CXR Screening

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Consultant, WHO - StopTB
Radiography, CXR, X-ray
Screening, not diagnosis
• At field level - Normal or Abnormal.
• By employing intentional over-reading it is expected that there will be some CXR which are labelled ‘abnormal’ at the field level but ‘normal’ at the central level. As long as this percentage is small, it is acceptable.
• **Normal CXR** – A normal chest X-ray means clear lung fields and no abnormality detected. Participants with normal CXR have no radiological basis for undergoing bacteriological examination.

• **Abnormal CXR** - An abnormal chest X-ray means any lung (including pleura) abnormality detected on interpretation by the medical officer (e.g. opacities, cavitation, fibrosis, pleural effusion, calcification(s), any unexplained or suspicious shadow, etc.). Congenital abnormalities, normal variants, and bony abnormalities like fractures are excluded by definition as are findings like increased heart size and other heart-related abnormalities.
• A more detailed interpretation (audited reading) can be performed at the central level
• The central team should classify x-rays based on a classification decided upon earlier (as mentioned in the x-ray reference manual)
• May help identify quality issues with lab
CXR Selection

- ? Technology
- ? Number of units
- ? Value additions (e.g. CAD, Teleradiology)
X-ray technologies

CONVENTIONAL

• Conventional radiography
• Conventional with autoprocessor

DIGITAL

• Computed radiography (CR)
• Direct radiography (DR, DDR)
Conventional radiography
Autoprocessor
Computed Radiography (CR)

1. X-ray Exposure
   Patient

2. Image Reader

3. Image Scaling

4. Image Record

5. Computed Radiograph

X-ray system

Phosphor plate

unexposed

exposed
Direct Radiography
DDR

- Flat panel
- CCD
- CMOS
- Slot-scan
Post processing – Digital only
Value additions

• Teleradiology
• CRRS
• Computer-Aided-Detection (CAD)
• Computed-Aided-Diagnosis (CADx)
• Temporal subtraction imaging
## Comparison chart

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Conventional</th>
<th>CR</th>
<th>Digital</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electronic data collection, reporting and storage, data management &amp; privacy, back-up data</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2</td>
<td>High Image readability and quality</td>
<td>NO</td>
<td>YES/NO</td>
<td>YES</td>
</tr>
<tr>
<td>3</td>
<td>Value additions (CAD, Teleradiology)</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>4</td>
<td>Use of films and chemicals (potential environmental issues)</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>5</td>
<td>Radiation safety</td>
<td>NO*</td>
<td>NO*</td>
<td>YES*</td>
</tr>
<tr>
<td>6</td>
<td>Cost*</td>
<td>Cheap initially</td>
<td>Intermediate</td>
<td>Cheap in long run</td>
</tr>
<tr>
<td>7</td>
<td>Faster throughput</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>8</td>
<td>Immediate image reproducibility</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
Costs

• Conventional: 10-25,000 USD
• Autoprocessor: 7-12,000 USD
• CR: 50-70,000 USD
• DR with imaging panel: 100-120,000 USD
• DDR: 150,000 USD and above
Long term costs
Hidden costs
Fine print
Logistics, maintenance, breakdown
CXR Requirements

• Planning
• Procurement
• Teamwork
• Allied equipment
• Radiation safety
• Legal and regulatory requirements
• Logistic requirements
• Technical assistance
Planning & Procurement

• Local technical expertise with TA
• Frequent bottleneck and time-consuming step
• Initiate early
• Attention to minute details
  – Accessories
  – Software/hardware
• Legal/regulatory issues
Radiation exposure

• MBUR Referral guidelines, Royal College of Radiologists London: ‘typical effective dose = 0.02 mSv = 3 days app. Equivalent period of natural background radiation

• HPA – RCR: CXR associated risk of childhood cancer is very low and acceptable when compared with natural risk. Radiation doses resulting from Dx procedures present a negligible risk of induced hereditary disease in descendants of the unborn child

• ACR: Some procedures (incl. CXR in 1st & 2nd trimester) render so low exposures that pregnancy status need not be considered for a “medically indicated” exam, as long as good radiation practice is ensured

• At 1 meter, occupational exposure (if no apron is worn) is 0.1% of that which enters the patient.
Regulatory

- No ‘safe’ radiation, use regulated
- Radiation regulatory authority/body clearance
- Ethics committee clearance
- Consent, voluntary participation
- Exclude children, pregnant participants
- Good comprehensive protocol
- Timely engagement
Logistics
Fieldwork
Technical Assistance

- WHO
- TBTEAM
- CDC
- KNCV
- JICA
IDENTIFY X-RAY TECHNOLOGY
- Involve country experts, technical partner, WHO/TB TEAM etc.
- Base decision on available infrastructure (like roads, electricity etc.), regulations on radiation safety, manpower availability, cost

PROCURE
- Start early as it may take considerable time
- Possible facilitators - WHO, UNICEF, UNOPS, GDF etc.

X-RAY TEAM
- Teaching hospital radiology staff / expert radiologist / chest physician / radiographer
- Achieve consensus on methodologies (interpretation, QA etc.)

X-RAY MANUAL
- X-ray team to develop. Assistance can be provided by technical partner, WHO etc.
- Include SOPs, QA, interpretation methodology, radiation safety etc

TRAIN
- Central X-ray team to impart training
- Include hands-on training and field simulation

PILOT
- Co-ordination of X-ray team, survey team, technical partner, experts
- Identify practical issues and how to tackle them

PRE-VISIT
- Inspect site for housing x-ray equipment
- Sketch map for participant flow in x-ray area

FIELD WORK
- Carried out by field X-ray team under supervision of team leader
- Innovate and adapt to local factors and needs

MONITOR
- To be done by central X-ray team
- Monitor for QA, Interpretation consistency, imputing

POST SURVEY
- To be done by central X-ray team
- Decide on radiological - bacteriological result mismatch
Thank you!