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Working Group on AI for Human Health
WG-AI4HH

The WG-AI4HH focuses on AI for supporting physicians in the diagnosis and treatment of cancer through better image interpretation, improved treatment plans and contouring as well as allowing efficient adaptive radiotherapy.

Ms Cornelia Loechl, Mr Mauro Carrara, Ms Miriam Mikhail, Mr Arthur Andrade

4 working sub-groups
12 external experts
1 plenary speaker
15 IAEA staff members

8+ meetings together with:

- Data Privacy (MT)
- NSRW
- CLP4NET
- MTIT

Mr Yaroslav Pynda
WG-AI4HH coordinator

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WG Session 4.2
The use of AI in nuclear nutrition assessments

Ms Cornelia Loechl
Ms Alexia Alford

Nutritional and Health-Related Environmental Studies Section
IAEA

Technical Meeting on Artificial Intelligence for Nuclear Technology and Applications
#AI4Atoms Virtual Event 25–29 October 2021

State of the Art

- AI and nutrition is a growing area – many areas beyond IAEA nutrition scope
  - Clinical research
  - Nutritional epidemiology
  - Personalised nutrition
- Challenges of AI in nuclear nutrition techniques:
  – performance is only as good as the quality of the data

Next Steps

- Body composition data to predict clinical outcomes of diet-related NCDs and all-cause mortality
- More efficient and accurate analysis of CT scans and DXA scans for body composition or bone analysis
- Federated learning approaches

Accelerating Progress—IAEA's Role

- R&D of AI in using body composition to predict clinical outcomes of diet-related NCDs
- R&D of AI to improve analysis of body composition from CT and DXA scans
- Support Member States to collect quality data using nuclear techniques
- Data curation activities
- Integration of AI in regional capacity building efforts (benefits, appropriate use)

Expected Outcomes

- IAEA Databases of nuclear nutrition techniques
- Capacity in Member States to use DXA and CT scans in assessing body composition
- New R&D opportunities

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The use of AI in Radiotherapy: summary of the sub-WG discussion

Mauro Carrara on behalf of the sub-WG

Division of Human Health - Department of Nuclear Sciences and Applications

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State of the art

- Interest in the use of AI in radiotherapy and medical physics has been growing
  - Lack of clear definitions about terms related to AI
  - Data curation is fundamental (data selection, standardization and harmonization, processing)
- Despite the “popularity” in the scientific literature, the use of AI-based tools is not widely spread so far
  - Profound potential but real risks of unintended and negative consequences
  - Challenges in their implementation
  - Legal and ethical issues

Next steps

- The routine use of deployed AI-based technologies in radiotherapy and medical physics is expected to grow over the next 5-10 years
- Clinical introduction of AI-based technologies:
  - For supervised task replacement (e.g. image segmentation) or decision support (e.g. treatment planning)
  - Shall **not** reduce the need for education and training of radiotherapy professionals (RO, MP, RTTs)
  - Shall **not** be used for complicated tasks to circumvent lack of trained radiotherapy professionals who can do it
  - Radiotherapy professional are in the lead. A bigger core team might be needed for support, depending on the application.

Accelerating Progress—IAEA's Role

- Practices using AI-based technologies should adhere to the IAEA International Basic Safety Standards (e.g. justification, optimization)

- In regard to the use of AI-based technologies, IAEA support to Member States may be needed in the fields of:
  - Education and training of the involved health professionals
  - Global oversight and governance in partnership with other UN organizations
  - Define specs and support in procurement
  - Clinical implementation and harmonization of the use of AI-based technologies

Expected Outcomes

- Document summarizing the discussion of the WG
- Guidelines in critical areas identified during the WG discussion, for safe and effective use clinically deployed AI-based technologies

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Summary of the Medical Imaging and Nuclear Medicine Working Group

IAEA Coordinators:

Ms. Miriam Mikhail
Ms. Diana Paez
Mr. Francesco Giammarile

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State of the Art

1. Which **AI applications are already being used most frequently with success**?

- **AI as second reader for the detection of lung nodules in patients with cancer (CT)**
- **Commercially developed models to rule out pathology on chest CT**
- **CRP on radiomics and AI for evaluation of patterns on chest CT for COVID-19 patients**
- **AI to improve radiology workflow, RSNA education certificate**

a. In which clinical field and to what extent? (Limited to one country/multiple country examples?)

- **AI for lung cancer screening, France example**
- **Evaluation of COVID-19 patients**

State of the Art

2. Which **clinical applications hold the greatest potential for countries**, and for which clinical indications or contexts?

- **Cancer imaging**
  - **especially AI for lung cancer screening (including restaging)**
- **TB and CXR**
- **Pandemics**

Acknowledging

- **Potential for all organ systems**
- **Multidisciplinary nature of AI and imaging**
  - **in RT planning, surgical planning…**

State of the Art

3. Coupled with technologies like radiomics, telemedicine, machine learning and virtual reality, **how could AI best help bridge gaps in medical imaging access and improve quality and safety**? What are the successful stepwise implementation phases?

Quality and safety

- **Image reconstruction**
- **Applications→ protocols, patient-specific optimization**
- **Quality assurance and validation of AI tools, medical physicists**

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Home / Activities / Calibrating computer-aided detection for TB

Overview

A research toolkit to support the effective use of computer-aided detection (CAD) software for TB by calibrating CAD score thresholds and other parameters.

Chest radiography (CXR) plays a key role in the screening and triage of pulmonary tuberculosis (TB) and can guide the effective use of diagnostic testing to improve case detection and cost-efficiency. Computer-aided detection (CAD) products use artificial intelligence (AI) to analyse CXR for the presence of abnormalities suggestive of pulmonary TB and can improve the feasibility and performance of CXR for TB screening and triage. CAD technologies for TB detection have recently been recommended for use by WHO among adults aged 15 years or more, in place of human readers for interpretation of digital chest radiography in both screening and triage for TB disease.

Next steps

5. What **further implementation (translational) research is needed**; could more IAEA **Coordinated Research Projects** (CRPs) make a difference, perhaps for particular high-priority epidemiologic needs or clinical indications? **Yes**

   - **ongoing CRP on CT and COVID-19 as part of pandemic preparedness**
   - **proposed CRP on chest X-ray and TB**

Accelerating Progress—IAEA's Role

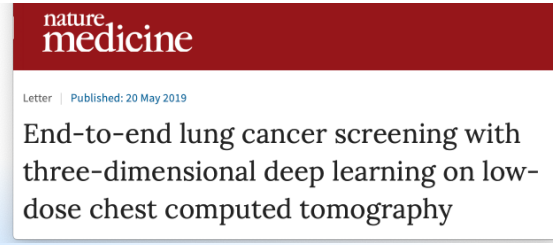
6. In compliance **with the IAEA's mandate** and available mechanisms to assist Member States, how can the agency best work with the scientific and medical community to maximize the benefits of AI on-the-ground while minimizing its risks and avoiding its pitfalls?

- **As there is no long-term prospective validation of any AI solution for imaging, the IAEA is uniquely positioned to conduct multinational research**
  - **A primary topic of interest is thoracic imaging**
    - **lung cancer, tuberculosis, the identification of emerging infections which involve the lungs**
- **Convene > on this topic**
  - **AI is applicable to the imaging of multiple organ systems and has tremendous prognostic capacity when combined with radiomics, machine learning, and big data.**
- **IAEA is uniquely positioned to collect and curate data, paucity of data for LMICs**

Low-dose CT screening reduces lung cancer–related mortality by 20 to 39%, *when CT scans are read by expert (s)*

1- Aberle DR et al. Reduced lung-cancer mortality with low-dose computed tomographic screening. N Engl J Med 2011
2- Pastorino U et al. Prolonged lung cancer screening reduced 10-year mortality in the MILD trial: new confirmation of lung cancer screening efficacy. Ann Oncol. 2019
3- de Koning HJ et al. Reduced Lung-Cancer Mortality with Volume CT Screening in a Randomized Trial. N Engl J Med. ২০২০

- **What about AI reading?**
  - No prospective validation, problem of technology change



A team of researchers at Google is planning to use deep learning to look for signs of lung cancer in people. So far

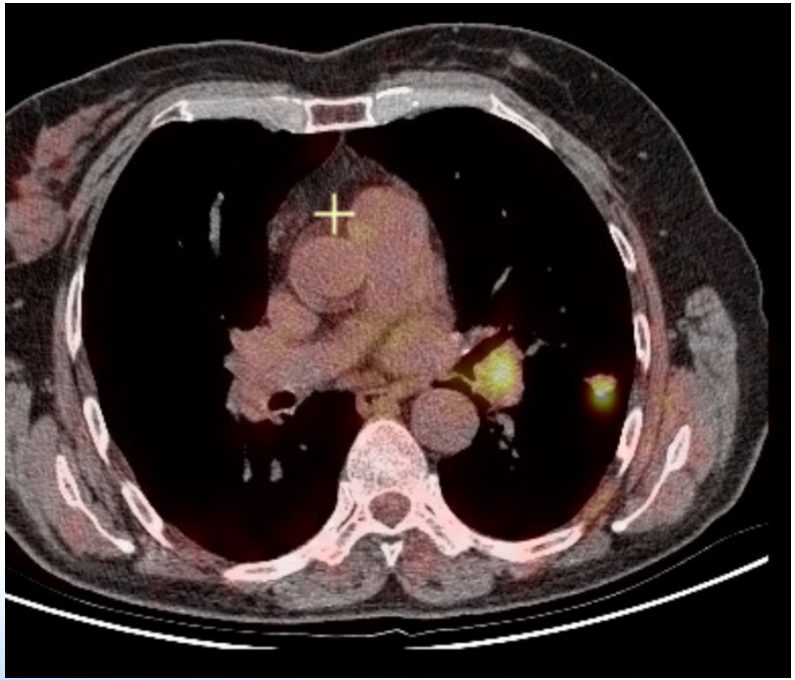
Google engineers have developed a new AI program capable of diagnosing lung cancer in patients more accurately than most human doctors.

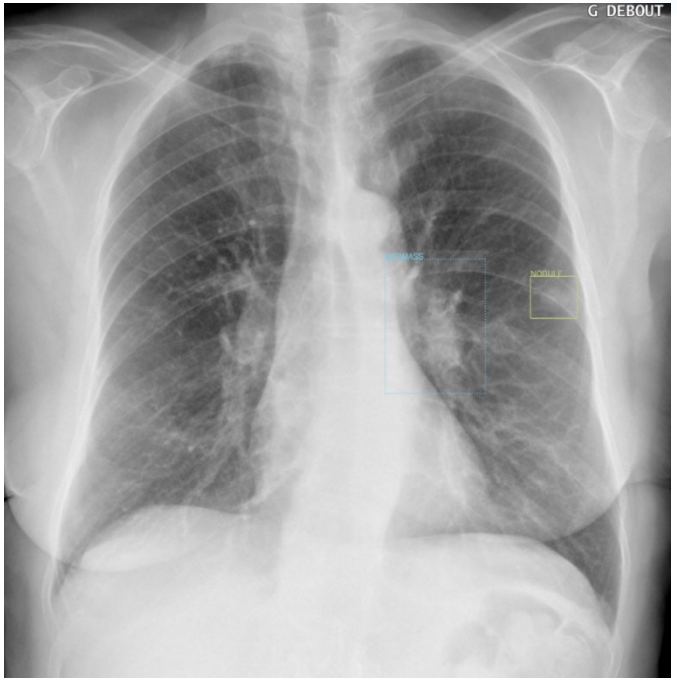
In a study featured in the journal *Nature Medicine*, researchers trained a deep learning program to detect the malignancy with success rate of 94.4 percent.

While Google AI is still considered a work in progress, it offers a brief glimpse of what the technology holds for the future of medicine.

*Presented by Professor Marie-Pierre Revel

Next step: allow detection of lesion invisible to the human eye





*Presented by Professor Marie-Pierre Revel

AI will *not* replace professionals, but complement them and strengthen their capacity to best serve patient populations.

No long-term prospective validation of any AI solution for imaging exists, and the IAEA is uniquely positioned to conduct multinational research.

Frontier

Expected Outcomes

1st output of this meeting would be a publication

Future results

- CRPs
- Data collection and curation
- Agency to be involved, to assist MS as they integrate the privacy / ethical and legal framework on data collection (structured guidance)

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Summary of the Working Group on AI in Health Education

Arthur Andrade on behalf of the sub-WG

Division of Human Health - Department of Nuclear Sciences and Applications

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State of the Art

- AI implications for Education:
  1. Design and Use of AI technologies to tackle educational challenges
  2. Educating people about AI so that they can use it effectively and ethically
  3. Innovation in Education to prepare people for an AI-driven world
- Research shows that AI applications (such as ITS) can have a **positive impact on learning** and that it is possible to create **effective AI** in Education
- General AI Applications involve the use of AI Chatbots, AI in AR/VR, AI in Serious Games, Automation/Search, Recommendation Systems, AI for Accessibility in Training, enhanced learning analytics, ITS
- Challenges:
  - Ethical and legal considerations;
  - Potential biases;
  - Quantity, quality and source of input data

Next Steps

- AI in Education will get more prevalent in the future
- Focus on Human-AI hybrid systems for intelligence augmentation and enhancement of learning experiences with high human agency
- AI will continue to be used to improve the learning experience
- Data input will come from different sources (multimodal data)
- Learning Sciences should lead AI development and adoption in Health Education (AI to solve learning problems)
- Strong stakeholder collaboration and value-alignment will be needed to implement AI in Health Education

Accelerating Progress—IAEA's Role

- Identify the added value of AI in terms of impact, investments, human resources for educational/training activities in NAHU
- Consider the use of AI in the learning design of future educational/training activities in Health, but not as a first choice
- Consider the use of AI to assess human behaviour in terms of participant success while being mindful of potential biases
- Investigate the ethical and legal framework needed for data collection in education settings and how this may play a role in the future for the adoption of AI solutions in NAHU activities

Expected Outcomes

- Monitor AI in (Health) Education trends and assess use in NAHU educational/training activities in the future
- Further discussion and assessment of AI in Health Education are needed

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Thank you!