Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L01. Suspected congenital malformation of the brain	MRI	Indicated [B]	0	MRI is the definitive examination for suspected congenital malformation of the brain, providing the best definition of brain anatomy.
	CT	Indicated [B]	☢☢	In suspected congenital malformation of the skull, CT is required for the evaluation of bony anatomy. 3-D reconstruction is indicated for patients with craniosynostosis and craniofacial syndromes.
L02. Suspected congenital malformation of the spine	MRI	Indicated [B]	0	MRI is the definitive examination for suspected congenital malformation of the spine, giving the best depiction of the spinal cord, conus and cauda equina.
	CT	Moderately indicated [B]	☢☢☢	Targeted CT may be required in addition to MRI in order to define bony anatomy, e.g. with complex forms of spinal dysraphism.
L03. Suspected hydrocephalus, new diagnosis	MRI	Indicated [B]	☢☢	MRI is the definitive examination for all malformations of the brain, offering superior resolution of brain anatomy, compared to other modalities.
	CT	Moderately indicated [B]	0	CT can identify hydrocephalus rapidly and may therefore be preferred to MRI in a patient who is neurologically unstable. CT can provide some information about the cause of hydrocephalus and associated brain malformations when MRI is not readily available; however, its resolution of brain anatomy is inferior to that of MRI.
	US	Moderately indicated [B]	☢☢	US can identify hydrocephalus rapidly and without the need for ionizing radiation or sedation in young infants with open fontanelles; however, US alone does not permit a complete evaluation of the cause of hydrocephalus or associated brain malformations.
L04. Treated hydrocephalus, suspected shunt malfunction	XR shunt series	Indicated [B]	☢	XR of the whole shunt system (skull, chest, abdomen/pelvis) is required to identify the site of interruption.
	MRI	Indicated [B]	0	MRI focused on the evaluation of size and configuration of cerebrospinal fluid spaces can be performed rapidly and without sedation in most patients, using single shot fast spin echo sequences. MRI is contraindicated in patients with some biomedical devices. Programmable shunt valves may be a problem.

(continued on next page)

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L04. Treated hydrocephalus, suspected shunt malfunction *(continued)*	US head	Moderately indicated [B]	0	US can identify hydrocephalus rapidly and without the need for ionizing radiation or sedation in young infants with open fontanelles. However, US may not reliably detect subtle changes in size or configuration of cerebrospinal fluid spaces on serial examinations.
	CT	Moderately indicated [B]	☢☢	CT can reliably detect changes in size and configuration of cerebrospinal fluid spaces on serial examinations. However, multiple examinations over time may impose a significant radiation burden on patients with repeated episodes of shunt malfunction. CT may be used when US is not appropriate and MRI is unavailable or contraindicated.
L05. Treated hydrocephalus, suspected shunt malfunction due to CSF loculation around the distal end of the shunt	US abdomen/ pelvis	Indicated [C]	0	US can detect CSF loculation around the distal end of the shunt.
L06. Febrile seizure	Imaging	Not indicated [B]	N/A	Abnormalities can be found in children with febrile seizures, especially focal or prolonged febrile seizures. However, there is no evidence that management is altered by imaging. Meningitis must be ruled out clinically, using lumbar puncture if appropriate.
L07. Suspected epilepsy	MRI	Indicated [B]	0	MRI is the definitive examination for all malformations of the brain, offering superior resolution of brain anatomy, compared to CT. It is therefore preferred to CT for the detection and characterization of malformations of cortical development and other epileptogenic lesions in children. Imaging is not indicated in any of the following conditions, which are typically not associated with structural epileptogenic lesions: childhood absence epilepsy, juvenile absence epilepsy, juvenile myoclonic epilepsy, benign childhood epilepsy with centrotemporal spikes (BECTS).
	CT	Moderately indicated [B]	☢☢	CT can reveal structural lesions that cause seizures, but has significantly lower resolution than MRI and requires radiation exposure. CT may be helpful to rule out acute or evolving intracranial pathology (e.g. hemorrhage, mass) in a child with non-febrile seizures, if MRI is not readily available or if MRI is contraindicated.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L08. Suspected cerebral palsy or developmental delay	MRI	Specialized investigation [A]	0	The clinical diagnosis of cerebral palsy or developmental delay is rarely aided by imaging. However, MRI can demonstrate periventricular leukomalacia or hypoxic-ischemic injury in children with cerebral palsy. MRI can also demonstrate abnormalities in some genetic/metabolic conditions associated with developmental delay.
	CT	Specialized investigation [A]	☢☢	CT may be considered if MRI is contraindicated.
L09. Headache: chronic / recurrent	MRI	Specialized investigation [B]	0	In chronic/recurrent headache with a normal neurological examination, the yield of imaging is low. MRI may be used to rule out CNS pathology, if there remains concern after an evaluation by a neurologist. MRI is preferred to CT, because of its superior anatomical resolution and lack of radiation. Consideration should be given to magnetic resonance venography (MRV) to rule out venous sinus thrombosis.
	CT	Specialized investigation [B]	☢☢	CT may be used to rule out a space occupying lesion, if there remains concern after an evaluation by a neurologist. CT may be considered where MRI is not available or MRI is contraindicated. Consideration should be given to contrast enhanced CT to rule out venous sinus thrombosis.
L10. Headache: acute, sudden, severe, "thunderclap"	CT	Indicated [B]	☢☢	Although rare, aneurysmal hemorrhage can occur in children. In cases of sudden, severe headache ("thunderclap" headache), CT has excellent sensitivity and specificity for the detection of acute blood. CTA is required for the detection and characterization of aneurysms and vascular malformations.
	MRI	Indicated [B]	0	Diffusion weighted imaging (DWI), fluid attenuated inversion recovery (FLAIR) and gradient recalled echo (GRE) sequences should be used to maximize detection of acute blood. MRA of the circle of Willis is required for the detection and characterization of aneurysms and vascular malformations.
L11. Uncomplicated acute sinusitis	Imaging	Not indicated [B]	N/A	Mucosal thickening is frequently seen in asymptomatic children, limiting the value of imaging for ruling in/out sinusitis.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L12. Diagnosis of sinusitis in doubt	XR sinuses	Moderately indicated [B]	☢	XR is not reliable for confirming the diagnosis (see above). However, in some circumstances, such as when the diagnosis of sinusitis is in doubt, a negative XR may be helpful in shifting the focus of therapy.
	CT sinuses	Not indicated [B]	☢☢	The anatomical resolution of CT is not required in this scenario. Therefore, the increased radiation dose is not warranted.
L13. Definite sinusitis, resistant to maximal medical therapy	CT sinuses	Specialized examination [B]	☢☢	CT can demonstrate anatomical causes of sinus obstruction that may require surgical intervention. It should therefore be performed in conjunction with ENT evaluation.
	XR sinuses	Not indicated [B]	☢	The anatomical resolution of XR is not sufficient to assess for anatomical causes of sinus obstruction.
L14. Complicated sinusitis	CT sinuses	Indicated [B]	☢☢	CT with contrast enhancement can be used to assess for periorbital cellulitis, cavernous sinus thrombosis, and epidural/subdural empyema. The threshold for imaging should be lower in immunocompromised children.
	MRI sinuses	Indicated [B]	0	MRI is superior to CT for the assessment of epidural/subdural empyema and brain abscess. MRI is therefore preferred when intracranial extension is strongly suspected. The threshold for MRI should be lower in immunocompromised children.
	XR sinueses	Not indicated [B]	☢	The anatomical resolution of XR is not sufficient to assess complicated sinusitis (e.g. periorbital swelling, ptosis, visual changes, cranial nerve palsies, altered mental status).
L15. Congenital torticollis	US	Indicated [B]	0	US of the sternocleidomastoid muscles is useful to assess for fibromatosis colli. If US is negative, other imaging is indicated (see below).
L16. New onset torticollis, no history of trauma	XR	Indicated [B]	☢	Muscular causes are most common, but XR is advised when history and physical examination are atypical.
	MRI	Specialized investigation [B]	0	Persistent torticollis for one week justifies further imaging, following orthopaedic or neurosurgical consultation. MRI is preferred to CT when available, because of its superior definition of soft tissues and its lack of ionizing radiation.
	CT	Specialized investigation [B]	☢☢	Persistent torticollis for one week justifies further imaging, following orthopaedic or neurosurgical consultation. CT may be used if MRI is contraindicated.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L17. Back pain	NM	Indicated [C]	☢☢	NM bone scan with SPECT of the spine can be used to localize the site of abnormality for further imaging.
	MRI	Specialized investigation [B]	0	Persistent back pain in children may have an underlying cause and justifies investigation. Back pain with scoliosis or neurological signs merits imaging. Choice of imaging should be made in consultation with a specialist (e.g. spine surgeon, rheumatologist) to maximize yield.
	CT	Specialized investigation [B]	☢☢☢	Persistent back pain in children may have an underlying cause and justifies investigation. Back pain with scoliosis or neurological signs merits imaging. Choice of imaging should be made in consultation with a specialist (e.g. spine surgeon, rheumatologist) to maximize yield.
L18. Spina bifida occulta reported on XR, neurological findings and cutaneous stigmata of dysraphism absent	Imaging	Not indicated [C]	N/A	Incomplete fusion of posterior elements at the lumbosacral junction can be a benign variant in the absence of neurological findings or cutaneous stigmata of spinal dysraphism.
L19. Suspected spinal dysraphism, screening in low risk infants	US	Moderately indicated [B]	0	US has very good diagnostic performance, and it does not require sedation. Therefore, it is the preferred screening modality in infants of diabetic mothers and infants with intergluteal dimples. However, the yield in this population is very low. US should be performed before 6 months of age, because visualization becomes progressively more difficult with ossification of the posterior elements.
	MRI	Not indicated [B]	0	MRI has the best diagnostic performance, but it requires sedation. It should therefore not be used as a screening modality.
	XR lumbar spine	Not indicated [B]	☢☢	XR lumbar spine has the poorest diagnostic performance and exposes children to radiation. It should therefore not be used as a screening modality for spinal dysraphism.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L20. Suspected spinal dysraphism, screening in higher risk infants	US	Indicated [B]	0	Infants with lumbosacral dimple, hairy patch, hemangioma or anorectal/cloacal malformation are at higher risk of spinal dysraphism. US should be sufficient to rule out spinal dysraphism in infants presenting with only a lumbosacral dimple.
	MRI	Specialized examination [B]	0	MRI requires sedation, and the strength of the clinical indication must be weighed against the risk of sedation in consultation with a neurosurgeon. MRI should be considered when the risk of spinal dysraphism is high despite a negative US, or when the child is too old to have US.
	XR lumbar spine	Not indicated [B]	☢☢	XR lumbar spine has the poorest diagnostic performance and exposes children to radiation. It should therefore not be used as a screening modality for spinal dysraphism.
L21. Suspected child abuse (non-verbal child)	XR skeletal survey	Indicated [A]	☢☢	A skeletal survey with appropriately coned views of skull, spine, chest/ribs, pelvis, upper and lower extremities should be performed by radiographers trained in pediatric imaging technique.
	XR skeletal survey, follow-up after 2 weeks	Specialized investigation [B]	☢☢	A follow-up skeletal survey can detect additional fractures and clarify equivocal lesions on the initial survey. Skull views should be omitted. This should be done in direct consultation with the child protection specialist to weigh the need for additional information against the additional radiation exposure. Consideration may be given to targeted views.
	NM whole body bone scan	Indicated [B]	☢☢	Whole body bone scan can be complementary to XR skeletal survey in the detection of fractures. It is less sensitive with respect to metaphyseal fractures and skull fractures, but more sensitive with respect to rib fractures.
	CT head	Indicated [B]	☢☢	Unenhanced CT of the head should be part of the initial work-up for skull fractures, intracranial hemorrhage and parenchymal brain injury in all infants less than one year of age and in any infant or child with encephalopathy, focal neurological findings or retinal hemorrhage. CT is complementary to MRI in the estimation of timing of injuries.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L22. Suspected child abuse (verbal child)	XR skeletal survey	Not indicated [C]	☢☢	Injured bones/joints should be identified by history and physical examination in the verbal child.
	XR of individual bones/joints	Indicated [C]	☢	XR should be targeted to injured bones/joints.
	NM whole body bone scan	Not indicated [C]	☢☢	Injured bones/joints should be identified by history and physical examination in the verbal child.
	CT head	Specialized examination [C]	☢☢	The need for CT of the head should be discussed with a child protection specialist on an individual basis and guided by history and physical examination.
	MRI brain	Specialized examination [C]	0	The need for MRI of the brain should be discussed with a child protection specialist on an individual basis and guided by history and physical examination.
L23. Suspected child abuse (visceral injury, any age)	CT chest, abdomen and/or pelvis	Indicated [C]	☢☢☢	All CT should be performed with intravenous contrast enhancement to optimize detection of vascular and solid visceral injuries; CT of the abdomen and pelvis should be performed with oral contrast enhancement to optimize detection of hollow visceral injuries. (Also see the section on “Blunt Abdominal Trauma”.)
	US abdomen and pelvis	Moderately indicated [C]	0	US may be used as a screening tool to detect intraperitoneal fluid in cases of suspected visceral injury; however, its ability to depict solid and hollow visceral injuries is limited, compared to CT. (Also see the section on “Blunt Abdominal Trauma”.)
L24. Limb injury, comparison of opposite side	XR opposite bone/joint	Not indicated [B]	☢	Comparison views are rarely necessary to distinguish abnormal findings from normal changes related to growth and development; comparison views may be obtained if there remains uncertainty after consultation with a radiologist.
L25. Hip pain or limping referable to hip pathology, initial evaluation	XR	Indicated [C]	☢	XR is the most appropriate first imaging examination for suspected avascular necrosis and slipped capital femoral epiphysis. AP and frog leg lateral views of the pelvis and both hips should be performed, with gonadal shielding on one of these views.
	US	Indicated [B]	0	US is the most appropriate initial imaging examination for suspected septic arthritis, transient synovitis, juvenile idiopathic arthritis or hemarthrosis. US has high sensitivity for the detection of hip effusion, but cannot distinguish reliably among the different causes.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L26. Hip pain or limping referable to hip pathology, further evaluation and treatment planning	MRI	Specialized investigation [C]	0	MRI is now considered the modality of choice to assess the severity and complications of avascular necrosis. MRI can also be helpful in assessing inflammatory arthropathies. MRI may require sedation and should be performed in consultation with an orthopaedic surgeon or rheumatologist.
	NM	Moderately indicated [C]	☢☢	NM bone scan with pinhole views of the hips may also be used to assess avascular necrosis if MRI is not available.
L27. Limping in a child too young to localize symptoms	XR tibia/fibula	Indicated [C]	☢	In the initial evaluation, XR of the tibia and fibula may identify a toddler's fracture.
	US hip	Indicated [B]	0	US may identify hip pathology. In the initial evaluation, US has high sensitivity for the detection of hip effusion, but cannot distinguish reliably among the different causes.
	NM	Moderately indicated [B]	☢☢	NM is moderately indicated following a negative XR and US. NM bone scan has a higher radiation dose than the above combination of XR and US. Therefore, NM should be considered as a second-line investigation if XR and US fail to localize the pathology and symptoms persist.
	MRI	Specialized investigation [C]	0	MRI may be used instead of NM or as an adjunct to NM at some centres, depending on availability and local expertise.
L28. Focal bone pain, initial evaluation	XR	Indicated [B]	☢	XR should be done first. It is less sensitive than MRI and NM, but it provides complementary information.
	NM	Indicated [B]	☢☢	A bone scan may be helpful if an x-ray is negative or if the pain is poorly localized. A negative multiphase study does not exclude arthritis.
L29. Focal bone pain, further characterization of an abnormality on XR and/or NM	MRI	Specialized investigation [C]	0	MRI should be performed in consultation with an orthopaedic surgeon for further assessment of an aggressive osseous lesion identified on XR and/or NM. MRI and/or CT may be required for surgical planning and staging. It needs to be performed in accordance with current pediatric oncology protocols.
	CT	Specialized investigation [C]	☢☢ – ☢☢☢[1]	CT should be performed in consultation with an orthopaedic surgeon for further assessment of an aggressive osseous lesion identified on XR and/or NM. MRI and/or CT may be required for surgical planning and staging. It needs to be performed in accordance with current pediatric oncology protocols.

1 Expected to vary with the area covered.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L30. Suspected developmental dysplasia of the hip (DDH), newborn with risk factors	US	Indicated [A]	0	US is the examination of choice in the newborn with risk factors for DDH (e.g. family history, primiparous mother, female gender, breech presentation, oligohydramnios, club foot, genu recurvatum, torticollis). US should be performed between 4 and 6 weeks of age to reduce the false positive rate resulting from physiological laxity in the newborn period. Treatment of DDH within 6 to 8 weeks after birth is associated with significantly improved outcomes.
	XR	Not indicated [C]	☢	US is the examination of choice in the newborn period. XR provides no significant added information and exposes infants to radiation.
L31. Clinical evidence of DDH, infant < 3 months of age	US	Indicated [B]	0	US best depicts the relationship between the unossified femoral head and acetabulum. Alternatively, where clinical suspicion is strong, consideration should be given to direct referral to orthopaedics.
	XR	Not indicated [C]	☢	US is the examination of choice in the newborn period. XR provides no added information and exposes infants to radiation.
L32. Clinical evidence of DDH, infant 3-6 months of age	US	Indicated [C]	0	US visualization may be compromised by ossification of the femoral head in some infants.
	XR	Moderately indicated [C]	☢	XR can depict ossification of the femoral head, contour of the acetabulum and alignment of the hip.
L33. Clinical evidence of DDH, infant > 6 months of age	XR	Indicated [C]	☢	XR can depict ossification of the femoral head, contour of the acetabulum and alignment of the hip.
	US	Moderately indicated [C]	0	US visualization may be compromised by ossification of the femoral head in many infants.
L34. Suspected Osgood-Schlatter disease	XR	Not indicated [C]	☢	Osgood-Schlatter disease is a clinical diagnosis. XR findings of Osgood-Schlatter disease overlap with normal findings. XR may be considered if the diagnosis is uncertain, or if more serious bone pathology is being considered.
L35. Idiopathic adolescent scoliosis, initial evaluation	XR full spine	Indicated [C]	☢ – ☢☢	The presence of scoliosis should be established by physical examination. The purpose of radiographs is to quantify the scoliosis and to assess for malsegmentation. Frontal view should be performed in PA projection in all cases. Lateral view should be performed for scoliosis greater than 10 degrees.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L36. Suspected non-idiopathic scoliosis	XR full spine	Indicated [C]	☢ – ☢☢	PA and lateral views may be performed for initial localization and characterization of pathology in patients with suspected non-idiopathic scoliosis (e.g. onset before 11 years of age, rapid progression, curve > 45 degrees, apex left thoracic curve, apex right lumbar curve, short segment scoliosis, associated pain, neurological findings or midline cutaneous anomalies).
	NM	Indicated [C]	☢☢	Should be performed for initial localization if vertebral tumour is suspected.
	CT	Indicated [C]	☢☢ – ☢☢☢[1]	Should be targeted to focal bone pathology identified by XR or NM examinations.
	MRI	Indicated [C]	0	Should include sequences targeted to the pathology, as well as sequences covering the whole spine for adequate assessment of cord, conus and cauda equina.
L37. Patients aged 5-19 years with increased risk of fracture (see 2007 ISCD Official Positions), initial skeletal health assessment	DXA	Indicated [A]	☢	When technically feasible, PA spine and total body less head (TBLH) BMC and areal BMD should be measured. The hip (including total hip and proximal femur) is not a reliable site for measurement in the growing skeleton. The diagnosis of osteoporosis should NOT be made on the basis of densitometric criteria alone and therapeutic interventions should NOT be instituted on the basis of a single DXA measurement in children. Z-scores, NOT t-scores, should be used in reporting BMD/BMC in children.
	pQCT (peripheral quantitative computed tomography)	Not indicated [C]	☢	Reference data insufficient for clinical use to diagnose low bone mass. Mainly used as a research tool in children.
L38. Patients aged 5-19 years with increased risk of fracture (see 2007 ISCD Official Positions), monitoring of disease process or treatment with a bone active agent	DXA	Indicated [A]	☢	When technically feasible, PA spine and total body less head (TBLH) BMC and areal BMD should be measured. The hip (including total hip and proximal femur) is not a reliable site for measurement in the growing skeleton. Z-scores, NOT t-scores, should be used in reporting BMD/BMC in children.
	pQCT	Not indicated [C]	☢	Reference data insufficient for clinical use to diagnose low bone mass. Mainly used as a research tool in children.

2 Expected to vary with the area covered.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L39. Short stature / growth failure, child aged < 1 year	XR knee	Indicated [A]	☢	XR knee is more precise than XR of the hand and wrist for assessment of bone age in a child aged < 1 year.
L40. Short stature / growth failure, child aged ≥ 1 year	XR hand and wrist	Indicated [A]	☢	A single PA view of the non-dominant hand and wrist should be obtained and compared to published standards.
L41. Short stature / growth failure, suspected skeletal dysplasia	XR skeletal survey	Specialized investigation [A]	☢ – ☢☢[3]	Skeletal survey should include appropriate views of axial and appendicular skeleton in consultation with a medical geneticist.
L42. Work-up of congenital hypothyroidism	NM	Indicated [B]	☢☢	Tc-99m or I-123 thyroid scintigraphy is the most accurate diagnostic test to detect thyroid dysgenesis or one of the inborn errors of T4 synthesis in patients with congenital hypothyroidism.
L43. Chest infection, uncomplicated presentation	CXR	Not indicated [A]	☢	Routine CXR does not improve clinical outcome in children with uncomplicated pneumonia in the ambulatory care setting. Follow-up CXR is not indicated for uncomplicated pneumonia that responds to treatment.
L44. Chest infection, non-specific clinical findings or severe disease	CXR	Indicated [B]	☢	CXR can confirm pneumonia in children with a non-specific presentation and demonstrate complications of bacterial pneumonia (e.g. lung abscess, empyema) in severely ill children.
L45. Chest infection, recurrent or persistent pneumonia	CXR	Indicated [C]	☢	Evaluation of CXR should include review of any prior films. Spirometry should be considered if asthma is suspected, as this is the most common cause of recurrent pneumonia in North America.
	CT	Specialized investigation [C]	☢☢☢	High resolution CT of the lung is helpful for the confirmation and evaluation of suspected bronchiectasis. CT may be helpful when CXR raises suspicion of a congenital lung malformation, tracheobronchial structural anomaly or vascular ring. The strength of the clinical indication must be weighted against the risks of radiation exposure. Alternatively, consideration may be given to bronchoscopy at the discretion of a pediatric respirology specialist.
	MRI	Specialized investigation [C]	0	MRI may be helpful when CXR raises suspicion of a vascular ring. The strength of the clinical indication must be weighted against the risks of sedation.

3 Expected to vary with extent of skeletal survey.

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Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L45. Chest infection, recurrent or persistent pneumonia *(continued)*	US echocardiography	Specialized investigation [C]	0	Echocardiography may be an alternative to MRI depending on local expertise when CXR raises suspicion of a vascular ring.
	UGI	Moderately indicated [C]	☢☢	UGI may be helpful if chronic aspiration is suspected, particularly with involvement of multiple lobes. Alternatively, consideration may be given to esophagoscopy or esophageal pH probe.
	NM reflux scan	Moderately indicated [C]	☢☢	Reflux scan may be helpful if chronic aspiration is suspected, particularly with involvement of multiple lobes. Alternatively, consideration may be given to esophagoscopy or esophageal pH probe.
L46. Suspected inhaled foreign body, initial investigation	CXR (inspiration/expiration)	Indicated [B]	☢	CXR can demonstrate radio-opaque foreign bodies, focal atelectasis and focal air trapping on expiration. Right and left decubitus views may offer higher diagnostic yield than inspiration/expiration views in young, uncooperative children.
L47. Suspected inhaled foreign body, CXR negative	XR, airway fluoroscopy	Moderately indicated [B]	☢ – ☢☢	Airway fluoroscopy is a dynamic study that can visualize the entire tracheobronchial tree, identify focal air trapping or multiple sites of obstruction, and evaluate relative movement of the hemidiaphragms. Airway fluoroscopy does not replace bronchoscopy, which is mandatory in a child with history, physical findings and CXR consistent with inhaled foreign body.
L48. Asthma	CXR	Not indicated [B]	☢	CXR is normal or shows features of airways inflammation in most children with wheezing. CXR is only helpful if a complication of asthma (e.g. pneumothorax, lobar collapse) is suspected clinically, or if another cause for recurrent wheezing (e.g. aspiration) is suspected clinically.
L49. Acute stridor, unstable child	Imaging	Not indicated [C]	N/A	Emergency airway management takes precedence over imaging.
L50. Acute stridor, stable child	XR neck	Indicated [C]	☢	Frontal and lateral XR of the neck allows evaluation of the epiglottis, glottis and subglottic airway and may be of value to confirm suspected obstructing foreign body or retropharyngeal abscess.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L51. Persistent stridor, initial investigation	CXR	Indicated [C]	☢	CXR may be used as an initial screen for evidence of recurrent aspiration or a vascular ring.
	XR airway fluoroscopy	Indicated [B]	☢ – ☢☢	Airway fluoroscopy may be considered if CXR is negative, or if a vocal cord abnormality, laryngomalacia, tracheomalacia or airway compression is considered most likely. Airway fluoroscopy is a safe, quick and noninvasive method for evaluating the entire airway dynamically. Endoscopy is an alternative consideration, depending on local expertise.
	XR upper gastro-intestinal series	Moderately indicated [C]	☢☢	Upper gastrointestinal series is most appropriate if recurrent aspiration secondary to gastroesophageal reflux or tracheo-esophageal fistula is considered most likely. Upper gastrointestinal series can also identify a vascular ring, but CT/MRI is preferred for this diagnosis.
L52. Persistent stridor, further investigation	CT chest	Specialized investigation [C]	☢☢☢	CT chest can evaluate the mediastinum, hila, tracheobron-chial tree and lung parenchyma. CT should be considered after pediatric respirology consultation to weigh the clinical indication against the risks of radiation exposure.
	MRI chest	Specialized investigation [C]	0	MRI can evaluate vascular rings and other compressive mediastinal lesions well. MRI may require sedation, which is problematic in a child with stridor. MRI should therefore be considered after pediatric respirology consultation to weigh the clinical indication agains the risks of sedation.
L53. Heart murmur, clinically not an "innocent" murmur	CXR	Moderately indicated [C]	☢	CXR provides information about situs, heart size and pulmonary vascularity. However, CXR is unlikely to alter management in these children who ultimately require pediatric cardiology consultation and echocardiography.
L54. Acute abdominal pain, suspected appendicitis	US	Indicated [B]	0	US has very good sensitivity and specificity for the diagnosis of appendicitis. It is also the preferred investigation if the differen-tial diagnosis includes gynaecological causes of abdominal pain. It imparts no radiation. US should therefore always be the first line investigation for suspected appendicitis in children.
	CT	Moderately indicated [B]	☢☢☢	CT has higher sensitivity for the diagnosis of appendicitis than US. However, it imparts a significant radiation dose. It is therefoere not recommended as the first imaging study, except in obese children.
	XR abdomen	Not indicated [C]	☢	Appendicitis can be diagnosed or ruled out in many children by clinical evaluation alone. Good evidence that XR improves the accuracy of clinical diagnosis is lacking.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L55. Suspected appendicitis, US negative or equivocal	CT	Indicated [B]	☢☢☢	US followed by CT has been shown to be the most effective strategy, although it is also the most costly strategy. When US is negative and clinical suspicion is low, consideration might be given to observation/follow-up without further imaging. When US is equivocal and clinical suspicion is high, consideration might be given to surgery without further imaging.
L56. Suspected intussusception, imaging diagnosis	US	Indicated [B]	0	US has very high sensitivity and specificity for the diagnosis of intussusception. US may predict reducibility of an intussusception. Although imperfect, US remains the gold standard for non-invasive diagnosis of pathologic lead points. US is therefore the investigation of choice for suspected intussusception.
	CT	Not indicated [C]	☢☢☢	US should be sufficient to rule out intussusception. In patients with a negative or equivocal US, a broader differential diagnosis must be considered, and any further imaging should be guided by this differential diagnosis. Patients with a positive US should proceed to image-guided therapy or surgery.
	XR abdomen	Not indicated [B]	☢	XR is not indicated for the diagnosis of intussusception, due to poor interobserver agreement and poor overall diagnostic performance.
L57. Proven intussuception, image-guided therapy	Enema reduction	Indicated [A]	0 – ☢☢☢[4]	Dehydrated children must be adequately resuscitated with intravenous fluids before any image-guided reduction attempt. The radiologist must be prepared for the potential complication of perforation and must have pediatric surgical support at his/her institution before attempting this procedure. Absolute contraindications to attempted image-guided reduction are perforation, shock and peritonitis. These children require surgical intervention. Free intrapertioneal air must be ruled out fluoroscopically before enema reduction is attempted; an upright or decubitus abdominal x-ray should be obtained prior to any reduction attempt if there is a question of free air at fluoroscopic examination.
L58. Swallowed foreign body	XR chest and abdomen	Indicated [C]	☢	For a suspected sharp or potentially poisonous foreign body (e.g. battery), XR should cover the aerodigestive tract from the pharynx to the rectum.

4 Expected to vary considerably, depending on imaging modality (ultrasound vs. fluoroscopy), contrast medium (air vs. barium), total fluoroscopy time and number of attempts.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L59. Blunt abdominal trauma, high risk mechanism or clinical examination consistent with visceral injury	CT abdomen and pelvis	Indicated [B]	☢☢☢	CT with IV contrast enhancement remains the initial imaging investigation of choice to identify sites of hemorrhage, solid and hollow visceral injuries, as well as associated bony injuries. CT can guide management in hospital as well as post-discharge follow-up.
	US abdomen and pelvis	Not indicated [B]	0	US has only moderate sensitivity for hemopertioneum, misses approximately one fifth to one quarter of solid visceral injuries and cannot be used to rule out hollow visceral injuries. The contribution that US makes to the management of hemodynamically stable and unstable children with hemoperitoneum in the acute setting is debatable. US may be useful in the follow-up of known visceral injuries to reduce the total radiation burden to the patient.
	XR abdomen	Not indicated [C]	☢	Suspected abdominal injury should be evaluated with cross-sectional imaging.
L60. Bilious vomiting in an infant or young child, initial investigation	XR abdomen	Indicated [C]	☢	Bilious vomiting in an infant or young child is an emergency. AXR is needed immediately to rule out perforation and to distinguish proximal obstruction from distal obstruction. Normal findings on AXR do not rule out malrotation/volvulus. Further imaging is needed, as outlined below.
L61. Bilious vomiting in an infant or young child, suspected proximal obstruction or uncertain level of obstruction	UGI	Indicated [B]	☢☢	UGI should be performed emergently to assess for malrotation/volvulus. If UGI is negative or equivocal, further imaging investigations should be considered. This may include small bowel follow-through, contrast enema and/or US.
	Contrast enema	Moderately indicated [B]	☢☢	Contrast enema has lower sensitivity and specificity than UGI for malrotation and is no longer considered the preferred first-line investigation. Contrast enema should be considered as an ancillary investigation, if UGI is negative or equivocal.
	US	Moderately indicated [B]	0	US has a high false positive rate for malrotation, compared to UGI. Therefore, positive findings on US require confirmation by UGI.
L62. Bilious vomiting in an infant or young child, suspected distal obstruction	Contrast enema	Indicated [B]	☢☢	Contrast enema should be performed emergently to determine the site and etiology of distal obstruction.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L63. Non-bilious vomiting in an infant, suspected hypertrophic pyloric stenosis (HPS)	US pylorus	Indicated [B]	0	US is the preferred modality to identify HPS in term infants as well as preterm infants. US screening for associated urinary tract anomalies in children with proven HPS is not worthwhile.
	UGI	Moderately indicated [B]	☢☢	May be used to assess for HPS when US is non-diagnostic, or when US is not available.
L64. Non-bilious vomiting in an infant, suspected uncomplicated gastroesophageal reflux (GER)	UGI	Not indicated [B]	☢☢	History and physical examination should be sufficient to diagnose uncomplicated GER and initiate therapy in most infants. However, UGI is appropriate for GER with the following features: failure to resolve with medical management by 18-24 months; associated with poor weight gain; any child > 2 years of age; any child with dysphagia or odynophagia. UGI has lower sensitivity for GER than pH monitoring and lower sensitivity for esophagitis than endoscopy.
	NM reflux scan	Moderately indicated [B]	☢☢	An NM reflux scan may be used in tandem with UGI to document reflux, if pH monitoring is not available.
L65. Persistent neonatal jaundice	US	Indicated [B]	0	Abdominal US must be performed within the first 10 weeks of life.
	NM	Indicated [B]	☢☢	Hepatobiliary scan with Tc-99m labeled IDA derivatives must be performed within the first 10 weeks of life.
L66. Suspected necrotizing enterocolitis	XR abdomen	Indicated [C]	☢	AXR must include a decubitus or cross-table lateral view for free air.
	US	Moderately indicated [C]	0	US can detect bowel thickening, intramural air and lack of peristalsis, but small amounts of free air may be missed.
L67. Suspected Meckel's diverticulum or duplication cyst	NM	Indicated [C]	☢☢	Meckel's scan can identify a Meckel's diverticulum or duplication cyst with gastric mucosa. SPECT or premedication with ranitidine may increase sensitivity.
L68. Suspected juvenile polyp or polyposis	Double contrast enema	Specialized investigation [C]	☢☢	Contrast enema should be considered in consultation with a gastroenterologist or surgeon, as colonoscopy with snare polypectomy may be the preferred first-line investigation/ therapy.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L69. Constipation	XR abdomen	Not indicated [A]	☢	The diagnosis of constipation should be made on the basis of history and physical examination. XR interpretation is highly variable, and the correlation between constipation and stool burden on XR is poor.
	Contrast enema	Indicated [B]	☢☢	For children who have failed initial medical management, contrast enema may distinguish those who require referral for rectal manometry and/or biopsy to rule out Hirschsprung disease from those who can continue to be managed medically and referred only if their constipation proves refractory to therapy.
L70. Palpable abdominal or pelvic mass, initial evaluation	US abdomen and pelvis	Indicated [C]	0	Recommended as the first investigation to confirm the presence of a mass. If positive, the patient should be referred to a specialist centre. All further imaging for diagnosis and staging should be performed at the specialist centre.
	XR abdomen	Moderately indicated [C]	☢	XR may confirm a large mass suspected on physical examination; however, it lacks sensitivity compared to cross sectional imaging. XR may be used to confirm calcification suspected on US.
	CT	Specialized investigation [C]	☢☢☢	CT may be required for surgical planning and staging. These investigations must be performed in accordance with current pediatric oncology protocols.
	MRI	Specialized investigation [C]	0	MRI may be required for surgical planning and staging. These investigations must be performed in accordance with current pediatric oncology protocols.
L71. Typical enuresis	Imaging	Not recommended [B]	N/A	History, physical examination and urinalysis should take precedence over imaging, especially in children with monosymptomatic night-time enuresis. An anatomical abnormality is unlikely in the absence of unusual clinical features.
L72. Atypical enuresis	US kidneys and bladder	Indicated [C]	0	In toilet trained girls with continuous dribbling or wetting, US of kidneys and bladder should be used initially to search for a duplex kidney and to assess the urinary bladder in conjunction with video urodynamics. US may also be considered to screen for urinary tract anomalies or bladder trabeculation in children with refractory night-time enuresis, daytime enuresis or symptoms of dysfunctional voiding. Consideration should be given to urological consultation with a view to urodynamic assessment.

(continued on next page)

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L72. Atypical enuresis *(continued)*	NM renal scan	Indicated [B]	☢☢	DMSA scan is useful to confirm or locate a dysplastic kidney or the upper moiety of a duplex system, suspected on the basis of US findings.
	IVP	Specialized investigation [B]	☢☢	IVP may be considered in consultation with a urologist if it is necessary to confirm an infrasphincteric ectopic ureter in a girl with a duplex system identified on US and/or DMSA.
	CT abdomen and pelvis	Specialized investigation [B]	☢☢☢	If US and NM renal scan fail to locate a dysplastic kidney or a dysplastic renal moiety, CT with delayed images may demonstrate a suspected infrasphincteric ectopic ureter.
	MRI urography	Specialized investigation [B]	0	If US and NM renal scan fail to locate a dysplastic kidney or a dysplastic renal moiety, MR urography may demonstrate a suspected infrasphincteric ectopic ureter.
	MRI spine	Specialized investigation [B]	0	In children with abnormal neurological or musculoskeletal examination, bladder wall thickening or trabeculation on US or neuropathic vesicoureteral dysfunction on urodynamics, MRI is the imaging examination of choice for spinal dysraphism and tethered cord.
	XR lumbosacral spine	Not indicated [C]	☢☢	XR may show spinal dysraphism; however, MRI is ultimately required to assess cord, conus and cauda equine in addition to the spinal column.
L73. Impalpable testes	US	Indicated [B]	0	US is the best initial imaging modality.
	MRI	Specialized investigation [B]	0	If US fails to reveal testes in the inguinal canal, MRI can be used to locate intra-abdominal testes. MRI should be considered in consultation with a surgeon, because laparoscopy without further imaging is a reasonable alternative.
	CT	Specialized investigation [B]	☢☢☢	If US fails to reveal testes in the inguinal canal, CT can be used to locate intra-abdominal testes. CT should be considered in consultation with a surgeon, because laparoscopy without further imaging is a reasonable alternative.
L74. Fetal renal pelvic dilatation, initial postnatal evaluation	US	Indicated [B]	0	US of kidneys and bladder should be performed no sooner than 72 hours post-partum to avoid a false negative examination, unless there is strong suspicion of bladder outlet obstruction on prenatal ultrasound. Mild pyelectasis should be followed at 4-6 weeks to ensure resolution.

Clinical/Diagnostic Problem	Investigation	Recommendation (Grade)	Dose	Comment
L75. Fetal renal pelvic dilatation, moderate-to-severe pyelectasis on initial evaluation or persistent mild pyelectasis on follow-up	NM	Indicated [B]	☢☢	MAG3 diuretic renography is essential to estimate differential renal function (differential uptake) as well as drainage.
L76. Febrile urinary tract infection (UTI) in a child younger than 24 months – uncomplicated	US kidneys and bladder	Indicated [C]	0	US of kidneys and bladder should be performed to rule out anatomical anomalies and hydronephrosis, to assess renal parenchyma and renal size. The yield of US for significant abnormalities in this setting is low, but non-invasiveness and lack of radiation exposure argue in favour of performing the test. US should not be performed during the acute illness, as transient dilation of the renal collecting system and swelling of the renal parenchyma may be misleading.
	DMSA renal scan	Not indicated [A]	☢	Renal DMSA scan does not contribute to management decisions in uncomplicated UTI and should be reserved for cases of complicated or recurrent UTI, where the risk of renal parenchymal scarring is higher.
	VCUG	Not indicated [A]	☢☢	Antibiotic prophylaxis has not been shown to prevent recurrent UTI or pyelonephritis in infants without vesicoureteral reflux (VUR) or with grade I-IV VUR.
L77. First episode of febrile UTI in a child younger than 24 months – complicated	US kidneys and bladder	Indicated [A]	0	UTI is considered complicated if any of the following apply: 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. In such cases, urgent US is indicated to assess for pyonephrosis, renal abscess or perirenal abscess.
	DMSA renal scan	Moderately indicated [C]	☢	DMSA renal scan is the most sensitive modality for the detection of pyelonephritis and renal scarring.
	VCUG	Moderately indicated [C]	☢☢	VCUG may be considered to rule out high grade VUR in this setting. VCUG should be performed after the active infection has settled.
L78. Recurrent UTI, or first episode of UTI with abnormal US, in a child younger than 24 months	Nuclear medicine renal scan	Indicated [C]	☢☢	The type of renal scan (e.g. DMSA, MAG3) should be determined in consultation with a pediatric nephrologist/ nephrologist/nuclear medicine physician.
	VCUG	Indicated [C]	☢	VCUG is indicated to identify high grade VUR in children with recurrent UTI and in children with US findings of hydronephrosis and/or scarring.