Artificial Intelligence (AI): Help or Curse in Paediatric Global Radiology?

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Taskforce Session Outreach: Global Paediatric Radiology Challenges and Innovations

ESPR 10 June 2022 – Marseille, France

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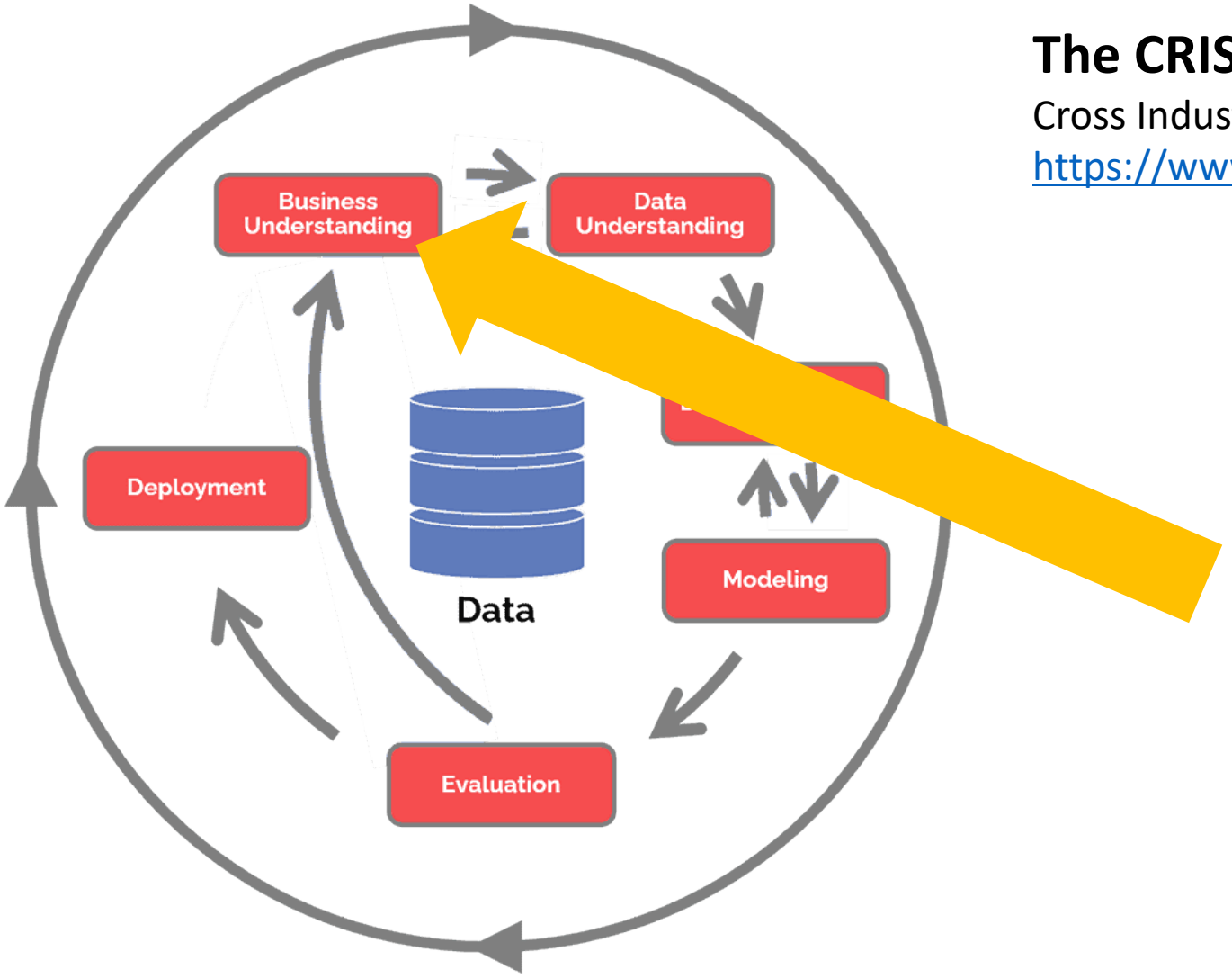
"Any sufficiently advanced technology is indistinguishable from magic."

- Arthur C. Clarke

AI is a tool - not the goal!



The CRISP-DM model (1999)

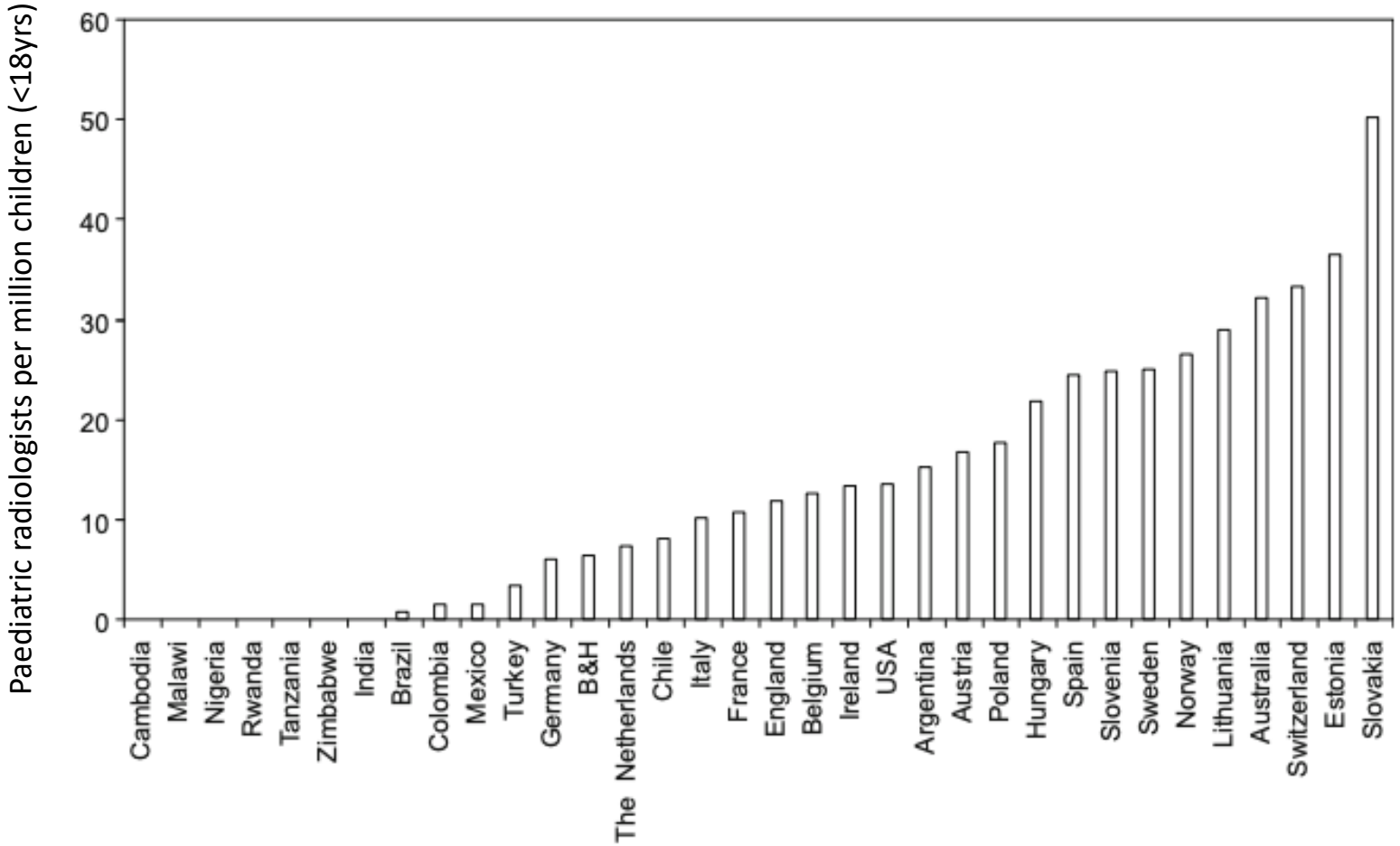
Cross Industry Standard Process for Data Mining

https://www.datascience-pm.com/crisp-dm-2/

- What is the problem we are trying to solve?
- Do we have a good understanding of it?
- Is AI really the solution we need for this problem?
- Can it be solved by other simpler, cheaper means?

So… what is the problem?

- >50% of world lack radiology resources
- Paediatric radiology is almost non-existent
- But these are places with highest number of children with serious diseases!!



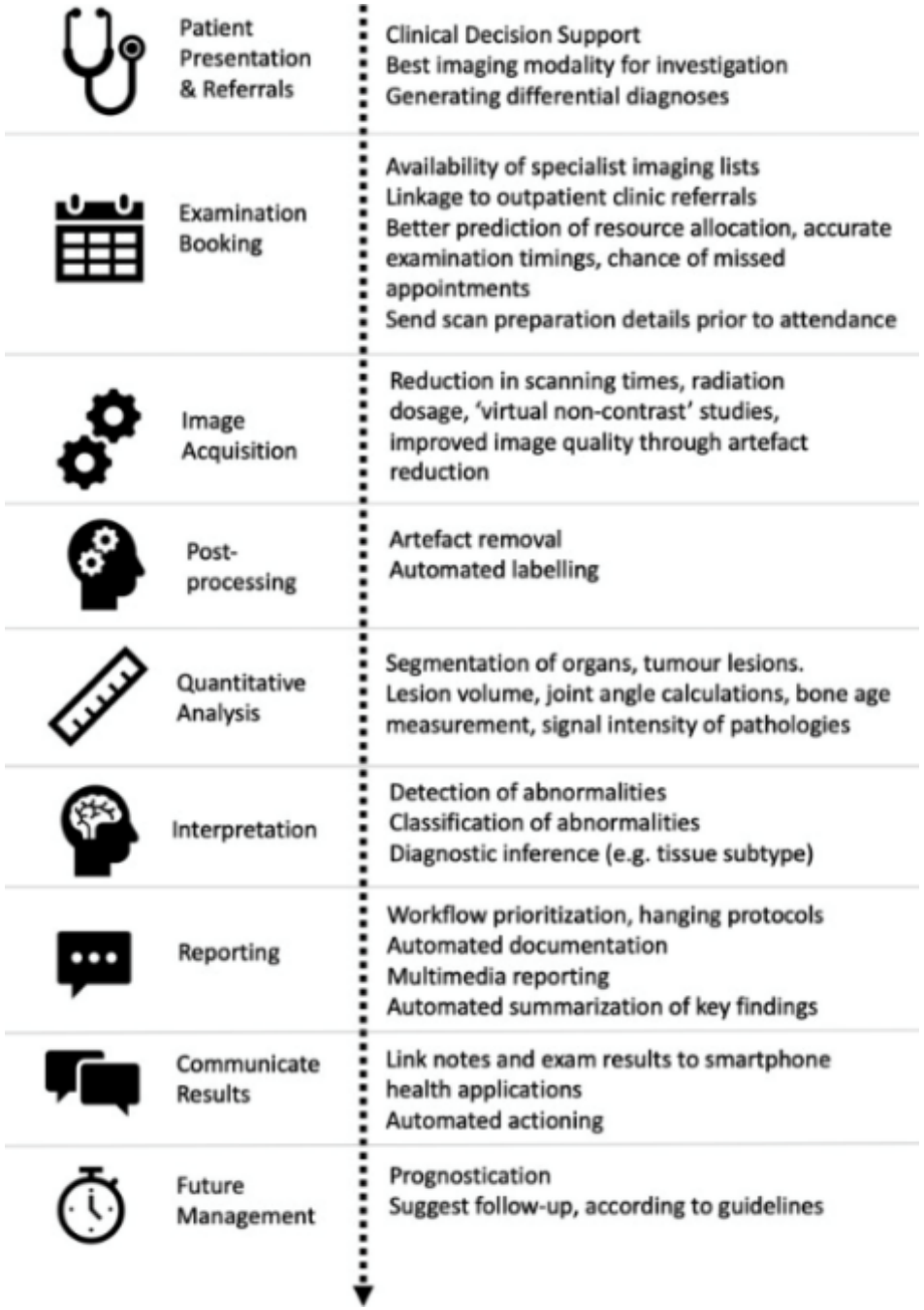
UNICEF (2017) The State of the World's Children 2017 statistical tables

How AI can help

1. A more efficient workflow
2. Shortened radiology reading time
3. Reduction of radiation dose and contrast agents
4. Earlier detection of disease
5. Improved diagnostic accuracy
6. Personalised diagnostics/prognostics

Davendralingham N et al. BJR 2021 Jan 1;94(1117):20200975. Artificial intelligence in paediatric radiology: Future opportunities

Van Leeuwen KG et al. Pediatric Radiology 2021. How does artificial intelligence in radiology improve efficiency and health outcomes?



… issues with technology adoption?

1. Accelerated acquisition of up-to date equipment (with rapid economic growth)

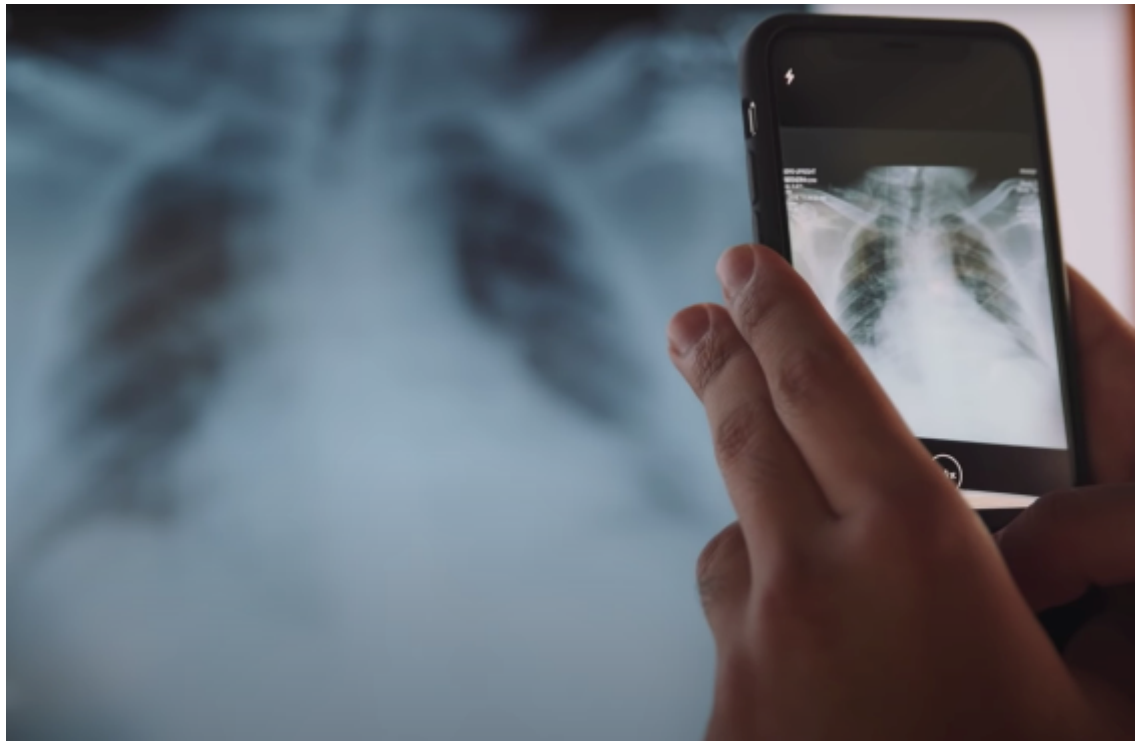
2. Implementation of older (obsolete) equipment bought at low cost

3. Acquiring modified technologies with reduced functionality (e.g. experimental or developmental technology by new vendor market entrants)

4. Adoption of innovations superior to conventional technology, with higher function and lower cost (‘leapfrog’) e.g. proliferation of smartphone system superseding landline communications

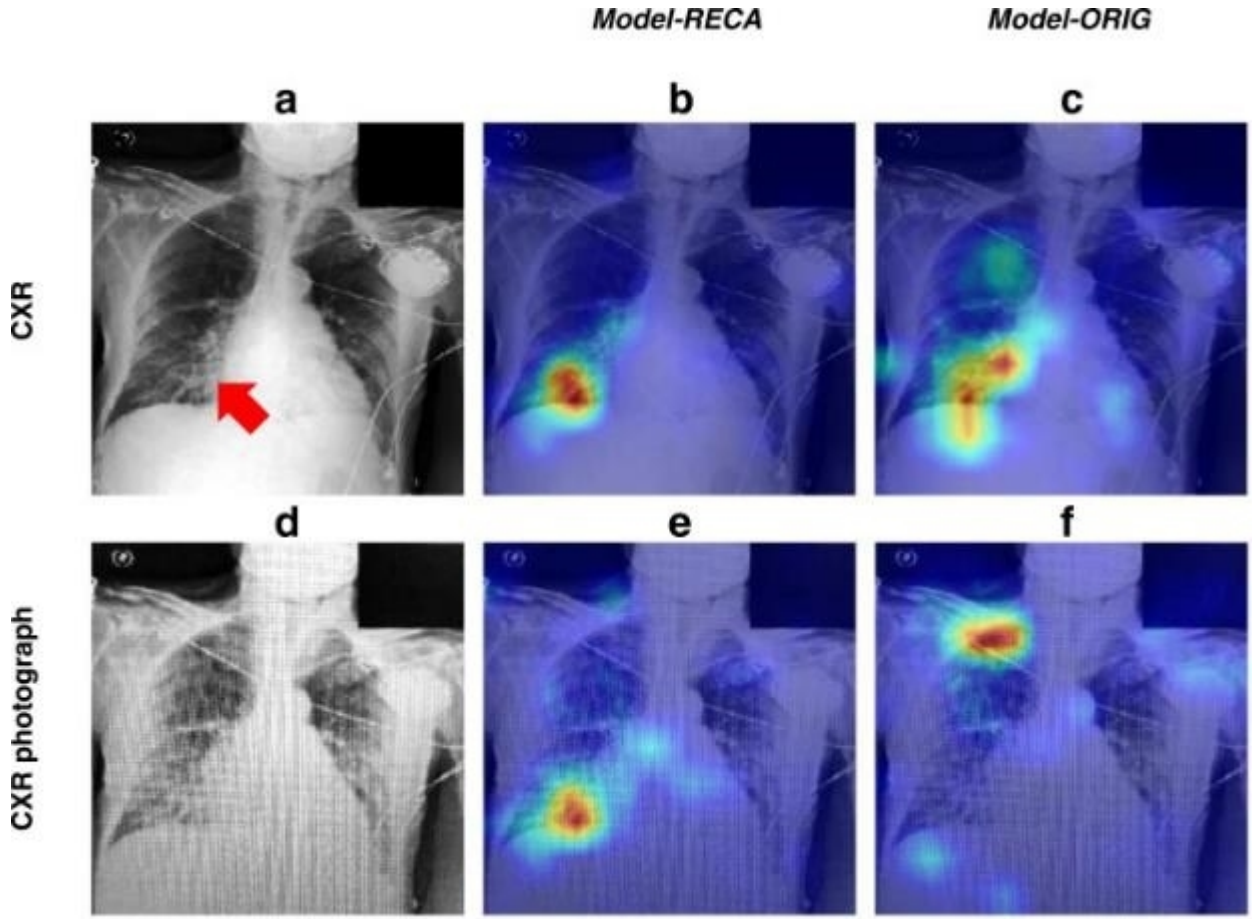
Mollura DJ et al. J Am Coll Radiol. 2017 14(6):841-847. 2016 RAD-AID Conference on International Radiology for Developing Countries

Smartphone technology!



Stanford University – CheXphoto Database

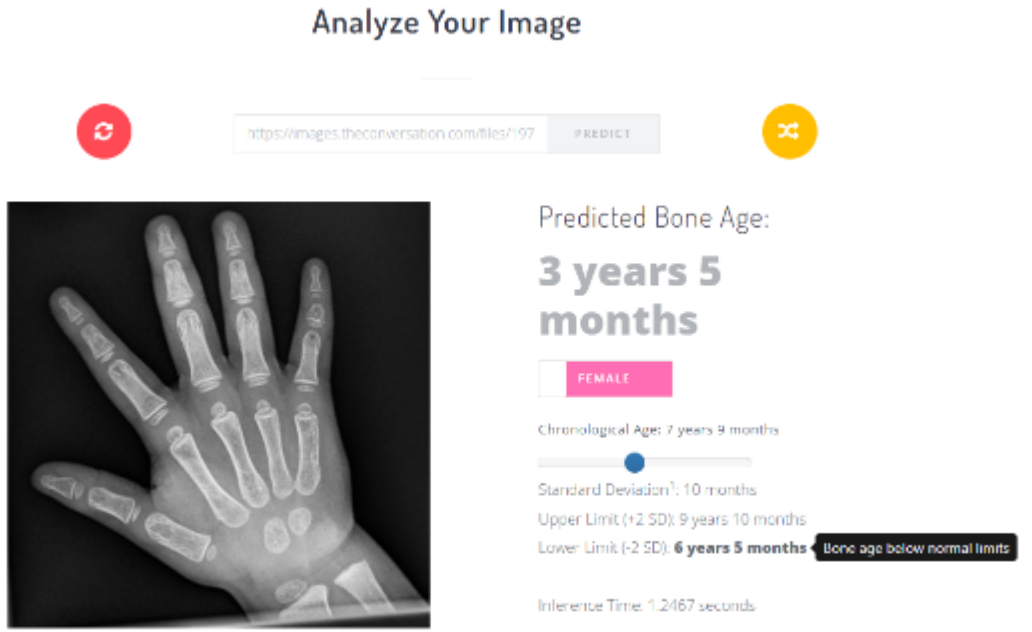
14 observations on CXR labelled by radiology reports on 10,507 xrays from 3000 patients sampled at random from CheXpert database (of 224,316 radiographs). Publically available dataset. Images by 2 different smartphones (Nokia 6.1, iPhone 8)



RECA – recalibrated DL model
ORIG – original DL model

Kuo PC et al. NPJ Digital Medicine 2021 Feb 4(1):25 Recalibration of DL models for abnormality detection in smartphone –captured chest radiograph

Smartphone technology!

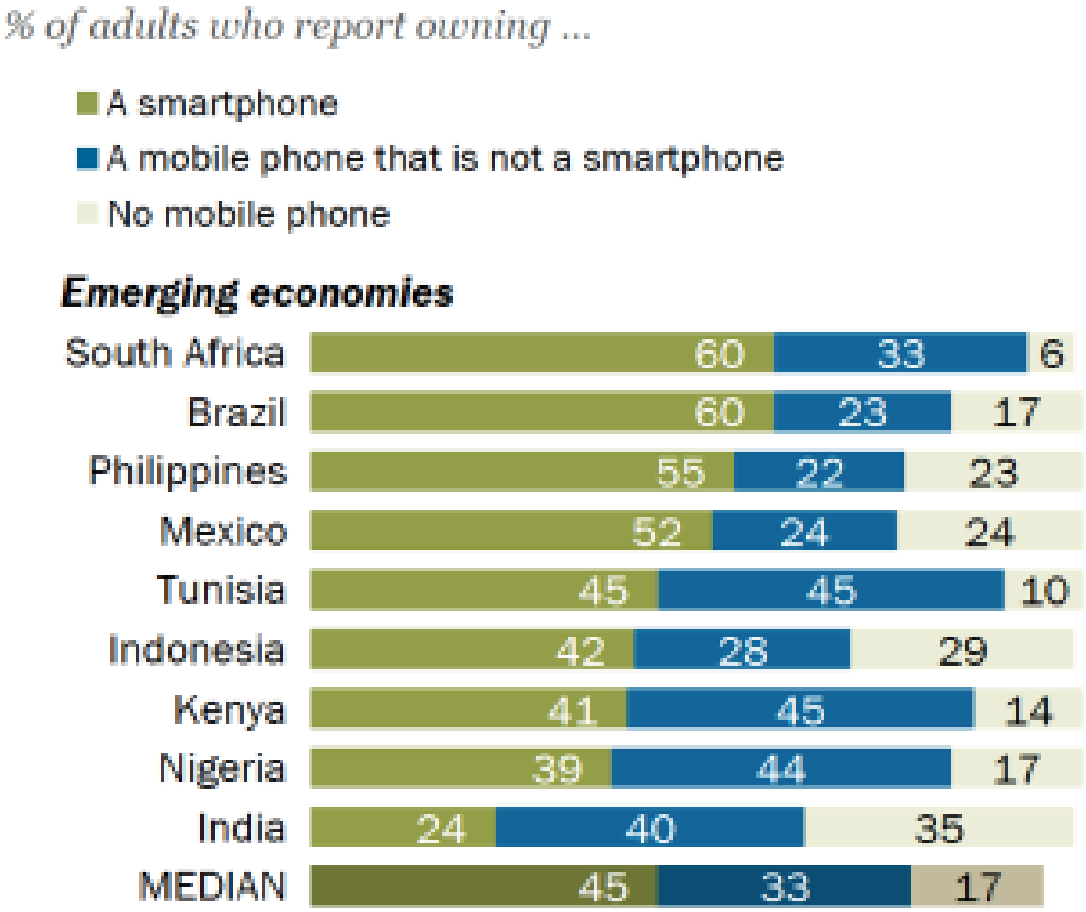


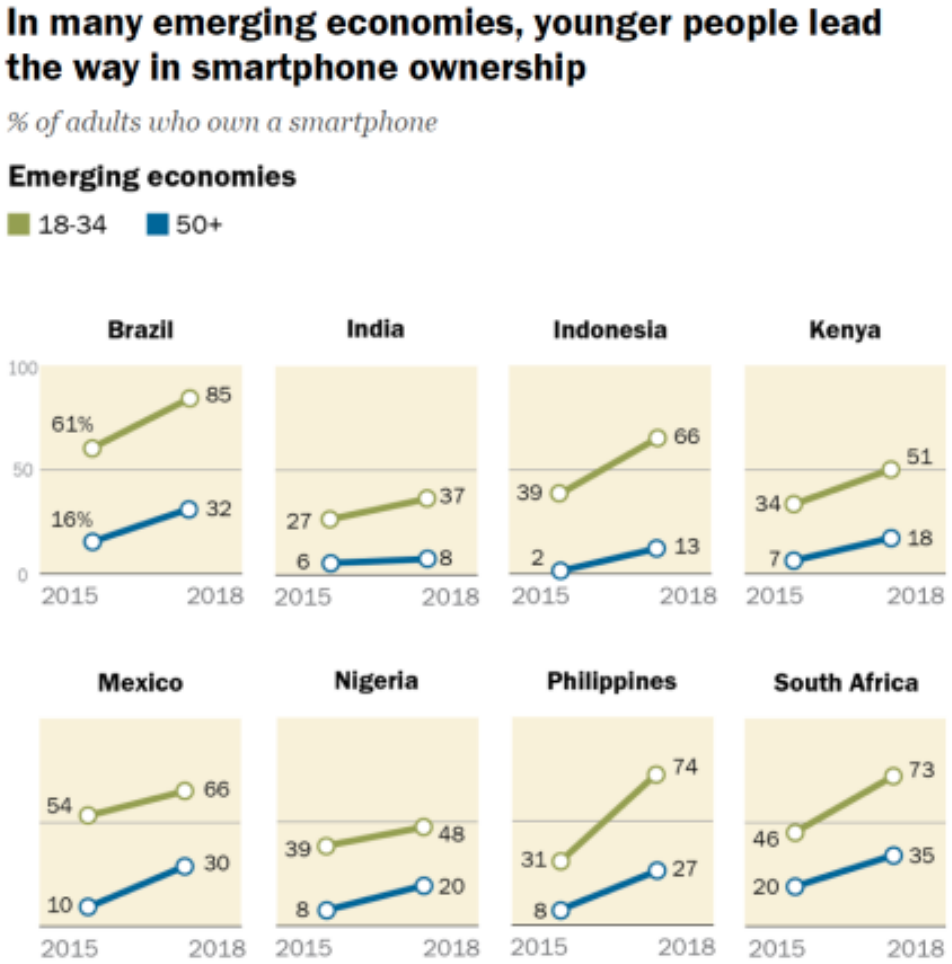
16 Bit AI – Physis TM - https://www.16bit.ai/

12612 from 2 x USA hospitals. Ages 1 month – 19 years old (mean 127 months, 10 years 7 months). Winner of RSNA Bone Age Challenge.

Halabi SS et al. The RSNA Pediatric Bone Age Machine Learning Challenge. Radiology 2019. Feb 290(2):498-503

Smartphone ownership?



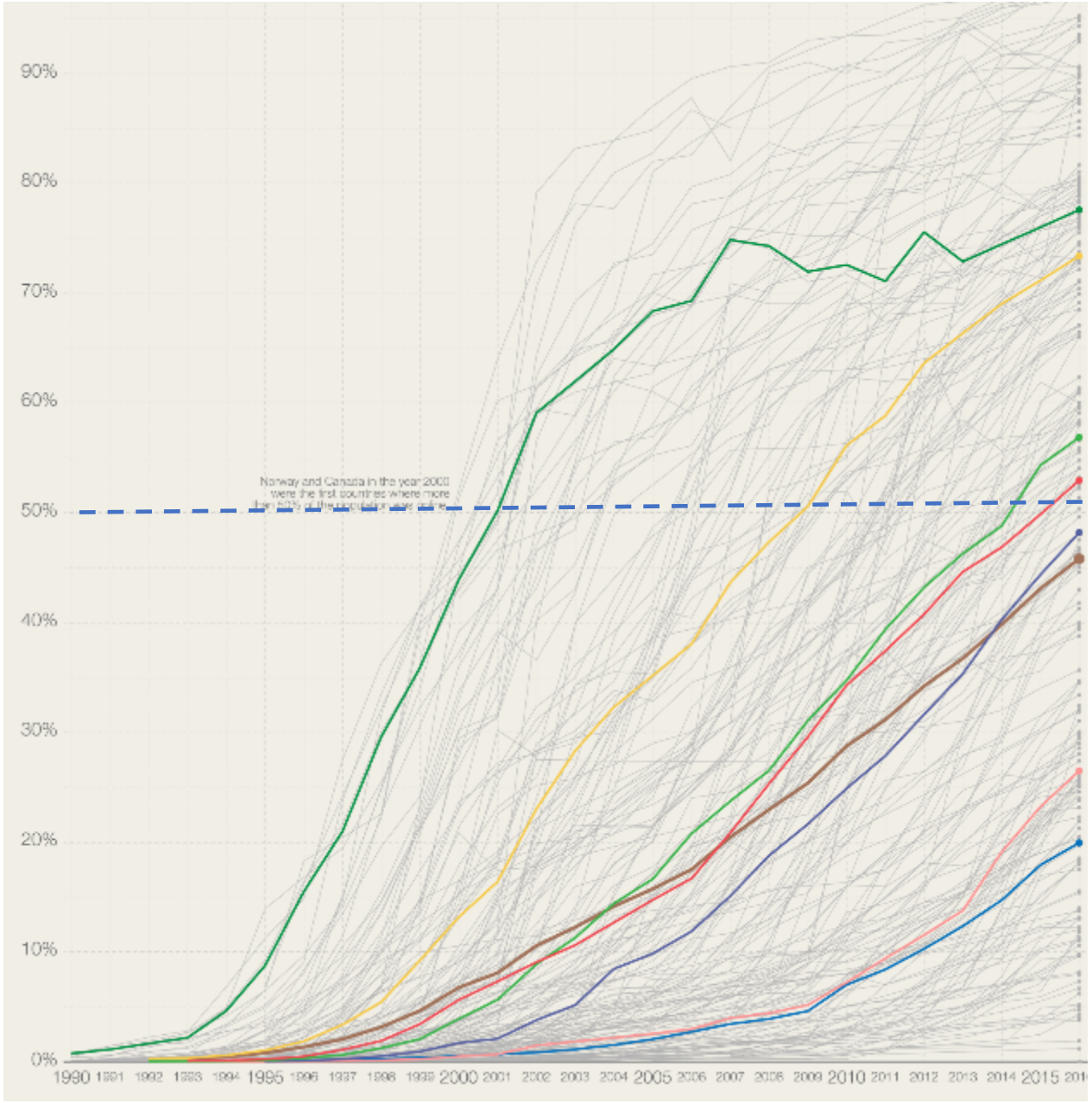


Pew Research Center. Smartphone ownership is growing rapidly around the world, but not always equally. Feb 2019. www.pewresearch.org

Internet access

In many developing countries, less than 25% of population have access to internet.

But it is growing…!



Our World in Data, www.ourworldindata.org/internet

Help?

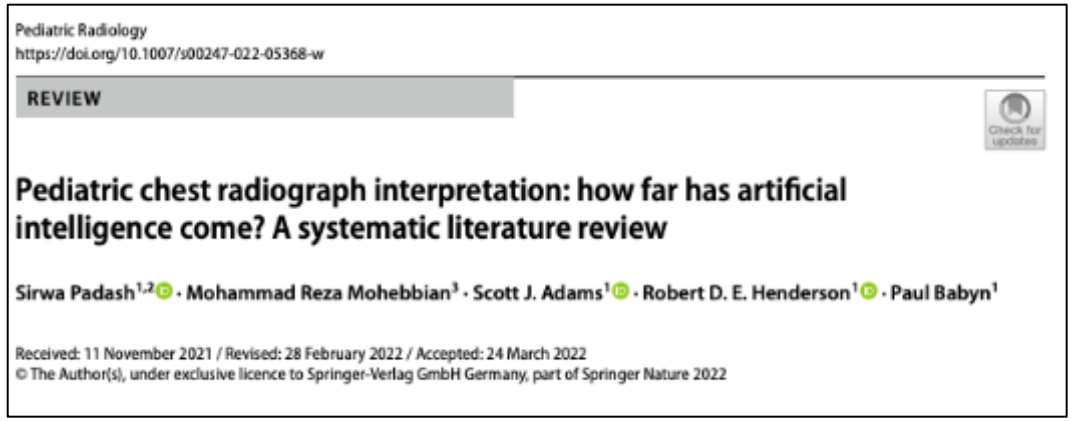
- Help with lack of local expertise/staff
- Can be used for point of care, immediate response for disease identification
- No need for expensive software installation if on smartphone
- Better efficiencies? Good for triage?
- Identify what cases need expert opinion via teleradiology

Curse?

- Need trained radiographers
- Need good radiography equipment.
- Need a good PACS / smartphone cameras
- Internet access, smartphone cost
- Experience using smartphone
- Tech support if failure?
- Narrow AI solutions
  - Single diseases/body system
  - Single modality

AI specific concerns

- External validation – does it work on different populations? Paeds?!
- Do we have enough data on rare diseases? E.g. TB
- Can't get an AI to cover all possible eventualities/ diseases
- Are our systems biased and increase the health inequalities?
- Are staff trained to know when AI is giving erroneous results?
- Does greater accuracy = better care?



Pediatric Radiology
https://doi.org/10.1007/s00247-022-05368-w

REVIEW

Pediatric chest radiograph interpretation: how far has artificial intelligence come? A systematic literature review

Sirwa Padash[1,2] · Mohammad Reza Mohebbian[3] · Scott J. Adams[1] · Robert D. E. Henderson[1] · Paul Babyn[1]

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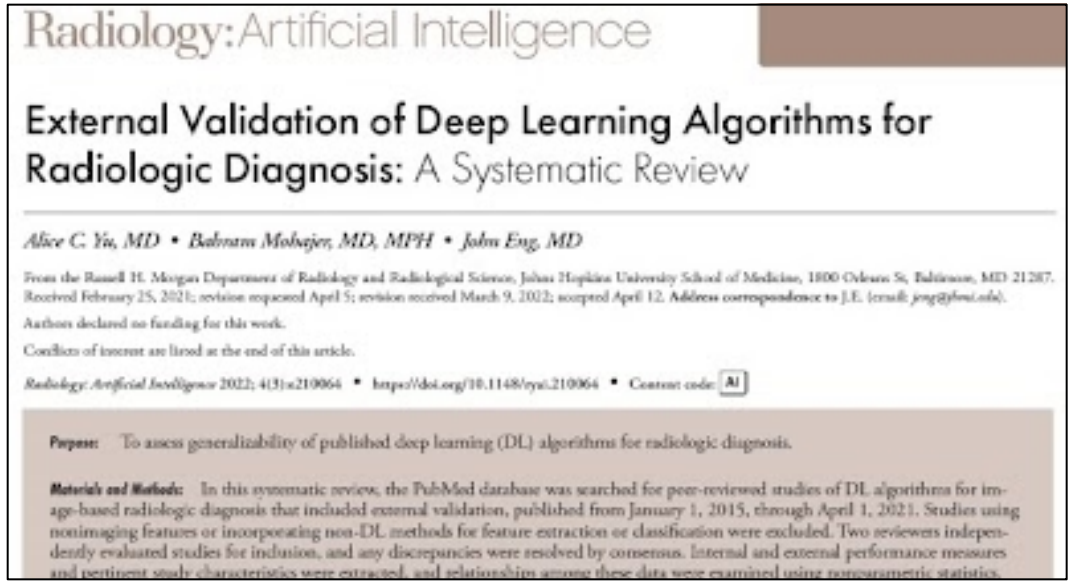

Radiology: Artificial Intelligence

External Validation of Deep Learning Algorithms for Radiologic Diagnosis: A Systematic Review

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From the Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, 1800 Orleans St, Baltimore, MD 21287. Received February 25, 2021; revision requested April 5; revision received March 9, 2022; accepted April 12. **Address correspondence to** J.E. (email: *jeng@jhmi.edu*).

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Conflicts of interest are listed at the end of this article.

Radiology: Artificial Intelligence 2022; 4(3):e210064 • https://doi.org/10.1148/ryai.210064 • Content code: AI

Purpose: To assess generalizability of published deep learning (DL) algorithms for radiologic diagnosis.

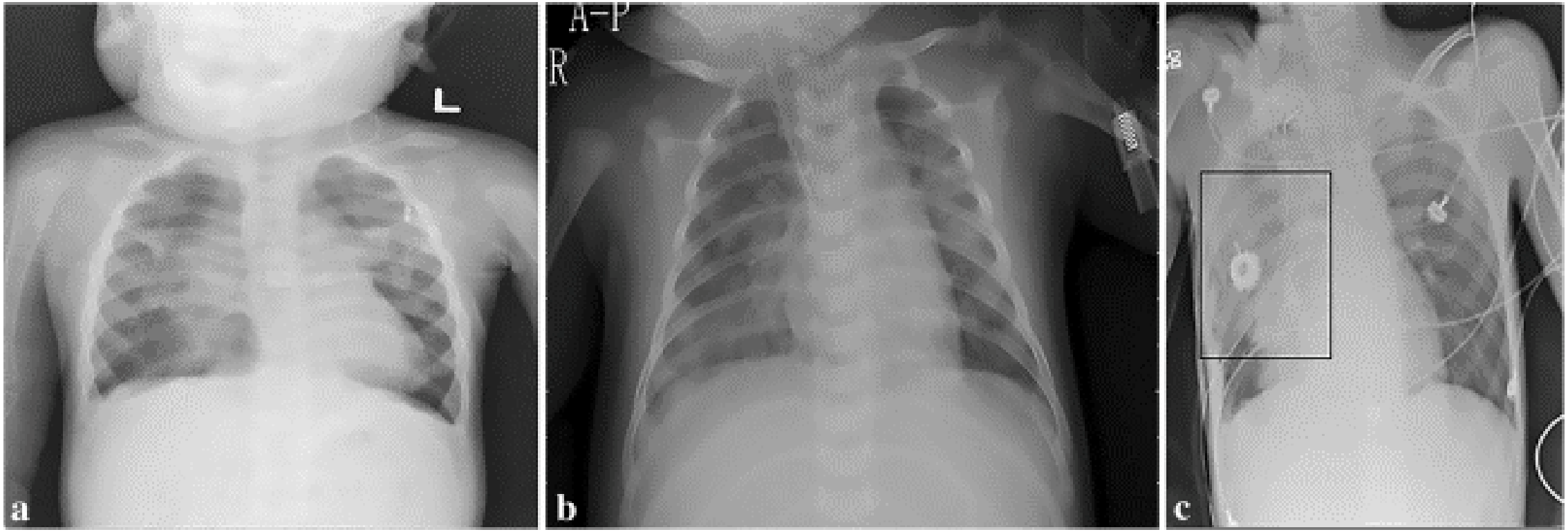
Materials and Methods: In this systematic review, the PubMed database was searched for peer-reviewed studies of DL algorithms for image-based radiologic diagnosis that included external validation, published from January 1, 2015, through April 1, 2021. Studies using nonimaging features or incorporating non-DL methods for feature extraction or classification were excluded. Two reviewers independently evaluated studies for inclusion, and any discrepancies were resolved by consensus. Internal and external performance measures and pertinent study characteristics were extracted, and relationships among these data were examined using nonparametric statistics.

What do I call this…? Labelling Datasets

NIH-14 CXR dataset
Label: Infiltration, Effusion

GWCMC CXR dataset
Label: Bacterial pneumonia
Lines/tubes not labelled

RSNA CXR dataset
Label: Lung opacity



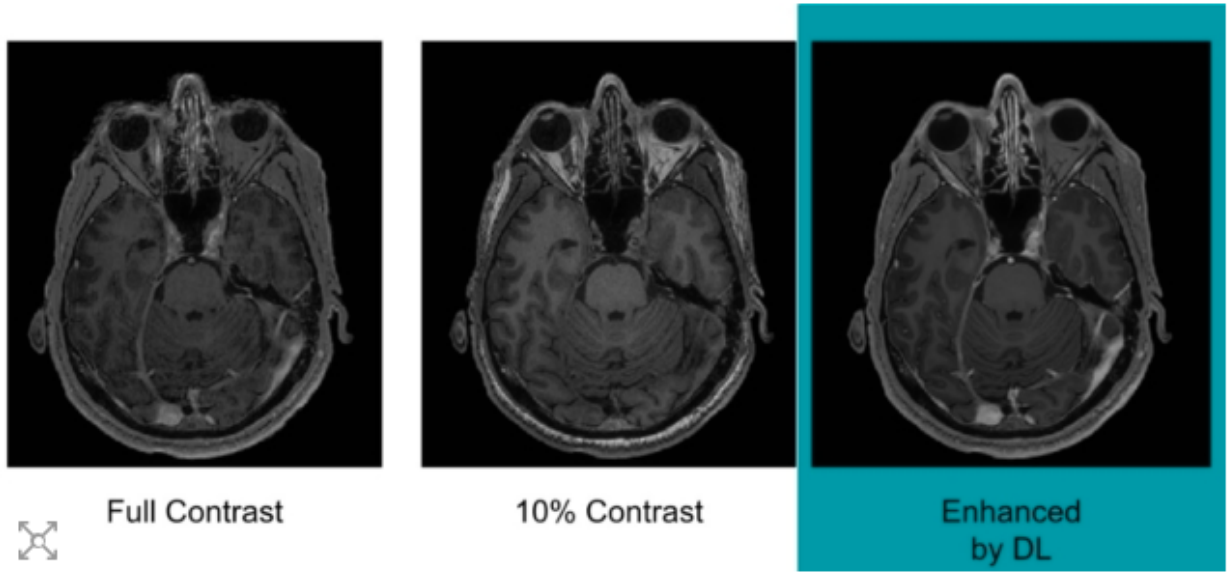
Padash S et al. Ped Rad 2022. Pediatric chest radiograph interpretation: how far has artificial intelligence come? A systematic literature review.

If we get over this…

DIAGNOSTIC IMAGING | RESEARCH UPDATE

Artificial intelligence helps reduce gadolinium dose in MR imaging

26 Nov 2018 Tami Freeman

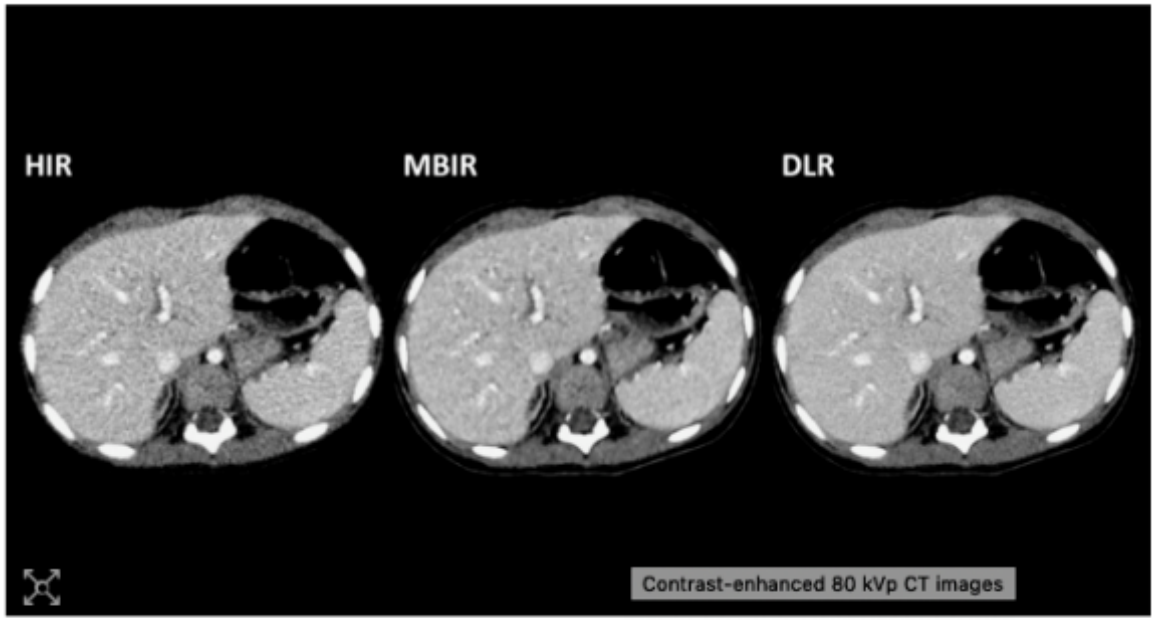


Full-dose and low-dose (10%) MR images, and low-dose images enhanced by the deep learning algorithm. (Courtesy: Radiological Society of North America)

DIAGNOSTIC IMAGING | RESEARCH UPDATE

Deep learning can decrease radiation dose in paediatric CT scans

29 Mar 2022



Reducing the scan dose Contrast-enhanced low-dose CT images of a 4-year-old boy, reconstructed using hybrid iterative reconstruction (HIR), model-based iterative reconstruction (MBIR) and deep learning-based reconstruction (DLR). (Courtesy: Yasunori Nagayama)

AI the solution? Don't forget the basics!

Quality images are vital to provide quality reports & opinions

Possibly helped by AI, mostly need to train sonographers/radiographers

Need good quality equipment to work with first

Radiation Safety

May be reduced with some AI techniques? Needs training and optimization

Cost saving options

Possibly AI can play a role for contrast/radiation reduction, still requires further research

Triage cases requiring specialist opinions, and reassure those not needed

Can be assisted by AI, possibly using smartphone technology – need good PACS/equipment

Thank you very much

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Join or new ESPR AI Taskforce

Meeting today – Friday 10th June

Salle 50 BIS at 12:30pm – 13.30pm