

# Diagnostic Accuracy of Preliminary Reporting Templates for the Evaluation of Critical and Urgent Findings in Whole-Body Trauma CTs: *Comparison with Final Radiology Reports*

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## 1. Background

Accurate emergent diagnosis of injuries in trauma patients is essential for timely and adequate management of life-threatening injuries. In trauma centers, Whole-Body CT (WBCT) is used routinely to investigate traumatic injuries and decide treatment priorities with the aim to increase survival and reduce morbidity. In many institutions, a radiologist (or radiology learner) is present at the CT scanner to convey life-threatening and/or immediate management changing injuries without delay, often referred to as the ‘wet read’. These preliminary interpretations of WBCT at the console are crucial for the trauma team to make management decisions before the patient leaves the CT suite.

For efficient and concise documentation of the preliminary interpretation, various standardized assessment tools, preliminary report templates, and primary survey protocols (checklists) have been developed for WBCT in trauma patients.<sup>1</sup> These templates and checklists facilitate a structured initial assessment and enable immediate written documentation of the verbal communication of critical findings before a comprehensive final report with all findings is available.

Given the pivotal role of WBCT in regular trauma care, imaging commonly also is integrated in evaluation of victims of Mass Casualty Incidents (MCIs). In the overwhelming setting of an MCI with relative understaffing and increased throughput, there can be – and often is – a (much) longer delays to final

reports, making reliance on concise and immediate ‘wet read’ templated reports provided at the scanner even more crucial. Common conviction is that conducting this imaging primary survey at the CT console with a preliminary report will suffice to identify, communicate and document the most critical and immediately management changing findings and adequately document them. Templated reports facilitate structured assessment and of critical (emergent) and urgent findings and direct communication to the trauma team. However, a previous study showed that a delayed diagnosis of injuries may occur in 14% of trauma patients who had a WBCT and that 50% of the clinically significant injuries identified with delay were visible on the CT images but not recognized.<sup>2</sup> Nevertheless, no studies have assessed the accuracy of imaging primary surveys by WBCT and adequacy of template reports of ‘wet reads’.

## 2. Objectives and hypotheses

### *Primary objective:*

- To evaluate the diagnostic accuracy of imaging primary surveys from WBCT in trauma when compared to the final report.

Null hypothesis: Primary surveys of WBCT in trauma using standardized reporting template have a sensitivity >90% and a specificity of >99% for the detection of critical (emergent) as well as urgent findings in the preliminary imaging survey of WBCTs.

### *Secondary objectives:*

- To compare the diagnostic accuracy of radiology residents, fellows and radiologists.

Null hypothesis: Higher levels of experience are associated with the higher diagnostic accuracy for the detection of critical and urgent findings in the preliminary imaging survey of WBCTs.

- To compare the diagnostic accuracy and reproducibility of two different reporting templates to communicate the most urgent clinical findings.

Null hypothesis: The diagnostic accuracy of the preliminary imaging survey for the detection of critical and urgent findings in WBCTs does not depend on the evaluated standardized reporting template.

## 3. Methods

This multidisciplinary prospective diagnostic accuracy study will include trauma patients from the Sunnybrook Health Sciences Centre, Toronto, Canada (hereafter “Sunnybrook”) requiring WBCT. This study will be reported according to the “Standards for the Reporting of Diagnostic Accuracy Studies” (STARD). The research protocol will need to be approved by the institutional ethical review board.

### 3.1 Study population

The institutional trauma registry at Sunnybrook will be searched for trauma patients who received a WBCT during initial resuscitation at time of presentation in the trauma bay in the calendar year 2024. From these patients, 50 patients will be selected that meet the following inclusion criteria:

- Age of 18 years or older
- Injury Severity Score (ISS) >15,
- WBCT that at minimum included:
  - o Unenhanced CT head
  - o CTA head and neck
  - o CTA chest that includes the abdominal organs
  - o CTPV abdomen and pelvis

- Availability of a final radiology report.

Exclusion criteria include:

- Incomplete or missing CT images (e.g., unscanned body parts, missing axial thin slices)
- Unenhanced body CTs
- Missing or incomplete final radiology report.

### 3.2 Imaging

WBCTs were acquired using a 3<sup>rd</sup> generation dual-source 192-MDCT scanner (SOMATOM Force, Siemens Healthcare, Germany). The routine imaging protocol for trauma at Sunnybrook constitutes of the unenhanced CT head, post contrast CTA head and neck, CTA chest including the solid abdominal organs, and CT PV of the abdomen and pelvis. If the injury mechanism so requires, CTA run-offs of extremities can be obtained, done before the routine WBCT. As required, delayed phase CTAP can be done to evaluate for injury to the urinary tract. Rarely and only in the setting of penetrating trauma, additional CTAP with rectal contrast administration is obtained after the routine protocol.

### 3.3 Image interpretation

#### *Index Test – Primary CT reporting template*

Trauma CTs will be evaluated by 10 different observers using the hospital specific PACS available at their respective institutions, or alternatively an online research PACS with short training. Each WBCT will be evaluated and reported using standardized reporting templates by [at least] four observers; two radiology residents (>1 year in training and > 1 month working in a level 1 trauma center) and two board-certified radiologist (table 1).

To evaluate the potential effect of different reporting templates to communicate the most urgent clinical findings, two different templates for the primary CT report will be used (Supplement 1). Each observer will report 10 cases per reporting template, with sessions separated and randomly assigned. Following the evaluation of 20 WBCT, observers will complete a questionnaire about their experience with each template (Supplement 2). To simulate time pressure and a potential high throughput of trauma patients in MCI, each observer will only be allowed one hour to complete each session of 10 WBCTs, which includes evaluation of the images and filing out the template form. The verbal communication to the trauma team will not be simulated in this study.

**Table 1.** Observers, cases evaluated, and primary CT reporting templates used.

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*Primary CT report templates can be found in supplement 1.*

#### *Reference standard – Expert consensus meetings*

The full radiology report provided in clinical care will be used to evaluate all possible findings in the WBCT. Prior to scoring, we will document consensus of the category of clinical relevance for each finding, to be used as reference. This consensus will be achieved by group meeting(s) that involve the two Co-PIs, who are fellowship-trained emergency & trauma radiologists with >4 years and >16 years-experience in trauma radiology as board-certified radiologist, and representatives of the trauma teams at their institutions. Trauma findings will be categorized according to predefined criteria as: 1. Critical – very likely to impact patient management immediately; 2. Urgent – likely relevant for patient management <60 min; or 3. Not urgent – likely not affecting patient management <60 min. (Table 2).

**Table 2.** Example of whole-body trauma CT findings and categorized clinical urgency [will be finalized during project in consensus meetings]

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### 3.4 Sample size

For a formal sample size calculation, data on the (expected) sensitivity and specificity, as well as data on the prevalence of the disease is needed. Literature about the sensitivity and specificity, and prevalence of specific critical and urgent findings on WBCT in trauma is lacking. For our sample size calculation, we expected a sensitivity 90% and a specificity of 99% for the detection of critical and urgent findings in the preliminary imaging survey of WBCTs compared to the final report. The prevalence of clinically critical and urgent findings on WBCTs in trauma was estimated at 70%. Dropout rate was not applicable. An online sample size calculator using the formula from Buderer et al indicated the need of a sample size of 50.<sup>3,4</sup>

### 3.5 Analyses

Medians with interquartile ranges (IQR) or percentages will be calculated for patient characteristics. Calculated diagnostic accuracy parameters with 95% confidence intervals (CI) will be the sensitivity, specificity, positive predictive value, negative predictive value and percentage of trauma related findings correctly identified during primary survey. Analyses will be performed for trauma related findings classified as critical only, and for findings classified as critical and urgent combined. Inter-observer reproducibility of reported critical and urgent preliminary CT findings combined will be evaluated using Kappa statistics. Kappa values will be interpreted according to Landis and Koch: 0–0.20 slight agreement; 0.21–0.40 fair agreement; 0.41–0.60 moderate agreement; 0.61–0.80 substantial agreement; and 0.81–1 almost perfect agreement.<sup>5</sup>

## 4. Timeline

**Table 3.** Timeline of study activities

	2025 Q3	2025 Q4	2026 Q1	2026 Q2	2026 Q3	2026 Q4	2027 Q1	2027 Q2
Institutional Review Board submission	X							
Funding		X						
Scoring of trauma CTs			X	X	X	X		
Consensus meetings			X	X	X	X		
Data analysis						X	X	
Data presentation, manuscript submission							X	X

## 5. References

1. Royal College of Radiologists, T. *Clinical Radiology: Major Adult Trauma Radiology Guidance*. <https://www.rcr.ac.uk/our-services/all-our-publications/clinical-radiology-publications/major-adult-trauma-radiology-guidance/> (2024).
2. Kok, D. *et al.* Delayed diagnosed injuries in trauma patients after initial trauma assessment with a total-body computed tomography scan. *Injury* 111304 (2023) doi:10.1016/j.injury.2023.111304.
3. Arifin, W. Sample size calculator (web). <http://wnarifin.github.io> (2025).
4. Buderer, N. M. Statistical methodology: I. Incorporating the prevalence of disease into the sample size calculation for sensitivity and specificity. *Acad Emerg Med* **3**, 895–900 (1996).
5. Landis, J. R. & Koch, G. G. The measurement of observer agreement for categorical data. *Biometrics* **33**, 159–74 (1977).

## Supplementary materials

### Supplement 1. Example of reporting templates from institution A and B

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## Supplement 2.

### Radiology resident

Years of training

EPA WBCT trauma

Years in level 1 trauma center

### Radiologist

Years since board-certification

Years in level 1 trauma center

#### **Reporting template 1 is easy to use**

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

#### **Reporting template 1 allows to communicate urgent and critical findings**

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

#### **Reporting template 1 is suitable for clinical practice**

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

#### **Reporting template 2 is easy to use**

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

#### **Reporting template 2 allows to communicate urgent and critical findings**

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

#### **Reporting template 2 is suitable for clinical practice**

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

#### **Preferred reporting template:**

- A. Template 1
- B. Template 2