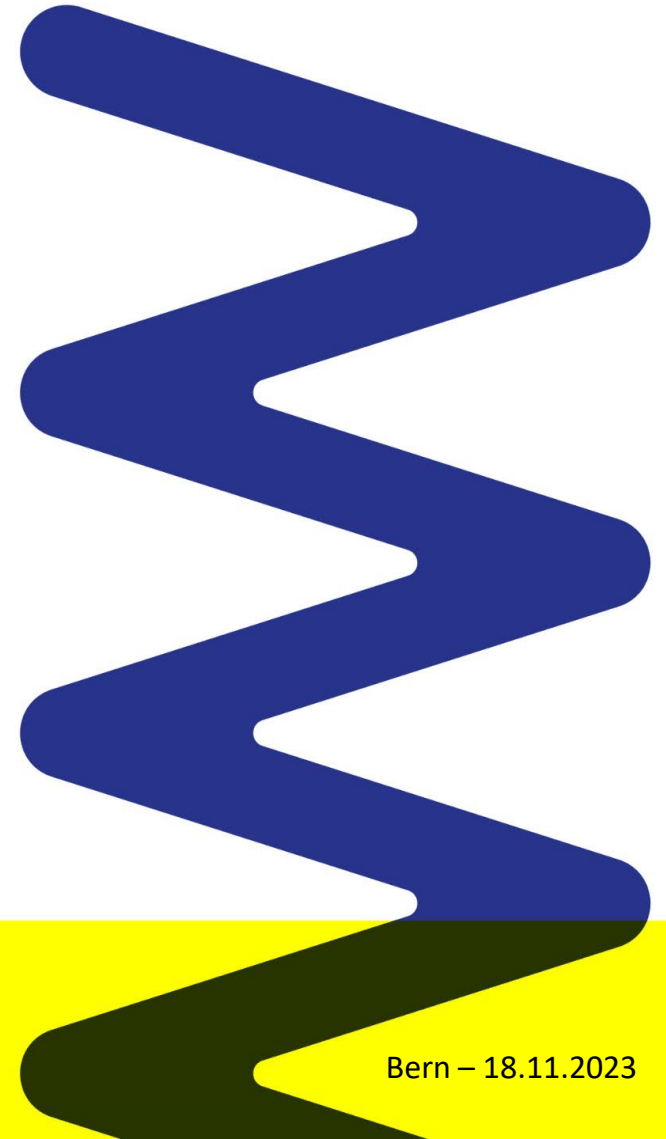# Artificial Intelligence in radiology – hype or mutation of the profession?

Journée des TRM 2023 // Tag der Radiologiefachpersonen 2023

Prof. Jérôme Schmid

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h e d s
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Hes·so GENÈVE
Haute Ecole Spécialisée
de Suisse occidentale

Bern – 18.11.2023

Artificial Intelligence in radiology – hype or mutation of the profession?

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Artificial Intelligence in radiology – hype or mutation of the profession?

Artificial Intelligence in radiology – hype or mutation of the profession?

AI+RAD: A GROWING PRESENCE OF AI IN RADIOLOGY

TODAY: AI AND RADIOGRAPHERS

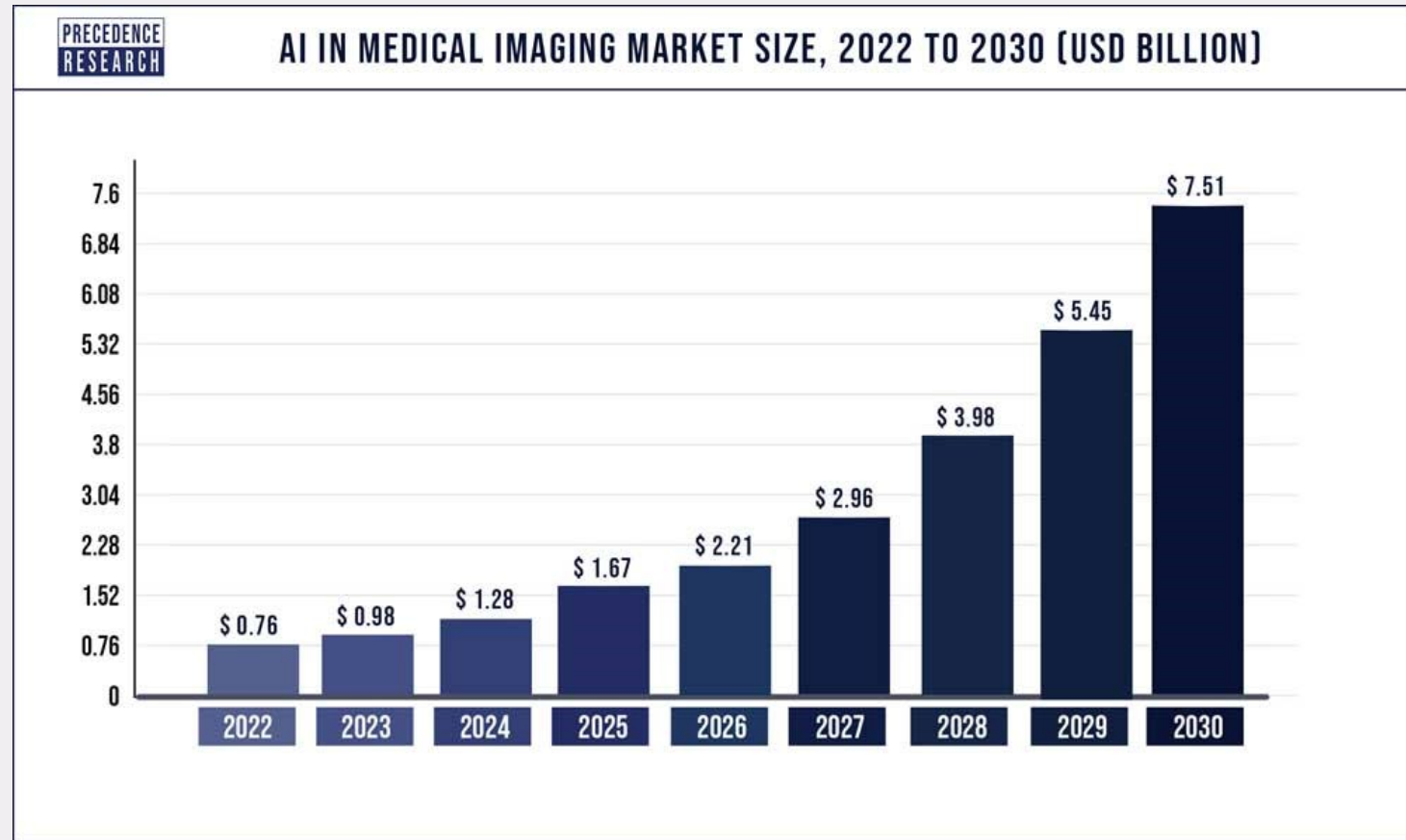**CLINICAL:** AI INTEGRATION IN CLINICAL PRACTICE

IMPACT: HOW AI MAY SHAPE OUR FUTURE PRACTICE

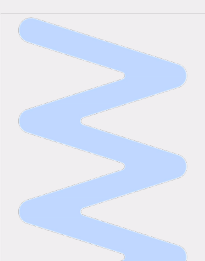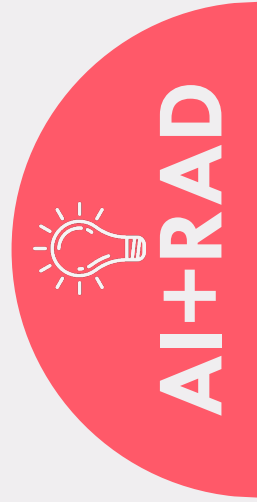**FUTURE:** RECOMMENDATIONS TO PREPARE OURSELVES

Q&A: YOUR QUESTIONS & COMMENTS

AI increasing presence in medical imaging market

AI IN MEDICAL IMAGING MARKET SIZE, 2022 TO 2030 (USD BILLION)

PRECEDENCE RESEARCH

Year	Value
2022	$ 0.76
2023	$ 0.98
2024	$ 1.28
2025	$ 1.67
2026	$ 2.21
2027	$ 2.96
2028	$ 3.98
2029	$ 5.45
2030	$ 7.51

https://www.precedenceresearch.com/ai-in-medical-imaging-market

Q&A FUTURE IMPACT CLINICAL TODAY

AI+RAD

AI in radiology boosting product certifications and investments

531 FDA-cleared AI solutions for radiology
https://grand-challenge.org/aiforradiology/
(nov. 2023)

~ **88%** of the 64 AI products in radiology (2020)

npj | Digital Medicine

www.nature.com/npjdigitalmed

ARTICLE **OPEN**

Check for updates

The state of artificial intelligence-based FDA-approved medical devices and algorithms: an online database

Stan Benjamens[1,2], Pranavsingh Dhunnoo[3] and Bertalan Meskó[3,4]

ELSEVIER

Journal of the American College of Radiology

JACR

Available online 16 October 2023

In Press, Corrected Proof (?) What's this? ↗

Original Article

Projected Growth in FDA-Approved Artificial Intelligence Products Given Venture Capital Funding

Nicole K. McNabb BS [a], Eric W. Christensen PhD [b], Elizabeth Y. Rula PhD [c], Laura Coombs PhD [d], Keith Dreyer DO, PhD [e], Christoph Wald MD [f], Christopher Treml MS [g]

" *By 2035, we project medical imaging venture capital funding will increase to roughly $32.7 billion with 304 new FDA-approved products, assuming an accelerated 5-year lag between funding and approval* "
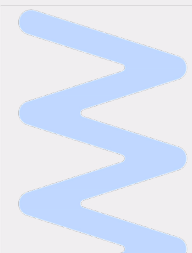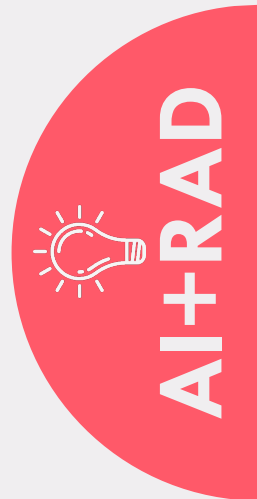
Q&A FUTURE IMPACT CLINICAL TODAY

AI+RAD

AI in radiology boosting product certifications and investments

GUIDANCE DOCUMENT

Marketing Submission Recommendations for a Predetermined Change Control Plan for Artificial Intelligence/Machine Learning (AI/ML)-Enabled Device Software Functions

Draft Guidance for Industry and Food and Drug Administration Staff

APRIL 2023

https://www.fda.gov/regulatory-information/search-fda-guidance-documents/marketing-submission-recommendations-predetermined-change-control-plan-artificial

- FDA plans to allow AI manufacturers to update their product without the need to submit a new application or supplement.
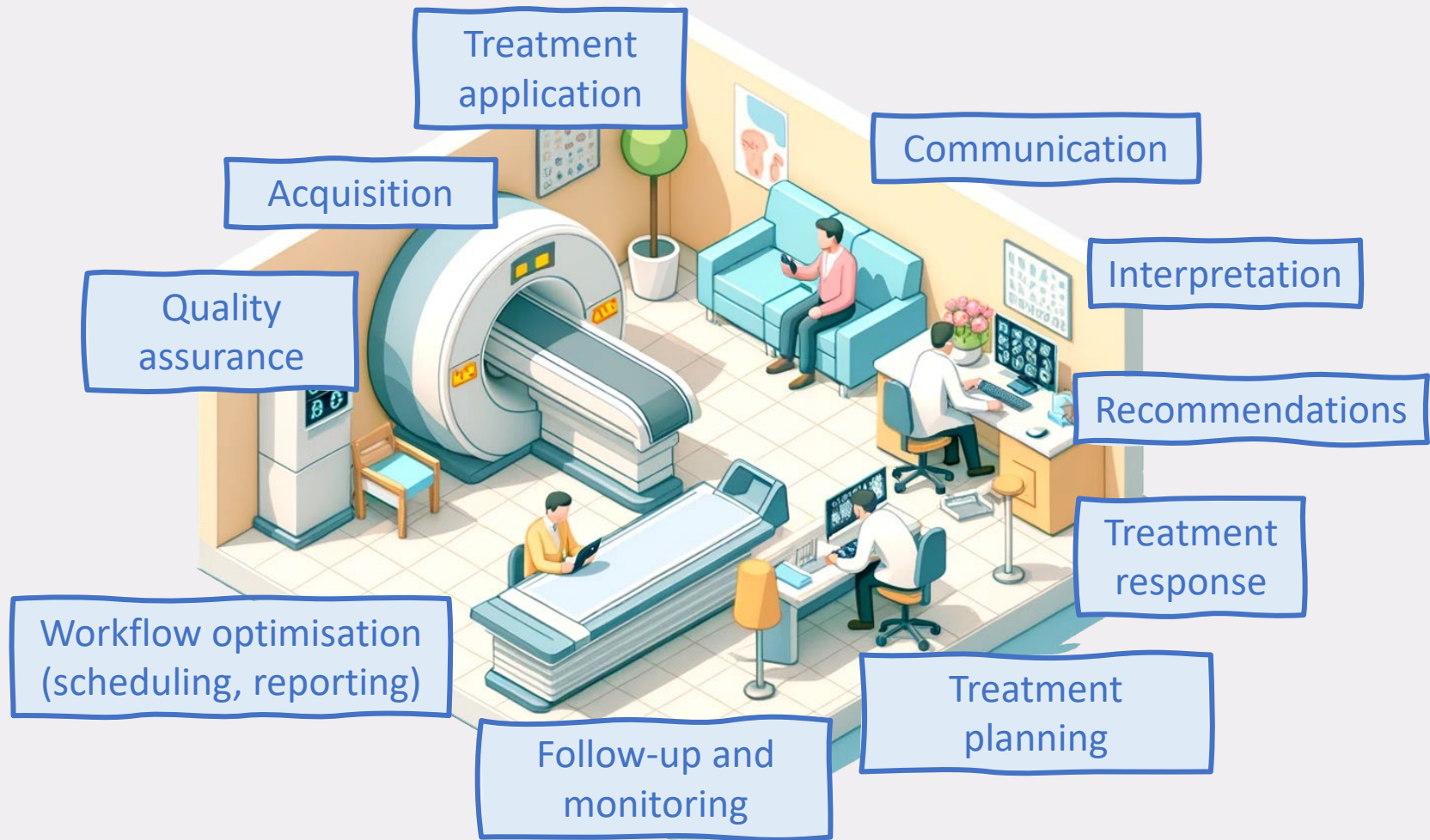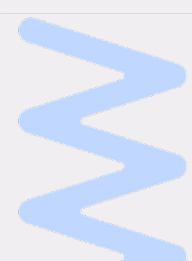
→ Paves the way for **ADAPTATIVE AI**

Where is AI found in radiology (research)?

AI+RAD

Treatment application

Acquisition

Communication

Quality assurance

Interpretation

Recommendations

Treatment response

Workflow optimisation (scheduling, reporting)

Follow-up and monitoring

Treatment planning

Where is AI found in radiographer practice?

- Patient or equipment positioning
- Selection of image acquisition parameters (scan range, MRI FOV, kV, mAs, sequence parameters, etc.)
- Therapy planning (contouring, dosimetry, MR-to-CT conversion, etc.)
- Image reconstruction across modalities to improve image quality, reduce artifacts, speed-up the acquisition
- Dose optimization
- Standardization (projective radiography, ultrasound, etc.)
- Post-processing (e.g., multiplanar imaging, 3D reconstructions)

Malamateniou, C., Knapp, K. M., Pergola, M., Woznitza, N., & Hardy, M. (2021). Artificial intelligence in radiography: where are we now and what does the future hold?. Radiography, 27, S58-S62.

Al-Naser, Y. A. (2023). The impact of artificial intelligence on radiography as a profession: A narrative review. Journal of Medical Imaging and Radiation Sciences, 54(1), 162-166.

What do radiographers think about AI?

frontiers in Digital Health

OPEN ACCESS

Beauty Is in the AI of the Beholder: Are We Ready for the Clinical Integration of Artificial Intelligence in Radiography? An Exploratory Analysis of Perceived AI Knowledge, Skills, Confidence, and Education Perspectives of UK Radiographers

Edited by:
Yiannis Kyratsis,
Vrije Universiteit
Amsterdam, Netherlands

Reviewed by:
Niamh Lennox-Chhugani

Clare Rainey[1], Tracy O'Regan[2], Jacqueline Matthew[3], Emily Skelton[3,4], Nick Woznitza[5,6], Kwun-Ye Chu[7,8], Spencer Goodman[2], Jonathan McConnell[9], Ciara Hughes[1], Raymond Bond[10], Sonyia McFadden[1†] and Christina Malamateniou[3,4*†]

HESAV

Artificial Intelligence impact on radiographers' activities and profession in Switzerland

M. Champendal[1], S. De Labouchère[1,2], I. Gremion[1], S. Ghotra[1], S. Torre[3], R. Khine[4], L. Marmy[1], C. Malamateniou[1,5,6], C. Sá dos Reis[1]

[1] HESAV/HES-SO; Lausanne, CH;
[2] CHUV, Lausanne, Switzerland
[3] Frimley NHS Trust, Greater London, UK
[4] School of Health and Social Care Professions, Buckinghamshire New University, Wycombe, UK
[5] King's College London, St Thomas' Hospital, London, UK
[6] City - University of London, London, UK

Radiography 28 (2022) 943–948

Contents lists available at ScienceDirect

Radiography

ELSEVIER

journal homepage: www.elsevier.com/locate/radi

Radiographers' knowledge, attitudes and expectations of artificial intelligence in medical imaging

S. Coakley[a], R. Young[a], N. Moore[a], A. England[a,*], A. O'Mahony[b], O.J. O'Connor[b], M. Maher[b], M.F. McEntee[a]

[a] Discipline of Medical Imaging and Radiation Therapy, School of Medicine, University College Cork, Ireland
[b] Department of Radiology, Cork University Hospital, Ireland

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essentia

2019 Artificial Intelligence Survey

asrt

American Society of Radiologic Technologists

Q&A · **FUTURE** · **IMPACT** · **CLINICAL** · **AI+RAD**

What do radiographers think about AI?

Champendal et al. 2023: 🇨🇭
- 57.2%: AI is an opportunity vs. 18.5%: AI is a threat
- AI will mainly impact CT, MR and RT planning and the tasks of image reconstruction and post-processing

Coakley et al. 2022: 🇪🇺
- Overall positive attitudes towards AI implementation but with some apprehensions

Rainey et al. 2021: 🇬🇧
- Most radiographers with some AI knowledge, acquired it in a self-taught manner

Common to all three studies:
- Lack of sufficient technical knowledge, low confidence in AI terminology
- Perception of insufficient training provision on AI

ASRT 2019: 🇺🇸
- Mostly positive opinion on AI
- Sufficiently familiar with AI, with ~50% of training received onsite
- Lack of standardized process for resolving discrepancies between machine advice and radiographer judgment
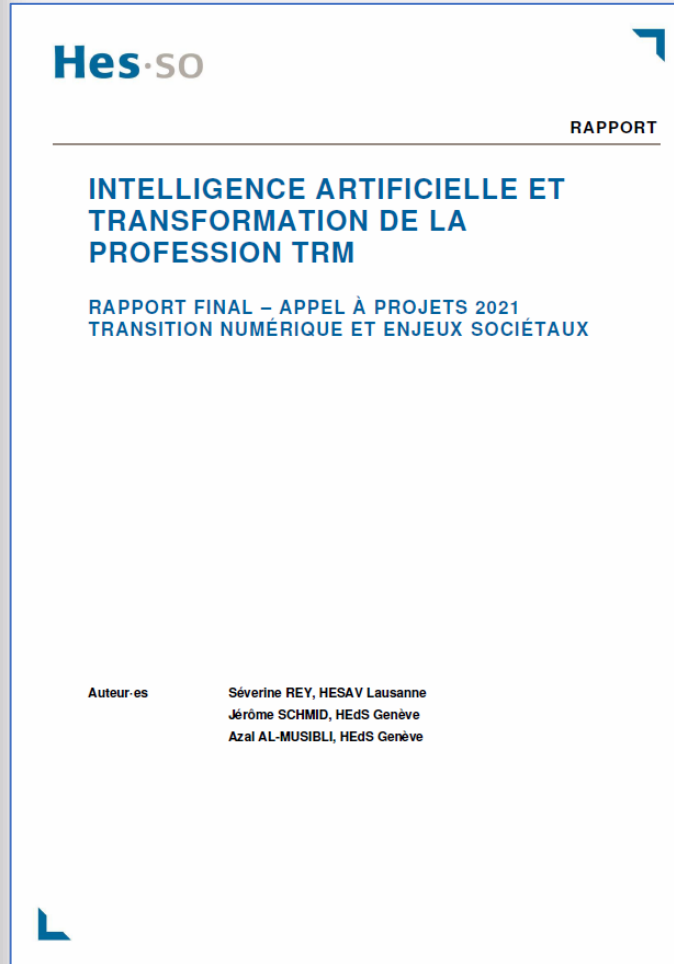
What do radiographers think about AI?

- Observation at 3 clinical sites in French-speaking Switzerland on how radiographers interacted with AI systems
- Interviews

- Highlights:
  - Representation of AI that varies between people, often (wrongly) limited to CAD.
  - AI is positive if it reduces repetitive tasks, improves training or dose management
  - AI is negative as it does not consider the diversity of patients, has bugs, or weakens the radiographer profession

Q&A   FUTURE   IMPACT   CLINICAL   TODAY   AI+RAD

Clinical integration of AI

REVIEW ARTICLE

Artificial Intelligence and Machine Learning in Radiology
Current State and Considerations for Routine Clinical Implementation

Julian L. Wichmann, MD,*† Martin J. Willemink, MD, PhD,‡ and Carlo N. De Cecco, MD, PhD§

Investigative Radiology • Volume 55, Number 9, September 2020 | www.investigativeradiology.com

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Physica Medica 100 (2022) 12–17

Contents lists available at ScienceDirect

Physica Medica

journal homepage: www.elsevier.com/locate/ejmp

ELSEVIER

Review paper

Current challenges of implementing artificial intelligence in medical imaging

Shier Nee Saw [a,*], Kwan Hoong Ng [b,c]

- Huge potential of AI supported by research, manufacturers and startups.
- But deployment in clinical practice is limited.
- Need to involve all stakeholders and solve ethical and regulatory issues.
- Data is the bottleneck of AI.

Clinical integration of AI

IMAGING INFORMATICS AND ARTIFICIAL INTELLIGENCE

Artificial intelligence in radiology: 100 commercially available products and their scientific evidence

Kicky G. van Leeuwen[1] · Steven Schalekamp[1] · Matthieu J. C. M. Rutten[1,2] · Bram van Ginneken[1] · Maarten de Rooij[1]

- +100 AI products in radiology with CE marking, 64% of which do not demonstrate clinical efficacy.
- Only 18% demonstrated a (potential) clinical impact.

- Essential to test the validity and feasibility of AI results in clinical conditions.

Contents lists available at ScienceDirect

Clinical Radiology

ELSEVIER

journal homepage: www.clinicalradiologyonline.net

Review

Challenges and opportunities for artificial intelligence in oncological imaging

H.M.C. Cheung[a], D. Rubin[b],*

Clinical integration of AI

European Radiology
https://doi.org/10.1007/s00330-023-10181-6

REVIEW

Barriers and facilitators of artificial intelligence conception and implementation for breast imaging diagnosis in clinical practice: a scoping review

Belinda Lokaj[1,2,3] · Marie-Thérèse Pugliese[1] · Karen Kinkel[4] · Christian Lovis[2,3] · Jérôme Schmid[1]

- 107 publications included in the 2012-2022 period
- Focus on conception and clinical integration
- Exemplified for clinical breast imaging but most observed barriers and facilitators present in other types of studies

Clinical integration of AI

BARRIERS

FACILITATORS

B1 DATA

B2 BLACK-BOX AND TRUST

B3 ALGORITHMS AND CONCEPTION

B4 EVALUATION AND VALIDATION

B5 LEGAL, ETHICAL AND ECONOMIC ISSUES

B6 EDUCATION

Papers

F1 DATA

F2 CLINICAL IMPACT

F3 ALGORITHMS AND CONCEPTION

F4 EVALUATION AND VALIDATION

F5 EDUCATION

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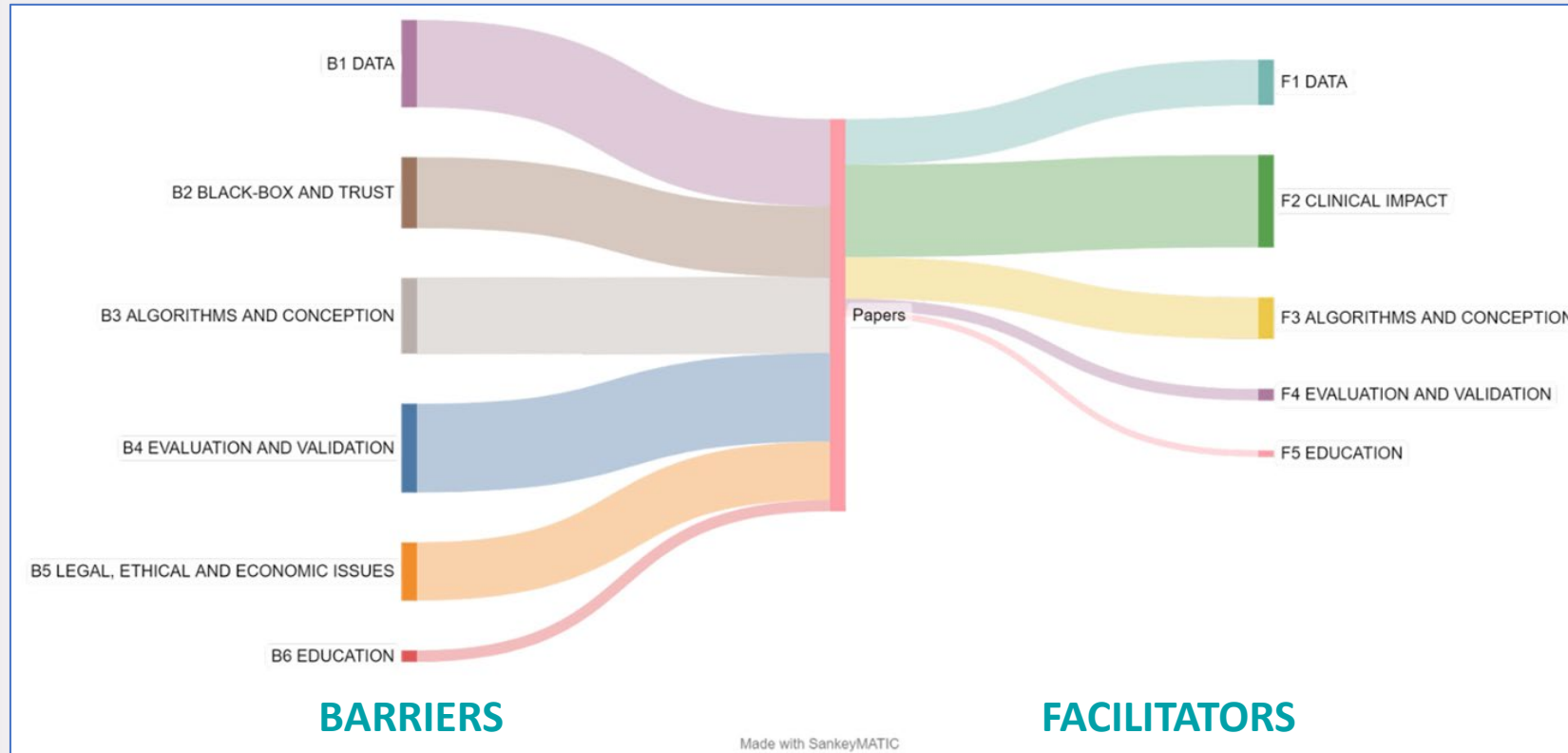
Impact of AI

Take-over due to automation

What are the conditions for a task to be challenged by AI? (Villani et al. 2018)

- Lack of flexibility (repetition of the same series of gestures or operations)
- Lack of adaptability (no need to interrupt a task in progress to perform an unplanned one and the task consists of a strict application of orders, instructions)
- Lack of problem-solving skills (radiographers would rely on other professionals to solve a problem in an abnormal situation)
- Absence of social interactions (limited contact with the public, pace of work not imposed by external demand): when the patient is absent, or the radiographer mostly work alone (no intra/inter-collaborative work)
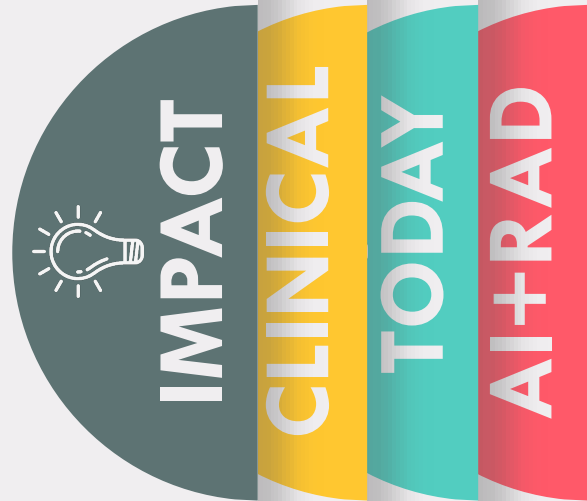
Villani, C., Bonnet, Y., Berthet, C., Levin, F., Schoenauer, M., Cornut, A. C., & Rondepierre, B. (2018). *Donner un sens à l'intelligence artificielle: pour une stratégie nationale et européenne*. Conseil national du numérique.
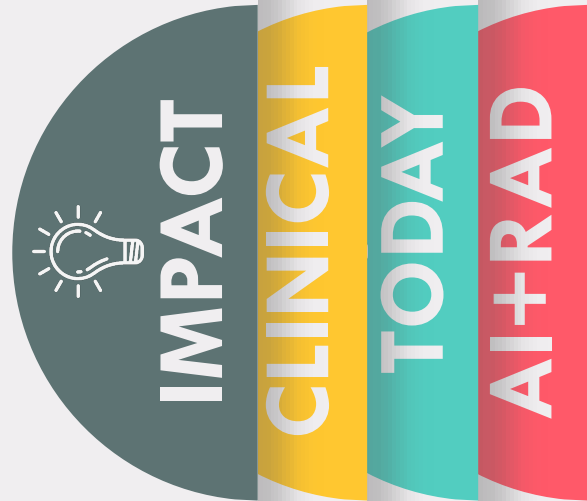
Impact of AI

Transformation of activities

- AI may assist radiographers in current tasks to:
  - Achieve better performance and efficiency
  - Support radiographer and patient satisfaction

- AI may affect other professionals, which may in return transform the radiographer activities
  - e.g., radiologists mainly rely on AI → AI prefer images acquired in a certain manner → radiographers will have to update their protocols

- AI may strengthen the radiographer-patient relationship (Young et al. 2021):
  - Patients and the general public convey in general positive attitudes toward AI
  - But had many reservations and prefer human supervision

Young, A. T., Amara, D., Bhattacharya, A., & Wei, M. L. (2021). Patient and general public attitudes towards clinical artificial intelligence: a mixed methods systematic review. *The Lancet Digital Health*, *3*(9), e599-e611.
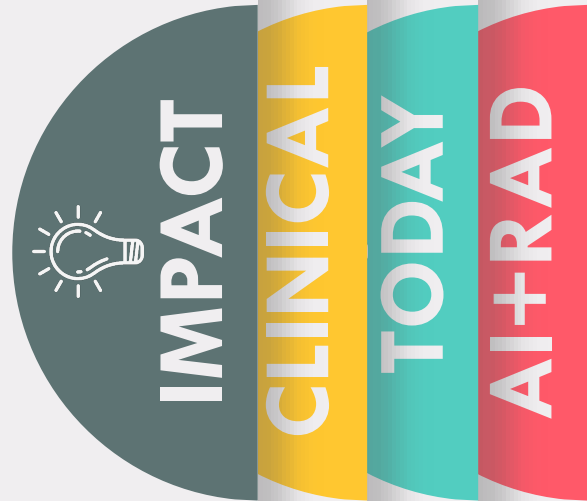
Impact of AI

Creation of new profiles and skills

- Clinical AI / data specialists responsible of onsite data curation, model performance monitoring (adaptive AI), QA, etc.
- Validation of AI tools in clinical setup, considering regulation, safety and efficacy
- Industry support in the design of explainable AI solutions
- Participated in discussions on clinical accountability for AI solutions.
- Training around AI
- Communication and actions to improve understanding and correct use of AI among patients (e.g., use of generative AI such as ChatGPT)
- Participation in the definition of future careers or extensions of radiographer roles around AI

Malamateniou, C., Knapp, K. M., Pergola, M., Woznitza, N., & Hardy, M. (2021). Artificial intelligence in radiography: where are we now and what does the future hold?. Radiography, 27, S58-S62.

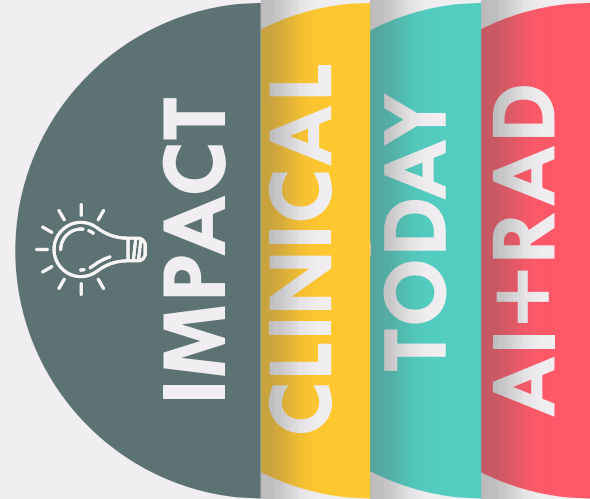Q&A FUTURE IMPACT CLINICAL TODAY AI+RAD

Impact of AI

Overblown hype of AI

Following the rationale of Dr. Kau on the profession of radiologists, an excessive hype of AI capabilities can:

- Scare away people from becoming a radiographer
- Increase use of medical imaging

→ Ultimately contributes to and worsen the shortage of radiographers

Kau, T. (2023). AI in clinical imaging: 5 years of AICI. AI Symposium 2023, Unibe.

Q&A FUTURE IMPACT CLINICAL TODAY AI+RAD

Recommendations

1. Adapt teaching and training curriculum (postgraduate, continuing education)
2. Continue to learn
3. Participate in the design and validation (e.g., data analysis, annotation) of AI systems
4. Position ourselves as possible managers of the quality assurance of AI systems
5. Don't focus on possible losses but accept change and recognize the added value of AI in presence of objective facts
6. But highlight the human and care skills of radiographers, as well as a developed critical sense on the pros and cons of AI systems
7. Don't forget that patients prefer to interact with people, but also value the quality and efficacy of care
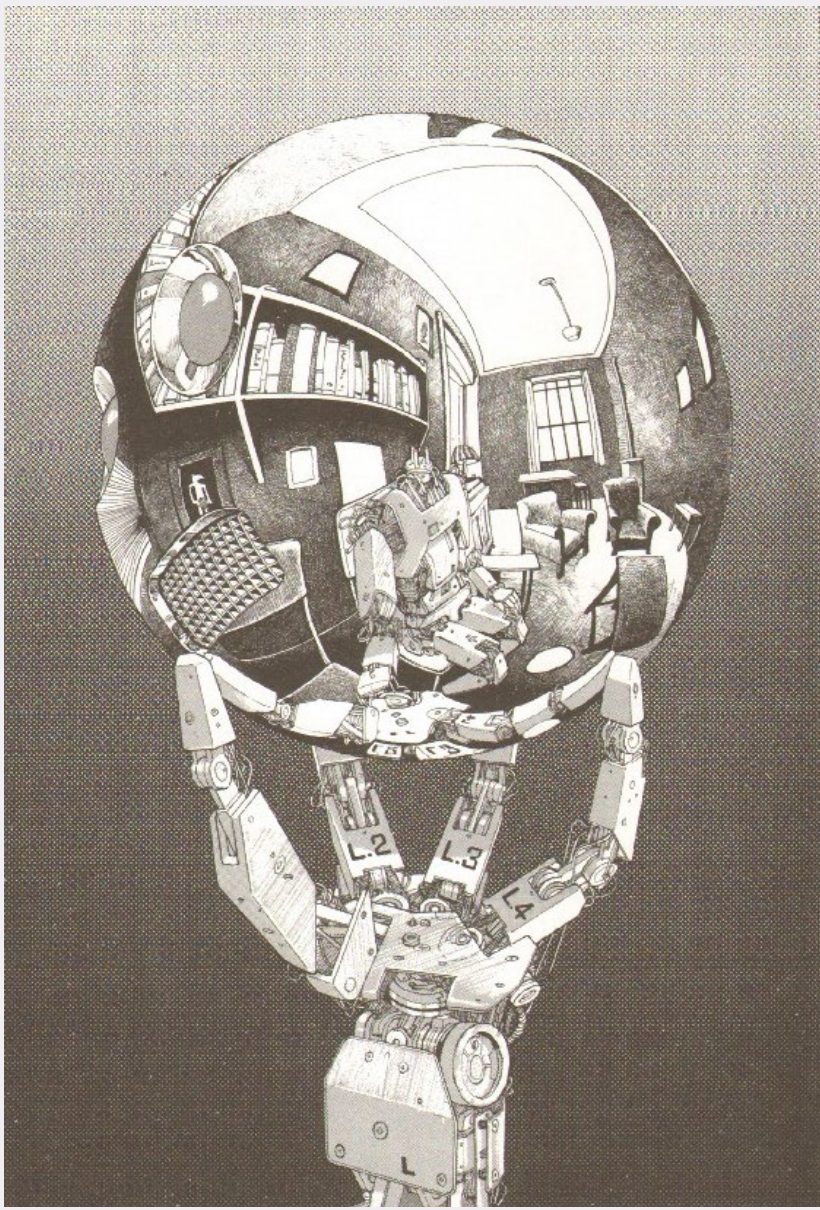
FUTURE

IMPACT

CLINICAL

TODAY

AI+RAD

8. Remember that AI is slowly but surely transforming radiology and that some of its hype will turn into productivity over time

Hype Cycle for Artificial Intelligence, 2023
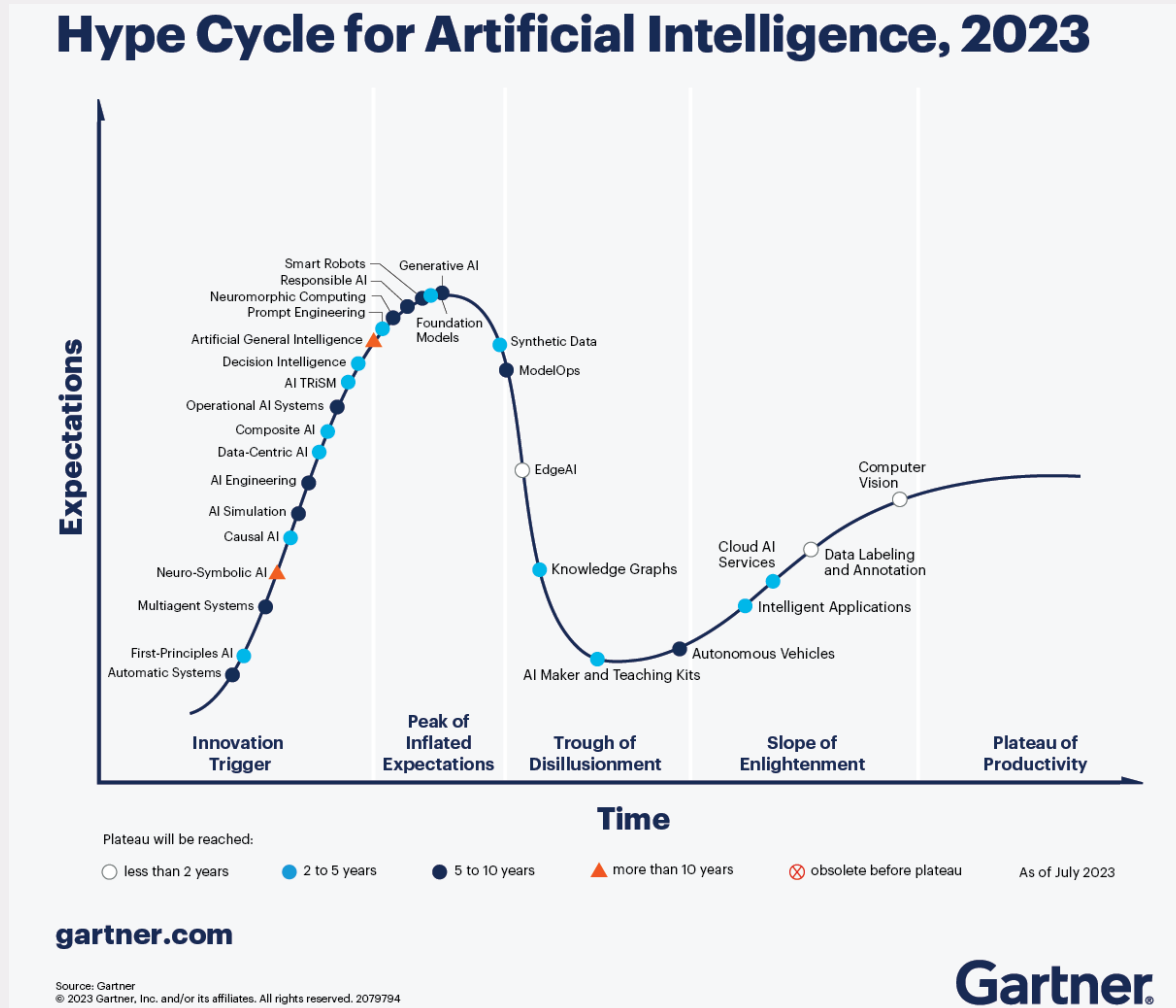
« Anthology », Katsuhiro Otomo (1990)

THANK YOU FOR YOUR ATTENTION

Q&A

FUTURE

IMPACT

CLINICAL

TODAY

AI+RAD