CHOOSE WISELY

2016

The Royal Australian and New Zealand College of Radiologists®

RECOMMENDATIONS AND CLINICAL DECISION RULES

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^ Joint recommendation with the Australasian College for Emergency Medicine

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CHOOSING WISELY NEW ZEALAND 2016

RECOMMENDATIONS AND CLINICAL DECISION RULES

As featured in the Educational Modules for Appropriate Imaging Referrals project

SIX RECOMMENDATIONS

The Royal Australian and New Zealand College of Radiologists® (RANZCR) is proud to be one of the founding partners in the Choose Wisely New Zealand® campaign. This campaign urges clinicians to perform less unnecessary scans in order to decrease the potential harm to patients and to target healthcare resources more efficiently. Choose Wisely New Zealand plans to accomplish this through the use of six new recommendations.

Each recommendation has its own set of evidence-based Clinical Decision Rules (CDR) to support clinicians. A CDR is developed by gathering clinical datasets from large numbers of patients with a particular condition. The CDRs are a specific combination of a of set of examination findings and/or aspects of history that, when absent or present, increase or decrease the likelihood of a particular condition in a clinically important way. CDRs help clinicians stratify patients into higher and lower risk for a given clinical condition, and this helps to determine whether or not they would benefit from diagnostic imaging. The following pages elaborate on each recommendation and its CDRs.

More detailed information about the application of all the CDRs covered in this booklet are available in the Education Modules for Appropriate Imaging Referrals section of the RANZCR website.

For more information around what a clinical decision rule is, how they are developed and how to use them appropriately, please read the “Introduction to Clinical Decision Rules” item.

For further information about Choose Wisely New Zealand please visit: http://choosingwisely.org.nz

RANZCR Recommendations: http://choosingwisely.org.nz/professional-resource/ranzcr-radiology/

RECOMMENDATION 1

Acute Ankle Trauma

Don't request imaging for acute ankle trauma unless indicated by the Ottawa Ankle Rules (localised bone tenderness or inability to weight-bear as defined in the Rules).

OTTAWA ANKLE RULES – ADULT[1]

ALGORITHM:

APPLYING THE OTTAWA ANKLES RULES FOR PATIENTS AGED OVER 18 YEARS

Does a patient presenting with acute ankle or foot trauma pain require x–rays of the foot or ankle?

INCLUSION CRITERIA

Patients presenting with acute blunt injuries of the ankle
(e.g. twisting injuries, falls from height, direct blows and motor vehicle accidents)

NO → **Exclude**

YES ↓

EXCLUSION CRITERIA

Is/does/has the patient:

- Pregnant?
- Have isolated injuries of the skin (superficial lacerations, abrasions or burns)?
- Returning for reassessment of the same ankle injury?
- Suffered the injury more than ten days earlier?

YES to ANY → **Exclude**

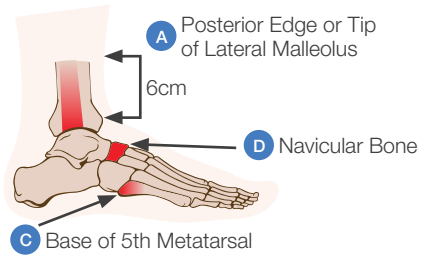
NO to ALL ↓

STEP ONE: Is there any pain in the malleolar zone and any of these findings?:

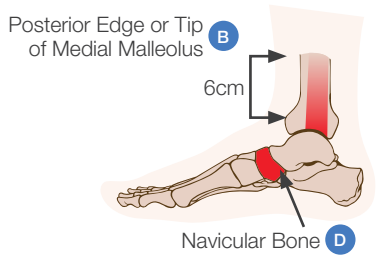
1. Bone tenderness at **A**
2. Bone tenderness at **B**
3. Inability to bear weight both immediately and in the emergency department

YES to ANY → **ANKLE X–RAY SERIES RECOMMENDED**

LATERAL VIEW



MEDIAL VIEW



Ankle and Foot x–rays are recommended when there is an inability to bear weight both immediately and in the emergency department

STEP TWO: Is there any pain in the mid–foot zone and any of these findings?:

1. Bone tenderness at **C**
2. Bone tenderness at **D**
3. Inability to bear weight both immediately and in the emergency department

YES to ANY → **FOOT X–RAY SERIES RECOMMENDED**

NO to ALL → **IMAGING NOT RECOMMENDED**

NO to ALL

DEFINITIONS

The malleolar zone

- Posterior aspect of the distal 6cm of the tibia (medial malleolus)
- Posterior aspect of the distal 6cm of the fibula (lateral malleolus)

The midfoot zone*

- navicular
- cuboid
- cuneiforms
- anterior process of the calcaneus
- the base of the fifth metatarsal

*** NOTE:**
Does not include fractures of the body and tuberosity of the calcaneus

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INCLUSION CRITERIA

All patients presenting with acute blunt injuries of the ankle (e.g. twisting injuries, falls from height, direct blows and motor vehicle accidents), where ankle was broadly defined to include the area involved in common twisting injuries and was subdivided into two zones that require assessment by a standard ankle radiographic series (malleolar area) and a standard foot radiographic series (the midfoot):

- The malleolar area: distal 6cm of tibia, distal 6cm of fibula, and talus; AND
- The midfoot: navicular, cuboid, cuneiforms, anterior process of the calcaneus, and the base of the fifth metatarsal. The body and tuberosity of the calcaneus were not included in this definition.

EXCLUSION CRITERIA

- Age under 18 years old
- Pregnancy
- Isolated injuries of the skin (superficial lacerations, abrasions or burns)
- Returning for reassessment of the same ankle injury
- Suffered the injury more than ten days earlier

SUMMARY STATEMENT

The Ottawa Ankle Rules (OARs) aim to determine if a patient presenting with acute ankle or foot trauma pain requires x-rays of the foot or ankle.

The derivation study for the OARs used an adult population as its subjects but extensive validation studies have shown that the OARs can be safely applied to both the adult and paediatric populations. Validation studies by Bachmann *et al*[2] have found that the OARs have an almost 100% sensitivity in many studies in differing clinical settings. Used appropriately, they reduce the unnecessary performance of x-rays by 30–40%.

REFERENCES

1. Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. *Ann Emerg Med.* 1992; 21(4): 384–90.
2. Bachmann LM, Kolb E, Koller MT, Steurer J, Riet G. Accuracy of Ottawa Ankle Rules to exclude fractures of the ankle and mid-foot: systematic review. *BMJ*. 2003; 326(7386): 417.

OTTAWA ANKLE RULES – PAEDIATRICS[1]

ALGORITHM:

APPLYING THE OTTAWA ANKLES RULES FOR PAEDIATRIC PATIENTS <18 YEARS

INCLUSION CRITERIA

Most validation studies in children did not include children under the age of 2 years (i.e. non-walkers) and therefore the performance of the OARs in this age group is less clear.

- All patients presenting with acute blunt injuries of the ankle (e.g. twisting injuries, falls from height, direct blows and motor vehicle accidents)

NO → **Exclude**

YES ↓

EXCLUSION CRITERIA

- Children under 2 years old (i.e. non-walkers)
- Open fractures
- Isolated injuries of the skin
- Presentation >48 hours after trauma
- Suspected non-accidental injury
- Multi trauma in areas away from the foot and ankle
- Patients returning for reassessment of the same ankle injury OR patients referred to the emergency department with x-rays
- Prior surgery to the symptomatic foot/ankle in the past 3 months
- Neurovascular compromise, diseases predisposing to fractures (e.g. osteogenesis imperfecta)
- Underlying disease with sensory/neural abnormalities of the lower limb(s) (e.g. spina bifida)
- Metabolic disorders or coagulopathy.
- Developmental delay
- Intoxication

YES to ANY → **Exclude**

NO to ALL ↓

STEP ONE: Is there any pain in the malleolar zone and any of these findings?

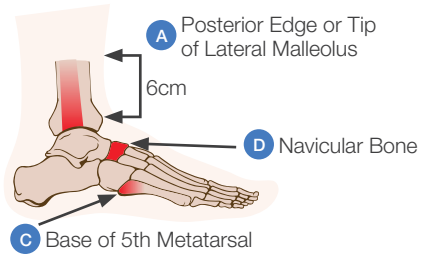
1. Bone tenderness at **A**
2. Bone tenderness at **B**
3. Inability to bear weight both immediately and in the emergency department

NO to ALL → **IMAGING NOT RECOMMENDED**

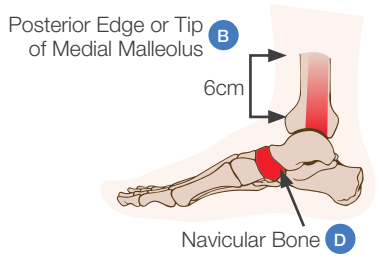
YES to ANY → **ANKLE X–RAY SERIES RECOMMENDED**

Ankle and Foot x–rays are recommended when there is an inability to bear weight both immediately and in the emergency department

LATERAL VIEW



MEDIAL VIEW



STEP TWO: Is there any pain in the mid–foot zone and any of these findings?:

1. Bone tenderness at **C**
2. Bone tenderness at **D**
3. Inability to bear weight both immediately and in the emergency department

YES to ANY → **FOOT X–RAY SERIES RECOMMENDED**

NO to ALL

DEFINITIONS

The malleolar zone

- Posterior aspect of the distal 6cm of the tibia (medial malleolus)
- Posterior aspect of the distal 6cm of the fibula (lateral malleolus)

The midfoot zone*

- navicular
- cuboid
- cuneiforms
- anterior process of the calcaneus
- the base of the fifth metatarsal

*** NOTE:**
Does not include fractures of the body and tuberosity of the calcaneus

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INCLUSION CRITERIA

All patients presenting with acute blunt injuries of the ankle (e.g. twisting injuries, falls from height, direct blows and motor vehicle accidents), where ankle was broadly defined to include the area involved in common twisting injuries and was subdivided into two zones that require assessment by a standard ankle radiographic series (malleolar area) and a standard foot radiographic series (the midfoot).

EXCLUSION CRITERIA

These exclusion criteria vary from study to study but have included some or all of the following:

- Salter–Harris I and non- significant fractures defined as <3mm
- Children under 2 years old
- Open fractures
- Neurovascular compromise
- Diseases predisposing to fractures (e.g. osteogenesis imperfecta)
- Underlying disease with sensory/neural abnormalities (spina bifida)
- Isolated injuries of the skin
- Patients returning for reassessment of the same ankle injury
- Patients referred to the emergency department with x-rays
- Intoxication
- Presentation >48 hours after trauma
- Developmental delay
- Neurological disorder of the lower limb such as spina bifida
- Multi trauma in areas away from the foot and ankle
- Suspected non accidental injury
- Prior surgery to the symptomatic foot/ankle in the past 3 months
- Metabolic disorders or coagulopathy

SUMMARY STATEMENT

The Ottawa Ankle Rules (OARs) aim to determine if a patient presenting with acute ankle or foot trauma–related pain requires plain radiographs of the foot or ankle to exclude a fracture. The OARs were not developed to exclude ligamentous or tendon injuries in the foot and ankle.

The derivation study for the OARs used an adult population as its subjects but validation studies have shown that the OARs can be safely applied to both the adult and paediatric populations. Correct use of the OARs can result in reduction of 30–40% in the need for plain radiographs in people with acute blunt trauma to the ankle and foot.

Myers *et al*[2] reviewed paediatric validation studies of the OARs and concluded that:
"Based on the mean 21.4% prevalence of fractures among the included studies, and the pooled negative LR of 0.11, the posterior probability of fracture given a negative OAR assessment is approximately 2.9%".

REFERENCES

1. Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. *Ann Emerg Med*. 1992; 21(4): 384–90.
2. Myers A, Canty K, Nelson T. Are the Ottawa ankle rules helpful in ruling out the need for x ray examination in children? *Arch Dis Child*. 2005; 90(12): 1309–11.

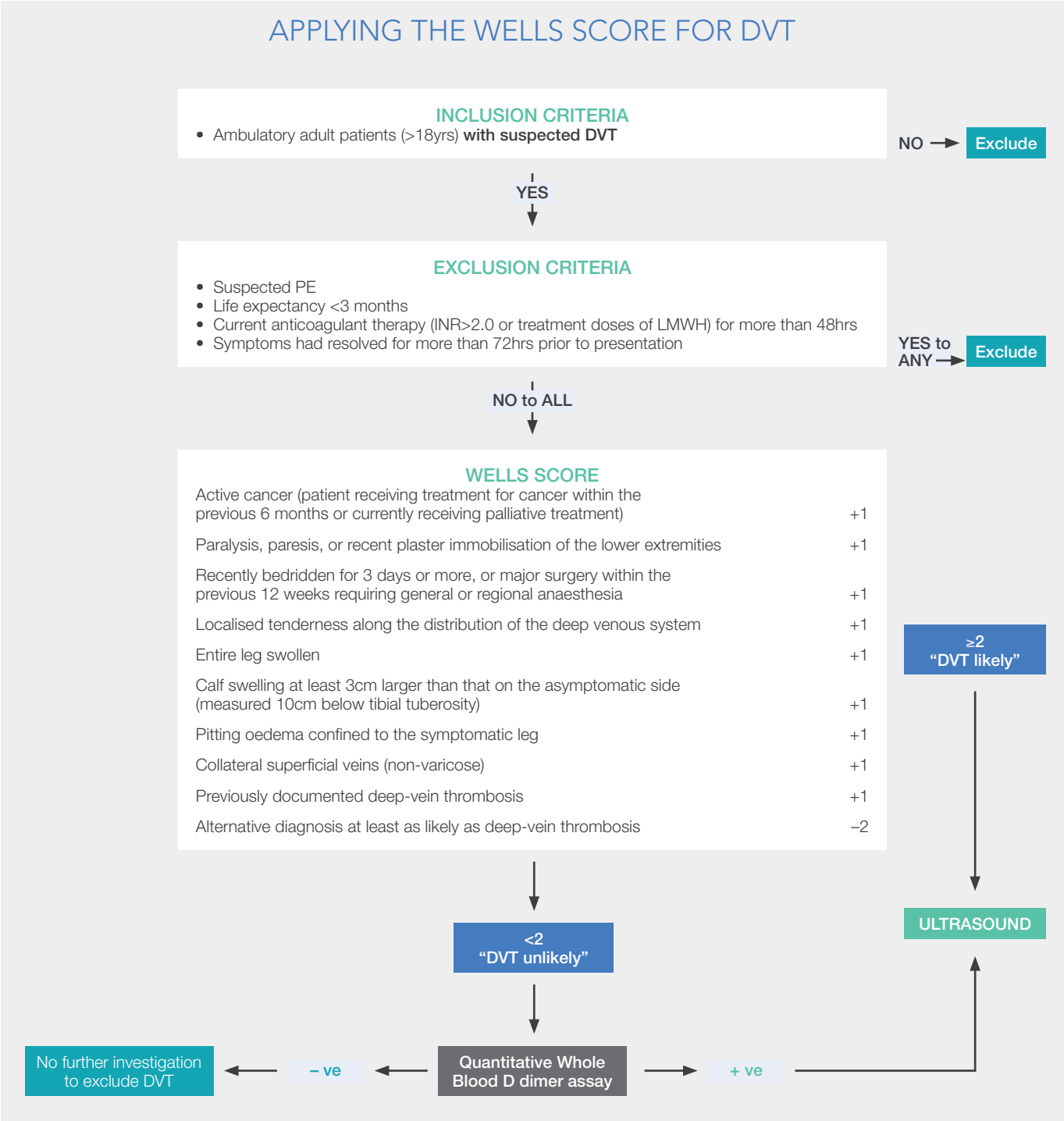
RECOMMENDATION 2

Suspected Lower Limb DVT

Don't request duplex compression ultrasound for suspected lower limb deep venous thrombosis in ambulatory outpatients unless the Wells Score (deep venous thrombosis risk assessment score) is greater than 2, OR if less than 2, D dimer assay is positive.

WELLS SCORE FOR DVT[1]

ALGORITHM:



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INCLUSION CRITERIA

- Ambulatory adult patients (>18yrs)
- With suspected deep venous thrombosis (DVT)

EXCLUSION CRITERIA

- Suspected pulmonary embolism (PE)
- Life expectancy <3 months
- Current anticoagulant therapy (INR>2.0 or treatment doses of LMWH) for more than 48 hours
- Symptoms have resolved for more than 72 hours prior to presentation.

SUMMARY STATEMENT

This study[1] established that in ambulatory outpatients with suspected lower limb DVT and a Wells score of less than 2, it is safe to exclude DVT by performing a D dimer assay which, if negative, obviates the need for imaging to exclude DVT. The lower limit of the negative predictive value of the combination of a score <2 and negative D dimer was found to be 96.7%, making it very comparable with the negative predictive value of a normal ventilation perfusion lung scan in a patient with suspected pulmonary embolism. It has been extensively validated by investigators apart from those who developed it.

REFERENCE

1. Wells PS, Anderson DR, Rodger M, Forgie M, Kearon C, Dreyer J, *et al.* Evaluation of D dimer in the diagnosis of suspected deep-vein thrombosis. *N Engl J Med.* 2003; 349(13): 1227–35.

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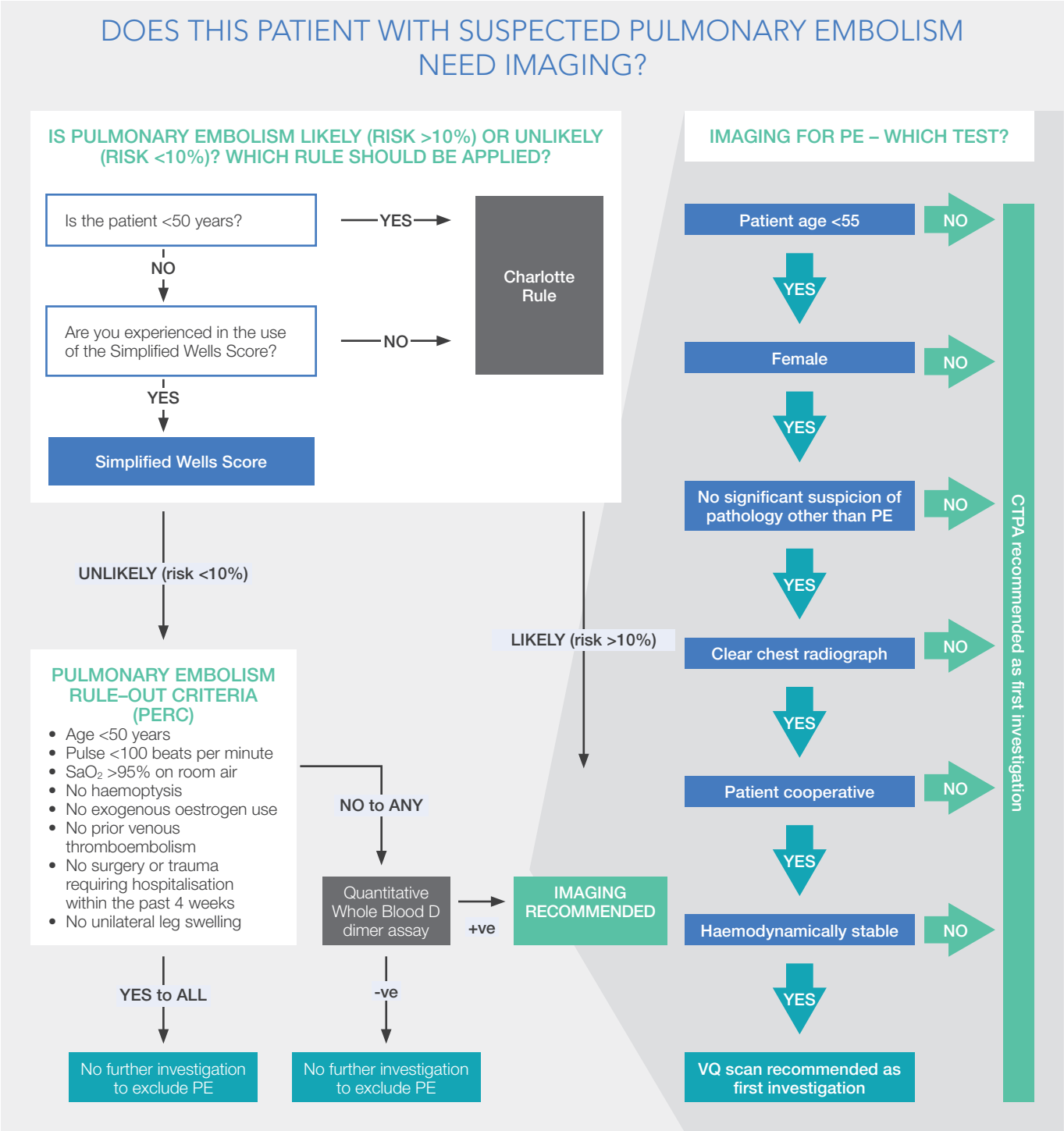
RECOMMENDATION 3

Suspected Pulmonary Embolism

Don't request any diagnostic testing for suspected pulmonary embolism (PE) unless indicated by Wells Score (or Charlotte Rule) followed by PE Rule-out Criteria (in patients not pregnant). Low risk patients in whom diagnostic testing is indicated should have PE excluded by a negative D dimer, not imaging.

IMAGING APPROACH TO PATIENT WITH SUSPECTED PULMONARY EMBOLISM

ALGORITHM:



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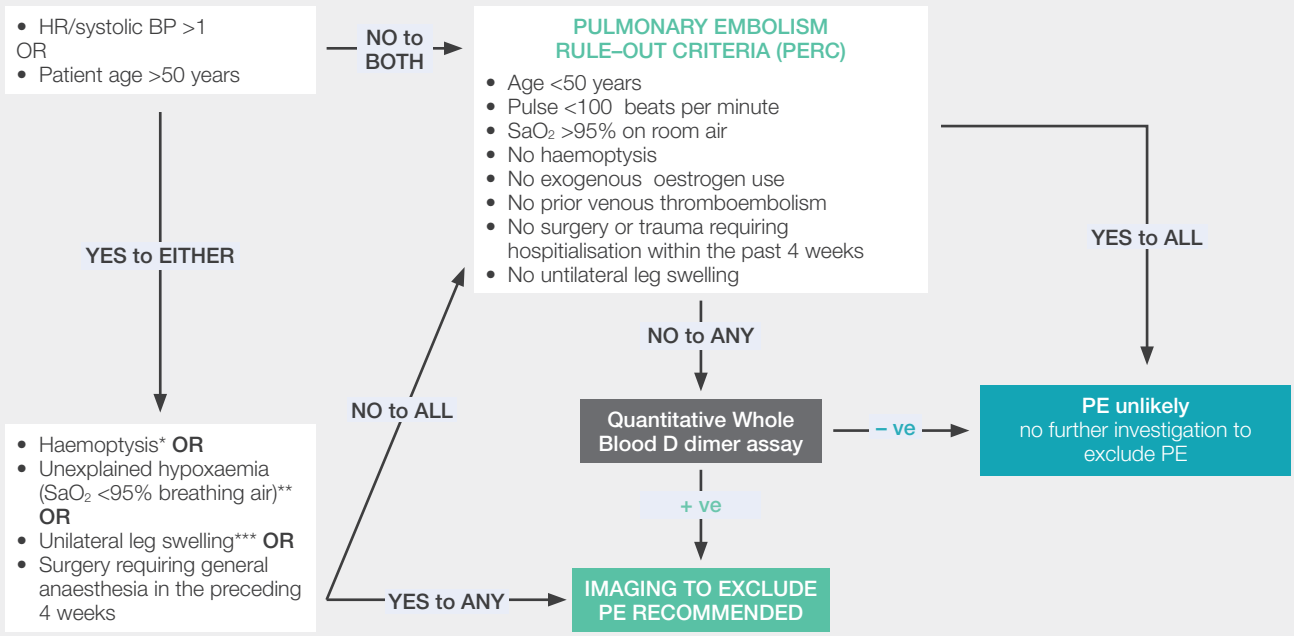
THE CHARLOTTE RULE[1]

ALGORITHM:

APPLYING THE CHARLOTTE RULE FOR PE



DEFINITIONS

*Reported by the patient or observed
**Non-smoker, no clinical evidence or history of asthma, COPD or other cause of hypoxaemia except PE
***Reported by the patient or observed in the emergency department

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INCLUSION CRITERIA

- Patients (age limitation not specified) admitted to the emergency department, in whom pulmonary embolism (PE) is suspected.

EXCLUSION CRITERIA

- No clear exclusion criteria described

SUMMARY STATEMENT

This decision tool is for patients presenting to the emergency department in which an emergency physician has enough suspicion for PE, to order a pulmonary vascular imaging study (either a contrast-enhanced CT scan of the chest or a ventilation-perfusion lung scan [V/Q scan]).

The rule has been extensively validated and safely rules out PE in patients classified as “safe” or “low probability” in the presence of a negative result using a sensitive whole blood D dimer assay (sensitivity of at least 90%). Its disadvantage in practice is that use of the Charlotte Rule may result in more patients over age 50 being triaged to imaging rather than D dimer due to the way the rule works than would be the case if the Wells Score were used. This may lead to more imaging in this particular age group than if the Simplified Wells Score was used but the Charlotte Rule has the advantage of potentially more reproducible rule criteria and does not require the user to make a subjective judgement about whether PE is more likely than another diagnosis.

Patients who are classified as “unlikely” for PE with the Charlotte Rule, who also have a negative result on a sensitive whole blood D dimer assay, have a probability of PE of 2% or less and thus require no further investigation, such as imaging, to exclude PE.

In addition, the PERC rule may be used with patients identified as “unlikely” to determine those who should have a D dimer test and those who require no further testing for PE.

REFERENCE

1. Kline JA, Nelson RD, Jackson RE, Courtney DM. Criteria for the safe use of D–dimer testing in emergency department patients with suspected pulmonary embolism: a multicenter US study. *Ann Emerg Med*. 2002; 39: 144–52.

WELLS SCORE[1]

ALGORITHM:

PREDICTOR	SCORE
Clinical signs and symptoms of DVT (minimum of leg swelling and pain with palpation of deep veins)	+3
An alternative diagnosis is less likely than PE	+3
Heart rate greater than 100	+1.5
Immobilisation at least 3 days or surgery in previous 4 weeks	+1.5
Previous DVT/PE	+1.5
Haemoptysis	+1
Malignancy	+1
Total	**/12.5**

RISK OF PE	ASSOCIATED SCORE
Low (3% risk of PE)	<2
Moderate (28%)	2–6
High (78%)	>6

RISK OF PE	ASSOCIATED SCORE
Unlikely (5.1–7.8% rate of PE)	≤4
Likely (~40%)	>4

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INCLUSION CRITERIA

(Unless ALL are satisfied, the Wells Score cannot be applied to assess the pre-test probability of PE)

- Inpatients or outpatients with clinical suspicion for PE
- Symptoms for <30 days

EXCLUSION CRITERIA

(If ANY these are satisfied, the Wells Score cannot be applied to assess the pre-test probability of PE)

- Suspected upper extremity DVT as source of PE
- No symptoms of PE for more than 3 days before presentation
- Use of anticoagulation for more than 72 hours
- Expected survival <3 months
- Contraindication to contrast media
- Pregnancy

SUMMARY STATEMENT

Based on the primary derivation study, a Wells Score of ≤4 and a negative whole blood D dimer assay result is associated with a sufficiently low probability of PE that anticoagulation is not required and an alternative diagnosis should be sought.

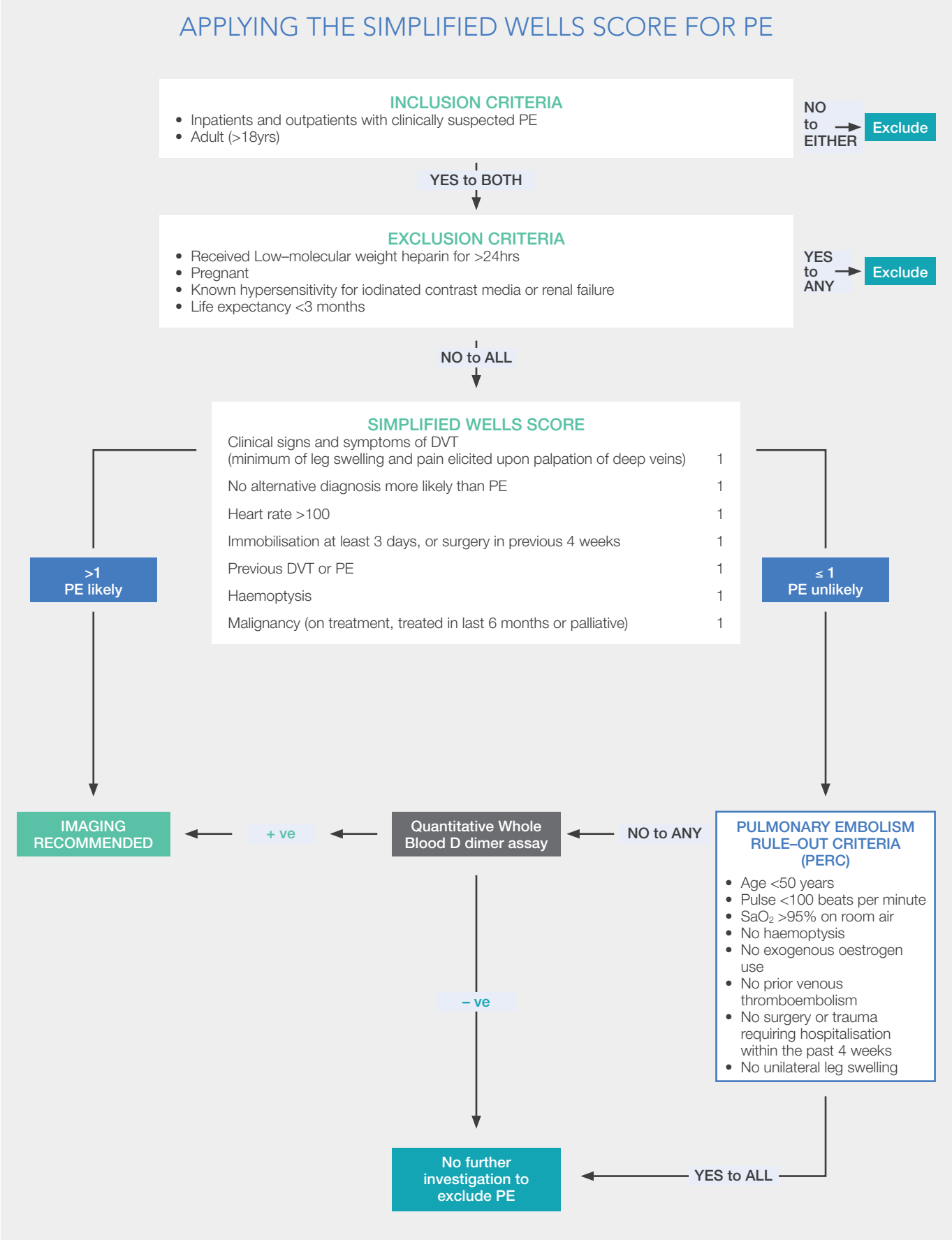
In addition, the PERC rule may be used with patients with a score of ≤4 to determine who should have a D dimer and who require no further testing for PE.

REFERENCE

1. Wells PS, Anderson DR, Rodger M, Ginsberg JS, Kearon C, Gent M, *et al*. Derivation of a simple clinical model to categorize patients probability of pulmonary embolism-increasing the models utility with the SimpliRED D–dimer. *Thromb Haemost*. 2000; 83(3): 416–20.

SIMPLIFIED WELLS SCORE

ALGORITHM:



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INCLUSION CRITERIA

- Inpatients and outpatients with clinically suspected PE
- Adult (>18yrs)

EXCLUSION CRITERIA

- Received low–molecular weight heparin for >24 hours
- Pregnant
- Known hypersensitivity for iodinated contrast media or renal failure
- Life expectancy <3 months

SUMMARY STATEMENT

This is a large study based on the Wells Score[1]. It creates a simplified version of the Wells rule that is easier to follow and should be easier to apply in clinical situations. It is also a larger external validation of the Wells Score. It may be applied in adult inpatient and outpatients with confidence. The study found that using the Simplified Wells Score, a patient with a score of ≤1 and a negative D dimer has an extremely low probability of PE and an alternative diagnosis should be sought.

In addition, the PERC rule may be used with patients with a score of ≤1 to determine who should have a D dimer and who require no further testing for PE.

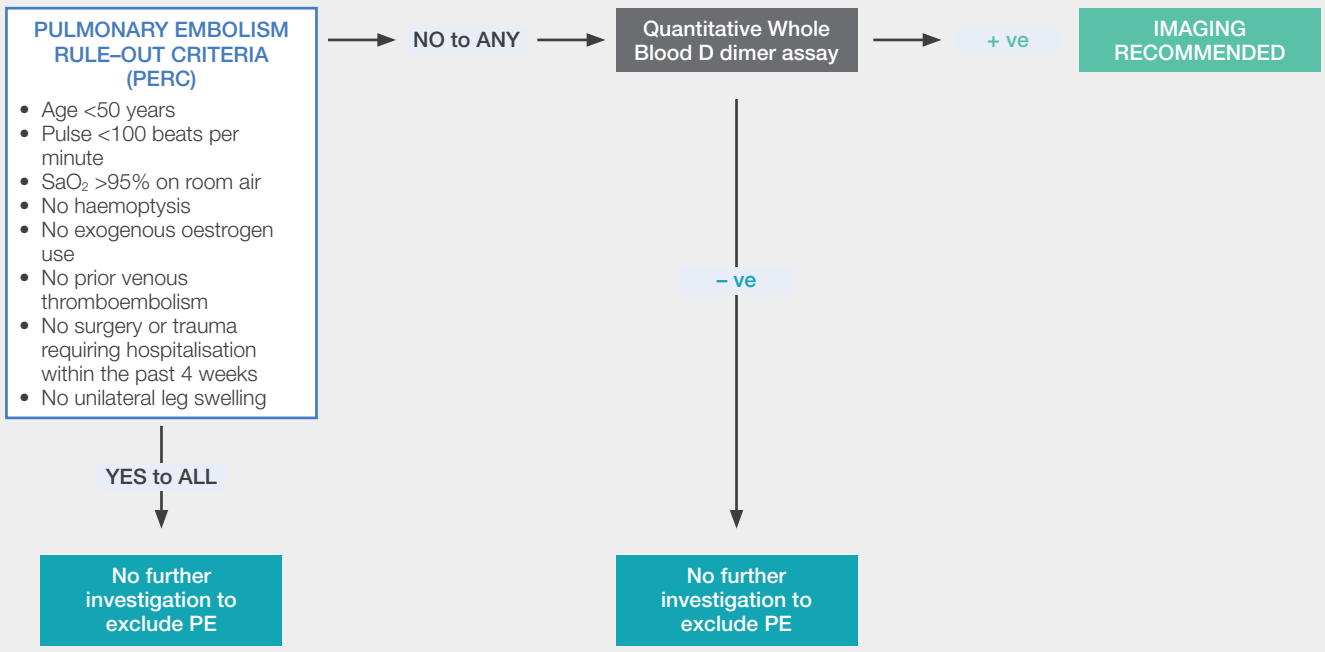
REFERENCE

1. Gibson NS, Sohne M, Kruip MJ, Tick LW, Gerdes VE, Bossuyt PM, *et al*. Further validation and simplification of the Wells clinical decision rule in pulmonary embolism. *J Thromb Haemost*. 2008; 99(1): 229–34.

PULMONARY EMBOLISM RULE OUT CRITERIA (PERC)[1]

ALGORITHM:

PERC RULE – FOR PATIENTS AT LOW RISK OF PE



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Patients at low or very-low risk of PE (the population for whom the rule is intended), who meet the rule criteria (i.e. answer YES to the eight clinical variables), are deemed PERC negative.

The authors found that PERC negative patients have a probability of PE <1.8%, and hence are safe to have PE excluded without further diagnostic testing, since the post-test probability of PE after a negative VQ scan is greater than 1.8%.

INCLUSION CRITERIA

- Patients presenting to the emergency department with clinical suspicion of PE (board-certified emergency physician felt a formal evaluation for PE was necessary).

EXCLUSION CRITERIA

- No clear exclusion criteria described

SUMMARY STATEMENT

The Pulmonary Embolism Rule-out Criteria (PERC) score has undergone extensive validation and can be used for adult patients presenting to the emergency department with a sole or primary complaint of shortness of breath and low clinical suspicion of PE. When all eight predictors that comprise the rule are positive, further diagnostic testing for PE is not required since the post-test probability of PE is below the test threshold of 1.8%. In PERC(-) patients, the rule has a sensitivity of 96% (90-99%), specificity of 27% (25–30%), false negative rate of 1.4% (0.5–3.0%) and a LR- of 0.015. In a very low risk PERC(-) population, the rule performs better still; with sensitivity 100% (96–97.5%), specificity of 15% (11–18%) and LR- of 0.067. It has not been validated, and therefore should not be used in patients with high or intermediate probability of PE.

The PERC rule has been externally validated in a number of studies, including a systematic review and meta–analysis. The systematic review and meta–analysis by Singh *et al*[2] concluded that their pooled analysis strongly corroborates the safety of using PERC to avoid D dimer testing, reflected in the results of existing literature suggesting consistently high sensitivity and low but acceptable specificity of the PERC rule. However, an impact analysis by Kline *et al*[3] suggests that although just over one-fifth of surveyed clinicians are electing to use the rule in eligible patients in clinical practice, only 5% of these document the rule without missing any components. **This underlines the importance of referring to an electronic or hard copy when you use a CDR to remind you of the elements and the inclusion/exclusion criteria.**

REFERENCES

1. Kline JA, Mitchell AM, Kabrhel C, Richman PB, Courtney DM. Clinical criteria to prevent unnecessary diagnostic testing in emergency department patients with suspected pulmonary embolism. *J Thromb Haemost*. 2004; 2(8): 1247–55.
2. Singh B, Parsaik AK, Agarwal D, Surana A, Mascarenhas SS, Chandra S. Diagnostic accuracy of Pulmonary Embolism Rule-out Criteria: a systematic review and meta–analysis. *Ann Emerg Med*. 2012; 59(6): 517–20.e4.
3. Kline JA, Nelson RD, Jackson RE, Courtney DM. Criteria for the safe use of D–dimer testing in emergency department patients with suspected pulmonary embolism: a multicenter US study. *Ann Emerg Med*. 2002; 39(2): 144–52.

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RECOMMENDATION 4

Acute Low Back Pain

Don't perform imaging for patients with non-specific acute low back pain and no indicators of a serious cause for low back pain.

ALGORITHM:

IMAGING DECISION FLOW CHART FOR ACUTE LOW BACK PAIN

MAJOR RISK FACTORS FOR CANCER
- New onset of low back pain with history of cancer

RISK FACTOR(S) FOR SPINAL INFECTION
New onset of low back pain in the presence of risk factors:
- Fever
- History of intravenous drug use, recent infection, or recent invasive procedure
- Elevated CRP or WBC count
- High clinical suspicion in an at risk patient

IMAGING RECOMMENDED
Magnetic Resonance Imaging (MRI)

RISK FACTORS FOR (OR SIGNS OF) CAUDA EQUINA SYNDROME
- New urine retention
- Faecal incontinence
- Saddle anaesthesia

SEVERE NEUROLOGIC DEFICITS
- Progressive motor weakness
- Motor deficits at multiple neurologic levels

WEAKER RISK FACTORS FOR CANCER
- Unexplained weight loss
- Age >50 years
- ESR ≥100mm/h
- Haematocrit <30%

→ **Defer MRI after a trial of therapy** ←

RISK FACTORS FOR OR SIGNS OF ANKYLOSING SPONDYLITIS
- Morning stiffness that improves with exercise
- Alternating buttock pain
- Awakening because of back pain during the second part of the night
- Younger age (20 to 40yrs)

RISK FACTORS FOR VERTEBRAL FRACTURE
- Use of corticosteroids
- Significant trauma
- Older age (>70 yrs)
- Female gender

WITH A PRE-TEST PROBABILITY OF 0.5%
the post-test probability of spinal fracture is:

1	positive feature:	1%
2	positive features:	7%
≥3	positive features:	52%

→ **PLAIN RADIOGRAPHY**
If negative and persistent clinical suspicion then Magnetic Resonance Imaging (MRI) imaging

RISK FACTORS FOR OR SYMPTOMS OF SPINAL STENOSIS
In patients who are candidates for surgery
- Radiating leg pain
- Older age
- Pseudoclaudication

→ **Defer imaging after a trial of therapy**
Magnetic Resonance Imaging (MRI) ←

SIGNS AND SYMPTOMS OF RADICULOPATHY
In patients who are candidates for surgery or image guided epidural steroid injection
- Back pain with leg pain in an L4, L5 or S1 nerve root distribution
- Positive result on straight leg raise or crossed straight leg raise test

No criteria for immediate imaging and back pain improves or resolved after a 1-month trial of therapy → **NO IMAGING** ← Previous spinal imaging with no change in clinical status.

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ACUTE LOW BACK PAIN (ALBP) DUE TO MALIGNANCY

ALGORITHM:

APPLICATIONS OF RED FLAGS TO CLINICAL DECISION MAKING

	POST-TEST PROBABILITY (%)	
	PRE-TEST PROBABILITY 1%	PRE-TEST PROBABILITY 5%
Clinical feature		
No relief with bed rest	1.7	8.3
Age ≥50	2.2	10.4
Duration of pain >1 month	2.5	12.1
Not improved after 1 month	2.9	13.7
Previous history of cancer	19.2	55.7
Laboratory test result		
Anaemia	3.8	17.1
WBC* ≥12,000	3.9	17.9
Haematocrit <30%	15.4	49.1
ESR† ≥20 mm/h	2.3	10.9
ESR ≥50 mm/h	15.3	48.8
ESR ≥100 mm/h	35.7	74.7
Positive clinician judgement	10.8	39.1
Age ≥50 or unexpected weight loss or previous history of cancer or failure to improve over 1 month	2.3	11.3

Changes in the probability of cancer with a positive response to each red flag. Analysis is conducted for pre-test probabilities of 1 and 5%.

*WBC white blood cell count

†ESR erythrocyte sedimentation rate

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INCLUSION CRITERIA

- Adults (>18 years)
- Consulted health practitioner about acute low back pain

EXCLUSION CRITERIA

None

SUMMARY STATEMENT

A Cochrane Diagnostic Test Accuracy review by Henschke *et al*[1] evaluated clinical risk factors associated with the presence of malignancy in eight studies enrolling a total of 7,361 patients. The review found that overall the reporting of methodology of the eight studies included in the review was poor and the quality of the included studies low, based on evaluation of study methodology with the Quality Assessment tool for Diagnostic Accuracy Studies (QUADAS) tool, which is used for quality appraisal of studies of diagnostic accuracy. However, the review identified some risk factors as having high positive likelihood ratios (but poor sensitivity) for the identification of patients who had a malignant cause for their ALBP (for full table refer back to the Acute Low Back Pain Module, part of the RANZCR Educational Modules for Appropriate Imaging Referrals).

The data show that cancer is rare in patients presenting to primary care with low back pain and that most red flags are uninformative because they do not meaningfully increase the probability of cancer when present. **The exception is a previous history of cancer.**

Unfortunately, it was not possible to determine whether a combination of the risk factors would have identified these patients with greater sensitivity because this was not evaluated within the studies.

Therefore, although the presence of any one of these risk factors should certainly alert the clinician to the increased risk of malignancy as the cause for an ALBP presentation, and thus the need for further investigations (including imaging), the absence of all of these risk factors is not necessarily good evidence that malignancy is not the cause of the ALBP based on this systematic review.

REFERENCES

1. Henschke N, Maher CG, Ostelo RW, de Vet HC, Macaskill P, Irwig L. Red flags to screen for malignancy in patients with low-back pain. *Cochrane Database Syst Rev* 2013. 2013; 2.

ACUTE LOW BACK PAIN (ALBP) DUE TO FRACTURE

ALGORITHM:

DIAGNOSTIC ACCURACY OF RECOMMENDED "RED FLAG" QUESTIONS FOR DETECTING SPINAL FRACTURE IN THE 1,172 PATIENTS WITH ACUTE LOW BACK PAIN*

RED FLAG QUESTION	NO. (%) RED FLAG POSITIVE	SENSITIVITY, (%)	SPECIFICITY, (%)	POSITIVE LR (95% CI)	NEGATIVE LR (95% CI)
Age >70 years	56 (4.8)	50	96	11.19 (4.65–19.48)	0.52 (0.23–0.82)
Significant trauma (major in young, minor in elderly)	31 (2.6)	25	98	10.03 (2.76–26.36)	0.77 (0.42–0.95)
Prolonged use of corticosteroids	8 (0.7)	25	100	48.50 (11.62–165.22)	0.75 (0.41–0.93)
Sensory level (altered sensation from trunk down)	19 (1.6)	0	98	0.00 (0.00–21.01)	1.02 (1.02–1.03)
Clinical diagnosis of fracture	7 (0.6)	50	100	194.00 (52.10–653.61)	0.50 (0.22–0.79)

* LR = likelihood; 95% CI = 95% confidence interval.

DIAGNOSTIC RULE TO IDENTIFY VERTEBRAL FRACTURE*

	CRITERIA FOR A POSITIVE TEST		
	1 POSITIVE FEATURE	2 POSITIVE FEATURES	≥3 POSITIVE FEATURES
Sensitivity, %	88	63	38
Specificity, %	50	96	100
Positive LR (95% CI)	1.8 (1.1–2.0)	15.5 (7.2–24.6)	218.3 (45.6–953.8)
Post-test probability of vertebral fracture, (%)			
Pre-test probability 0.5%	1	7	52
Pre-test probability 3%	5	32	87

* Four features were included in the rule: female sex, age >70 years, significant trauma (major in young patients, minor in elderly patients), and prolonged use of corticosteroids.
LR = likelihood ratio; 95% CI = 95% confidence interval

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INCLUSION CRITERIA

- Adults (>18 years); AND
- Patients presenting to primary care practitioners about acute low back pain

EXCLUSION CRITERIA

None

SUMMARY STATEMENT

Henschke *et al*[1] studied adults with ALBP drawn from 170 Australian primary care practitioners (including 73 general medical practitioners, 77 physiotherapists, and 30 chiropractors). This study attempted to create CDRs that would help primary care practitioners identify patients at increased risk of one of the five "serious" causes of ALBP. However, due to the very low prevalence of these five conditions in a primary care patient cohort, valid information only about risk factors for spinal fracture was obtained. The following clinical findings were associated with vertebral fracture:

1. Prolonged use of corticosteroids
2. Age >70
3. Trauma involving the lower back (minor in the elderly, major in the young)
4. Female gender

When at least one of these features was positive, the positive likelihood ratio (LR) 1.8 (95% CI 1.1–2.0). With at least two positive features, the positive LR increased to 15.5 (95% CI 7.2–24.6), and with three positive features it increased to 218.3 (95% CI 45.6–953.8). If we presume a pre-test probability of vertebral fracture of ~1% it is only when two or more of the features are present that the post-test probability becomes sufficiently high to consider imaging on the initial presentation. When only one feature is present and the pre-test probability is ~1% the post-test probability rises to ~2%.

This decision tool requires validation in another general practice population and may not be applicable to emergency department and hospital patients.

This list of risk factors represents a type of CDR. In the eight patients in this study who had fractures as the cause for their low back pain, one of the eight (12.5%) had none of the four risk factors. This CDR is a helpful guide in identifying patients who are at greater than average risk of spinal fracture as the cause of their ALBP. **However, some caution needs to be exercised when using this CDR in practice for the following reasons:**

1. The CDR (comprised of these risk factors) remains to be externally validated.
2. It is unclear whether the elements of the CDR would work just as well in a hospital inpatient or emergency department population.
3. Finally, it is important to note that one of the eight patients with a final diagnosis of spinal fracture did not have any of the four clinical features listed above. Hence, it may be that the presence of risk factors other than those evaluated by the study would improve the sensitivity of the CDR.

REFERENCE

1. Henschke N, Maher C, Refshauge K, Herbert R, Cumming R, Bleasel J, *et al*. Prevalence of and screening for serious spinal pathology in patients presenting to primary care settings with acute low back pain. *Arthritis Rheum*. 2009; 60(10): 3072–80.

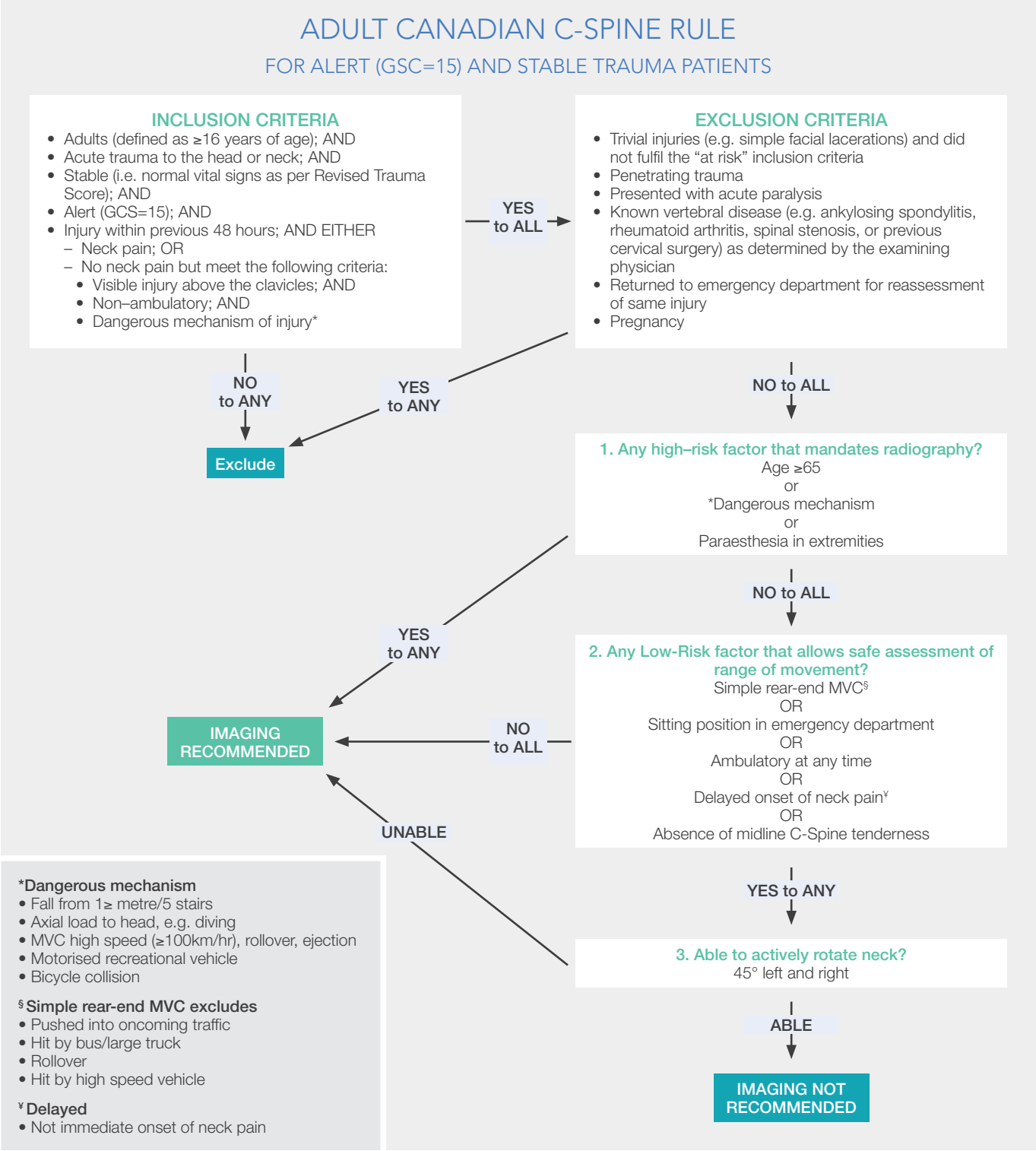
RECOMMENDATION 5^

Cervical Spine Trauma

Don't request imaging of the cervical spine in trauma patients, unless indicated by a validated clinical decision rule.

THE CANADIAN C-SPINE RULE[1]

ALGORITHM:



^Joint recommendation with the Australasian College for Emergency Medicine.

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INCLUSION CRITERIA

- Adults (defined as ≥16 years of age); AND
- Acute trauma to the head or neck; AND
- Stable (i.e. normal vital signs as per Revised Trauma Score); AND
- Alert (GCS=15); AND
- Injury within previous 48 hours; AND EITHER
  - Neck pain; OR
  - No neck pain but meet the following criteria:
    - Visible injury above the clavicles; OR
    - Non-ambulatory; OR
    - Dangerous mechanism of injury

EXCLUSION CRITERIA

- Trivial injuries (e.g. simple facial lacerations) and did not fulfil the "at risk" inclusion criteria
- Penetrating trauma
- Presented with acute paralysis
- Know vertebral disease (e.g. ankylosing spondylitis, rheumatoid arthritis, spinal stenosis, or previous cervical surgery) as determined by the examining physician
- Returned to ED for reassessment of same injury
- Pregnancy

SUMMARY STATEMENT

The Canadian C-Spine Rule (CCR) evolved from a landmark study[1] aimed at unifying the approach to emergency department decision-making in cervical spine assessment for alert and stable patients, to identify 'clinically important' cervical spine injury, defined as:

> "any fracture, dislocation or ligamentous instability evident on radiographic imaging except isolated injuries including osteophytic avulsion fracture, transverse process fracture exclusive of the facet, and spinous process fracture exclusive of the lamina, in **neurologically intact patients**".

The authors reported the proportion of patients with clinically important injury as 1.7%, with 0.3% of patients identified as having clinically unimportant injury. A reduction in the ordering of cervical spine imaging by 15.5% occurred during the study. The sensitivity of the CCR was reported as 100% (95% CI 98–100) and the specificity as 42.5% (95% CI 40–44).

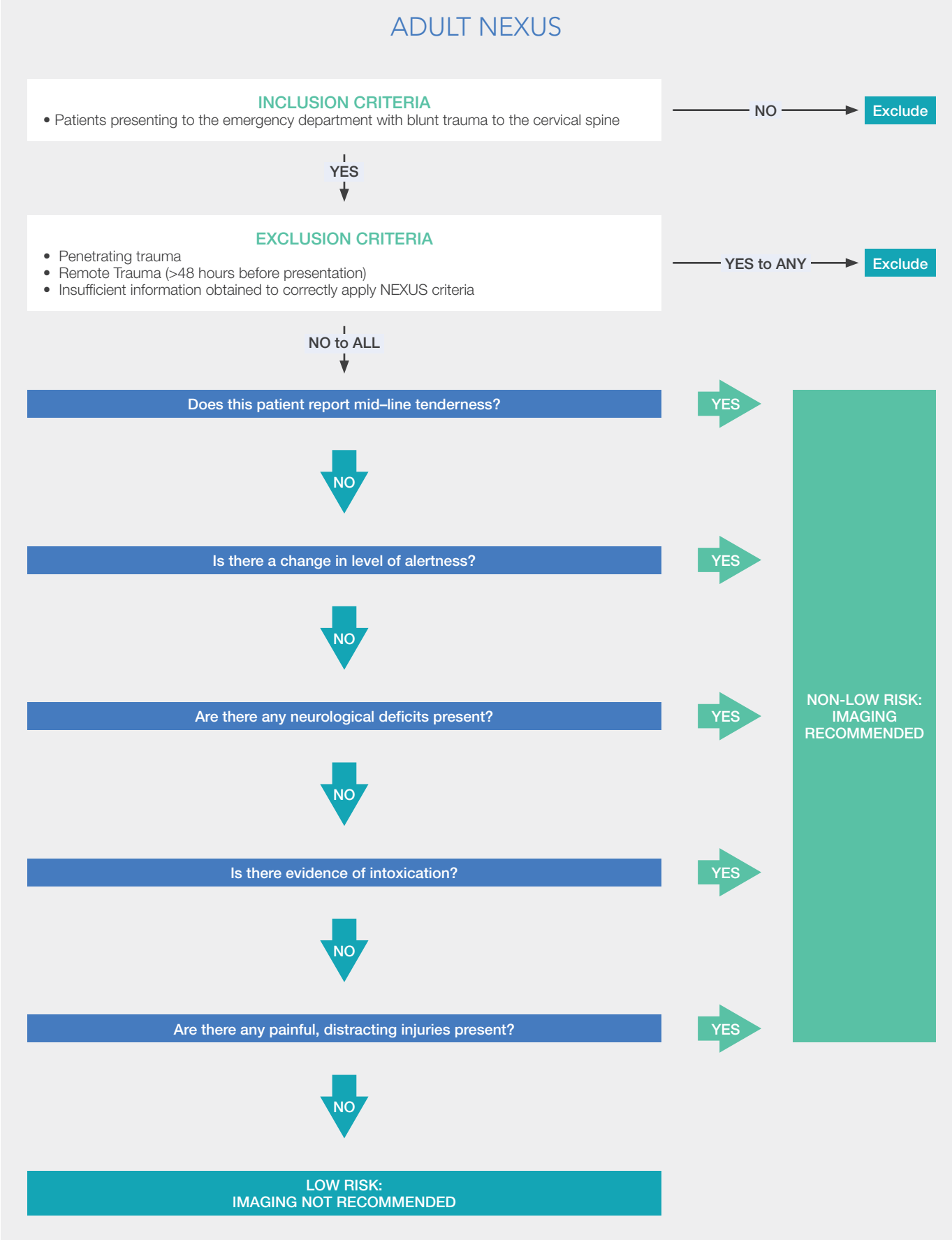
Following this study, the CCR was also found to be valid and effective when used in the pre-hospital setting by paramedics and in the emergency department when used by nursing staff. The CCR has consistently been found to have a sensitivity of >99% and therefore it is unlikely that a serious cervical spine injury will be missed. Specificity has been found to range between 0.01 and 0.77. **Only one direct comparison of the CCR and NEXUS has been completed. Based on this study the CCR should be recommend for use over the NEXUS as it is a more sensitive and specific rule[2].**

REFERENCES

1. Stiell IG, Wells GA, Vandemheen KL, Clement CM, Lesiuk H, De Maio VJ, *et al*. The Canadian C-Spine Rule for radiography in alert and stable trauma patients. *JAMA*. 2001; 286(15): 1841–8.
2. Stiell IG, Clement CM, McKnight RD, Brison R, Schull MJ, Rowe BH, *et al*. The Canadian C-Spine rule versus the NEXUS Low-Risk criteria in patients with trauma. *N Engl J Med*. 2003; 349(26): 2510–8.

NATIONAL EMERGENCY X-RADIOGRAPHY UTILIZATION STUDY (NEXUS)

ALGORITHM:



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INCLUSION CRITERIA

- Patients presenting to the emergency department with blunt trauma to the cervical spine

EXCLUSION CRITERIA

- Penetrating trauma
- Remote trauma (>48 hours before presentation)
- Insufficient information obtained to correctly apply NEXUS criteria

SUMMARY STATEMENT

In 2000, Hoffman *et al*[1] published the results of a large multicentre prospective observational study that enrolled 34,069 patients from 21 hospitals who presented to the emergency department with cervical spine symptoms following blunt trauma. These findings established the validity of the NEXUS criteria, a set of five clinical assessment items to identify patients at very low risk of cervical spine injury. Patients were considered to be at low risk of cervical spine injury if all of the criteria were fulfilled, in which case, clinical clearance of the cervical spine could occur without radiographic imaging.

The outcome measure of this study was 'clinically significant injury', which the authors defined as:

> **"any injury except isolated injury in the absence of associated bony, ligamentous or spinal cord injury which would be unlikely to result in harm to the patient if undetected".**

Such insignificant minor injuries were categorised as fracture of the spinous or transverse process, endplate or trabecular bone; osteophyte fracture exclusive of corner or teardrop configuration; vertebral body compression fracture with less than 25% loss of height; Anderson and D'Alonzo Type I odontoid process fracture, and avulsion without ligamentous involvement.

The main limitations of NEXUS include the lack of precise definitions of the five criteria, which may result in significant variability in the application of the tool. Although the definition of altered mental status is generally accepted to be a Glasgow Coma Scale (GCS) score of less than 15, the interpretation of intoxication and painful distracting injury may vary considerably between emergency medicine physicians who are unfamiliar with how these were originally defined in the derivation study.

REFERENCE

1. Hoffman JR, Mower WR, Wolfson AB, Todd KH, Zucker MI. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group. *N Engl J Med*. 2000; 343(2): 94–9.

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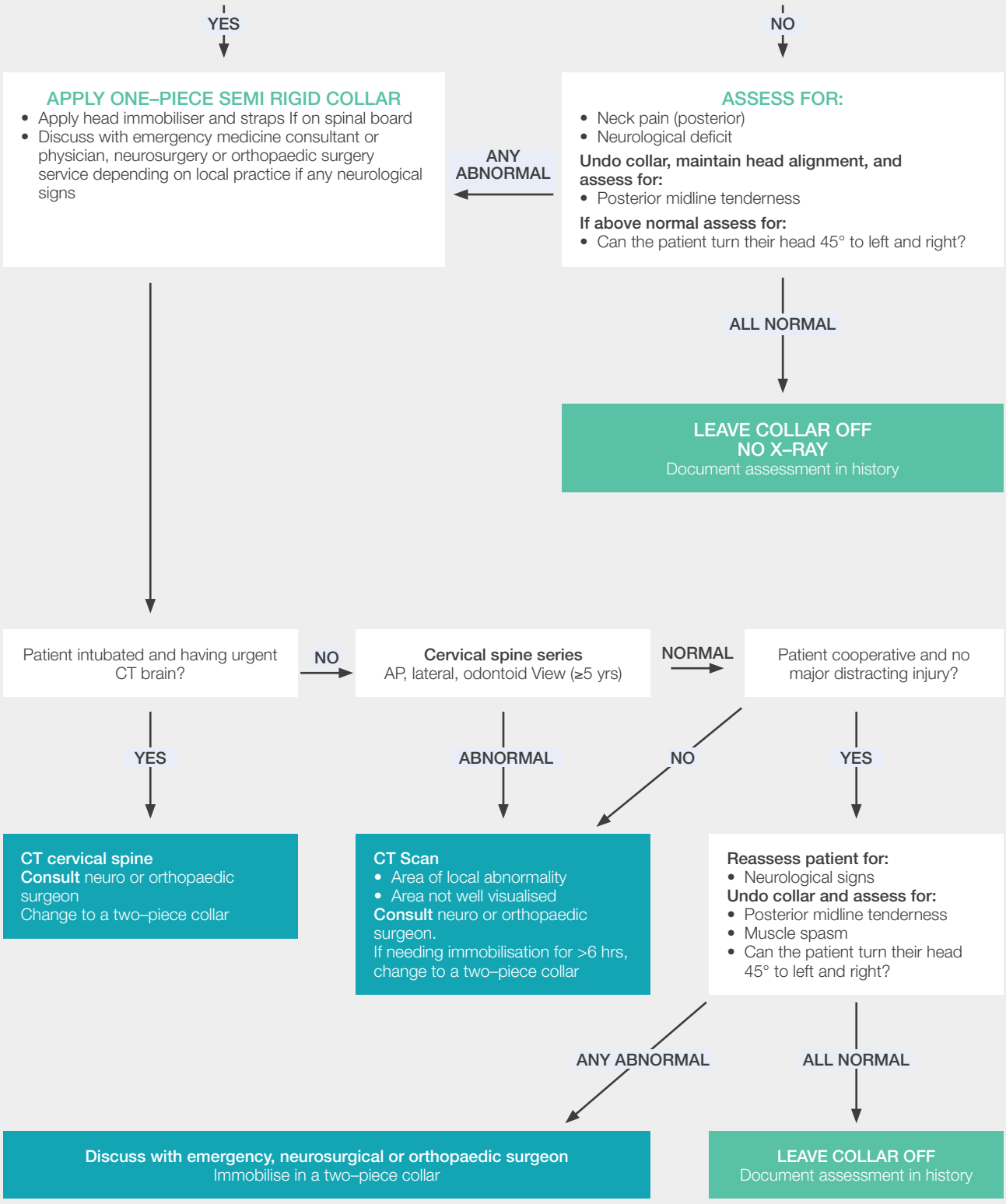
GUIDE TO MANAGEMENT OF THE POTENTIALLY INJURED CERVICAL SPINE – PAEDIATRICS

ALGORITHM:



Adapted from Cameron *et al*, Textbook of Paediatric Emergency Medicine (2011)

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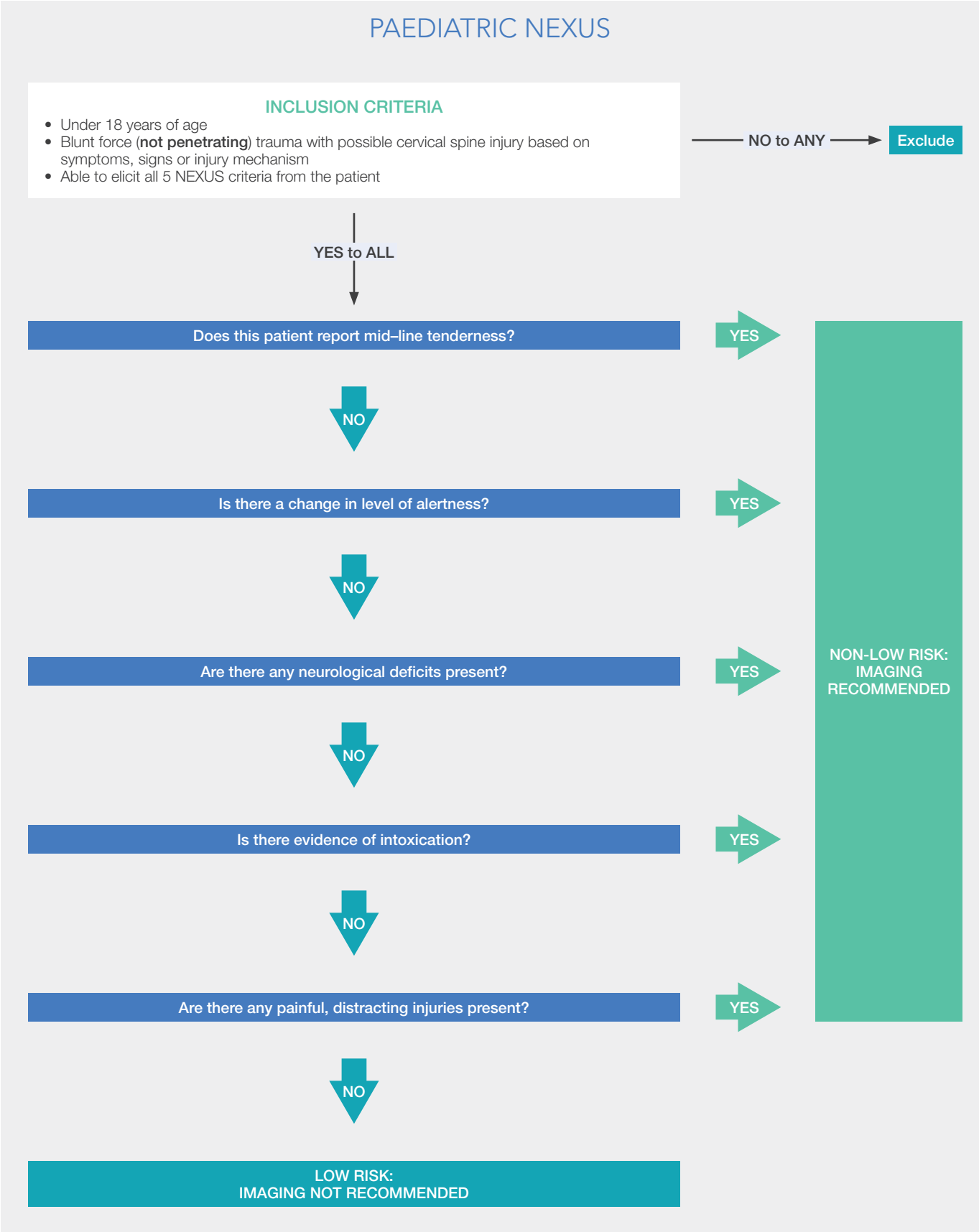
NATIONAL EMERGENCY X-RADIOGRAPHY UTILIZATION STUDY (NEXUS) – FOR UNDER 18 YEARS OF AGE

ALGORITHM:



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INCLUSION CRITERIA

- Under 18 years of age
- Blunt force (not penetrating) trauma with possible cervical spine injury based on symptoms, signs or injury mechanism
- Able to elicit all 5 NEXUS criteria from the patient

EXCLUSION CRITERIA

None

• SUMMARY STATEMENT

In the past, there has been little research about the appropriateness of cervical spine imaging in the trauma setting with regard to the paediatric population. In this large, prospective multicentre study, Viccellio *et al*[2] have demonstrated promising results applying the five NEXUS criteria to patients under the age of 18 years who have sustained blunt force trauma. In their study, the decision instrument did not miss any cases of cervical spine injury (CSI) and would have resulted in 20% fewer radiologic examinations. However, it must be remembered that investigation of CDR use in children is complicated by several factors:

1. Small numbers of paediatric patients with actual cervical spine injury.
2. Anatomical differences compared to adults with regard to the nature and location of clinically important CSI in children.
3. Developmental differences influencing assessment of the NEXUS criteria that were primarily developed for use in adults (e.g. posterior neck tenderness, painful distracting injuries or intoxication). Viccellio *et al*[2] point out that the youngest paediatric patients (aged 9 years or less) create most uncertainty about the performance of the NEXUS CDR, given that the number of study participants in this age group is small for both the original NEXUS study and the Viccellio *et al*[2] validation, and so too are the number of cervical spine injuries.

Ehrlich *et al*[3] applied the NEXUS criteria retrospectively in a group of 108 paediatric patients who had undergone cervical spine imaging and reported the sensitivity for predicting cervical spine injury as 43%. This is markedly different to the results of the Viccellio *et al* study. Booth[4] cautions that, “overall, there is conflicting information and limited agreement in the literature concerning the use of clinical screening tools in CSI involving the young child”. The use of CDRs in relation to potential cervical spine injury should be applied with caution in paediatric patients, and radiation dose should be minimised to reduce the risk of harmful long–term effects.

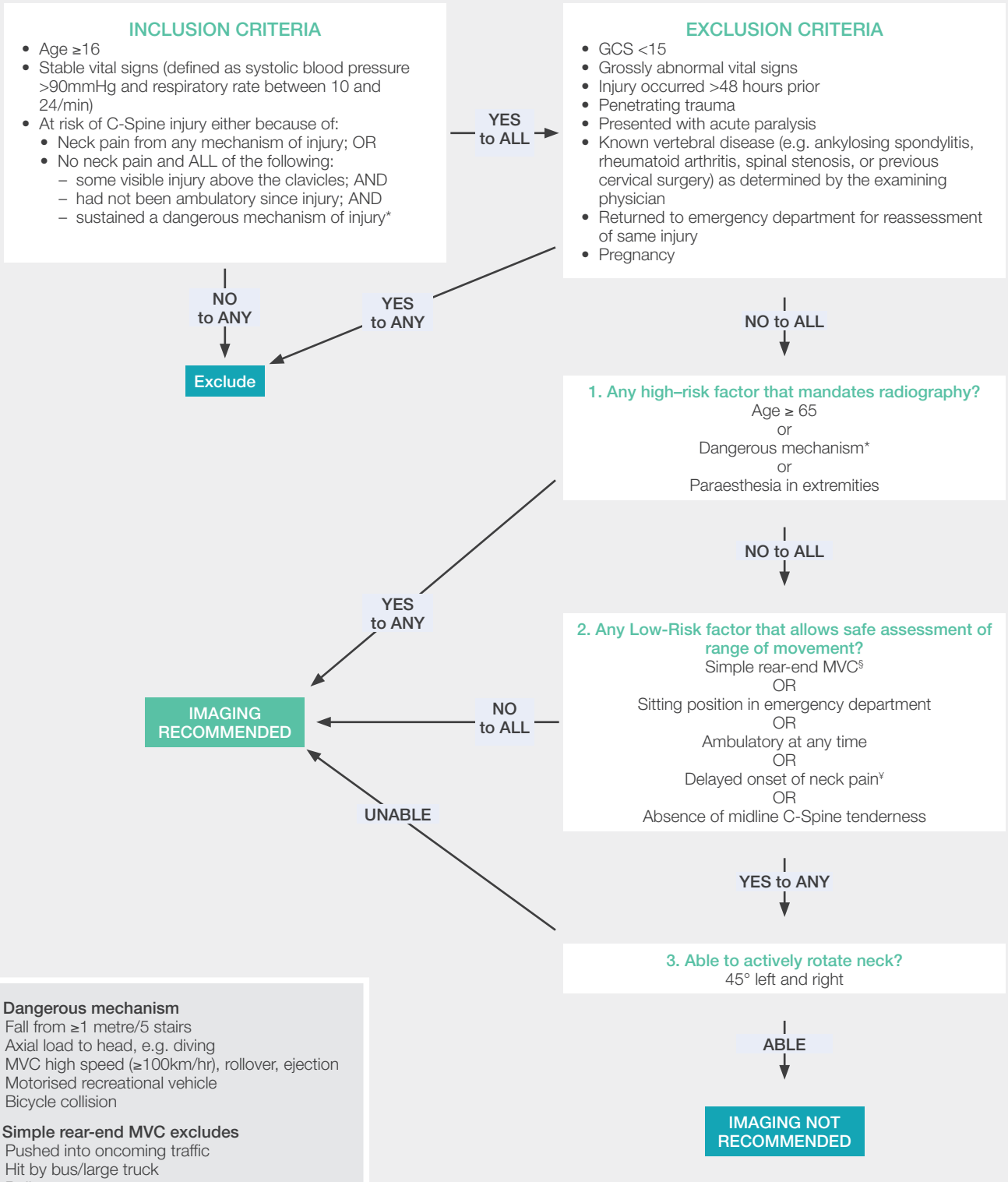
REFERENCES

1. Hoffman JR, Wolfson AB, Todd K, Mower WR. Selective cervical spine radiography in blunt trauma: methodology of the National Emergency X-Radiography Utilization Study (NEXUS). *Ann Emerg Med*. 1998; 32(4): 461–9.
2. Viccellio P, Simon H, Pressman BD, Shah MN, Mower WR, Hoffman JR. A prospective multicenter study of cervical spine injury in children. *Pediatrics*. 2001; 108(2): E20.
3. Ehrlich PF, Wee C, Drongowski R, Rana AR. Canadian C-Spine Rule and the National Emergency X-Radiography Utilization Low-Risk Criteria for C-Spine radiography in young trauma patients. *J Pediatr Surg*. 2009; 44(5): 987–91.
4. Booth TN. Cervical spine evaluation in pediatric trauma. *AJR Am J Roentgenol*. 2012; 198(5): W417–W25.

CANADIAN C-SPINE RULE – PAEDIATRICS

ALGORITHM:

CANADIAN C-SPINE RULE FOR ALERT (GCS=15) AND STABLE TRAUMA PATIENTS AGED 16 AND OVER



*** Dangerous mechanism**
- Fall from ≥1 metre/5 stairs
- Axial load to head, e.g. diving
- MVC high speed (≥100km/hr), rollover, ejection
- Motorised recreational vehicle
- Bicycle collision

§ Simple rear-end MVC excludes
- Pushed into oncoming traffic
- Hit by bus/large truck
- Rollover
- Hit by high speed vehicle

¥ Delayed
- Not immediate onset of neck pain

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INCLUSION CRITERIA

- Age ≥16 years of age
- Stable vital signs (defined as systolic blood pressure >90mmHg and respiratory rate between 10 and 24/min)
- At risk of C-Spine injury either because of:
  - Neck pain from any mechanism of injury; OR
  - No neck pain but all of the following:
    - some visible injury above the clavicles; AND
    - had not been ambulatory since injury; AND
    - sustained a dangerous mechanism of injury

EXCLUSION CRITERIA

- GCS ≤15
- Grossly abnormal vital signs
- Injury occurred ≥48 hours prior
- Penetrating trauma
- Presented with acute paralysis
- Known vertebral disease (e.g. ankylosing spondylitis, rheumatoid arthritis, spinal stenosis, or previous cervical surgery) as determined by the examining physician
- Returned to emergency department for reassessment of same injury
- Pregnancy

SUMMARY STATEMENT

Stiell *et al*[1] have developed a highly sensitive CDR with significantly higher specificity than NEXUS for use in patients aged 16 years and over with acute cervical spine trauma. Prior to the development of the Canadian C-Spine Rule (CCSR), the NEXUS criteria constituted the best CDR available to aid decisions about whether or not to perform radiologic imaging in the setting of blunt force trauma and possible cervical spine injury. The CCSR has been shown to have higher specificity than NEXUS and because either CDR can be used in the 16 and over age group, use of the CCSR may be expected to result in less imaging being performed on these older adolescents with cervical spine trauma.

The Canadian C-Spine Rule is a high-performance rule. It can be used safely in the defined population to minimise the volume of cervical spine radiology ordered for blunt head and neck trauma, without missing clinically significant cervical spine injuries. Its use has been validated in a number of other studies, across a variety of patient populations and clinical settings.

REFERENCE

1. Stiell IG, Wells GA, Vandemheen KL, Clement CM, Lesiuk H, De Maio VJ, *et al*. The Canadian C-Spine Rule for radiography in alert and stable trauma patients. *JAMA*. 2001; 286(15): 1841–8.

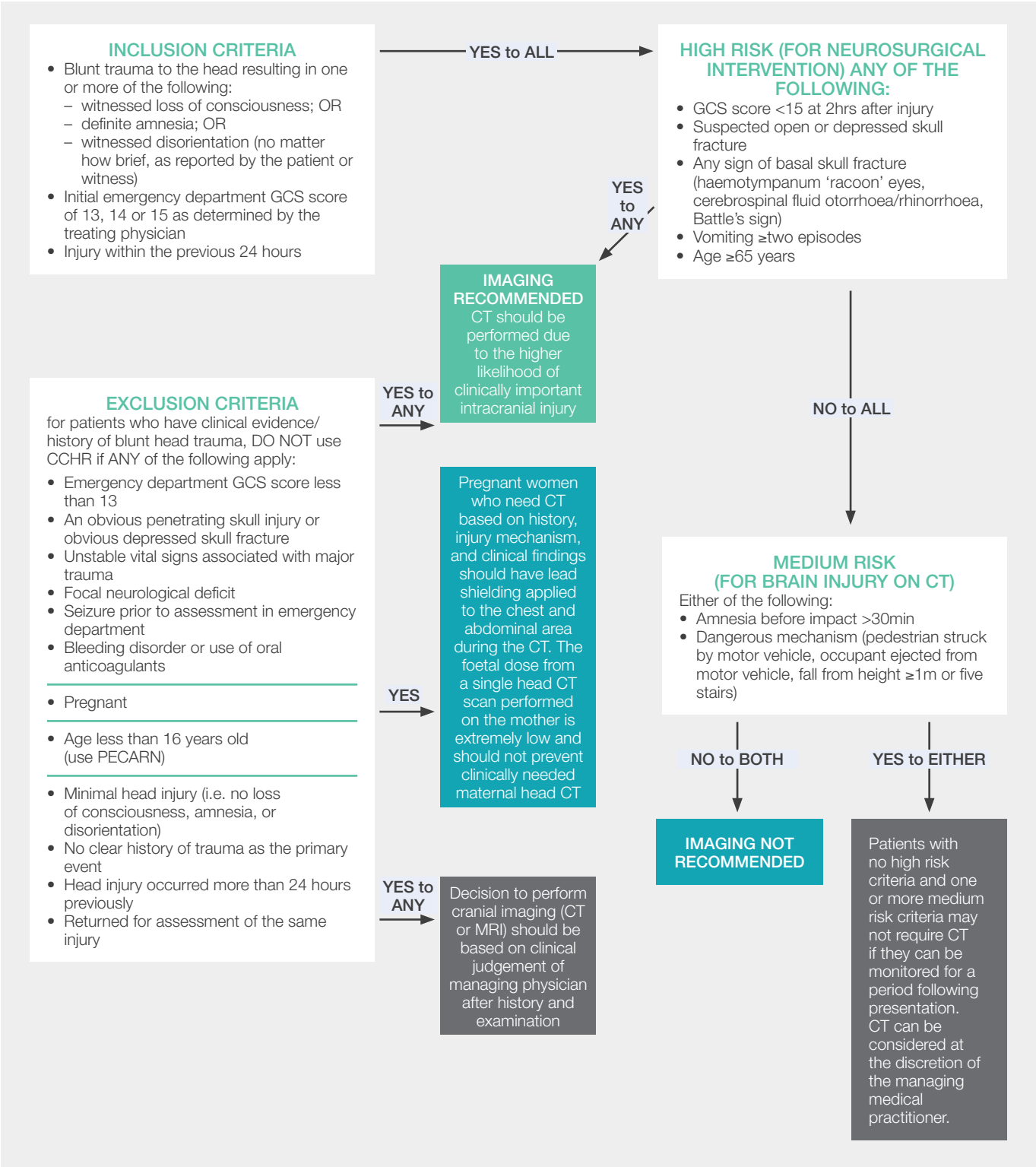
RECOMMENDATION 6^

Head Trauma

Don't request computed tomography (CT) head scans in patients with a head injury, unless indicated by a validated clinical decision rule. The Canadian CT Head Rule is the best performing and most validated of CDRs designed for this purpose.

THE CANADIAN CT HEAD RULE[1]

ALGORITHM:



^Joint recommendation with the Australasian College for Emergency Medicine.

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INCLUSION CRITERIA

- Blunt trauma to the head resulting in **witnessed loss of consciousness, definite amnesia, or witnessed disorientation** (no matter how brief, as reported by the patient or witness)
- **Initial** emergency department **GCS score of 13, 14 or 15** as determined by the treating physician
- Injury within the **previous 24 hours**

If you answer 'Yes' to all of the inclusion criteria, then ask yourself does your patient have any exclusion criterion that would prevent the rule being applied to them?

EXCLUSION CRITERIA

- Age less than 16 years old (other clinical decision rules such as PECARN are available for use in people under 16 – see Paediatric Head Trauma Module, part of the RANZCR Educational Modules for Appropriate Imaging Referrals for more details)
- **Emergency department GCS score less than 13**
- Minimal head injury (i.e. no loss of consciousness, amnesia, or disorientation)
- No clear history of trauma as the primary event
- Head injury occurred more than 24 hours previously
- **An obvious penetrating skull injury or obvious depressed skull fracture**
- **Focal neurological deficit**
- **Unstable vital signs associated with major trauma**
- **Seizure prior to assessment in ED**
- **Bleeding disorder or use of oral anticoagulants**
- Returned for assessment of the same injury
- Pregnant

For patients with any of the exclusion criteria in bold, CT should be performed due to the higher likelihood of clinically important intracranial injury.

SUMMARY STATEMENT

The Canadian CT Head Rule (CCHR) is a widely validated CDR for use in the emergency department for patients with minor head injury to identify clinically important brain injuries on CT scan that may require neurosurgical intervention. It has five high–risk clinical factors that, if any are present, indicate a substantial risk that the patient will require neurosurgical intervention. An additional two medium–risk factors can be used to determine if the patient has a risk of clinically important lesions on CT that would not require neurosurgical intervention.

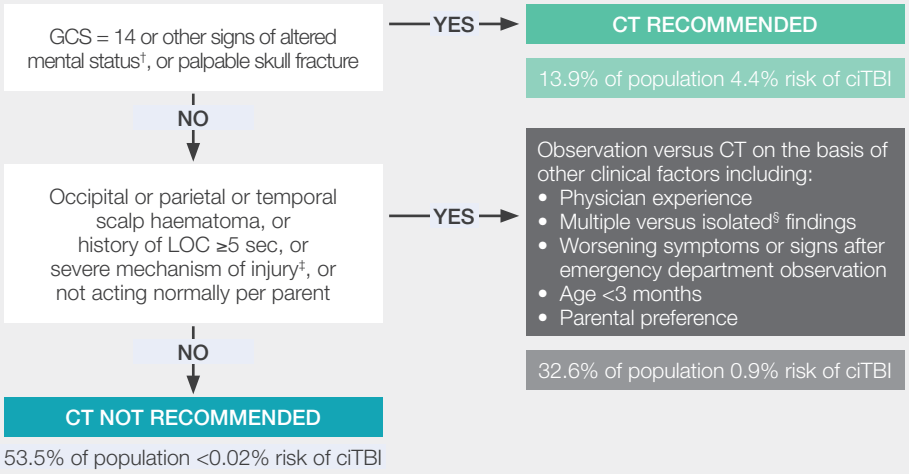
REFERENCE

1. Stiell IG, Lesiuk H, Wells G, McKnight R, Brison R, Clement C, *et al.* The Canadian CT Head Rule Study for patients with minor head injury: rationale, objectives, and methodology for phase I (derivation). *Ann Emerg Med*. 2001; 38(2): 160–9.

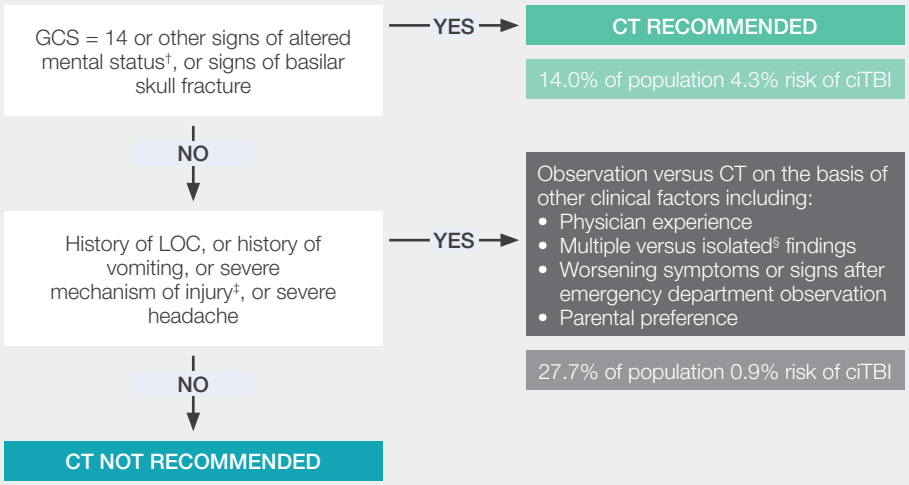
PECARN – PAEDIATRICS[1]

ALGORITHM:

A – FOR CHILDREN YOUNGER THAN 2 YEARS



B – FOR THOSE AGED 2 YEARS AND OLDER WITH GCS SCORES OF 14–15 AFTER HEAD TRAUMA*



EXPLANATORY NOTES

GCS = Glasgow Coma Scale.
ciTBI = clinically-important traumatic brain injury.
LOC = loss of consciousness.

* Data are from the combined derivation and validation populations.

† Other signs of altered mental status: agitation, somnolence, repetitive questioning, or slow response to verbal communication.

‡ Severe mechanism of injury:
- Motor vehicle crash with patient ejection, death of another passenger, or rollover
- Pedestrian or bicyclist without helmet struck by a motorised vehicle
- Falls of more than 0·9 m (3 feet) (or more than 1·5 m [5 feet] for panel B)
- Head struck by a high-impact object

§ Patients with certain isolated findings (i.e. with no other findings suggestive of traumatic brain injury), such as isolated LOC, isolated headache, isolated vomiting, and certain types of isolated scalp haematomas in infants older than 3 months, have a risk of ciTBI substantially lower than 1%.
Risk of ciTBI exceedingly low, generally lower than risk of CT-induced malignancies. Therefore, CT scans are not indicated for most patients in this group.

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INCLUSION CRITERIA

(ALL must be satisfied if PECARN algorithm to be applied)

- Age <18 years old
- GCS 14 or 15
- Presented to emergency department within 24 hours of head trauma

EXCLUSION CRITERIA

(If ANY are present the algorithm cannot be applied)

- Trivial injury mechanisms: ground level falls, walking or running into stationary objects, no signs or symptoms of head trauma other than scalp abrasions and lacerations
- Penetrating trauma
- Known brain tumours
- Pre-existing neurological disorders
- Neuroimaging at an outside hospital before transfer
- Patients with ventricular shunts
- Bleeding disorders

SUMMARY STATEMENT

The PECARN clinical decision rule aims to determine which children are at very low risk of important brain injury and who therefore do not require a CT scan of the head. It has been developed from the largest paediatric data set of the three CDRs featured in the Paediatric Head Trauma module in the RANZCR Educational Modules for Appropriate Imaging Referral suite. The PECARN clinical decision rule has been shown in a single, multicentre validation study to be high performing in identifying children who present within 24 hours of blunt head trauma with GCS of 14 or 15 who are at very low risk of a clinically important traumatic brain injury (defined as death, neurosurgical intervention, intubation more than 24 hours of admission of two nights or more due to traumatic brain injury). The PECARN clinical decision rule consists of two age specific rules: one for children less than 2 years of age and one for children 2 years and older. The elements for both age groups overlap but are not identical.

REFERENCE

1. Kuppermann N, Holmes JF, Dayan PS, Hoyle JD, Jr., Atabaki SM, Holubkov R, *et al*. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet*. 2009; 374(9696): 1160–70.

CHOOSE WISELY

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