



Validation of an Artificial Intelligence Algorithm for Chest X-ray Interpretation in Nigeria

Liliane Azabe, SUMR Scholar
August 17th 2022

Acknowledgement

Funds:

Google Foundation Grant awarded to RAD-AID International



Farouk Dako,
MD, MPH



Joanne Levy
MBA, MPC

Background

- ❖ Each year about 245,000 Nigerians die from tuberculosis (TB) and about 590,000 new TB cases emerge.
- ❖ Nigeria is the leading country in TB cases and burdens in Africa
- ❖ Nigeria has over 70% of global gap in TB case detection and Notification.



Copenhagen Consensus Center(2022); WHO(2020)

AI and Radiologists interpretations

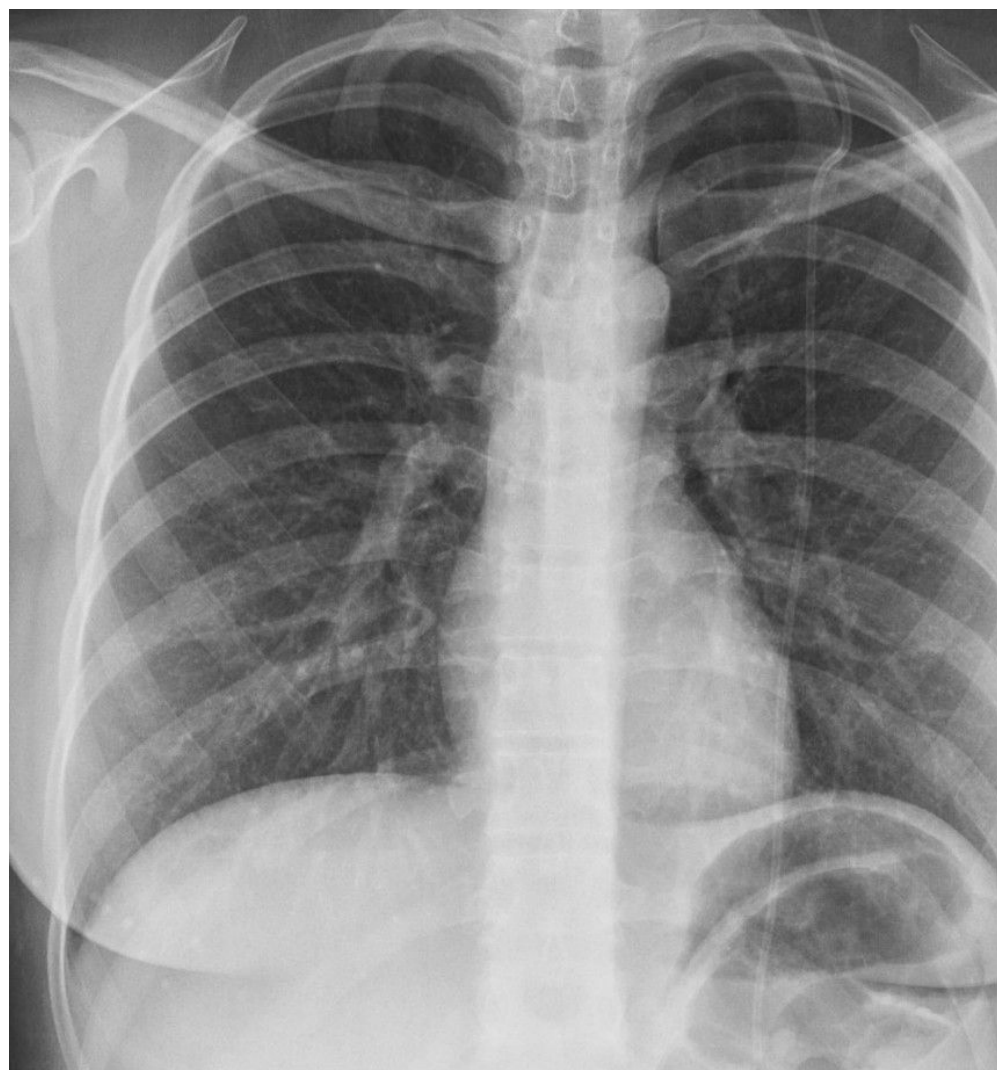
- WHO has recommended CAD (Computer Aided detection) with AI in place of human readers for chest X-rays diagnosis of Tuberculosis.
- Chest abnormality can go overlooked and unnoticed by either AI or radiologists locally or globally but their integration can make the work better.

Research aim: To test for the validity of AI chest X-ray interpretations of local studies in Nigeria.

Morton(2021)

Chest interpretations

- ❖ Abnormality: When chest radiograph looks different from how it normally should.
- ❖ Tuberculosis: Is a contagious disease caused by a bacteria *Mycobacterium tuberculosis* that infect the lungs and other body parts.
- ❖ Opacities: any shadow in the lungs that does not represent normal anatomy. Types:
 - Nodules
 - Fibrosis
 - Consolidation



Opacities types

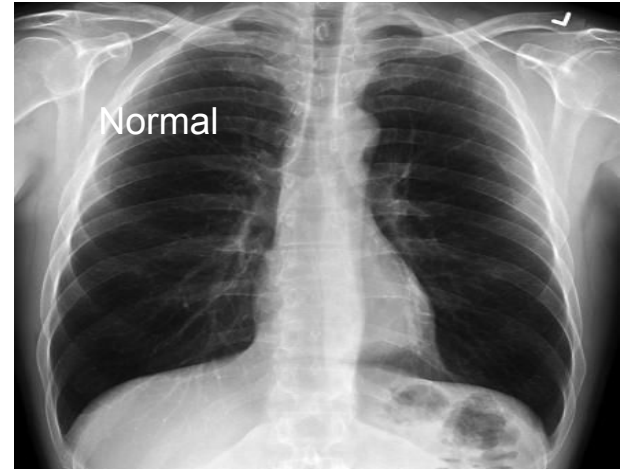
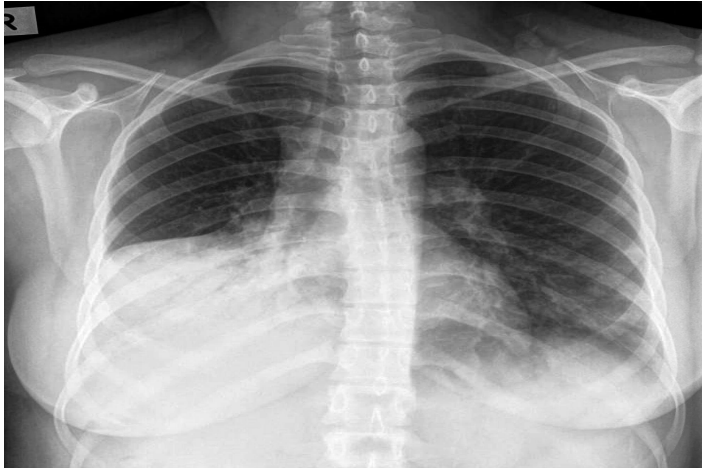
Nodular



Fibrosis



Consolidation



Study Design

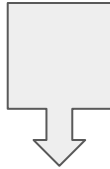
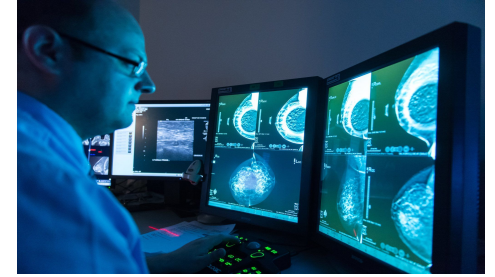
Radiographs in PACS



AI interpretation

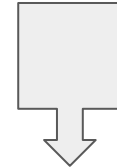


3 Radiologists evaluation



| Study | Study Date | Uploaded | Actions |
|--|------------------------|------------------------|----------------------------|
| CHESTPA DX 1 images Send status: 15 | 08-27-2021 12:43 PM | 10-25-2021 04:32 AM | Images Edit Route Download |
| CHESTPA DX 3 images Send status: 15 | 08-06-2021 02:22 PM | 10-08-2021 06:25 AM | Images Edit Route Download |
| CHESTPA DX 3 images Send status: 15 | 07-19-2021 03:39 PM | 09-27-2021 08:19 AM | Images Edit Route Download |
| CHESTAP DX 4 images Send status: 15 | 07-19-2021 03:05 PM | 09-27-2021 08:18 AM | Images Edit Route Download |
| CHESTLAT | 07-19-2021 | 09-27-2021 | Images Edit Route Download |

Protected software



| Item | Quantity | Unit Price | Total Price | Category |
|---------|----------|------------|-------------|------------|
| Item 1 | 100 | \$10.00 | \$1,000.00 | Category A |
| Item 2 | 200 | \$5.00 | \$1,000.00 | Category B |
| Item 3 | 300 | \$3.33 | \$1,000.00 | Category C |
| Item 4 | 400 | \$2.50 | \$1,000.00 | Category D |
| Item 5 | 500 | \$2.00 | \$1,000.00 | Category E |
| Item 6 | 600 | \$1.67 | \$1,000.00 | Category F |
| Item 7 | 700 | \$1.43 | \$1,000.00 | Category G |
| Item 8 | 800 | \$1.25 | \$1,000.00 | Category H |
| Item 9 | 900 | \$1.11 | \$1,000.00 | Category I |
| Item 10 | 1000 | \$1.00 | \$1,000.00 | Category J |

Recorded in Excel sheets

Data collection

From PACS, AI interpreted 123 data and data were kept in a password protected software.

Variables:

- Abnormal vs Normal
- Tuberculosis
- Opacities
- **To be read by a radiologist**

Same data set(123) was given to three individual radiologists for interpretation, and then was recorded in secured Excel sheets.

| Measurement | Variable |
|---|----------|
| Normal Vs Abnormal | Yes, No |
| Tuberculosis | Yes, No |
| Opacities (nodule, fibrosis, consolidation) | Yes, No |

Results on Abnormality

Table 1. Results on Normal VS abnormal: AI and radiologists interpretation

| | AI | Radiologists | | | |
|--------------------|--------|--------------|-------|-------|--------|
| | | R1 | R2 | R3 | Total |
| Normal | 36/123 | 6/18 | 15/55 | 15/49 | 36/123 |
| Abnormal | 61/123 | 13/18 | 40/55 | 34/49 | 87/123 |
| Radiologist needed | 25/123 | N/A | N/A | N/A | NA |
| Total | 123 | 18 | 55 | 49 | 123 |

Results

Table 2: Analysis of the 25 data marked by AI, “Need Radiologist interpretation”

| | Radiologists | | | |
|----------|--------------|------|-------|-------|
| | R1 | R2 | R3 | total |
| normal | 1/3 | 4/10 | 11/12 | 16/25 |
| Abnormal | 2/3 | 6/10 | 1/12 | 9/25 |
| Total | 3 | 10 | 12 | 25 |

Results on Tuberculosis

Table 3: AI and Radiologists Analysis On Tuberculosis

| | AI | Radiologists | | | |
|-------------|-------|--------------|-------|-------|-------|
| | | R1 | R2 | R3 | total |
| TB positive | 21/98 | 2/16 | 7/45 | 3/37 | 12/98 |
| TB negative | 77/98 | 14/16 | 38/45 | 34/37 | 86/98 |
| Total | 98 | 16 | 45 | 37 | 98 |

Results

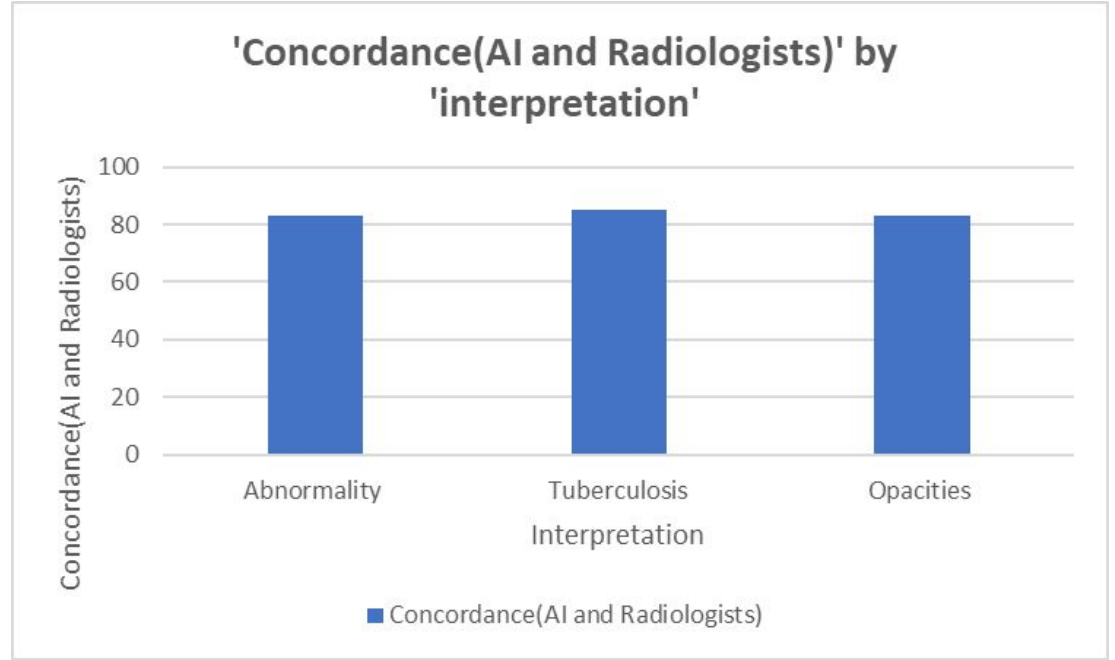
Table 4: Opacities detected by AI and 3 Radiologists

| | AI | Radiologists | | | |
|----------|-------|--------------|-------|-------|-------|
| | | R1 | R2 | R3 | total |
| positive | 36/98 | 6/16 | 10/45 | 15/37 | 31/98 |
| negative | 62/98 | 9/16 | 27/45 | 22/37 | 67/98 |
| Total | 98 | 16 | 45 | 37 | 98 |

Data Analysis: Concordance Analysis

Concordance on the 98 studies between AI and radiologist were as follows:

Concordance on abnormality: 85%
Concordance on Tuberculosis: 86%
Concordance on Opacities: 85%





- ❖ Artificial Intelligence interpretation can be used confidently to diagnose Chest X-rays in local studies.
- ❖ Artificial intelligence and radiologists can be integrated for maximized efficiency and accuracy of local studies.

Limitations

- ❑ Small number of data(123 collected and 98 for analysis) which could give a good estimate but not fully accurate findings.

Lesson learned

- ❖ The TB prevalence in Nigeria, Africa and the world
- ❖ Data collection and analysis skills
- ❖ Writing method and results sections of manuscript
- ❖ Artificial intelligence need in local studies



QUESTIONS?

COMMENTS?

CONCERNS?