Image quality and dose analysis for a PA chest X-ray: comparison between AEC mode acquisition and manual mode using the 10 kVp rule

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Outline

• Introduction
  – Motivation
  – Research question & Objectives

• Methods

• Results & Discussion

• Conclusion
Introduction

• PA chest X-ray: an important radiograph (30-40% of all radiographs)

• The best compromise
  – Image quality
  – Patient dose (ALARP)

Motivation

• Analogue to digital systems
  – Adjustment of the technique

  • Parameters
  • Exposure index (Amount of exposure received by the image receptor; IgM for AGFA (1.96)
  • New guidelines (for technical aspects)

• Advantages of digital systems
  – Wider dynamic range
  – Postprocessing

• Clinical problems
  – Overexposure

Objectives

– Compare the image quality and dose of a PA chest X-ray using AEC mode and the 10 kVp rule

– Verify if there is a difference between the exposure index
METHODS
Image Acquisition

Methods

445 images

- SID (160-200)
- Focus (F & B)
- 10 kVp rule (80-110)
- AEC sensors
- Lesions

Introduction

- Motivation
- Research question & Objectives

Results & Discussion

Conclusion

Image Acquisition

68 images

- 40 AEC
- 20 Manual
- 8 Lesions
## Image Acquisition

<table>
<thead>
<tr>
<th># of images</th>
<th>Parameters</th>
<th>SID</th>
<th>Focus</th>
<th>AEC/ manual values based on</th>
<th>lesions</th>
<th>kVp range</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 AEC, 4 manual</td>
<td></td>
<td>160</td>
<td>Fine</td>
<td>R</td>
<td>No</td>
<td>80-110</td>
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<tr>
<td>8 AEC, 4 manual</td>
<td></td>
<td>180</td>
<td>Fine</td>
<td>R</td>
<td>No</td>
<td>80-110</td>
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<td>8 AEC, 4 manual</td>
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<td>200</td>
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<td>R</td>
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<td>80-110</td>
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<td>RML</td>
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<td>180</td>
<td>Fine</td>
<td>RL</td>
<td>No</td>
<td>80-110</td>
</tr>
<tr>
<td>4 AEC, 4 manual</td>
<td></td>
<td>180</td>
<td>Fine</td>
<td>R</td>
<td>L=S</td>
<td>80-110</td>
</tr>
</tbody>
</table>
Effective Dose

• PCXMC software (Monte Carlo Simulation)
  – Effective dose based on ICRP 103
    • Most updated (new tissue factors)
  – Collected data
    • Dose Area Product (DAP)
    • kVp
    • Source Image Distance (SID)
    • Beam collimation
    • Patient size (phantom = average adult)
Image Quality

• 2 Alterative Forced Choice (2AFC)
• 5 blinded radiographers
• Likert point scale

Image Quality

Criteria for images without lesions

- Demonstration of vascular pattern in whole lung, particularly the peripheral vessels.
- Visually sharp demonstration of the borders of the heart.
- Visually sharp demonstration of the borders of the aorta.
- Visually sharp demonstration of the diaphragm.
- Visualisation of the retrocardiac lung and the mediastinum.
- Visualisation of the spine through the heart shadow.

Methods

# Image Quality

## Methods

### Criteria for images with lesions

- Demonstration of vascular pattern in whole lung, particularly the peripheral vessels.
- Visually sharp demonstration of the borders of the heart.
- Visually sharp demonstration of the borders of the aorta.
- Visually sharp demonstration of the diaphragm.
- Visualisation of the retrocardiac lung and the mediastinum.
- Visualisation of the spine through the heart shadow.
- Contrast of nodule, against background.
- Brightness of nodule, against background.
- Sharpness of nodule edge.

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RESULTS & DISCUSSION
### AEC vs MANUAL

<table>
<thead>
<tr>
<th>kVp</th>
<th>10 kVp Rule</th>
<th>AEC Mode</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>mAs</td>
<td>s</td>
</tr>
<tr>
<td></td>
<td>Mean (%)</td>
<td>Mean (%)</td>
</tr>
<tr>
<td>80</td>
<td>6.89</td>
<td>0.028</td>
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<tr>
<td>90</td>
<td>4.42%</td>
<td>0.021</td>
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<tr>
<td>100</td>
<td>2.63 34%</td>
<td>0.013</td>
</tr>
<tr>
<td>110</td>
<td>1.97 25%</td>
<td>0.011</td>
</tr>
</tbody>
</table>

- Higher reduction in mAs using manual mode
- Higher reduction in time (s) using AEC mode
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Image Quality (global)


Effective Dose (global)

Effective Dose (global)

- Manual mode (better ED);
- AEC – R or RL – depending on AEC calibration and users’ preferences.

IgM (Exposure index – AGFA)

- SID did not influence the IgM variation \( (p=0.931) \)
- \( \text{IgM} < \text{reference} - 1.96 \)

CONCLUSIONS
Conclusions

• AEC vs Manual
  – No significant differences between image quality and IgM
  – Using the 10 kVp on manual mode shows a lower effective dose
Further work

• More observers
  – Also clinical radiographers
• More images for lesion analysis
  – Only 8 images
  – Use of conspicuity software
• Perform this study using different types of equipment to confirm results
Thank you for your attention