148 (18.2)
2014-2015		161 (19.8)
2016-Mar2018		152 (18.6)
Study design		
Experimental	randomized controlled trial	38 (4.7)
	quasi-randomized controlled trial	7 (0.9)
Observational	retrospective cohort	266 (32.6)
	prospective cohort	156 (19.1)
	case series	104 (12.8)
	cross-sectional	8 (0.9)

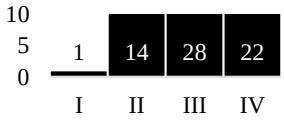
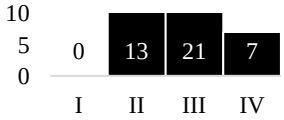
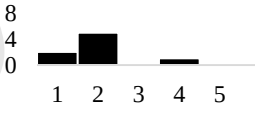
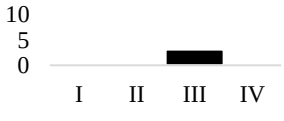
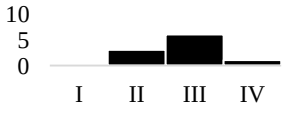
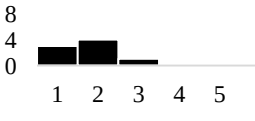
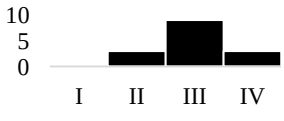
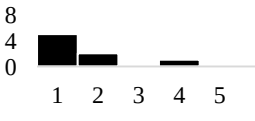
Review	narrative review	110 (13.5)
	systematic review with meta-analysis	33 (4.1)
	systematic review without meta-analysis	35 (4.3)
Expert opinion		44 (5.4)
Other		14 (1.7)
Main study objective		
Effectiveness of clinical practice		448 (55.0)
Development/validation of a clinical decision rule		119 (14.6)
Guidelines/recommendations		75 (9.2)
Prevalence of overuse		74 (9.1)
Efficacy of a deimplementation intervention		68 (8.3)
Safety		14 (1.7)
Development/validation of indicators		5 (0.6)
Other		12 (1.5)
Injury type*		
Head		326 (33.8)
Thoracoabdominal		258 (26.7)
Orthopaedic		155 (16.1)
Spine		120 (12.4)
All injury types		94 (9.7)
Other		12 (1.2)
Age group*		
Adult		356 (36.9)

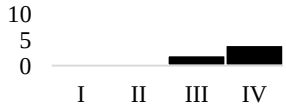
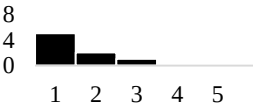
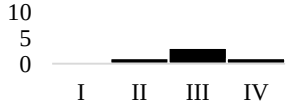
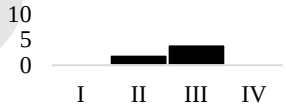
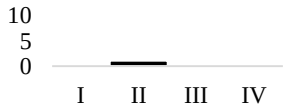
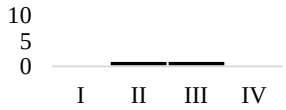
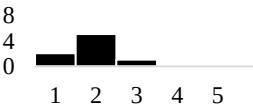
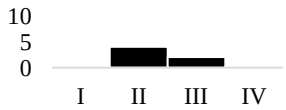
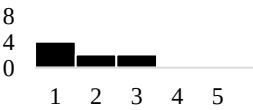
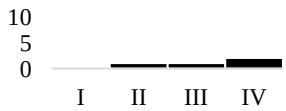
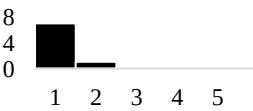
Pediatric		113 (11.7)
Geriatric		8 (0.8)
All		281 (29.1)
Not reported		207 (21.5)
Type of clinical practice*		
Diagnostic		496 (51.4)
Therapeutic	surgical	157 (16.3)
	medical	86 (8.9)
	drugs	104 (10.8)
	device	40 (4.2)
Admission		44 (4.6)
Consultation		21 (2.2)
Monitoring		9 (0.9)
Transfer		8 (0.8)

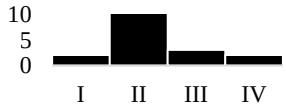
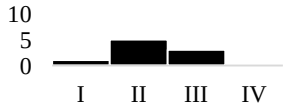
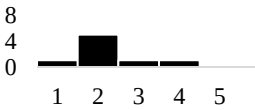
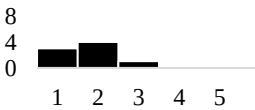
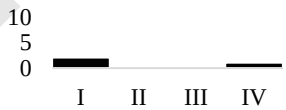
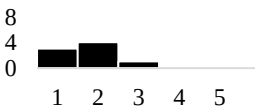
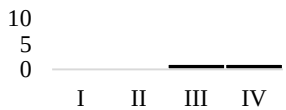
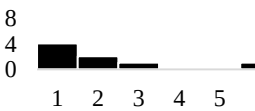
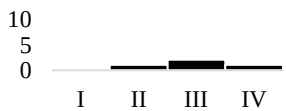
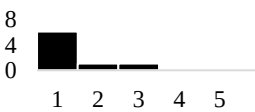
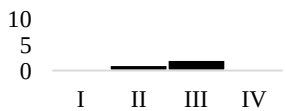
*Based on the number of low value clinical practices (n=965)

Table 2. Low value clinical practices in the **emergency department** according to level of evidence (review phase) and expert opinion (consultation phase)

ractices in the emergency department	Level of evidence† I-RCT to IV-expert consensus Number of studies	Expert opinion‡ 1-clearly low value to 5 beneficial Number of exper
dmission in adult blunt abdominal trauma with normal physical negative FAST or CT[1-3]◊		
dmission in pediatric blunt abdominal trauma with normal physical mptomatic and negative FAST or CT[4-6]		
dmission in stable anterior abdominal stab wound, negative on T and negative local wound exploration[7-9]		
dmission in adult mild TBI, negative on a validated clinical decision CCHR, NEXUS II) or normal CT and normal clinical exam, not on ation therapy[2 10-18]		
dmission in pediatric mild TBI, negative on validated clinical le (e.g. CATCH, PECARN, CHALICE) or normal CT and normal xam[19-21]		
ation in suspected scaphoid fracture with negative CT or MRI[22-		

n adult mild TBI, negative on a validated clinical decision rule (e.g. HIP, NEXUS II)[CW, EAST, NQF, CIHI] [13 15 25-88]		
n pediatric mild TBI, negative on a validated clinical decision rule ARN, CATCH, CHALICE)[CW, CIHI] [19-21 25 38 89-124]		
d CT in pediatric mild TBI, positive initial CT and no clinical on[125-134]		
pine CT in adult trauma, negative on a validated clinical decision Canadian C-Spine Rule, NEXUS)[CW, NQF, NICE] [47 58 135-149]		
pine CT in pediatric trauma, able to co-operate and communicate ve on a validated clinical decision rule (e.g. NEXUS)[109 124 150-		
raphy of the neck in suspected blunt cerebrovascular injury, negative ted clinical decision rule (e.g. DENVER)[160-162]		
n adult blunt thoracic trauma, negative on a validated clinical le (e.g. NEXUS-Chest)[163-172]		
l CT in pediatric blunt abdominal trauma, negative on a validated cision rule (e.g. PECARN, BATiC) and negative FAST[6 109 123		
in pediatric multiple trauma, no pain, normal exam of pelvis/hip, no rmity, no hematuria or abdominal pain/tenderness, GCS>13 and mically stable[183]		

ly CT in minor or single-system trauma[CW, NICE] [25 172 184-187]		
r CT in pediatric trauma for injuries that the facility does not have y to treat[6 188-191]		
er repeat CT in transferred trauma patient with imaging performed al center, no disease progression or additional details needed[88 192-		
ay in pediatric minor head injury, negative on a validated clinical le (e.g. C3PO)[124 197-199]		
ay in blunt trauma, hemodynamically stable with normal physical 200-205]		
ay in adult wrist injury with normal physical exam[206]		
ay in pediatric wrist injury, >2 years of age and normal physical 208]		
Ray in blunt trauma, stable with negative physical exam for pelvic 205 209-213]		
ay in adult trauma, negative on a validated clinical decision rule (e.g. ee Rule, Pittsburgh)[214-217]		

ay in adult trauma, negative on a validated clinical decision rule a Ankle Rule)[218-239]		
ay in pediatric trauma, >2 years of age and negative on a validated cision rule (e.g. Ottawa Ankle Rule)[240-248]		
ood tests in trauma, <60 years old, no regular medications, isolated or low-energy injury and no significant medical history[249]		
zymes in sternal fractures[250]		
costomy in pediatric blunt trauma with small hemothorax or occult orax[251]		
c acid >3h in trauma[NICE] [172 252 253]		
ant factor VIIa (rFVIIa) in isolated TBI with intracerebral e[254 255]		
my in penetrating trauma with CPR >15 minutes and no signs of life response, respiratory effort, or motor activity)[256-259]		
my in blunt trauma with CPR > 10 minutes, no signs of life or the presenting rhythm and no pericardial tamponade[257-259]		

*Review phase: at least one Level I, II or III study (review phase) AND Consultation phase: ≥ 75% of experts who responded to the question classified the practice as clearly or potentially low value and no experts classified it as clearly beneficial

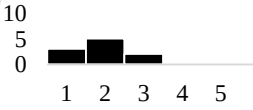
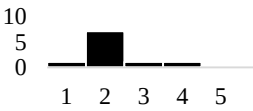
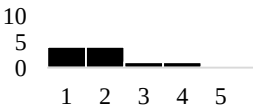
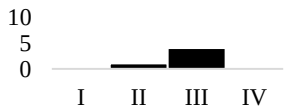
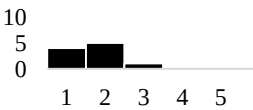
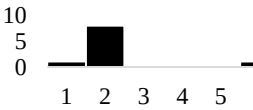
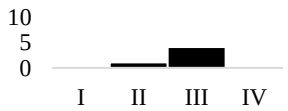
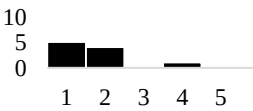
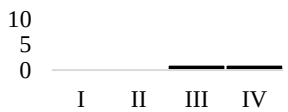
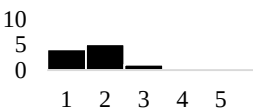
†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

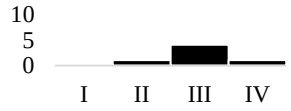
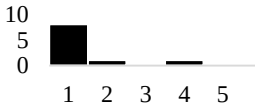
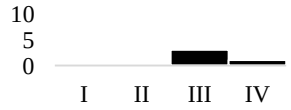
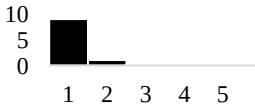
‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

◊See eReferences for table's references

BATIC, Blunt Abdominal Trauma in Children; CATCH, Canadian Assessment of Tomography for Childhood Head injury; CCHR, Canadian CT Head Rule; CHALICE, Children's Head Injury Algorithm for the prediction of Important Clinical Events; CHIP, CT in Head Injury Patients; CIHI, Canadian Institute for Health Information; CPR, cardiopulmonary resuscitation; CT, computed tomography; CW, Choosing Wisely; EAST, Eastern Association for the Surgery of Trauma; FAST, Focused Assessment with Sonography in Trauma; GCS, Glasgow Coma Scale; MRI, magnetic resonance imaging; NEXUS, National Emergency X-Ray Utilization; NICE, National Institute for Health and Care Excellence; NQF, National Quality Forum; PECARN, Pediatric Emergency Care Applied Research Network; RCT, randomized controlled trial; SR, systematic review**;** TBI, traumatic brain injury

Table 3. Low value clinical practices in **general trauma surgery** according to level of evidence (review phase) and expert opinion (consultation phase)

ractices in surgery*	Level of evidence† I-RCT to IV-expert consensus Number of studies	Expert opinion‡ 1-clearly low value to 5 beneficial Number of exper
bedrest for pediatric blunt splenic or liver injury; >1 night for grade nights for grade III[1 2]◊		
olization for grade I-III renal injuries[3]		
ontrol laparotomy for resuscitated trauma patients who are cally restored and not massively transfused[4]		
anagement of grade IV-V liver injury in patients who are mically stable with no indication for surgical treatment of associated T[5-9]		
anagement of pediatric liver injury[10 11]		
anagement of penetrating neck injury with soft signs on clinical negative on multidetector CT angiography[12-16]		
anagement of penetrating renal injury in patients who are mically stable, have no contrast blush indicating arterial e, have a viable kidney and have no gross extravasation[17 18]		

anagement of blunt isolated splenic injury in patients who are mically stable[EAST][19-24]		
anagement of pediatric splenic injury in children who are monitored ynamically stable[25-28]		

*Review phase: at least one Level I, II or III study (review phase) AND Consultation phase: ≥ 75% of experts who responded to the question classified the practice as clearly or potentially low value and no experts classified it as clearly beneficial

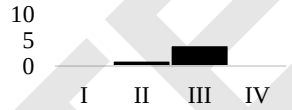
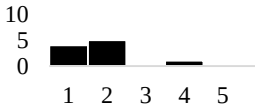
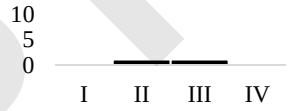
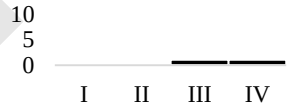
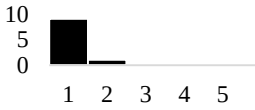
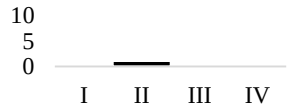
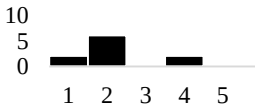
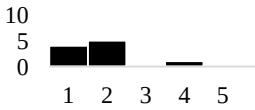
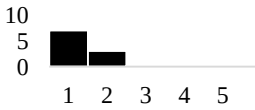
†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

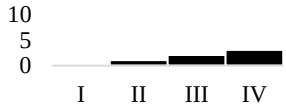
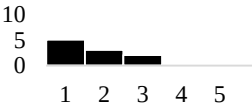
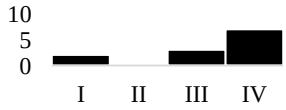
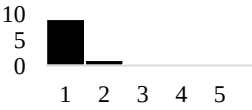
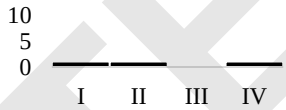
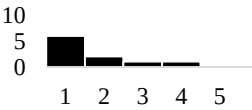
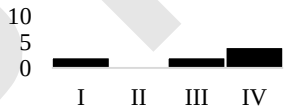
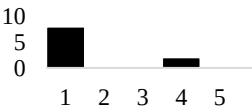
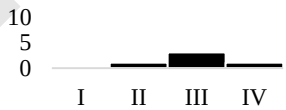
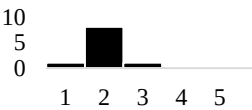
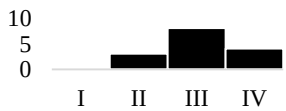
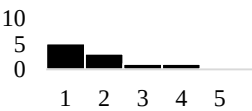
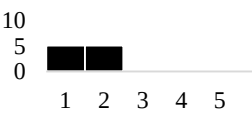
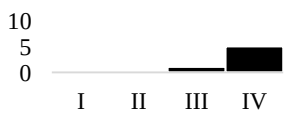
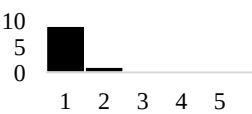
‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

◊See eReferences for table's references

CT, computed tomography; EAST, Eastern Association for the Surgery of Trauma; RCT, randomized controlled trial; SR, systematic review

Table 4. Low value clinical practices in the **intensive care unit** according to level of evidence (review phase) and expert opinion (consultation phase)

ractices in the intensive care unit*	Level of evidence† I-RCT to IV-expert consensus Number of studies	Expert opinion‡ 1-clearly low value to 5 beneficial Number of exper
sion in adults with acute mild complicated TBI who are not on e anticoagulation[1-5]◊		
ical consultation in adults with acute mild TBI and a negative CT[6		
na cava filter for prevention of PE in acute spinal cord injury VT and no contraindications for low-molecular weight heparin[8 9]		
t pneumatic devices for thrombophrophylaxis in nonambulatory itted to the trauma service with no contraindications for low- weight heparin[10]		
ay after chest tube removal in patients with thoracic trauma who are nically ventilated and have appropriate mental status to ate new symptoms[11]		
prophylaxis in basal skull fractures without evidence of CSF -14]		

corticosteroids in spinal cord injury[15-20]		
corticosteroids in adults with TBI[BTF, CW, NICE][21-32]		
e prophylaxis >1 week in adults with severe TBI[BTF] [32-36]		
n severe TBI[37-39]		
colloids (dextran, gelatin, hydroxyethyl starch) in trauma -46]		
nsfusion in adults with TBI on antiplatelet therapy[47-51]		
fusion in adult trauma patients above the transfusion threshold bin >7 gram/deciliter) with no ongoing or suspected uncontrolled o TBI and no coronary heart disease[52-66]		
c hypothermia in adults with TBI and ICP responding to other stage ts[ACS, BTF] [32 67-74]		
ic hyperventilation in adults with severe TBI[BTF] [22 28 32 67 75 76]		

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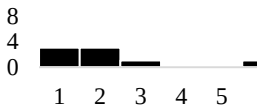
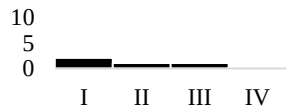
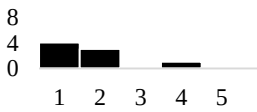
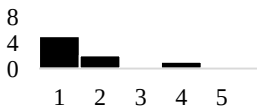
†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

◊See eReferences for table's references

ACS, American College of Surgeons; BTF, Brain Trauma Foundation; CSF, cerebral spinal fluid; CT, computed tomography; CW, Choosing Wisely; ICP, intracranial pressure; NICE, National Institute for Health and Care Excellence; RCT, randomized controlled trial; SR, systematic review; TBI, traumatic brain injury; RBC: red blood cell

Table 5. Low value clinical practices in orthopaedics according to level of evidence (review phase) and expert opinion (consultation phase)

ractices in orthopedics	Level of evidence† I-RCT to IV-expert consensus Number of studies	Expert opinion‡ 1-clearly low value to 5 beneficial Number of exper
consultation for pediatric closed isolated uncomplicated zone 2 acture[1]◊		
ce consultation for isolated thoracolumbar transverse process		
Ray for isolated closed Mason-Johnson type-I radial head/neck th no clinical complaints[3]		
r A0-A3 thoracolumbar burst fracture with kyphotic deformity <35 o associated posterior ligamentous complex injury and no symptoms[4-7]		
ve blood tests for American Society of Anaesthesiologists (ASA) nopedic injury requiring minor surgery[8]		

*Review phase: at least one Level I, II or III study (review phase) AND Consultation phase: ≥ 75% of experts who responded to the question classified the practice as clearly or potentially low value and no experts classified it as clearly beneficial

†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

◊See eReferences for table's references

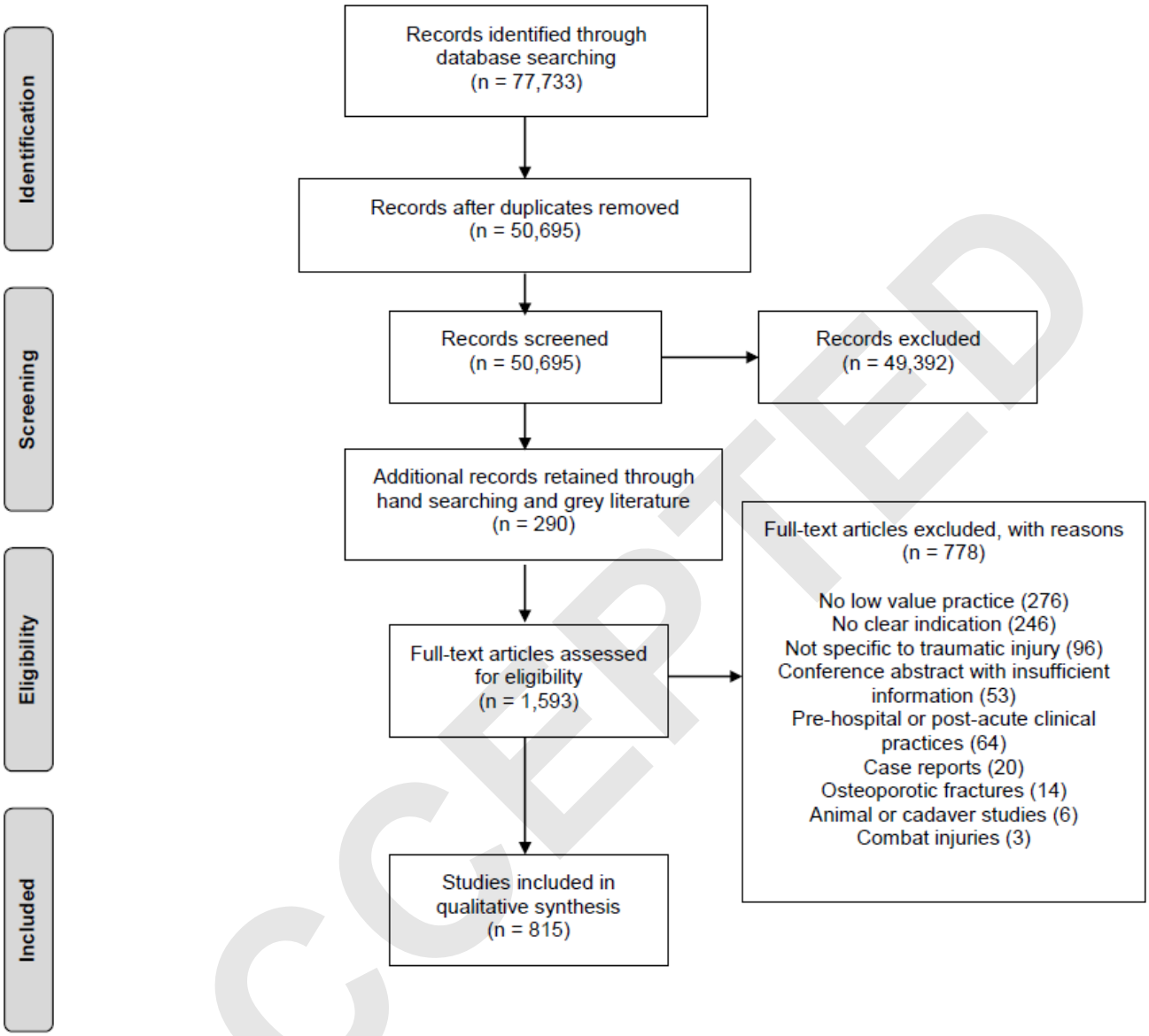
RCT, randomized controlled trial; SR, systematic review

eTable 1. Ovid search strategies

MEDLINE SEARCH STRATEGY
1. Trauma exp "Craniocerebral Trauma"/ OR "Craniocerebral Trauma".ti,ab. OR "head injur$".ti,ab. OR "traumatic brain injur$".ti,ab. OR Fracture.ti,ab. OR Injur$.ti,ab. OR exp "Motor Vehicles"/ OR "motor vehicle collision".ti,ab. OR "motor vehicle crash".ti,ab. OR "Traffic accidents".ti,ab. OR Spinal Cord Injuries/ OR Spinal Cord Injur$.ti,ab. OR Spinal cord trauma?.ti,ab. OR Trauma?.ti,ab. OR Wound$.ti,ab. OR exp "Wounds and Injuries"/
2. Criteria to evaluate overuse De-adopt$.ti,ab. OR Decommission$.ti,ab. OR de-commission$.ti,ab. OR Deimplent$.ti,ab. OR De-list$.ti,ab. OR Disinvest$.ti,ab. OR dis-invest$.ti,ab. OR Do-not-do.ti,ab. OR Harm$.ti,ab. OR "patient harm"/ OR Inappropriate$.ti,ab. OR Ineffective$.ti,ab. OR "low quality".ti,ab. OR "low-value".ti,ab. OR Misuse.ti,ab. OR "Health Services Misuse"/ OR (overuse$.ti,ab. not "overuse injury".ti,ab.) OR "medical overuse"/ OR "poor quality".ti,ab. OR "practice reversal".ti,ab. OR "medical reversal".ti,ab. OR Unnecessary.ti,ab. OR "Unnecessary Procedures"/ OR Unneeded.ti,ab. OR Wasteful.ti,ab.
3. Human animals only Animals/ NOT humans/
4. Years ("2006" or "2007" or "2008" or "2009" or "2010" or "2011" or "2012" or "2013" or "2014" or "2015" or "2016" or "2017" or "2018").yr.
Finalization **5. (1 AND 2 AND 4) NOT 3** **6. Limit 5 to English language**
EMBASE SEARCH STRATEGY
1. Trauma

exp "Craniocerebral Trauma"/ OR "Craniocerebral Trauma".ti,ab. OR "head injur$".ti,ab. OR "traumatic brain injur$".ti,ab. OR Fracture.ti,ab. OR Injur$.ti,ab. OR exp "Motor Vehicles"/ OR "motor vehicle collision".ti,ab. OR "motor vehicle crash".ti,ab. OR "Traffic accidents".ti,ab. OR Spinal Cord Injuries/ OR Spinal Cord Injur$.ti,ab. OR Spinal cord trauma?.ti,ab. OR Trauma?.ti,ab. OR Wound$.ti,ab. OR exp "Wounds and Injuries"/
2. Criteria to evaluate overuse De-adopt$.ti,ab. OR Decommission$.ti,ab. OR de-commission$.ti,ab. OR Deimplent$.ti,ab. OR De-list$.ti,ab. OR Disinvest$.ti,ab. OR dis-invest$.ti,ab. OR Do-not-do.ti,ab. OR Harm$.ti,ab. OR "patient harm"/ OR Inappropriate$.ti,ab. OR Ineffective$.ti,ab. OR "low quality".ti,ab. OR "low-value".ti,ab. OR Misuse.ti,ab. OR "Health Services Misuse"/ OR (overuse$.ti,ab. not "overuse injury".ti,ab.) OR "medical overuse"/ OR "poor quality".ti,ab. OR "practice reversal".ti,ab. OR "medical reversal".ti,ab. OR Unnecessary.ti,ab. OR "Unnecessary Procedures"/ OR Unneeded.ti,ab. OR Wasteful.ti,ab.
3. Human animals only Animals/ NOT humans/
4. Years ("2006" or "2007" or "2008" or "2009" or "2010" or "2011" or "2012" or "2013" or "2014" or "2015" or "2016" or "2017" or "2018").yr.
Finalization **5. (1 AND 2 AND 4) NOT 3** **6. limit 5 to English language**

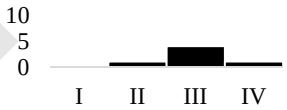
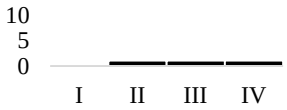
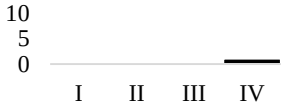
eFigure 1. Preferred Reporting Items for Systematic Reviews and Meta-analysis flow diagram

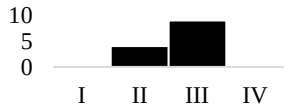
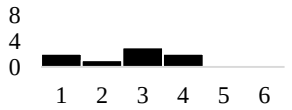
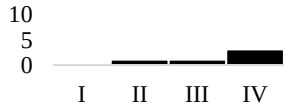
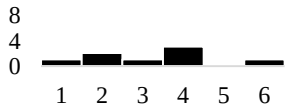


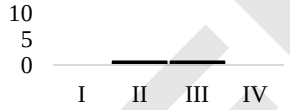
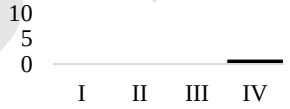
eFigure 2. Extract from the on-line survey

See Online Supplements 2

eTable 2a. Grey zone clinical practices in the emergency department according to level of evidence (review phase) and expert opinion (consultation phase)

Clinical practices in the emergency department	Level of evidence† I-RCT to IV-expert consensus Number of studies	Expert opinion‡ 1-clearly low value to 5-clearly beneficial Number of experts
Hospital admission in isolated sternal fractures with normal cardiac enzymes (troponin) and normal ECG[1]◊		
Hospital admission in pediatric isolated skull fracture with GCS=15, normal neurological exam and low-energy injury mechanism[2-7]		
Cervical collar retention in obtunded or intubated trauma patient with no injuries detected on cervical spine CT[8-10]		
Thoracolumbar spine X-Ray in patients with no complaints of thoracolumbar spinal pain, normal mental status and normal neurological and physical examination[11]		

Repeat head CT in adult mild TBI with negative initial CT and on anticoagulant and/or antiplatelet therapy[12-24]		
Repeat head CT in adult mild complicated TBI[12 25-30]		
Chest CT in pediatric blunt thoracic trauma with normal mediastinal silhouette on X-Ray[NICE][31 32]		
Abdominal CT in adult blunt abdominal trauma with normal physical exam and negative FAST[33-43]		
Routine panels in pediatric blunt abdominal trauma[44]		
Head MRI in adult TBI who received timely helical CT with a new generation scanner[NQF, NICE][45-49]		
Aerodigestive tract endoscopy in penetrating neck injury with negative neck exploration[50]		

Esophagography in esophageal injury with pneumomediastinum but a negative CT[51]		
Massive transfusion in trauma, negative on a validated score (e.g. TASH, revised MTS, ABC)[52 53]		
Thoracotomy in pediatric blunt trauma with cardiac arrest[54]		
Cardiopulmonary resuscitation in trauma, resuscitation >15 mins and no immediate reversible cause[55]		

†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

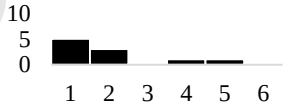
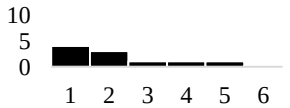
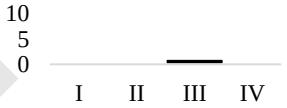
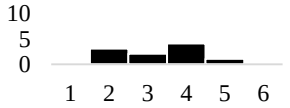
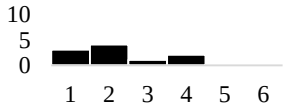
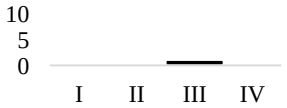
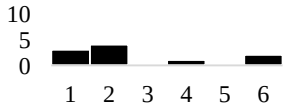
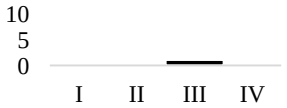
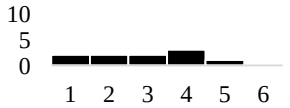
‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

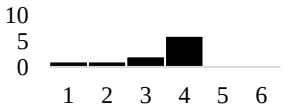
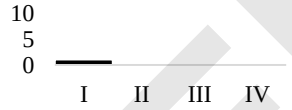
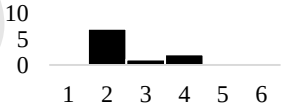
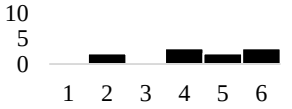
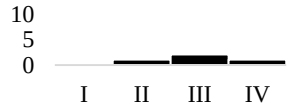
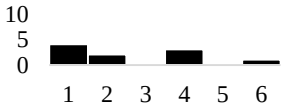
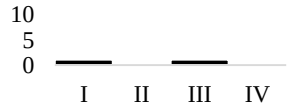
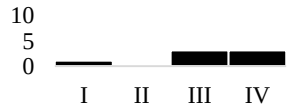
◊See eReferences for table's references

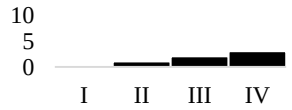
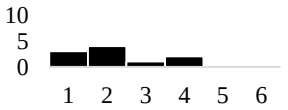
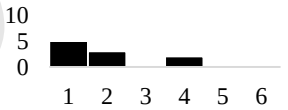
ABC, Assessment of Blood Consumption; CT, computed tomography; ECG, electrocardiogram; FAST, Focused Assessment with Sonography in Trauma; GCS, Glascow Coma Scale; MRI, magnetic resonance imaging; MTS, Massive Transfusion Score; NICE, National Institute for Health and Care Excellence; NQF, National Quality Forum; RCT, randomized controlled trial; SR, systematic review; TASH, Trauma Associated Severe Hemorrhage; TBI, traumatic brain injury

eTable 2b. Grey zone clinical practices in general trauma surgery according to level of evidence (review phase) and expert opinion (consultation phase)

Clinical practices in surgery	Level of evidence†	Expert opinion‡

	I-RCT to IV-expert consensus Number of studies	1-clearly low value to 5-clearly beneficial Number of experts
Hospital admission for stable patients with an abdominal anterior stab wound, negative FAST and negative wound exploration[EAST] [1-3]◊		
Hospitalisation > 24 hours for penetrating abdominal trauma with non-operative management, reliable abdominal examination, and minimal or no abdominal tenderness[EAST] [1]		
Follow-up imaging for blunt grade IV renovascular renal injury with non-operative management and no clinical deterioration[4]		
Follow-up imaging for blunt grade I-III renal injury with non-operative management and no clinical deterioration[4 5]		
Stent graft for minimal aortic injury with regression on follow-up CTA[6]		
Decompression, diversion, exclusion for full thickness duodenal laceration managed with damage control surgery[7]		

Foley catheter for temporary hemostasis in gaping cardiac injury[8]		
Prophylactic nasogastric decompression following emergency laparotomy for abdominal injury[9]		
Complex surgery for duodenal injury from low-velocity gunshot wound with <50% circumference[10]		
Damage control laparotomy for pediatric trauma[11 12]		
Surgical management of penetrating zone II neck injury without hard signs[EAST] [13-16]		
Surgical management of grade III-IV pancreatic injury in patients who are hemodynamically stable and have no hollow organ injuries[17 18]		
Surgical management of blunt grade IV-V renal injury in patients who are hemodynamically stable[2 18-23]		

Surgical management of blunt isolated splenic or liver injury in patients with no peritonitis who are hemodynamically stable or unstable but responsive[20 22 24-27]		
Surgical management of penetrating transmediastinal injury in patients who are hemodynamically stable and are either negative on CT or positive on CT but negative on esophagoscopy/esophagography, bronchoscopy or angiography[28]		

†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

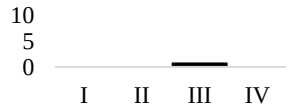
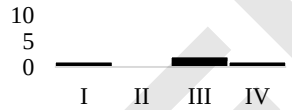
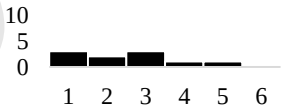
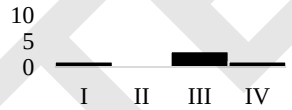
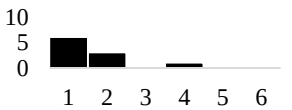
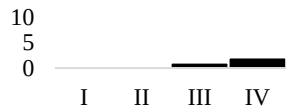
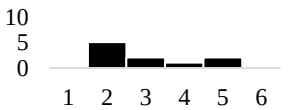
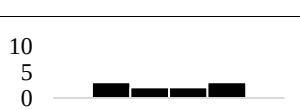
‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

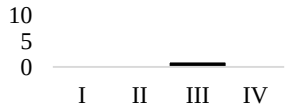
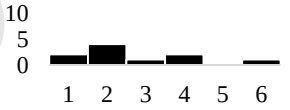
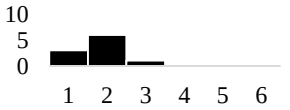
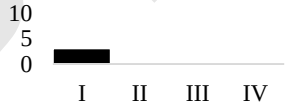
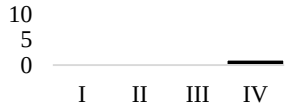
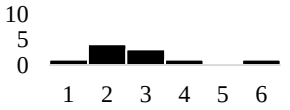
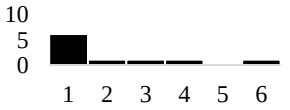
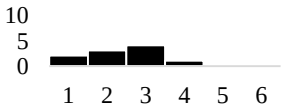
◊See eReferences for table's references

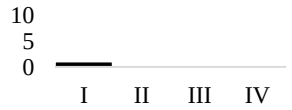
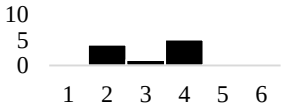
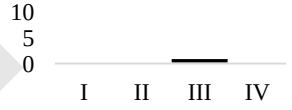
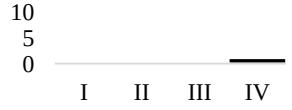
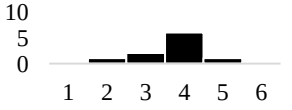
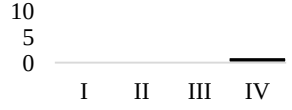
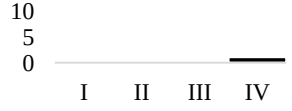
CT, computed tomography; CTA, CT angiography; EAST, Eastern Association for the Surgery of Trauma; FAST, Focused Assessment with Sonography in Trauma; RCT, randomized controlled trial; SR, systematic review

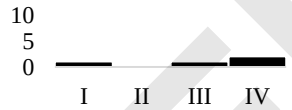
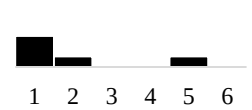
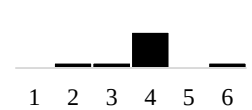
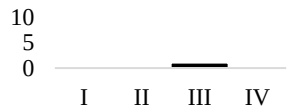
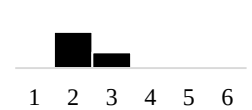
eTable 2c. Grey zone clinical practices in the intensive care unit according to level of evidence (review phase) and expert opinion (consultation phase)

Clinical practices in the intensive care unit	**Level of evidence†** **I-RCT to IV-expert consensus** **Number of studies**	**Expert opinion‡** **1-clearly low value to 5-clearly beneficial** **Number of experts**

Neurosurgical consultation in adults with acute mild complicated TBI[1]◊		
Decompressive craniectomy in severe TBI with diffuse injury and refractory ICP[2-5]		
Decompressive craniectomy in severe TBI as a standard of care[ACS, BTF] [2-6]		
Inferior vena cava filter for prevention of PE in isolated acute TBI with intracerebral hemorrhage and no DVT[7]		
ICP monitoring in adults with severe TBI, normal CT and not more than one of the following criteria: aged>40, unilateral or bilateral posturing, systolic blood pressure <90 mmHg[ACS] [8-10]		
Neurological assessments hourly >24h in adults admitted to the ICU with mild or moderate TBI who are stable[11]		
Neurological assessments hourly >24h in adults admitted to the ICU with severe TBI who are stable[11]		

Antibiotic combination therapy to cover gram negative bacilli as standard of care in trauma patients with ventilator-associated pneumonia[12]		
Antibiotic combination therapy to cover gram negative bacilli and MRSA as standard of care in trauma patients with ventilator-associated pneumonia[12]		
Postoperative antibiotic prophylaxis in penetrating abdominal trauma with no hollow viscus injury[13]		
Antibiotic prophylaxis in basal skull fractures with evidence of CSF leakage[14-16]		
Antibiotic prophylaxis >24h post-operation in penetrating abdominal trauma with or without hollow viscus injury[EAST][17]		
Antibiotic prophylaxis for external ventricular drain placement in adults with TBI[18]		
Barbiturates in adults with severe TBI[BTF][5 18-21]		

Dopamine antagonists (methylphenidate, amantadine, and bromocriptine) in adults with severe TBI[22]		
Antiseizure prophylaxis <1 week in adults with severe TBI and no seizure activity[18 23 24]		
Neuromuscular blocking agents in TBI with no refractory intracranial hypertension[25]		
Octreotide as routine post-operative prophylaxis to prevent fistula in pancreatic injuries[26]		
Hypertonic saline solution in severe TBI[7]		
Early hypertonic saline solution in TBI when intracranial pressure is not monitored[27]		
Plasma transfusion with international normalized ratio <1.3 in TBI[28]		

Therapeutic hypothermia in spinal cord injury[29]		
Hyperbaric oxygen therapy in TBI[19 30-32]		
Parenteral nutrition in trauma patients with no contraindications for enteral nutrition[25]		
Immunisation following angiographic embolization in splenic injury[33]		
Bed rest immobilization in blunt renal, hepatic or splenic injury[34]		

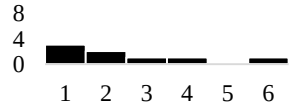
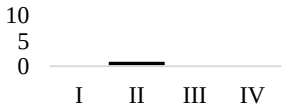
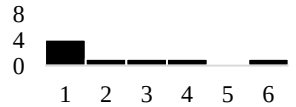
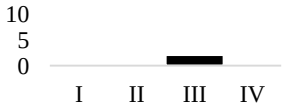
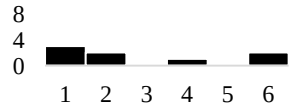
†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

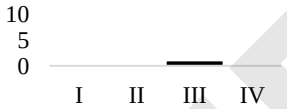
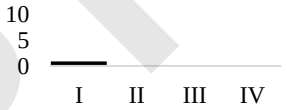
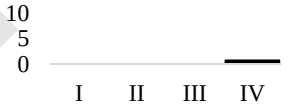
‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

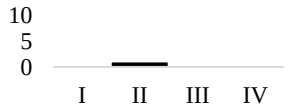
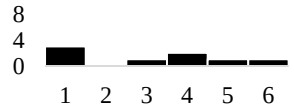
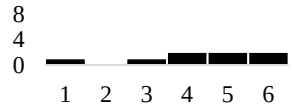
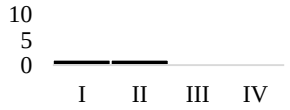
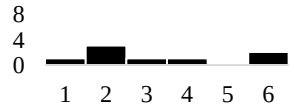
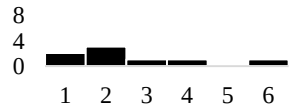
◊See eReferences for table's references

ACS, American College of Surgeons; BTF, Brain Trauma Foundation; CSF, cerebral spinal fluid; CT, computed tomography; DVT, deep vein thrombosis; EAST, Eastern Association for the Surgery of Trauma; ICP, intracranial pressure; MRSA, Methicillin-Resistant Staphylococcus Aureus; PE, pulmonary embolism; RBC, red blood cells; RCT, randomized controlled trial; SR, systematic review; TBI, traumatic brain injury

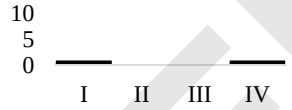
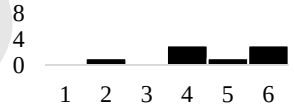
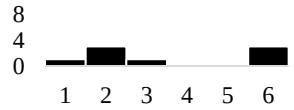
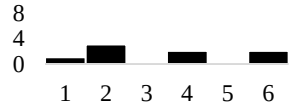
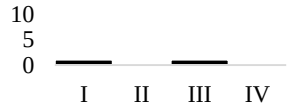
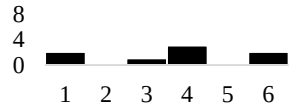
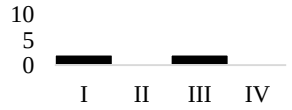
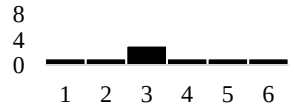
eTable 2d. Grey zone clinical practices in orthopaedics according to level of evidence (review phase) and expert opinion (consultation phase)

Clinical practices in orthopedics	Level of evidence† I-RCT to IV-expert consensus Number of studies	Expert opinion‡ 1-clearly low value to 5-clearly beneficial Number of experts
Follow-up consultation for adults with adequately aligned fifth metacarpal fracture[1-3]◊		
Follow-up consultation for adult with fifth metatarsal fracture[4]		
Follow-up consultation for adult with non-displaced or minimally displaced distal radius fracture[3]		
Follow-up consultation for adult with Mason I radial head and neck fracture[5]		
Hand surgery consultation for adult hand injury without injury to the nerves, tendons or joints, skin loss or complex fractures or injuries requiring skin grafting or		

reconstruction[6 7]		
Follow-up consultation for pediatric distal radial metaphysis buckle fracture[8]		
Follow-up consultation for uncomplicated pediatric toddler fractures[9]		
Repeat X-Ray for fractures with fixation repair and no clinical complaints[10]		
Repeat X-Ray for torus or buckle distal radial fracture[11]		
X-Ray on cast removal for adult ≥ 50 years old with a closed distal radius fracture, <2 cm from the distal end of the radius, living independently before the fracture[12]		
Post-operative X-Ray for pediatric forearm fracture treated with manipulation under anesthesia with fluoroscopic guidance[13]		

Post-operative X-Ray for pediatric pin-fixed displaced supracondylar humeral fracture[14]		
Post-operative X-Ray of fractures treated by operative fixation with a load-sharing construct in good quality bone[15]		
Post splinting X-Ray of non-displaced and minimally displaced fractures with no manipulation before or during immobilization[16 17]		
Magnetic resonance imaging for suspected scaphoid fracture[18]		
Routine in-hospital post-operative X-Ray for surgically treated thoracolumbar injuries with no clinical deterioration[19]		
Cast immobilization for adult fifth metacarpal neck fracture[1 20]		
Immobilization for suspected scaphoid fractures with negative computed tomography or magnetic resonance imaging[21 22]		

Reduction and cast immobilization in fifth metacarpal neck fracture with initial angulation of less than 70 degrees[20]		
Percutaneous pin fixation for adults with unstable, extra-articular distal radial fracture[23]		
Syndesmotic screw removal for adult surgical ankle fracture without persistent hardware complaints (asymptotic)[24-26]		
Radial head prosthesis in adult Mason IV radial head fracture-dislocation[27]		
Long arm cast for pediatric (>4 years old) displaced distal third radius and ulna fractures[28]		
Rigid cast for pediatric isolated distal fibular facture[29 30]		

Halo vest for geriatric type II odontoid fracture[31]		
Open Reduction and Internal Fixation (ORIF) in Mason II radial head fractures[32 33]		
Hemiarthroplasty in patients 65 years of age and over with a proximal, four-part humeral fracture[34]		
Supplementary cancellous bone graft in femoral, tibial or humeral fractures during renailing surgery when adequate reaming and a larger nail are used[35]		
Surgical management in thoracolumbar burst fractures with no more than minor neurologic deficit[36 37]		
Spinal fusion for thoracolumbar and lumbar burst fractures requiring surgery[38-41]		
Daily pin site care for fractures with an external fixation device[42 43]		

†**Level of evidence of clinical practices based on study design**, I, RCT or SR of RCT; II, prospective studies, quasi-randomized studies, SR of level II studies; III, case-control, case series, cross-sectional, retrospective, SR of level III studies; IV, expert consensus, narrative review, other

‡**Level of agreement of consulted experts on the value of clinical practices**, 1, clearly low-value; 2, possibly low-value; 3, controversial; 4, possibly beneficial; 5, clearly beneficial; 6, undecided

◊See eReferences for table's references

RCT, randomized controlled trial; SR, systematic review

eReferences

Index

References for Table 2

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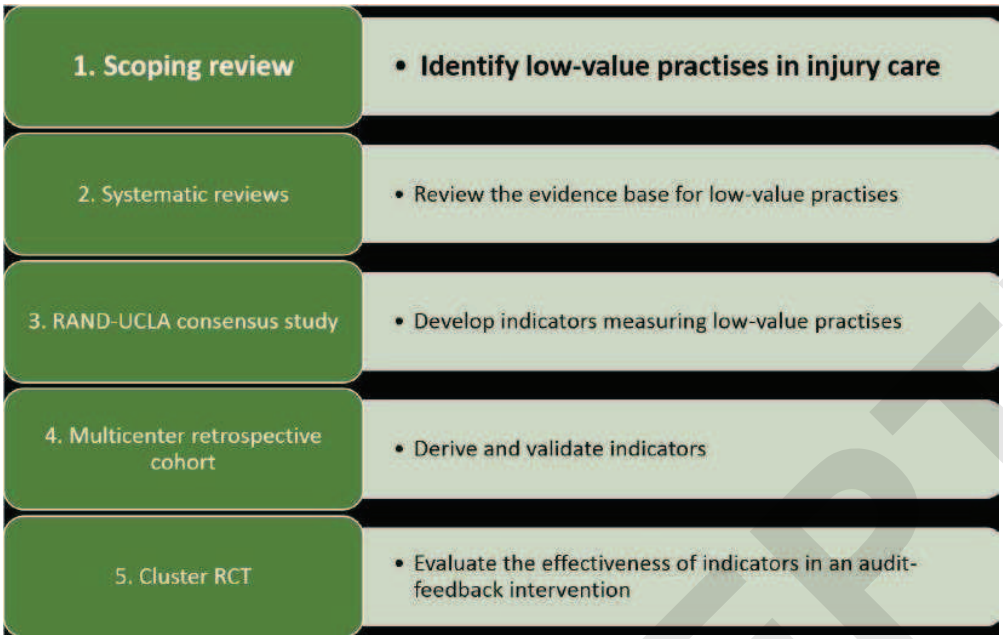
Low-value clinical practices in the intensive care unit

Thanks for your participation in the **consultation phase** of our **scoping review,** the first component of the **Canadian Program on Low Value Practices in Injury Care.**

FIGURE 1. THE CANADIAN PROGRAM ON LOW-VALUE PRACTICES IN INJURY CARE



The objective of this survey is to **identify around 10 clinical practices** that will go on to the systematic review phase. To do so, we would like you to **rate each intervention on its potential to be labeled as a low-value clinical practice** according to the following **definition:**

An intervention that is used in practice but is ineffective or its harm/cost outweighs its benefits

There are 53 questions in this survey

ICU ADMISSION AND NEUROSURGICAL CONSULTATION (page 1/7)

Low-value clinical practice (definition): **An intervention that is used in practice but is ineffective or its harm/cost outweighs its benefits.**

We would like you to rate each intervention on its potential to be labeled as a low-value clinical practice according to the following definition:

An intervention that is used in practice but is ineffective or its harm/cost outweighs its benefits

1. ICU ADMISSION
Indication: Adult acute mild TBI (GCS 13-15) with minimal findings on CT and not on nonreversible anticoagulation

Please choose the appropriate response for each item:

Clearly low-value	Possibly low-value	Controversial	Possibly beneficial	Clearly beneficial	Undecided
○	○	○	○	○	○

2. ICU ADMISSION
Indication: Pediatric acute mild TBI (GCS 13-15) with minimal findings on CT but no midline shift or depressed skull fracture

Please choose the appropriate response for each item:

Clearly low-value	Possibly low-value	Controversial	Possibly beneficial	Clearly beneficial	Undecided
○	○	○	○	○	○

3. NEUROSURGICAL CONSULTATION
Indication: Acute mild TBI with negative CT

Please choose the appropriate response for each item:

Clearly low-value	Possibly low-value	Controversial	Possibly beneficial	Clearly beneficial	Undecided
○	○	○	○	○	○

4. NEUROSURGICAL CONSULTATION
Indication: Acute mild TBI with minimal findings on CT

Please choose the appropriate response for each item:

Clearly low-value	Possibly low-value	Controversial	Possibly beneficial	Clearly beneficial	Undecided
○	○	○	○	○	○

Comments:

Please write your answer(s) here:

Question 1	
Question 2	
Question 3	
Question 4	