

## Structured reporting of CT polytrauma: a proposal

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## Learning objectives

We propose a RIS-integrated CT structured report (SR), to be used for the assessment of severely injured patients (SIP) following polytrauma.

## Background

The report is the essential record of the diagnostic service of radiologists.

Free-text reports are often inconsistent in their organization and terminology, which makes them difficult to use for referring physicians.

SR relies on a standardized language, enables radiologists to provide complete and useful reports and promotes adherence to guidelines.

Many clinicians prefer SR over free-text reports because they perceive SR provide improved clarity.

Some radiologists have expressed concern that SR is more time-consuming and may negatively impact workflow and reasoning.

Some older radiologists simply resist change.

These are the main reasons why SR has not gained wide acceptance.

## Findings and procedure details

In May 2017, a SR for CT polytrauma examinations was implemented in our department.

It was designed by an emergency radiologist, emergency physician and an intensivist in consensus, to include key features considered necessary for assessing SIP and to plan the medical/surgical approach.

The template was engineered, integrated in our RIS, presented to the emergency imaging staff in September 2017 and its use was highly recommended (not mandatory).

The template is divided into 5 sections: **brain, cervical spine, chest-abdomen, thoracolumbar spine** and **pelvis**.

Each section is structured with headings (technique, findings, collateral findings and conclusions) and subheadings.

Picklists fields, drop down menus, buttons and some free text boxes can be used to describe and measure different possible lesions for each single organ.

At the end of the process, the SR is automatically turned into narrative.

## Images for this section:

HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> axial CT images were obtained from the skull base to the vertex without contrast, with additional coronal and sagittal reconstructed images.				
<b>Findings</b>				
<b>Extra-axial spaces</b> Normal <input type="radio"/> Yes <input type="radio"/> No				
<b>Cerebral parenchyma</b> Focal lesions: <input type="radio"/> Yes <input type="radio"/> No Perilesional edema: <input type="radio"/> Yes <input type="radio"/> No Diffuse lesions: <input type="radio"/> Yes <input type="radio"/> No				
<b>Midline shift</b> Midline shift: <input type="radio"/> Yes <input type="radio"/> No Herniations: <input type="radio"/> Yes <input type="radio"/> No				
<b>Ventricular system</b> a. supratentorial ventricular system Size: <input type="radio"/> Normal <input type="radio"/> Abnormal <div></div> b. infratentorial ventricular system Size: <input type="radio"/> Normal <input type="radio"/> Abnormal <div></div>				

**Fig. 1**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Cerebellum and brainstem</b> Focal lesions: <input type="radio"/> Yes <input type="radio"/> No				
<b>Subarachnoid spaces</b> Enlarged: <input type="radio"/> Yes <input type="radio"/> No				
<b>Sella</b> Size: <input type="radio"/> Normal <input type="radio"/> Increased Pituitary stalk alignment : <input type="radio"/> no shift <input type="radio"/> right shift <input type="radio"/> left shift				
<b>Nasal cavities, paranasal sinuses and mastoid air cells</b> Clear: <input type="radio"/> Yes <input type="radio"/> No				
<b>Orbits</b> Normal: <input type="radio"/> Yes <input type="radio"/> No				
<b>Skull bones</b> Fractures: <input type="radio"/> Yes <input type="radio"/> No				
<b>Collateral findings</b> <div>Es. Hematoma sub-galeal, intervention outcomes, ecc..</div>				

**Fig. 2**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> axial CT images were obtained from the skull base to the vertex without contrast, with additional coronal and sagittal reconstructed images.				
<b>Findings</b>				
<b>Extra-axial spaces</b>				
Normal <input type="radio"/> Yes <input checked="" type="radio"/> No				
Subdural hematoma <input checked="" type="radio"/> Yes <input type="radio"/> No				
Location: <input checked="" type="checkbox"/> Frontal <input type="checkbox"/> Fronto-Parietal <input type="checkbox"/> Fronto-Temporal <input type="checkbox"/> Temporal <input type="checkbox"/> Parietal <input type="checkbox"/> Temporo-Parietal <input type="checkbox"/> Temporo-Occipital <input type="checkbox"/> Parieto-Occipital <input type="checkbox"/> Occipital				
Side: <input checked="" type="radio"/> Right <input type="radio"/> Left <input type="radio"/> Bilaterale				
Thickness: <input type="text" value="20 mm"/>				
Duration: <input checked="" type="radio"/> Acute <input type="radio"/> Subacute <input type="radio"/> Chronic				
<b>Add another subdural hematoma</b>				
Epidural hematoma <input type="radio"/> Yes <input checked="" type="radio"/> No				
Subarachnoid hemorrhage <input type="radio"/> Yes <input checked="" type="radio"/> No				
Collateral findings: solid lesions: <input type="radio"/> Yes <input checked="" type="radio"/> No				
<b>Cerebral parenchyma</b>				
Focal lesions: <input type="radio"/> Yes <input checked="" type="radio"/> No				
Hyperdense middle cerebral artery sign <input type="radio"/> Yes <input checked="" type="radio"/> No				
Perilesional edema: <input type="radio"/> Yes <input checked="" type="radio"/> No				
Diffuse lesions: <input type="radio"/> Yes <input checked="" type="radio"/> No				
<b>Midline shift</b>				
Midline shift: <input checked="" type="radio"/> Yes <input type="radio"/> No				
Side: <input type="radio"/> Right <input checked="" type="radio"/> Left				
Measure: <input type="text" value="8 mm"/>				
Herniations: <input type="radio"/> Yes <input checked="" type="radio"/> No				

**Fig. 3**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> Axial CT images were obtained through the cervical spine without contrast, with additional coronal and sagittal reconstructed images.				
<b>Findings</b>				
Fractures <input type="radio"/> Yes <input type="radio"/> No				

**Fig. 4**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> Axial CT images were obtained through the cervical spine without contrast, with additional coronal and sagittal reconstructed images.				
<b>Findings</b> Fractures <input checked="" type="radio"/> Yes <input type="radio"/> No <b>Fracture C1</b> Location: <input checked="" type="checkbox"/> Anterior arch <input checked="" type="checkbox"/> Posterior arch <input type="checkbox"/> Lateral mass Displacement: <input type="radio"/> displaced <input checked="" type="radio"/> undisplaced Alignment: Vertebral alignment: <input checked="" type="radio"/> Yes <input type="radio"/> No <b>Fracture C2</b> <input type="checkbox"/> Hangman fracture <input checked="" type="checkbox"/> Dens fracture (Andersen & D'Alonzo classification) <input type="radio"/> type I <input checked="" type="radio"/> type II <input type="radio"/> type III <input type="checkbox"/> Body fracture				

**Fig. 5**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> <input type="checkbox"/> without i.v. contrast <input type="checkbox"/> with i.v. contrast Contrast volume (cc) <input type="text"/> Brand name <input type="text"/> Iodine concentration <input type="text"/> Injection rate (cc/sec) <input type="text"/> <input type="checkbox"/> arterial phase <input type="checkbox"/> portal-venous phase <input type="checkbox"/> delayed phase <input type="text"/> <input type="checkbox"/> Patient immobilized on spineboard Hemodynamic stability <input type="radio"/> yes <input type="radio"/> no <input type="checkbox"/> Intensive care support during CT scan Reconstructed images <input type="checkbox"/> MPR <input type="checkbox"/> MIP <input type="checkbox"/> 3D <input type="checkbox"/> other reconstruction software				
<b>Findings</b> <b>CHEST</b> Vascular injury <input type="radio"/> Yes <input type="radio"/> No Mediastinum <input type="radio"/> Normal <input type="radio"/> Abnormal Lungs <input type="radio"/> Normal <input type="radio"/> Abnormal Diaphragm <input type="radio"/> Normal <input type="radio"/> Rupture Pleural space <input type="radio"/> Normal <input type="radio"/> Abnormal Chest wall <input type="radio"/> Normal <input type="radio"/> Rib fracture other findings <input type="text"/>				

**Fig. 6**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>ABDOMEN</b>				
Free gas <input type="radio"/> Yes <input type="radio"/> No				
Peritoneal fluid <input type="radio"/> Yes <input type="radio"/> No				
Bowel <input type="radio"/> Normal <input type="radio"/> Perforation				
Mesentery <input type="radio"/> Normal <input type="radio"/> Abnormal				
Vascular injury <input type="radio"/> Yes <input type="radio"/> No				
Retroperitoneum <input type="radio"/> Normal <input type="radio"/> Abnormal				
Pancreas <input type="radio"/> Normal <input type="radio"/> Abnormal				
Duodenum <input type="radio"/> Normal <input type="radio"/> Perforation				
Spleen <input type="radio"/> Normal <input type="radio"/> Abnormal				
Liver <input type="radio"/> Normal <input type="radio"/> Abnormal				
Kidneys/Urinary tract <input type="radio"/> Normal <input type="radio"/> Abnormal				
Urinary bladder <input type="radio"/> Normal <input type="radio"/> Rupture				
<input type="text" value="other findings"/>				

**Fig. 7**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b>				
<input checked="" type="checkbox"/> without i.v. contrast <input checked="" type="checkbox"/> with i.v. contrast				
Contrast volume (cc) <input type="text" value="120"/>				
Brand name <input type="text" value="Iopamiro"/>				
Iodine concentration <input type="text" value="370"/>				
Injection rate (cc/sec) <input type="text" value="3.5"/>				
<input checked="" type="checkbox"/> arterial phase <input checked="" type="checkbox"/> portal-venous phase <input checked="" type="checkbox"/> delayed phase				
<input checked="" type="checkbox"/> Patient immobilized on spineboard				
Hemodynamic stability <input checked="" type="radio"/> yes <input type="radio"/> no				
<input type="checkbox"/> Intensive care support during CT scan				
Reconstructed images <input checked="" type="checkbox"/> MPR <input checked="" type="checkbox"/> MIP <input checked="" type="checkbox"/> 3D <input type="radio"/> other reconstruction software				

**Fig. 8**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
Findings				
CHEST				
Vascular injury <input checked="" type="radio"/> Yes <input type="radio"/> No				
<input checked="" type="checkbox"/> Aorta <input type="checkbox"/> Ascending <input type="checkbox"/> Arch <input checked="" type="checkbox"/> Isthmus <input type="checkbox"/> Descending <input type="text" value="mural hematoma 2x1 cm"/>				
<input type="checkbox"/> Other vessel				
Mediastinum <input type="radio"/> Normal <input checked="" type="radio"/> Abnormal				
<input type="checkbox"/> Pneumomediastinum <input checked="" type="checkbox"/> Hemomediastinum <input checked="" type="radio"/> abnormal soft tissue density around the mediastinal structures <input type="radio"/> periaortic haematoma				
Lungs <input type="radio"/> Normal <input checked="" type="radio"/> Abnormal				
<input checked="" type="checkbox"/> Pulmonary contusions <input type="checkbox"/> Pulmonary lacerations <input checked="" type="checkbox"/> Right <input type="text" value="3"/> Max Diam. <input type="text" value="2 cm"/> <input type="button" value="Add lesion"/> <input checked="" type="checkbox"/> Left <input type="text" value="5"/> Max Diam. <input type="text" value="1 cm"/> <input type="button" value="Add lesion"/>				
Diaphragm <input checked="" type="radio"/> Normal <input type="radio"/> Rupture				
Pleural space <input type="radio"/> Normal <input checked="" type="radio"/> Abnormal				
<input checked="" type="checkbox"/> Pneumothorax <input type="checkbox"/> Hemothorax <input checked="" type="checkbox"/> Right thickness max. <input type="text" value="2 cm"/> <input checked="" type="checkbox"/> Left thickness max. <input type="text" value="1 cm"/>				
Chest wall <input type="radio"/> Normal <input checked="" type="radio"/> Rib fracture				
<input checked="" type="checkbox"/> Right <input type="checkbox"/> Left <input type="text" value="4"/> <input type="radio"/> Undisplaced <input checked="" type="radio"/> Displaced <input checked="" type="checkbox"/> posterior arch <input type="checkbox"/> mid-axillary line <input type="checkbox"/> anterior arch <input type="button" value="Add fracture"/>				

**Fig. 9**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>ABDOMEN</b>				
Free gas <input type="radio"/> Yes <input checked="" type="radio"/> No				
Peritoneal fluid <input checked="" type="radio"/> Yes <input type="radio"/> No				
Location: <input type="text" value="perisplenic"/>				UH: <input type="text" value="45"/>
Bowel <input checked="" type="radio"/> Normal <input type="radio"/> Perforation				
Mesentery <input checked="" type="radio"/> Normal <input type="radio"/> Abnormal				
Vascular injury <input type="radio"/> Yes <input checked="" type="radio"/> No				
Retroperitoneum <input checked="" type="radio"/> Normal <input type="radio"/> Abnormal				
Pancreas <input checked="" type="radio"/> Normal <input type="radio"/> Abnormal				
Duodenum <input checked="" type="radio"/> Normal <input type="radio"/> Perforation				
Spleen <input type="radio"/> Normal <input checked="" type="radio"/> Abnormal				
<input type="checkbox"/> Contusion <input type="checkbox"/> Laceration <input checked="" type="checkbox"/> Hematoma				
<input type="text" value="4 cm"/>				
Liver <input checked="" type="radio"/> Normal <input type="radio"/> Abnormal				
Kidneys/Urinary tract <input checked="" type="radio"/> Normal <input type="radio"/> Abnormal				
Urinary bladder <input checked="" type="radio"/> Normal <input type="radio"/> Rupture				
<input type="text" value="other findings"/>				

**Fig. 10**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b>				
Axial, coronal and sagittal images of the thoracic-lumbar spine were reconstructed using bone algorithm.				
<b>Findings</b>				
<b>THORACIC SPINE</b>				
Fracture <input type="radio"/> Yes <input type="radio"/> No				
<input type="text" value="Other findings"/>				
<b>LUMBAR SPINE</b>				
Fracture <input type="radio"/> Yes <input type="radio"/> No				
<input type="text" value="Other findings"/>				

**Fig. 11**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> Axial, coronal and sagittal images of the thoracic-lumbar spine were reconstructed using bone algorithm.				
<b>Findings</b> <b>THORACIC SPINE</b> Fracture <input checked="" type="radio"/> Yes <input type="radio"/> No D5 ▾ Location: <input checked="" type="checkbox"/> superior endplate <input checked="" type="checkbox"/> inferior endplate <input checked="" type="checkbox"/> anterior wall <input checked="" type="checkbox"/> posterior wall Deformity: <input checked="" type="radio"/> burst fracture <input type="radio"/> biconcave lens <input type="radio"/> wedge fracture Extension to: <input checked="" type="checkbox"/> right pedicle <input checked="" type="checkbox"/> left pedicle <input type="checkbox"/> right transverse process <input type="checkbox"/> left transverse process <input type="checkbox"/> right lamina <input type="checkbox"/> left lamina <input type="checkbox"/> spinous process <input type="checkbox"/> right superior articular facet <input type="checkbox"/> left superior articular facet <input type="checkbox"/> right inferior articular facet <input type="checkbox"/> left inferior articular facet Vertebral alignment: <input checked="" type="radio"/> No <input type="radio"/> Yes anterolisthesis D5 D6 Intracanal bone fragments: <input type="radio"/> No <input checked="" type="radio"/> Yes 1 bone fragment, max diam 5 mm Add fracture Other findings <b>LUMBAR SPINE</b> Fracture <input type="radio"/> Yes <input checked="" type="radio"/> No Other findings				

**Fig. 12**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> Axial, coronal and sagittal images of the pelvis were reconstructed using bone algorithm.				
<b>Findings</b> <b>PELVIS</b> Fracture <input type="radio"/> Yes <input type="radio"/> No Other findings				

**Fig. 13**

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HEAD CT	CERVICAL SPINE CT	CHEST-ABDOMEN CT	THORACIC-LUMBAR SPINE CT	PELVIS CT
<b>Technique</b> Axial, coronal and sagittal images of the pelvis were reconstructed using bone algorithm.				
<b>Findings</b> <b>PELVIS</b> Fracture <input checked="" type="radio"/> Yes <input type="radio"/> No				
<input type="checkbox"/> Right sacral wing <input type="checkbox"/> Left sacral wing <input type="checkbox"/> Right iliac bone <input checked="" type="checkbox"/> Left iliac bone				
Fracture: <input checked="" type="radio"/> Undisplaced <input type="radio"/> Displaced				
<input type="checkbox"/> Right acetabulum <input type="checkbox"/> Left acetabulum <input type="checkbox"/> Right superior pubic ramus <input type="checkbox"/> Left superior pubic ramus <input type="checkbox"/> Right inferior pubic ramus <input type="checkbox"/> Left inferior pubic ramus <input type="checkbox"/> Right femoral head <input type="checkbox"/> Left femoral head <input type="checkbox"/> Right femoral neck <input checked="" type="checkbox"/> Left femoral neck				
Fracture: <input type="radio"/> Undisplaced <input checked="" type="radio"/> Displaced <input type="checkbox"/> subcapital <input type="checkbox"/> transcervical <input checked="" type="checkbox"/> basicervical <input type="checkbox"/> pertrochanteric <input type="checkbox"/> subtrochanteric				
Other findings				

**Fig. 14**

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## Conclusion

The crucial role of diagnostic assessment of SIP and the lack of SR templates for CT polytrauma on most influential radiology sites, led us to contribute our template.

In the first 4 months since its introduction, the SR has been used for reporting ~ 50% of CT polytrauma exams performed in our department.

The first impressions from the radiologists who have used it are encouraging: they have found it easy to adopt and they especially appreciated its user-friendly graphic interface.

Some colleagues didn't even try to apply it, because they felt uncomfortable and had little confidence with advanced informatics tools.

Emergency physicians and intensivists have expressed their approval for SR, because it uses a standardized language and provides clear and complete information.

Further evaluation will be needed to complete assessment.

## Personal information

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