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Canadian Association of Radiologists Pediatric Imaging Referral Guideline

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Abstract

The Canadian Association of Radiologists (CAR) Pediatric Expert Panel is made up of pediatric physicians from the disciplines of radiology, emergency medicine, endocrinology, gastroenterology, general surgery, neurology, neurosurgery, respirology, orthopaedic surgery, otolaryngology, urology, a patient advisor, and an epidemiologist/guideline methodologist. After developing a list of 50 clinical/diagnostic scenarios, a rapid scoping review was undertaken to identify systematically produced referral guidelines that provide recommendations for one or more of these clinical/diagnostic scenarios. Recommendations from 32 guidelines and contextualization criteria in the Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) for guidelines framework were used to develop 133 recommendation statements across the 50 scenarios. This guideline presents the methods of development and the referral recommendations for head, neck, spine, hip, chest, abdomen, genitourinary, and non-accidental trauma clinical scenarios.

Résumé

Le groupe d'experts en pédiatrie de l'Association canadienne des radiologistes (CAR) regroupe des médecins spécialisés en radiologie, médecine d'urgence, endocrinologie, gastroentérologie, chirurgie générale, neurologie, neurochirurgie, pneumologie, chirurgie orthopédique, oto-rhino-laryngologie et urologie, ainsi qu'une représentante des patients et une épidémiologiste spécialisée en méthodologie de l'élaboration de lignes directrices. Après avoir élaboré une liste de 50 scénarios cliniques/diagnostiques, le groupe d'experts a entrepris une revue rapide des publications en vue de repérer les

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lignes directrices relatives aux demandes d'examen élaborées de façon systématique qui fournissent des recommandations pour un ou plusieurs de ces scénarios. Les recommandations de 32 lignes directrices et critères de contextualisation du cadre GRADE (notation des recommandations, analyses, développements et évaluations) concernant la structure des lignes directrices ont été utilisées pour rédiger 133 énoncés de recommandations couvrant les 50 scénarios. Ces lignes directrices présentent les étapes à suivre et les recommandations d'orientation dans les cas de scénarios cliniques liés à la tête, au cou, à la colonne vertébrale, aux hanches, à la poitrine, à l'abdomen, à l'appareil génito-urinaire et aux traumatismes non accidentels.

Keywords
pediatrics, diagnostic imaging, referrals, guideline, recommendations

Introduction

Beginning in May 2023, an Expert Panel (EP) made up of pediatric physicians from the disciplines of radiology, emergency medicine, endocrinology, gastroenterology, general surgery, neurology, neurosurgery, respirology, orthopaedic surgery, otolaryngology, urology, a patient advisor, and an epidemiologist/guideline methodologist met to develop a new set of recommendations specific to referral pathways for Pediatric conditions. Through discussion (via a virtual meeting) followed by offline communication, the EP developed a list of 50 clinical/diagnostic scenarios to be covered by this guideline. These recommendations are intended primarily for referring clinicians (eg, family physicians, specialty physicians, nurse practitioners); however, they may also be used by radiologists, individuals/patients, and patient representatives.

Our methods describing the guideline development process, including the rapid scoping review to identify the evidence base, has been published in *CMAJ Open*[1] and an editorial to this series of guideline publications is available in *CARJ*.[2] The application of well-established scoping review and rapid review guidance (JBI,[3] Cochrane Handbook,[4] Cochrane Rapid Review Methods Group[5]) and guideline methodology (ie, Grading of Recommendations Assessment, Development, and Evaluation or GRADE[6,7]) were used to identify the evidence-base and to guide the Expert Panel in determining the strength and direction of the recommendations for each clinical scenario (Table 1). The quality of conduct and reporting of the included guidelines identified in the scoping review were evaluated with the AGREE-II checklist,[8] using a modified scoring system. In instances where guidelines were lacking, expert consensus was used to develop the recommendation. Contextualization to the Canadian health care system was considered for each recommendation, with discussion around the factors found in the Evidence to Decision framework in GRADE for guidelines (eg, balance of desirable and undesirable outcomes, values and preferences, resources implications).[7]

A systematic search for guidelines (with an a priori defined inclusion criteria) was run in Medline and Embase on August 10, 2023. The search was limited to publications from 2018 onward (Supplemental Appendix 1). Supplemental searching included the following national radiology and/or guideline groups: the American College of Radiology and the National Institute for Health and Care Excellence. The 2012 CAR guideline[9] and the 2017

Table 1. Recommendation Text, Symbol, and Interpretation.

Recommendation	AGAINST	FOR
STRONG	**Strong, against** "we recommend against" (↓↓) • All or almost all informed people would not recommend/choose the course of action and only a small proportion would.	**Strong, for** "we recommend" (↑↑) • All or almost all informed people would recommend/choose the course of action and only a small proportion would not. • Request discussion if the intervention is not offered.
CONDITIONAL	**Conditional, against** "we suggest against" (↓) • Most informed people would not recommend/choose the course of action, but a substantial number would. • This may be conditional upon patient values and preferences, the resources available or the setting in which the intervention will be implemented.	**Conditional, for** "we suggest" (↑) • Most informed people would recommend/choose the course of action, but a substantial number would not. • This may be conditional upon patient values and preferences, the resources available or the setting in which the intervention will be implemented.

Note. Down arrows are red and Up arrows are green when available in colour.
Created using the guidance provided in Andrews et al.[6]

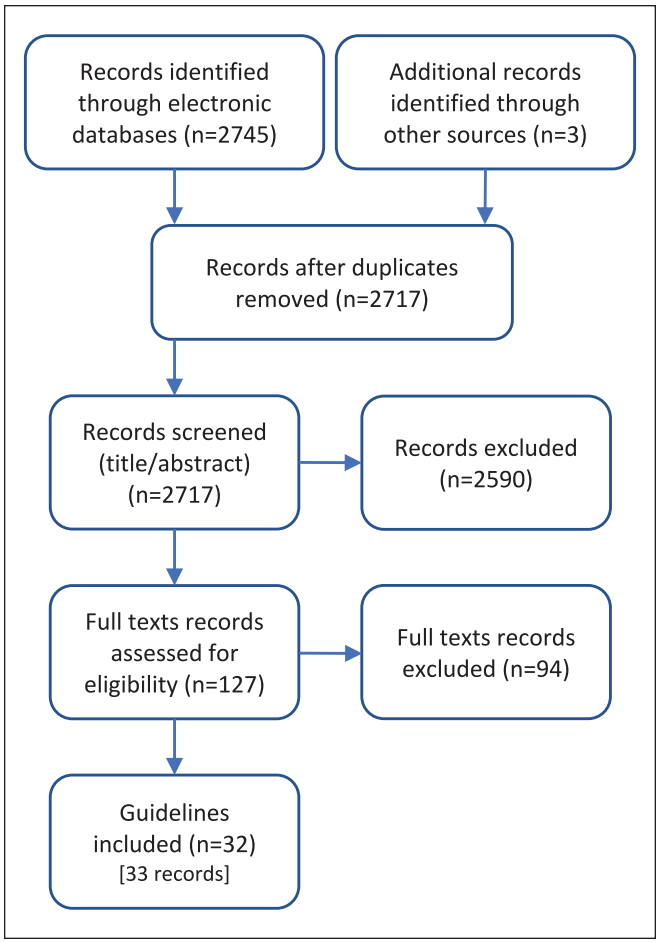

Figure 1. PRISMA flow diagram.

RCR iRefer guideline[10] recommendations were used in discussions. Recommendations for each clinical scenario were formulated over 10 virtual meetings between February 15 and April 23, 2024. External review and feedback were obtained from radiologists, emergency physicians, family physicians, and a nurse practitioner. The full guideline can be found on the CAR website (www.car.ca).

Results

Systematic Scoping Review

A total of 2745 records were identified through the electronic database and 3 additional records were added from the supplemental search. Thirty-two guidelines (plus one companion paper) were included (Figure 1). Potentially relevant guidelines published in languages other than English can be found in Supplemental Appendix 2. A list of excluded records with justifications for exclusion is available upon request. Most guidelines were rated as moderate or high quality, using the modified AGREE-II checklist[8] (Supplemental Appendix 3). The number of guidelines included per clinical/diagnostic scenario ranged from 0 to 10, with a median of 2 guidelines per clinical scenario.

Recommendations

Additional details of the included guidelines, including which imaging modalities (eg, computed tomography [CT], magnetic resonance imaging [MRI], radiograph [XR], ultrasound [US]) that were discussed can be found in Supplemental Appendix 4.

A guideline is intended to guide and not be an absolute rule. Medical care is complex and should be based on evidence, a clinician's expert judgment, the patient's circumstances, values, preferences, and resource availability. Not all imaging modalities are available in all clinical environments, particularly in rural or remote areas of Canada. Decisions about patient transfer, use of alternative imaging or serial clinical examination and observation can be complex and difficult. Therefore, the expected benefits of recommended imaging, risks of travel, patient preference, and other factors must be considered. The guideline recommendations are designed to assist the choice of imaging modality in situations where it is deemed clinically necessary to obtain imaging.

Unless the panel agreed a specific protocol is required to optimize patient care/diagnosis, the recommendations do not specify when contrast should or should not be used, as this decision may vary based on clinical presentation, regional practice preferences, preference of the referring clinician, radiologist and/or the patient, and resource availability.

We reviewed relevant recommendations related to the 50 clinical/diagnostic scenarios previously published by radiology and specialty societies, including: the Canadian Association of Radiologists,[9] the American College of Radiology,[11-22] the Canadian Urological Association,[23] the CHEST Expert Cough Panel,[24] the Egyptian Clinical Practice Guideline,[25] the European Crohn's and Colitis Organization/European Society of Paediatric Gastroenterology, Hepatology and Nutrition,[26] the European Pancreatic Club/Hungarian Pancreatic Study Group,[27] the European Respiratory Society,[28] the European Thyroid Association,[29] the European Society of Paediatric and Neonatal Intensive Care,[30] the German Society for Pediatric and Adolescent Medicine,[31] the Indian Society of Pediatric Nephrology,[32] the Italian Polispecialistic Society of Young Surgeons,[33] the Italian Society of Pediatric Gastroenterology, Hepatology and Nutrition,[34] the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition Pancreas Committee,[35] the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition/European Society for Pediatric Gastroenterology, Hepatology, and Nutrition,[36] the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition Pancreas Committee/Society for Pediatric Radiology,[37] the Polish guideline,[38] the Royal College of Radiologists,[10] the Société Française de Médecine d'Urgence/Société de Réanimation de Langue Française/French Group for Pediatric Intensive Care and Emergencies,[39] the Swiss consensus recommendations,[40] and the World Society of Emergency Surgery.[41]

Recommendations for head, neck, spine, hip, and bone clinical scenarios are presented in Table 2. Recommendations for chest and abdomen clinical scenarios are presented in Table 3. Last, recommendations for genitourinary and non-accidental trauma clinical scenarios are presented in Table 4.

Table 2. Head, Neck, Spine, Hip, and Bone Clinical Scenarios.

Clinical/Diagnostic Scenario and Recommendations
PD01. DEVELOPMENTAL DELAY/CONGENITAL MALFORMATIONS[9,10]
1. In children with a suspected congenital malformation of the brain, we recommend **MRI** as the initial imaging modality (↑↑).
↳ **1.1** In infants and neonates, if MRI is unavailable, contraindicated, or if the patient is uncooperative, we suggest **US** as an alternative imaging modality, recognizing the severe limitations for evaluation of cortical malformations (↑).
↳ **1.2** If a congenital malformation of the skull is suspected, or bony anatomy must be evaluated, we recommend **CT** as the next imaging modality (↑↑).
PD02. SUSPECTED CONGENITAL MALFORMATIONS OF THE SPINE/SPINAL DYSRAPHISM[9-11]
1. In infants with suspected congenital malformation of the spine, we recommend **US** as the initial imaging modality (↑↑).
↳ **1.1** If additional imaging is required, we recommend **MRI** as the next imaging modality (↑↑).
The timing of the MRI should be determined by the neurosurgeon.
2. In infants with suspected spinal dysraphism, we recommend **against XR for screening** (↓↓).
3. In low-risk infants with non-suspicious sacral dimple, we suggest **against routine US screening** (↓).
4. In high-risk infants <6 months of age with risk factors✧, we recommend **US** as the initial imaging modality (↑↑).
↳ **4.1** If US is abnormal or equivocal, we recommend **MRI** as the next imaging modality (↑↑).
The timing of the MRI should be determined by the neurosurgeon.
5. In infants with suspected congenital scoliosis, we recommend **XR** as the initial imaging modality (↑↑).
↳ **5.1** If further characterization of the spinal cord is required, we recommend **US or MRI** as the next imaging modality, depending on the age of the patient (↑↑).
✧For example, dimple depth (>5 mm), location of lumbosacral dimple (>2.5 cm from the anus), hairy patch, haemangioma, or anorectal/cloacal malformation.
PD03. HYDROCEPHALUS
PD03A. Suspected hydrocephalus[9]
1. In neurologically stable children with suspected hydrocephalus, we recommend **MRI** as the initial imaging modality (↑↑).
↳ **1.1** If MRI is unavailable in an appropriate time frame, is contraindicated, or if the patient is uncooperative, we recommend **CT** as an alternative imaging modality (↑↑).
↳ **1.2** In infants <6 months or with open fontanelle, if MRI and CT are unavailable, we suggest **US** as an alternative imaging modality, recognizing its significant limitations (↑).
2. In neurologically unstable children with suspected hydrocephalus, we recommend **CT** as the initial imaging modality (↑↑).
PD03B. Treated hydrocephalus, shunt malfunction[9,10]
1. In neurologically stable children with hydrocephalus and suspected shunt malfunction, we recommend **MRI and XR (shunt survey)** as the initial imaging modalities (↑↑).
Depending on local/regional practice, we suggest a rapid or shortened MRI protocol.
↳ **1.1** If MRI is unavailable in an appropriate time frame, is contraindicated, or if the patient is uncooperative, we recommend **CT** as an alternative imaging modality (↑↑).
↳ **1.2** In infants <6 months or with open fontanelle, if MRI and CT are unavailable, we suggest **US** as an alternative imaging modality, recognizing its significant limitations (↑).
2. In neurologically unstable children with hydrocephalus and suspected shunt malfunction, we recommend **CT and XR (shunt survey)** as the initial imaging modalities (↑↑).
PD04. CRANIOSYNOSTOSIS[10]
1. In children with suspected craniosynostosis, we recommend **against skull XR** (↓↓).
2. In children with suspected craniosynostosis, we recommend referral to a clinician expert in the evaluation for craniosynostosis (↑↑).
↳ **2.1** If this is unavailable, we recommend **US of the cranial sutures or low-dose CT**, depending on local practice and availability (↑↑).
PD05. MASTOIDITIS
1. In children with suspected mastoiditis, we recommend **CT with contrast** as the initial imaging modality (EP consensus).
PD06. ORBITAL CELLULITIS
1. In children with suspected orbital cellulitis, we recommend **CT with contrast** as the initial imaging modality (EP consensus).
CT orbits or CT orbits and head may be performed according to local practice preference.
PD07. CONGENITAL OR ACQUIRED HEARING LOSS[10]
1. In children with hearing loss, we recommend **pediatric otolaryngology consultation** prior to imaging investigation (↑↑).

(continued)

Table 2. (continued)

Clinical/Diagnostic Scenario and Recommendations

PD08. SEIZURE

PD08A. Febrile seizure[9,12]

Febrile seizure without any evidence of intracranial infection/inflammation and no underlying structural brain abnormalities.

1. In children with febrile seizure✧, we recommend **against routine imaging** (↓↓).

✧Simple or complex seizure

PD08B. Non-febrile seizure[9,10]

1. In children with first presentation of non-febrile/unprovoked seizures (excluding absence seizures) in whom imaging is indicated, we recommend **MRI** as the initial imaging modality (↑↑).
   - ↳ **1.1** If MRI is unavailable, contraindicated, or if the patient is uncooperative, we recommend **CT** as an alternative imaging modality (↑↑).

PD09. HEADACHE: ACUTE/SUBACUTE[9,10,13]

1. In children with primary headache (such as tension or migraine), we suggest **against routine imaging**, recognizing there may be clinical difficulty distinguishing primary from secondary headaches (↓).
2. In children with suspected acute/subacute secondary headache (such as suspected brain tumour), we recommend **MRI** as the initial imaging modality (↑↑).
   - ↳ **2.1** If MRI is unavailable, contraindicated, or if the patient is uncooperative, we recommend **CT** as an alternative imaging modality (↑↑).
3. In children with suspected intracranial haemorrhage (subarachnoid, subdural, or intracerebral), we recommend **CT** as the initial imaging modality (↑↑).
4. In children with suspected cerebral venous sinus thrombosis we recommend **CT with contrast or MRI** as the initial imaging modality (↑↑).

   CT or MRI may be performed according to local practice preference and/or availability.

If concern for mastoiditis, see PD05. Mastoiditis.
If concern for orbital cellulitis, see PD06. Orbital cellulitis.

PD10. HEADACHE: CHRONIC/RECURRENT[9,10,13]

1. In children with chronic/recurrent headache and normal neurological examination, we suggest **against routine imaging**, recognizing imaging may be acceptable when there is significant level of patient/parental concern, young age, atypical features, or changes in nature or pattern of headache (↓).
2. In children with chronic/recurrent headache and abnormal neurological examination or papilledema, we recommend **MRI** as the initial imaging modality (↑↑).
   - ↳ **2.1** If MRI is unavailable, contraindicated, or if the patient is uncooperative, we recommend **CT** as an alternative imaging modality (↑↑).

PD11. NECK MASS/NODULE

PD11A. Thyroid mass/nodule[29]

1. In children with a thyroid nodule, we recommend **US** as the initial imaging modality (↑↑).
2. In children with suspected goitre/diffuse enlargement with no concerning features✧, we suggest **against routine imaging** (↓).

✧For example, concerning features would include rapid or asymmetric enlargement, mass effect, dysphagia, dysphonia, or lymphadenopathy

PD11B. Non-thyroid mass/nodule[14]

1. In children with palpable but non-enlarged nodes, we suggest **against routine imaging** (↓).
2. In children with suspected retropharyngeal abscess, we recommend **lateral neck XR** as the initial imaging modality (↑↑).
   - ↳ **2.1** If XR is abnormal, we recommend **CT with contrast** as the next imaging modality (↑↑).
3. In children with non-thyroid neck mass or nodule with suspicion for infection, we recommend **US** as the initial imaging modality (↑↑).
   - ↳ **3.1** If further imaging is required, we recommend **CT with contrast** as the next imaging modality (↑↑).
4. In children with non-thyroid neck mass or nodule with suspicion for malignancy, we recommend **US** as the initial imaging modality (↑↑).
   - ↳ **4.1** If further imaging is required, we recommend **MRI or CT** as the next imaging modality (↑↑).

     Preference for MRI, but regional practice may influence test.
5. In children with non-thyroid neck mass or nodule with suspicion of congenital anomaly, we recommend **US** as the initial imaging modality (↑↑).
   - ↳ **5.1** If further imaging is required, we suggest **MRI** as the next imaging modality (↑).

     Preference for MRI, but CT may be used based on regional practice.

PD12. SINUSITIS

PD12A. Acute sinusitis (including acute complicated)[9,10,15]

1. In children with uncomplicated acute sinusitis, we recommend **against routine imaging** (↓↓).
2. In children with complicated sinusitis or in immunocompromised patients, we recommend **CT with contrast** as the initial imaging modality (↑↑).

(continued)

Table 2. (continued)

Clinical/Diagnostic Scenario and Recommendations

PD12B. Chronic sinusitis[9,15]

1. In children with chronic or recurrent sinusitis, we recommend **against routine imaging** (↓↓).

   Chronic sinusitis is rare in children. In children with chronic or recurrent sinusitis, otolaryngology consultation may be considered. If imaging is indicated based on a clinical decision rule or guideline,[15] *CT sinuses is the preferred modality.*

PD13. TORTICOLLIS

PD13A. Congenital torticollis[9,10]

1. In children with suspected congenital torticollis (fibromatosis colli) and unclear clinical diagnosis, we recommend **US** as the initial imaging modality (↑↑).

PD13B. New onset torticollis[9,10]

1. In children with new onset torticollis which is non-muscular or with an atypical history and examination, we recommend **XR** as the initial imaging modality (↑↑).
   - ↳ **1.1** Given the wide range of possible pathology, we recommend **orthopaedist, neurosurgeon, or neurologist consultation** prior to further imaging (↑↑).

PD14. CNS INFLAMMATION/INFECTION

1. In children with suspected central nervous system inflammation/infection, we recommend **MRI** as the initial imaging modality (EP consensus).
   - ↳ **1.1** If MRI is unavailable or contraindicated, we suggest **CT** as an alternative imaging modality, recognizing the significant limitations of CT in this context (EP consensus).

     CT is insensitive for CNS inflammation and infection and a normal CT does not exclude these diagnoses.

PD15. BACK PAIN[9,10,31]

1. Persistent, severe, or recurrent back pain in children is atypical, therefore, when red flags are present✧, we recommend **spine XR** as the initial imaging modality (↑↑).
   - ↳ **1.1** If XR is normal and the following diagnoses are suspected, spinal malignancy, infection, fracture, cauda equina syndrome, ankylosing spondylitis or another inflammatory disorder, we recommend **MRI** as the next imaging modality (↑↑).
   - ↳ **1.2** If XR shows bony pathology and further investigation is required, we recommend **CT or MRI** (↑↑).

✧Red flags may include the following: Child <5 years; Persistent back pain; Duration >4 weeks; Worsening pain; Morning stiffness; Night pain; Radicular pain; Vertebral tenderness on palpation; Fever, tachycardia; Abnormal neurological exam; Weight loss, bruising, adenopathy or abdominal mass; Altered spine shape/mobility; Altered gait; Functional disability; Bowel/bladder dysfunction; Past history of cancer/tuberculosis[10,42]

PD16. HIP PAIN OR LIMPING REFERABLE TO HIP PATHOLOGY[9,10,16]

1. In children with hip pain, we recommend **XR** as the initial imaging modality (↑↑).
   - ↳ **1.1** If further imaging is indicated for the assessment of joint effusion, we recommend **US or MRI** (↑↑).
   - ↳ **1.2** If further imaging is indicated for any other reason, we recommend **MRI** (↑↑).

PD17. LIMPING AND UNABLE TO LOCALIZE SYMPTOMS[9,10,16]

1. In limping children too young to localize symptoms, we recommend **XR of the affected extremity** as the initial imaging modality (↑↑).
   - ↳ **1.1** If XR is negative for fracture or other pathology, the need for and type of further imaging should be based on clinical grounds (EP consensus).

     For example, repeat XR in 10-24 days, US of the hip, or MRI of the affected extremity may be considered.

PD18. DEVELOPMENTAL DYSPLASIA OF THE HIP[9,10,17,18]

1. In a newborn <4-6 weeks of age with risk factors for development dysplasia of the hip and a normal examination, we recommend **against routine imaging** (↓↓).
   - ↳ **1.1** If there are physical findings (eg, positive Barlow's sign), we recommend **US** (↑↑).
2. In an infant between 4-6 weeks and 4-6 months of age with risk factors for or physical findings suggestive of developmental dysplasia of the hip, we recommend **US** as the initial imaging modality (↑↑).
3. In children 4-6 months of age or older, we recommend **XR** as the initial imaging modality (↑↑).

PD19. SUSPECTED OSGOOD-SCHLATTER DISEASE[9,10]

1. In children with a clinical diagnosis of Osgood-Schlatter disease, we recommend **against routine imaging** (↓↓).
2. In children where clinical diagnosis of Osgood-Schlatter disease is uncertain or if serious bone pathology is being considered, we recommend **XR** as the initial imaging modality (↑↑).

(continued)

Table 2. (continued)

Clinical/Diagnostic Scenario and Recommendations
PD20. SCOLIOSIS[9,11]
1. In children with a clinical suspicion of scoliosis, we recommend **standing full spine XR** as the initial imaging modality (↑↑). ↳ **1.1** If risk factors✧ are identified on XR, we recommend **full spine MRI** as the next imaging modality (↑↑). *MRI should only be considered after consultation with a pediatric orthopaedic surgeon.* ✧For example, age 0 to 9 years old, left thoracic curve, short segment curve (4-6 levels), absence of apical segment lordosis/kyphosis, long thoracolumbar curve, rapid curve progression (more than 1° per month), functionally disruptive pain, focal neurologic findings, male sex, and pes cavus.[11]
PD21. SHORT STATURE/GROWTH FAILURE[9,10]
1. In children ≥2 years of age with short stature/growth failure, we recommend **XR of the left hand and wrist for bone age**✧ as the initial imaging modality (↑↑). ✧A bone age should be completed according to appropriate reference standards, for example, Greulich and Pyle.[43]

Table 3. Chest, Abdomen, and Gastrointestinal Clinical Scenarios.

Clinical/Diagnostic Scenario and Recommendations
PD22. PNEUMONIA
PD22A. Uncomplicated pneumonia[9,10,19,30,38]
1. In children with suspected uncomplicated pneumonia, particularly in the presence of tachypnoea and/or a low SpO2, we recommend **chest XR** (↑↑). *If suspected bronchiolitis, see PD23.*
PD22B. Pneumonia with complications, including recurrent pneumonia[9,19,30,38]
1. In children with complicated pneumonia✧, we recommend **chest XR** as the initial imaging modality (↑↑). ↳ **1.1** If further investigation is required for evaluation of pleural effusion, we recommend **US** as the next imaging modality (↑↑). ↳ **1.2** If further investigation is required, for example in the case of suspected bronchiectasis, suspicion of a congenital lung malformation, lung abscess, pneumothorax, necrotizing pneumonia, we recommend **CT** as the next imaging modality (↑↑). ✧For example, recurrent pneumonia, pleural effusion, empyema
PD23. BRONCHIOLITIS[30,38]
1. In children with suspected bronchiolitis, we recommend **against routine chest XR** (EP consensus).
PD24. SUSPECTED FOREIGN BODY
PD24A. Suspected foreign body: Gastrointestinal[9,10,34]
1. In children with suspected swallowed batteries and magnets, we recommend **discussion with general surgery and/or gastroenterology** (↑↑). **2.** In children with suspected swallowed foreign body ingestion (ie, not battery or magnet), we recommend **XR of the neck, chest, abdomen** as the initial imaging modality (↑↑). If timing of ingestion is uncertain, the pelvis could be included. ↳ **2.1** If object has not passed and follow-up is required, we recommend **XR abdomen and pelvis** (↑↑).
PD24B. Suspected foreign body: Airway[9,10]
1. In children with suspected inhaled foreign body, we recommend **chest XR (inspiration and expiration views)** as the initial imaging modality (↑↑). *Right/left decubitus views could be substituted for expiration view if the patient is not cooperative.* ↳ **1.1** If chest XR is negative or equivocal and there is a significant suspicion of foreign body, we recommend **otolaryngology or surgery consultation** for consideration for bronchoscopy (↑↑).

(continued)

Table 3. (continued)

PD25. ASTHMA[9,10,24,28,39]

1. In children with asthma, we recommend **against routine chest XR** (↓↓).
2. In children with asthma with clinical suspicion of complication of asthma (eg, pneumothorax) or another cause of recurrent wheezing (eg, aspiration), we recommend **chest XR** as the initial imaging modality (↑↑).

PD26. STRIDOR[9,10]

1. In stable children with acute stridor where epiglottitis or retropharyngeal abscess is suspected and the child is stable enough to undergo imaging, we recommend **lateral neck XR** as the initial imaging modality (↑↑).
2. In children presenting with typical croup, we recommend against routine imaging (↓↓).
3. In children with chronic stridor, we recommend **neck XR** as the initial imaging modality (↑↑).
   - ↳ **3.1** If further evaluation or characterization is required, we recommend **CT or MRI** as the next imaging modality (↑↑).

PD27. ACUTE ABDOMINAL TRAUMA

1. In children who have sustained abdominal trauma, in whom internal injury is suspected, we recommend **CT** as the initial imaging modality (↑↑).
   - ↳ **1.1** In the specific clinical context where CT in not available, we suggest that **US** be used, while considering its significant limitations (↑).
     In the pediatric population, US is not reliable in excluding significant acute injury.
2. In children with suspected urinary system injury, we recommend **excretory phase CT** (↑↑).

Note: Recommendation 2 is a modification of the recommendation in the CAR Trauma guideline.[44]

PD28. VOMITING IN INFANT OR YOUNG CHILDREN

PD28A. Bilious vomiting, suspected proximal obstruction[9,20]

1. In infants and young children with bilious vomiting and suspected proximal obstruction on abdominal XR, we recommend **urgent upper GI series** as the initial imaging modality (↑↑).
   - ↳ **1.1** If upper GI series is not immediately available, we suggest **transfer and urgent pediatric surgery consultation** (↑).
     - ↳ **1.2** If transfer and upper GI series will not be delayed by referral to imaging, we suggest **urgent US** as an alternative, while recognizing its limitations (↑).

PD28B. Suspected distal obstruction[9,20]

1. In infants and young children with suspected distal obstruction, we recommend **abdominal XR** as the initial imaging modality (↑↑).
   - ↳ **1.1** If XR suggests a distal obstruction, we recommend **contrast enema** as the next imaging modality (↑↑).

PD28C. Suspected hypertrophic pyloric stenosis[9,10,20]

1. In infants with suspected hypertrophic pyloric stenosis, we recommend **US abdomen** as the initial imaging modality (↑↑).

PD28D. Suspected uncomplicated gastroesophageal reflux (GER)[9,20,36]

1. In infants and young children with suspected uncomplicated gastroesophageal reflux, we recommend **against routine imaging** (↓↓).

PD29. PERSISTENT NEONATAL JAUNDICE[9,10]

1. In infants with persistent neonatal jaundice and conjugated hyperbilirubinemia, we recommend **urgent US** as the initial imaging modality **and urgent referral to pediatric gastroenterology** (↑↑).

PD30. RECTAL BLEEDING[9,10]

1. In children with suspected Meckel's diverticulum, we recommend **NM** as the initial imaging modality (↑↑).
2. In neonates with suspected necrotizing enterocolitis, we recommend **XR** as the initial modality (↑↑).
3. In children with other causes of rectal bleeding (eg, intussusception, inflammatory bowel disease, juvenile polyposis, etc.), we recommend **US** as the initial imaging modality (↑↑).
   - ↳ **3.1** If vascular anomaly or angiodysplasia is suspected, we suggest **CT** as the next imaging modality (↑).

NM: nuclear medicine

(continued)

Table 3. (continued)

PD31. ACUTE ABDOMINAL/PELVIC PAIN[9,10,21,23,26,27,33,35,37,41]

Suspected appendicitis

1. In children with suspected appendicitis, we recommend **US** as the initial imaging modality (↑↑).
   - ↳ **1.1** If US is equivocal and there is ongoing suspicion of appendicitis, we suggest **repeat US or CT/MRI** as the next imaging modality (↑).

Suspected intussusception

1. In children with suspected intussusception, we recommend **US** as the initial imaging modality (↑↑).

Suspected ovarian torsion

1. In patients with suspected ovarian torsion, we recommend **transabdominal US** as the initial imaging modality (↑↑).
   - ↳ **1.1** We suggest **Doppler** as an adjunct (↑).

Note: Suspected ovarian torsion recommendations from OBGYN guideline,[45] with the modification of removal of transvaginal US

Inflammatory bowel disease

1. In children with suspected inflammatory bowel disease (eg, Crohn's, ulcerative colitis), we recommend **US** as the initial imaging modality prior to pediatric gastroenterology consultation (↑↑).
   - ↳ **1.1** If further imaging is required (eg, for characterization), we recommend **MR enterography** as the next imaging modality (↑↑).
     - ↳ **1.2** If the patient is not cooperative (eg, age), we recommend an **upper GI and small bowel follow-through** (↑↑).
     - ↳ **1.3** In the acute setting where MR enterography is not tolerated, we recommend **CT** (↑↑).

MR: magnetic resonance

Suspected pancreatitis

1. In children with suspected pancreatitis, we recommend **US** as the initial imaging modality (↑↑).
   - ↳ **1.1** If complication of pancreatitis is suspected, we recommend **CT or MRI** as the next imaging modality (↑↑).
   - ↳ **1.2** If duct anomaly (eg, pancreas divisum) is suspected, we recommend **MRI with MRCP** as the next imaging modality (↑↑).

Other causes of abdominal pain

1. In children other causes of abdominal pain, such as suspected renal/ureteral calculi or cholecystitis, we recommend **US** as the initial imaging modality (↑↑).

PD32. PALPABLE ABDOMINAL OR PELVIC MASS[9,10]

1. In children with a palpable abdominal or pelvic mass, we recommend **US** as the initial imaging modality (↑↑).
   - ↳ **1.1** If US is not available, we suggest **XR abdomen** as an alternative (↑).

PD33. CONSTIPATION[9,10]

The diagnosis of constipation should be made based on clinical history and a physical examination.

1. If imaging is required, we suggest **XR abdomen/pelvis** as the initial imaging modality (↑).

Table 4. Genitourinary and Non-Accidental Trauma Clinical Scenarios.

Clinical/Diagnostic Scenario and Recommendations

PD34. UNDESCENDED TESTES[9,10]

1. In children with undescended testes, we recommend **against routine imaging** (↓↓).

Visit Choosing Wisely Canada[a] for additional information.

PD35. FETAL RENAL PELVIC DILATATION, INITIAL POSTNATAL EVALUATION[9,22]

1. In infants with fetal renal pelvic dilatation, we recommend **US** as the initial imaging modality, performed no sooner than 3 days post-partum (↑↑).
   If there is severe bilateral pre-natal hydronephrosis or concern for posterior urethral valves, US could be performed sooner.

PD36. URINARY INCONTINENCE

PD36A. Enuresis[9,10]

1. In children with typical enuresis (ie, monosymptomatic night-time enuresis), we recommend **against routine imaging** (↓↓).

PD36B. Continual incontinence[9,10]

1. In children with continuous dribbling or wetting, we recommend **kidney and urinary bladder US** as the initial imaging modality (↑↑).

(continued)

Table 4. (continued)

Clinical/Diagnostic Scenario and Recommendations
PD37. URINARY TRACT INFECTION
PD37A. First episode[9,10,25,32,40]
1. In children presenting with a first non-febrile episode of UTI, we recommend **against routine imaging** (↓↓).
2. In children <2 years of age presenting with a first febrile episode of UTI, we recommend **US** as the initial imaging modality (↑↑).
3. In children with complicated/atypical first episode of UTI✧, we recommend **US before discharge from hospital** as the initial imaging modality (↑↑).
✧For example, very ill child, evidence of sepsis, low urine output, raised serum creatinine, abdominal/pelvic mass, infection with organisms other than E. coli and/or failure to respond to appropriate antibiotics within 48 hours
PD37B. Recurrent[9,10,25,40]
1. In children presenting with recurrent UTI, we recommend **US** as the initial imaging modality (↑↑).
↳ **1.1** If US is abnormal, we recommend that any decision for further intervention (eg, VCUG) should be made **in consultation with an experienced pediatrician, nephrologist, or urologist** (EP consensus).
Voiding cystourethrogram (VCUG) is not indicated in children with recurrent cystitis or non-febrile urinary tract infections. VCUG may be indicated in males with bilateral hydroureteronephrosis, infant with hydronephrosis and UTI.
2. In children presenting with complicated recurrent episode of UTI✧, we recommend **US before discharge from hospital** as the initial imaging modality (↑↑).
✧For example, very ill child, evidence of sepsis, low urine output, raised serum creatinine, abdominal/pelvic mass, infection with organisms other than E. coli and/or failure to respond to appropriate antibiotics within 48 hours
PD38. NON-ACCIDENTAL TRAUMA
1. In children with suspected non-accidental trauma, we recommend **skeletal survey XR** as the initial imaging modality (↑↑).
2. If there is suspicion of non-accidental head trauma, we suggest **CT head** (↑).
3. In children with abnormal CT head, abnormal skull or spine XR, or persistent neurological symptoms, we recommend **MRI of the head and spine** (↑↑).
4. If there is clinical suspicion of acute intra-abdominal injury, we recommend **CT** (↑↑).
Note: Recommendations 3 and 4 have been added to the original CAR Trauma guideline recommendations.[44]

[a]https://choosingwiselycanada.org/recommendation/urology/.

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Supplemental Material

Supplemental material for this article is available online.

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