

# Clinician's Ability to Accurately Determine Patient Angulation in Portable Chest Radiography With a More Quantitative Marker

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# Disclosures

- Les Folio
  - Research agreement: Philips Healthcare
  - Patents (no royalties since NIH and military owned):
    - “Radiographic marker that displays upright angle on portable x-rays.” US Patent 9,541,822 B2
    - “Multigrayscale Universal CT Window.” US Patent 8,406,493 B2
    - Interactive enterprise imaging personal health record (patient portal). Provisional USPTO docket 10110-403PV1
  - Author royalties, Springer
- Andrew Yen, Jeffrey Cook, Julie An, Kurt Lee
  - Nothing to disclose

# Background and Objectives

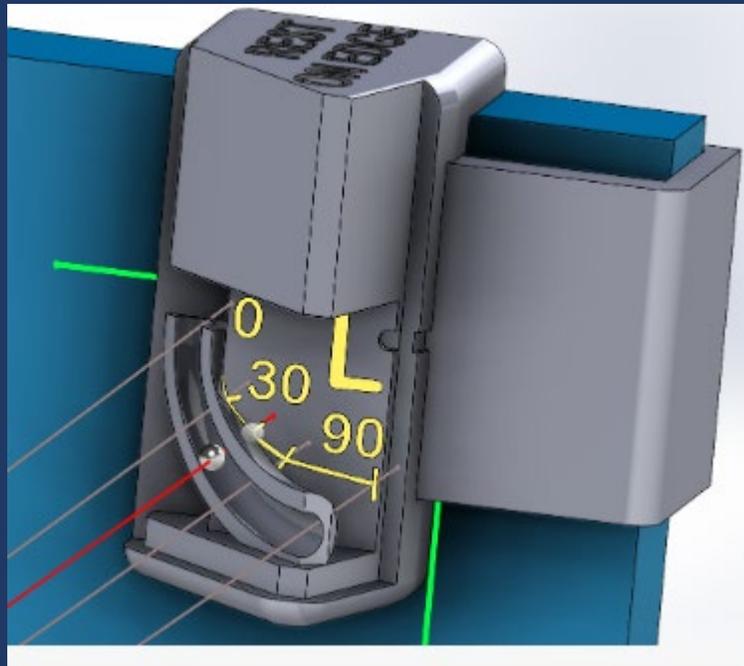
- Traditional method of describing patient positioning in portable chest x-rays (pCXR) relies on imprecise radiopaque markers such as the triple BBs and subjective “upright/supine” marker
  - Accurate knowledge of patient angulation is highly relevant in assessing findings such as cardiac size, atelectasis, and pleural effusion among others
  - Lack of consensus on subjective angle ranges may lead to confusion and inaccurate readings

What is the approximate angle here, described as “upright”?

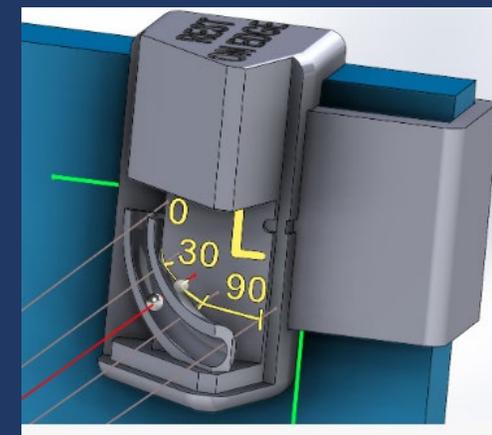
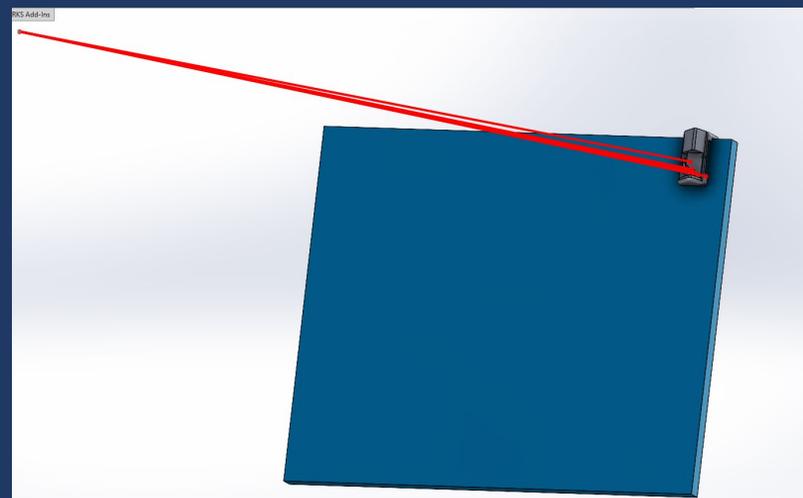


# Background and Objectives

- Goals:
  - to assess estimations of patient angle with traditional markers
  - to evaluate potential improved accuracy pCXR readings using a more quantitative marker (the x-clometer, available on NIH 3D print exchange)



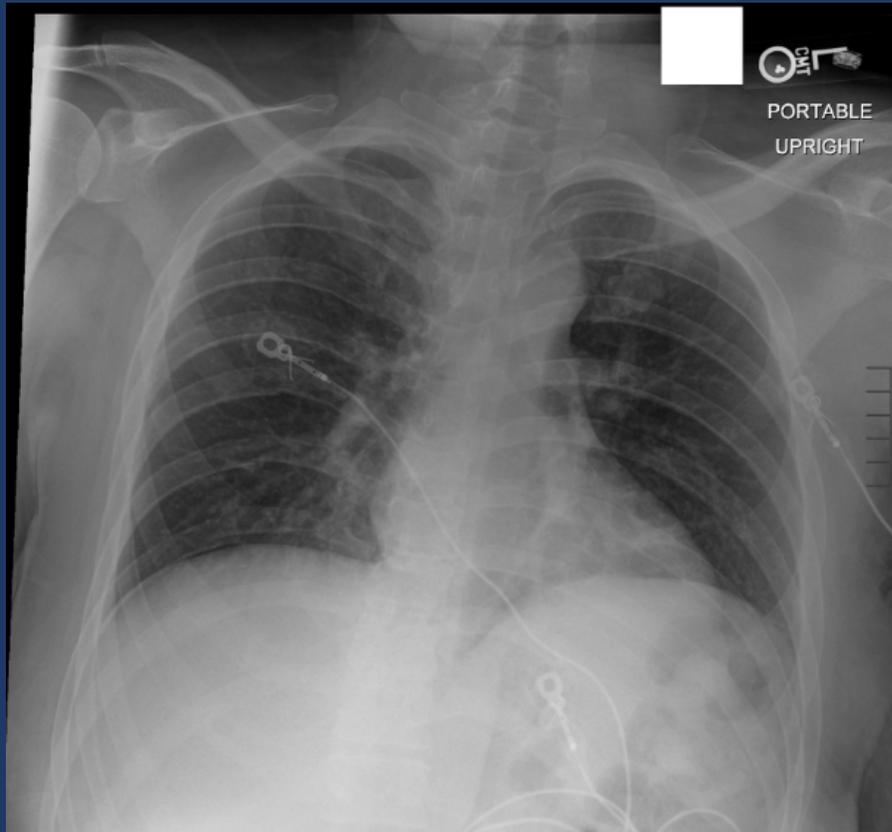
# Background and Objectives



# Materials and methods

- X-clometer used to obtain patient positioning in pCXR for one week. Images retrospectively reviewed to identify those with CT exams within 24h of chest radiograph
- Survey including 5 such cases was administered to physician volunteers (radiologists and non-radiologists). The survey included 2 tasks:
  - Estimating patient angle with traditional markers alone
  - Identifying findings first without and then with x-clometer angulation reading
- Responses then compared to findings from each case's corresponding CT report

# Materials and methods – case example



- Normal
- Small R pleural effusion
- Small L pleural effusion
- Moderate R pleural effusion
- Moderate L pleural effusion
- Large R pleural effusion
- Large L pleural effusion
- R atelectasis
- L atelectasis
- R consolidation
- L consolidation

# Results

- Estimation of patients' position based on BB makers and technician labels alone was highly inaccurate
  - Respondents estimates were accurate (within +/- 15 degrees of true angle per x-clometer) only **23% of the time**.
  - In one case, an image labeled "upright" was most commonly estimated at 90° while in fact the true angle was ~50°



# Results Contd.

- Before being given x-clometer readings (i.e. traditional markers only), respondents identified the correct findings 66% percent of the time
- After being given the x-clometer readings, respondents identified correct findings 59% of the time
- Among attending radiologists, the accuracies were 73% and 70% respectively.

# Discussion

- Traditional labels were highly unreliable and in some cases misleading in conveying accurate information about patient position
  - Subjective markers clearly inadequate, and a more precise method of communicating patient angulation, such as the x-clometer, is needed
- Respondents, especially radiologists, were relatively successful at identifying findings even before given angle information
  - Results potentially limited by small size of study (respondents + cases)