

# Lines, Lungs, and Landmarks: Evaluating Image Quality in Mobile Neonatal Chest Radiographs



United Lincolnshire  
Teaching Hospitals  
NHS Trust

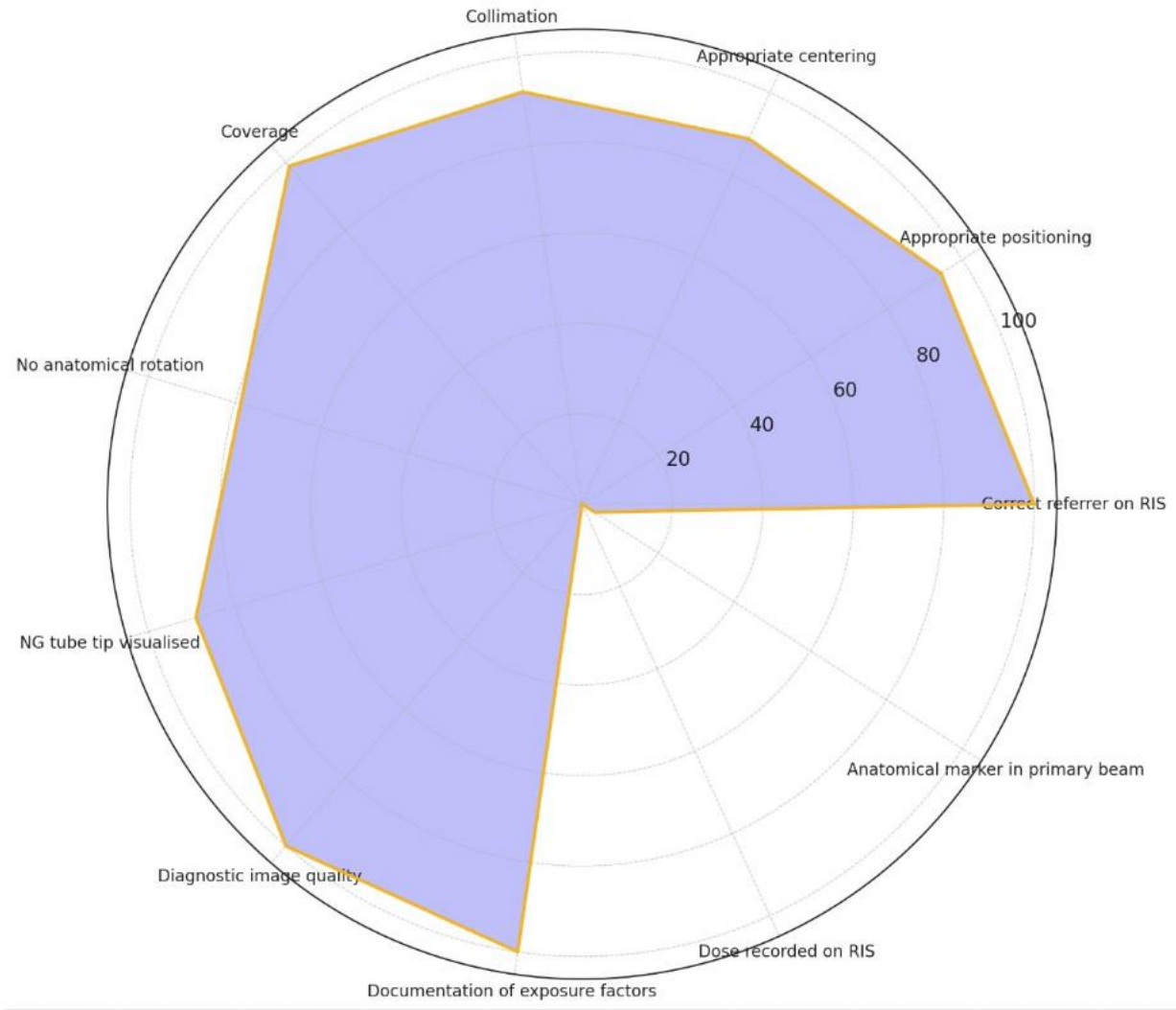
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## Background

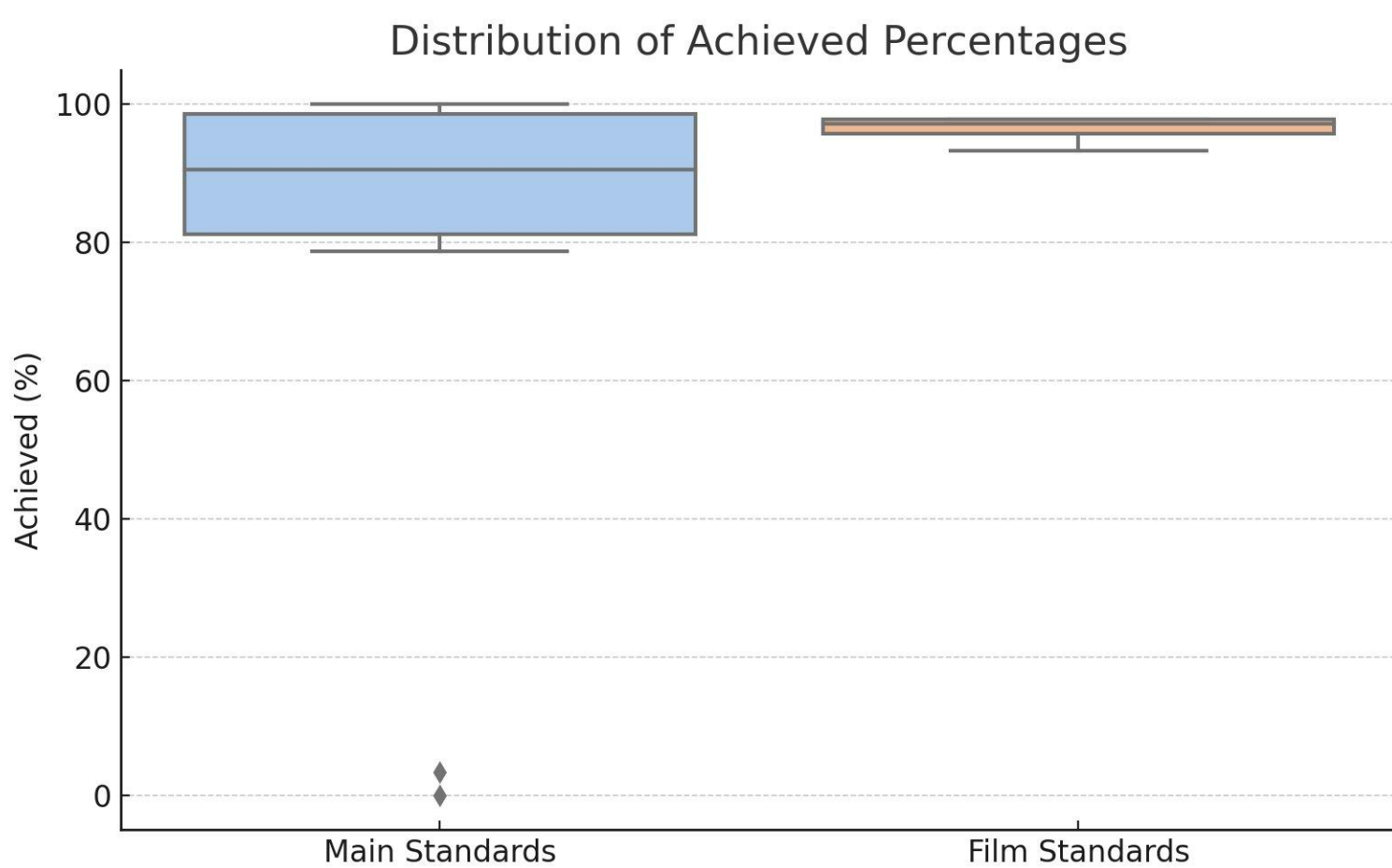
- Mobile chest radiographs are vital in NICU settings for monitoring respiratory status, evaluating lung pathology, and verifying the placement of lines and tubes in critically ill neonates who cannot be moved to the radiology department.
- Due to patient fragility, small size, and the limitations of mobile equipment, these radiographs often suffer from poor positioning, suboptimal coverage, and inadequate image quality, which can compromise diagnostic accuracy.

## Results

| Image Standard                    | Achieved (%) |
|-----------------------------------|--------------|
| Correct referrer on RIS           | 100          |
| Appropriate positioning           | 94.4         |
| Appropriate centering             | 88.8         |
| Appropriate Collimation           | 91           |
| Adequate Coverage                 | 98.9         |
| No anatomical rotation            | 78.7         |
| NG tube tip visualised (n=73)     | 89.0         |
| Diagnostic image quality          | 100          |
| Documentation of exposure factors | 100          |
| Dose recorded on RIS              | 0.0          |
| Anatomical marker in primary beam | 3.3          |



| Film Standard    | Achieved (%) |
|------------------|--------------|
| Mobile indicated | 93.2         |
| Position stated  | 96.6         |
| Date on image    | 97.8         |
| Time on image    | 97.8         |



### Image Standards:

- The box is wider, indicating greater variability in how different standards were met.
- While some standards like “image quality”, “referrer details” and “exposure factors” had 100% compliance, others like “dose recording on RIS” (0%) and “marker in primary beam” (3.3%) pulled the average and consistency down.
- This inconsistency reflects areas needing focused improvement, especially technical and safety-related parameters.

### Film Standards:

- The box is narrow, showing high consistency in documentation-related tasks.
- The median is close to 98%, indicating that nearly all radiographs had date, time, position, and mobile status documented correctly.
- This reflects strong performance and reliable adherence to film labelling protocols.

## Challenges

### Anatomical Marker in the Primary Beam:

- Size mismatch:** Conventional radiographic markers are often too large relative to neonatal chest size, obscuring anatomy.
- Field compromise:** Placing the marker requires widening the collimation, inadvertently increasing radiation exposure.
- Movement risk:** Neonates are prone to involuntary movements, making precise marker placement difficult without assistance.
- Infection control:** Introducing a physical marker near a fragile neonate increases infection risk, especially in intensive care settings.
- Detector limitations:** On direct digital mobile detectors, markers are typically fixed in the corner. To include this in the image, one must either:
  - Shift the neonate towards the edge (negating the desired minimal handling of the neonate, especially preterm neonates), or
  - Expand the field, exposing non-targeted anatomy unnecessarily.

### Positioning and Collimation:

- Size and fragility:** Neonates are too small and delicate to use most standard immobilisation aids.
- Optimal positioning requires two personnel:**
  - Arms by the sides ensures inclusion of clavicles and AC joints, but requires two people to hold both hands symmetrically.
  - Arms placed above the head can be done by one person, but this may compromise clavicular inclusion and rotation assessment.
- Fine collimation is difficult:** Due to the limitation of mobile tolerance to the field of view (which can be  $\geq 1$  cm), accurately collimating all anatomical landmarks without either cropping or overexposing is challenging.

## Cases

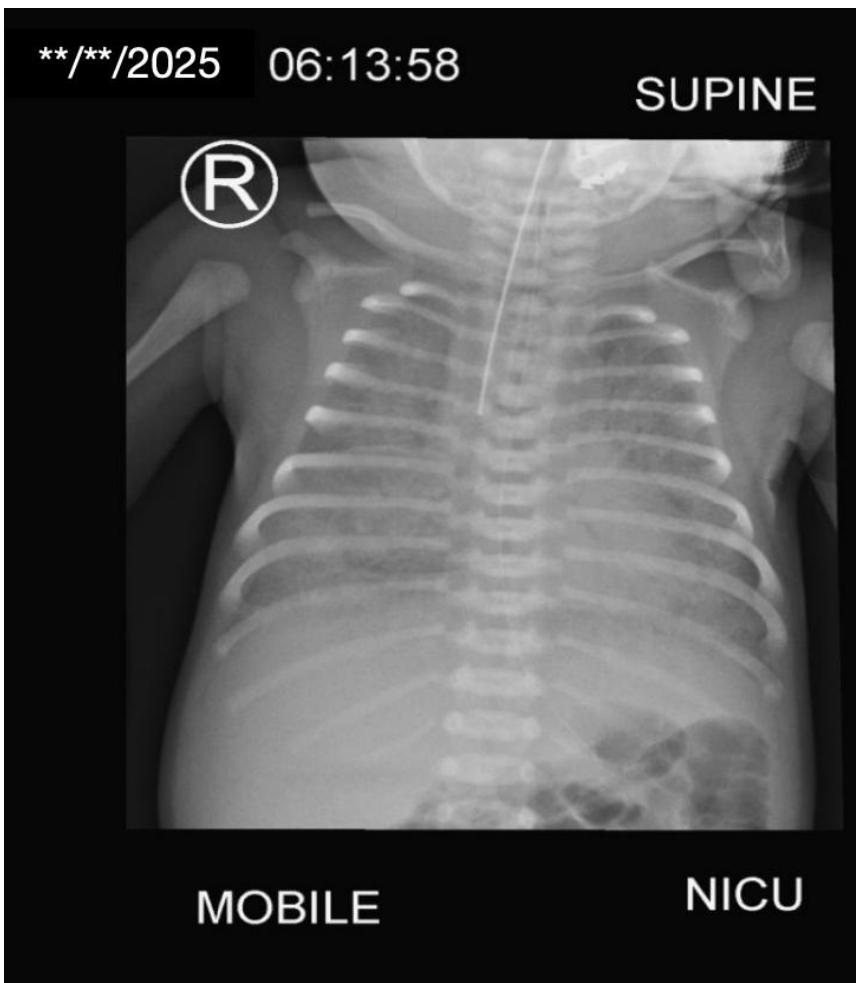


**Figure 1:** Radiograph demonstrating overall good image quality and adequate documentation. However, it does not fully meet ideal standards due to the absence of a physical anatomical marker in the primary beam, with only a digital marker included post-acquisition.



**Figure 2:** Radiograph showing a physical marker placed in the right lower corner. Note the disproportionately large marker for neonatal use, over-collimation, and unnecessary radiation exposure of the left upper limb—highlighting both safety and quality concerns.

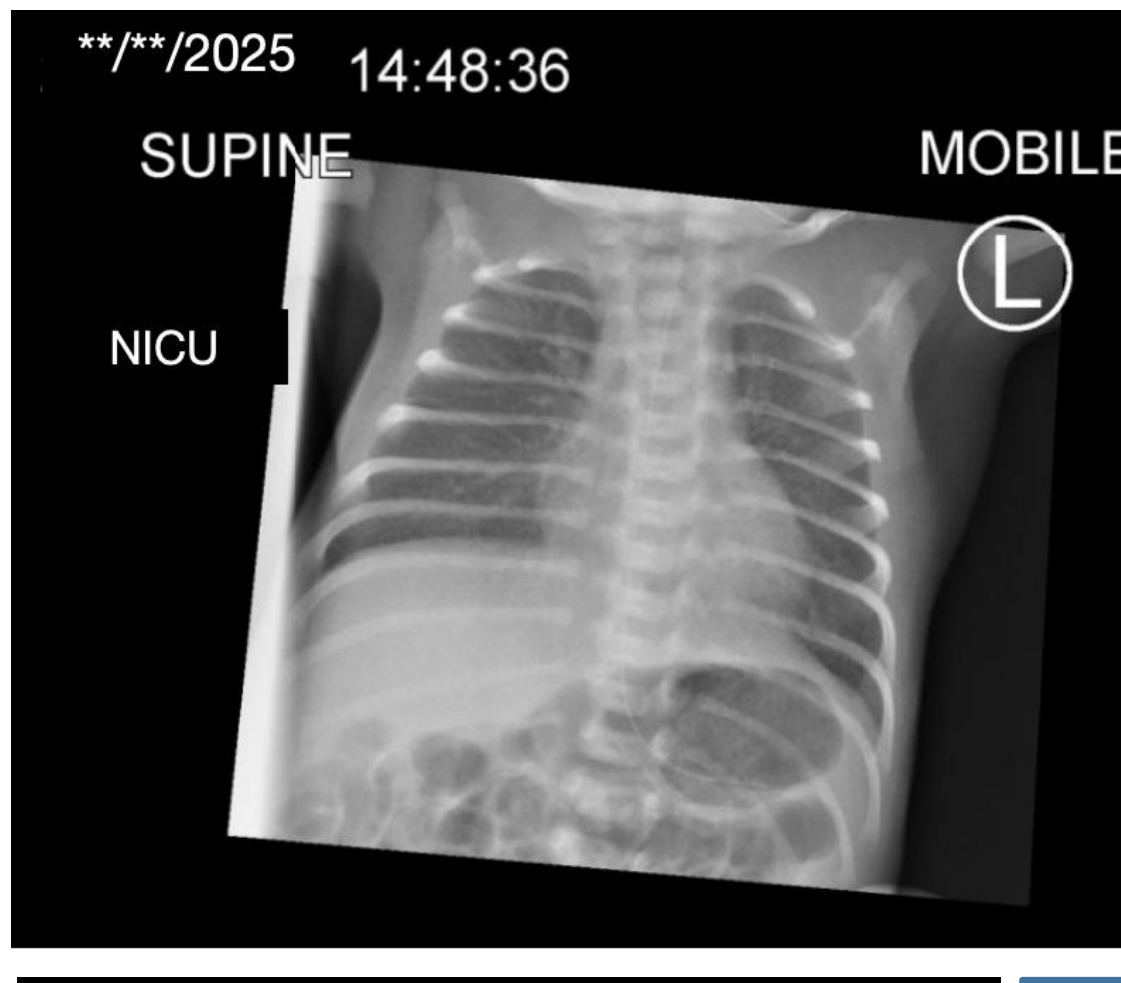


**Figure 3:** Examples of radiographs with suboptimal coverage and collimation. Lordotic projection with poor collimation; clavicles are absent, and right ribs are cut off (CP angle is not clear), indicating incomplete coverage.

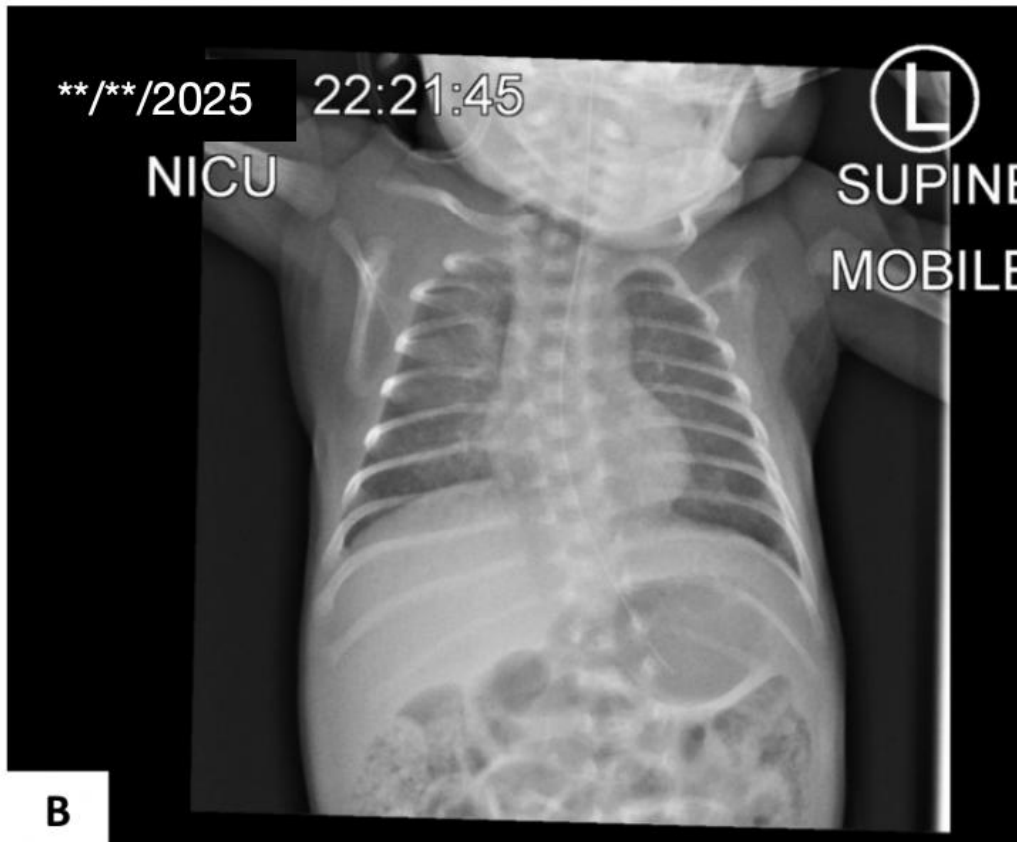
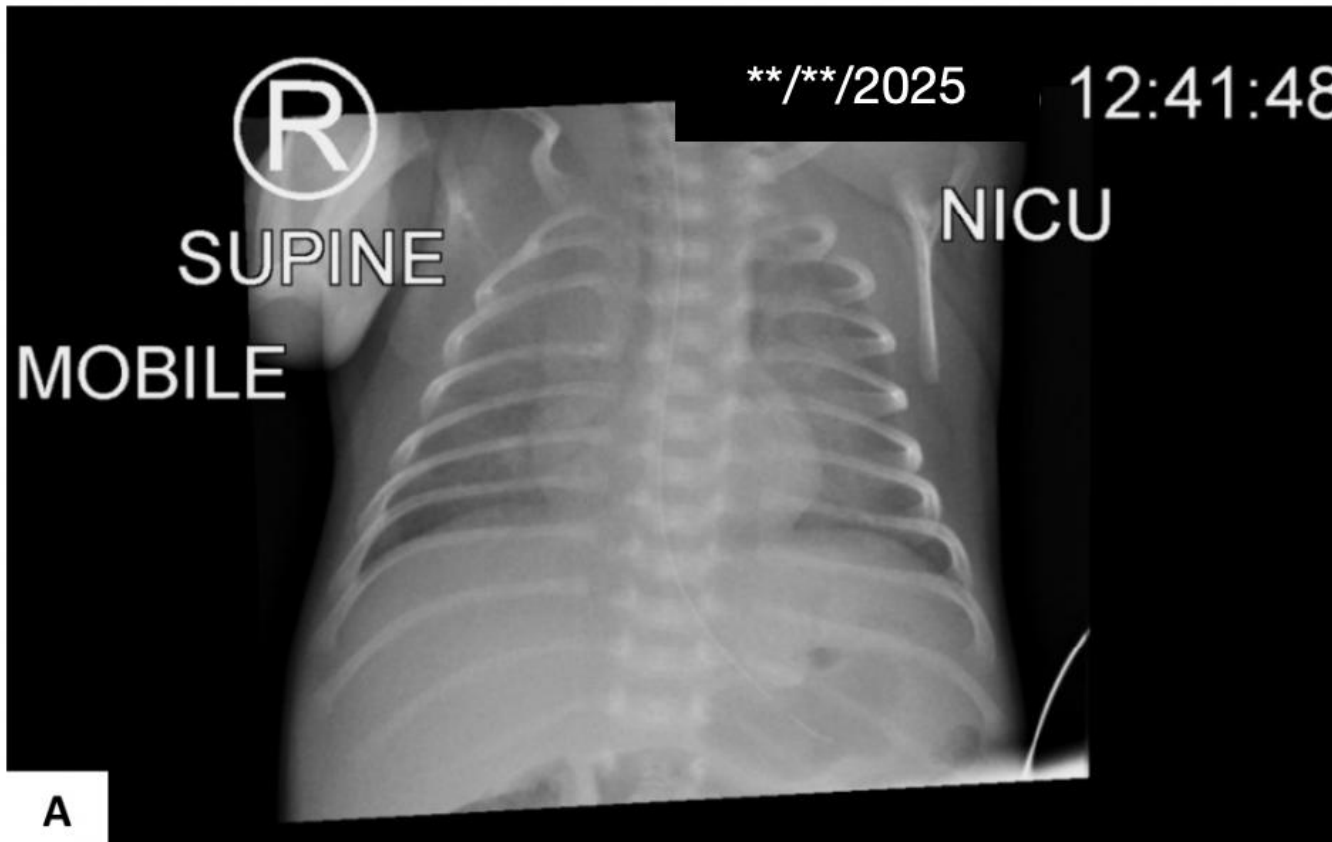


**Figure 4:** Sequential chest radiographs of the same neonate acquired 10 hours apart. Radiograph A (earlier): Demonstrates significant rotational artefact misinterpreted as a left-sided pneumothorax. Radiograph B (later): Correctly positioned with no evidence of pneumothorax, confirming the artefactual nature of the initial finding.

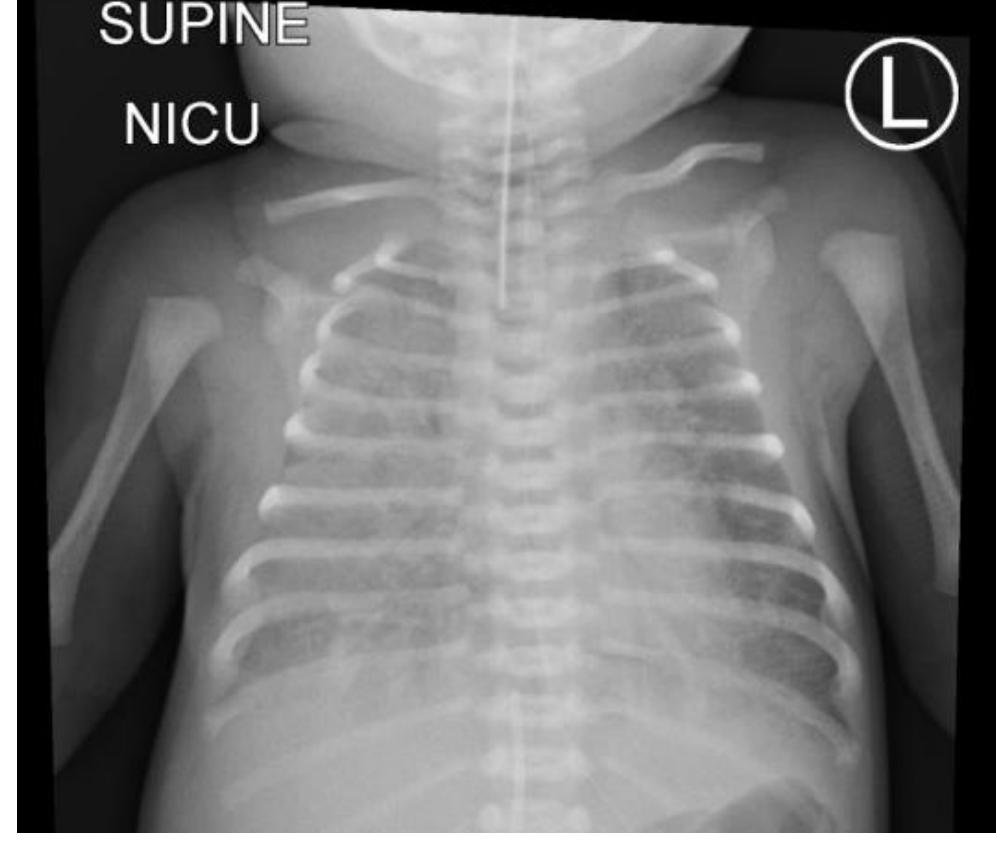


**Figure 5:** Radiograph demonstrating suboptimal filming standards. Frontal chest radiograph performed on a preterm neonate of 34-weeks period of gestation on day 2 of life shows lack of documentation of mobility, date, and time of exposure.

## Recommendations

- Familiarize radiographers on correct centering, positioning, and collimation for neonatal chest X-rays.
- Encourage the placement of anatomical marker in primary beam under feasible circumstances.
- Use a real time QA checklist at bedside to check anatomical marker, positioning, collimation and NGtube tip visibility.
- Consider introducing a real-time QA prompt system at image acquisition stations with periodic image reviews.
- Encourage collaborative practice between radiographers and NICU staff to ensure optimal patient handling and radiographic positioning.

| Area                      | Issue Identified               | Recommended Action                                                |
|---------------------------|--------------------------------|-------------------------------------------------------------------|
| Marker use                | Only 3.3% compliance           | Mandate physical markers (at least whenever possible)             |
| Dose documentation on RIS | 0% compliance                  | Dose data is automatically captured on OpenREM. No action needed. |
| Rotation/positioning      | Suboptimal positioning (21.3%) | Use immobilization aids and radiographer-NICU cooperation         |
| NG tube visualisation     | 11% failure to visualise tip   | Minimum view guidelines; checklist prompt                         |
| Centering/collimation     | Incomplete in ~10–12%          | Poster protocols; targeted education                              |