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Systematic analysis of chest radiographs and their dose exceedances

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How can we get better?

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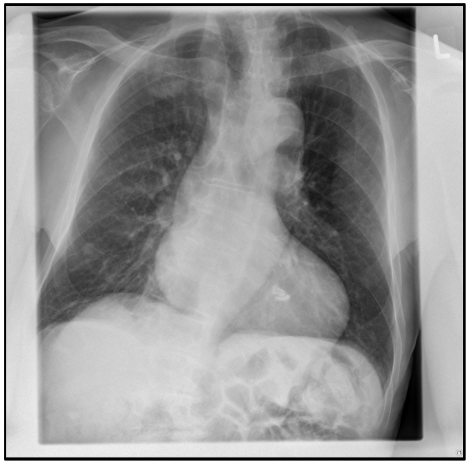
The authors have no actual or potential conflict of interest in relation to this program/presentation.

Purpose

- Analyze dose exceedances in chest radiographs
- Increase the image quality
- Reduce the radiation exposure
- German diagnostic reference levels:
  - PA: 15 cGycm²
  - LAT: 40 cGycm²



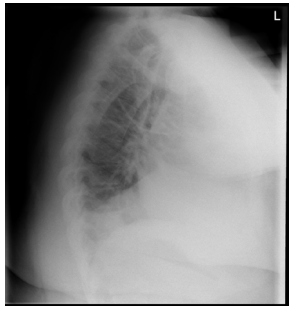
Materials & Methods

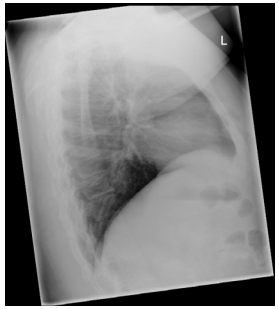
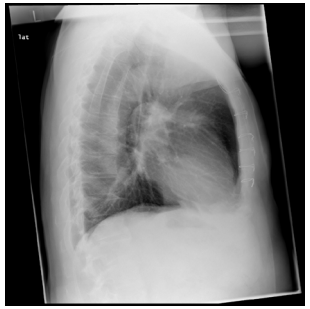
- Study interval: 10/2021-11/2021
- Modality: Digital Diagnost 3.1 (Philips Healthcare, the Netherlands; installation 2014)
- Patient height & weight documented

- Dose management system Sectra DoseTrack™, Sectra (Sweden)
  - Dose area product (cGycm²)
  - Tube settings (potential (kV), tube current-time product (mAs))
  - Reason for dose exceedance

Analysis of dose exceedances

- Selected reasons for dose alerts
  - Obesity
  - Insufficient collimation
    - Unstable posture of patient
  - Dense pulmonary parenchyma
  - Low arm positioning
  - Metallic implants
  - Mixture of several factors
  - Others




Initial results

- 1354 radiographs in two months
- BMI 25.0-29.9 kg/m²: 29%
- BMI >30 kg/m²: 18%
- 24% alerts in total (p.a. (15%) and LL. (85%))

Major reasons for dose exceedance (LL)	PA	LL
Insufficient collimation	28 %	52%
Obesity	50%	25%
Combination of collimation and obesity	8%	2%
Arm positioning	4%	6%
Dense lung parenchyma	1%	2%
Not evaluable/no definite reason	4%	18%

Interventions

- Feedback to technicians and technicians-in-training
  - Why do we see dose exceedances?
  - Where do we see them?
  - (How) can they be prevented?

Radiologists and physicists with technicians

- Regular attendance of physicists at x-ray examination rooms
  - Analyze daily clinical practice and associated problems
  - Provide tips & tricks
  - Availability for questions and discussions

Physicists with technicians

Interventions

- Involvement in dose-monitoring-system analysis
  - Increase awareness
  - Increase personal responsibility
  - Compare self acquired images and dose values to others

Physicists with technicians

Technicians with technicians

- Demonstrations of good and bad image examples in morning meetings
  - Are there general problems with the X-ray unit or its settings?
  - How to increase quality?

Radiologists and physicists with technicians

Effects from interventions

- Technicians and technicians-in-training are more aware of DRLs and dose values to be expected
  - Improved critical reflection on image quality and dose
- Feedback conversations between physicists, technicians and radiologists are a valuable tool
  - Useful suggestions for improvement
  - Important: Positive feedback for good acquisitions!
- Dose alerts due to insufficient collimation occur less frequently, however
  - Collimation in overweight and obese patients remains challenging
  - Lack of straight posture in elderly patients requires larger collimation

Discussion

- German DRLs applicable for patients with a weight of 70 ± 3 kg
  - Nearly 50% of the patients were overweight → higher dose necessary to maintain image quality
  - Proper collimation is more difficult in overweight patients
- Varying and large technician teams → difficult to reach the whole team directly
- Additional step after first intervention: pre-set collimation was reduced to a smaller initial FOV (similar to p.a. acquisitions)
  - Further improvement notable

Future directions

- Ongoing critical revision of x-ray image quality and doses
- More emphasis on patient breathing
  - Deep inhaling reduces lung density
    - Increased image quality of lung parenchyma
    - Reduces the automatically chosen tube current – time product
- Replacement of the x-ray unit in 2022
  - Old detectors are less sensitive than modern ones