# JOINT SCOPING

# Artificial Intelligence in Healthcare

**Context**

AI (artificial intelligence)[1] / ML (machine learning) are increasingly used in healthcare settings, and in the consumer market (personal monitoring). For example, AI/ML are deployed in tumour diagnosis from image analyses, prediction of oxygen needs in hospitalised Covid patients, medicine administration, homecare in healthy ageing, etc. AI may be incorporated as a clinical tool in care pathways; as a component in medical devices or surgical robots; in the delivery and monitoring of combinational therapy e.g. precision medicine involving identification of high-risk/likely responder groups. Advanced modelling can also be used in disease surveillance and prevention, estimations of patients' prognosis, early detection of emerging zoonoses, and in health systems management to help guide the deployment of healthcare resource.

To summarise a use-case, AI can successfully detect tumour lesions, characterize them as malignant, predict aggressiveness, link to genomic expression and estimate response to treatments. AI can be employed, using either only images or integrating images and clinical data, to assist radiologists, nuclear medicine specialists and physicians to make better decisions with an increasing accuracy on individual patients with a specific cancer type. Examples already validated in these scenarios have been described in many different clinical situations such as brain, breast, lung and prostate tumours.

Thus, the application and integration of AI can extend widely across primary care and specialist care settings, clinical support (e.g. pathology), with the potential to better integrate across these healthcare boundaries, underpinned by the necessary transformation and connection of large-scale digital data platforms. With the ability to analyse large volumes of health data at speed to detect complex patterns, the promise of AI is for greater efficiency, speed and accuracy[2]. Alongside opportunities, there are nonetheless associated challenges and risks such as on data quality, algorithmic and governance issues which the proposed project will address.

[1] For the purposes of this proposal, AI is used in the "popular" sense – (the science of developing) computer programmes and digital devices to simulate and support intelligent (human) behaviour and decision making, currently largely using machine learning (ML) - ~~rather than the purist definition of artificial human (self-aware) intelligence which does not exist~~ [Ref CMS]. The report will further expand on types of AI (e.g. general AI, narrow AI) to make clear the current and near-term applications in healthcare that we are focusing on. *[NB The EP definition: "AI is the capability of a computer program to perform tasks or reasoning processes that we usually associate with intelligence in a human being"]*

[2] Use-cases, both current and future, their opportunities/ value and limitations, will be expanded on in the report.

**The policy problem**

Since end-users (patients, healthcare professionals) are unlikely to examine the validity of the AI within the product/service offered, it is vital that there is an adequate framework of regulation and guidance governing the development and deployment of AI, to ensure that it is optimally harnessed for health gain, that health is not harmed, and privacy and public trust is maintained. In the next section, we address the pertinent aspects of AI in regulation and standardisation. While policy gaps in these areas are recognised by experts, some are best addressed at national/supranational level (e.g. data privacy, certification of algorithms), while others could be pragmatically addressed as demonstrators at local level with subsequent clustering more widely to deliver practical solutions (e.g. federating data).

*[For this project, we are excluding the use of AI in discovery research and development of medicines. Although downstream implications may reach-back into development, it is not the* a priori *focus]*

**The policy issues arising**

Issues arising from the emerging AI technology centre around a lack of standardisation and approaches to evaluation. As AI relies on "big data"-type approaches, many issues stem from data mining, data analysis, and data linkage. Ultimately these affect the accuracy and reliability of the ensuing clinical predictions. Along with highlighting the issues for consideration, the project will recommend how they might be addressed.

- Quality of data, quality control – the reliability of algorithm development based on the use of training datasets hinge on the quality of initial data (with implications for R&D, plus the long-term aspiration for data from routine healthcare to automatically feed back into validation cycles, an area that has been challenging in quality data capture). While there are ways to increase the quality of data retrospectively (again based on algorithms), it would be advantageous to reduce an additional layer of variability / error.
- Data heterogeneity, data uncertainty, progression from prediction at subpopulation level towards individual patient level and heightened significance of residual error, are issues relevant to the prediction of outcomes.
- Validation of algorithms is impacted by several factors:
    - Training and validating datasets used – variation may arise from how data is selected (bias), robustness (e.g. genuine replication vs repeated measures), representation (e.g. diversity of the demographic), and volume of data, with implications for fairness, equity, and transparency.
    - Continuous learning for the algorithm and refinement with new data.
    - Updating of software given the rapid pace of advance – version control, stage-gating of "approval" or kitemarking are options that the project can explore. How to ensure these are performed consistently and transparently.
    - A role for regulators and guidances. As a precedent, Europe has had experience in examining the technical approaches and associated policy implications of the application of modelling and simulation in clinical developments (EMA in conjunction with FDA, MHRA, and MHLW), developing guidance documents and regulatory requirements based on interdisciplinary workshops and technical surveys as part of a specific joint project.

- Ability to federate datasets that sit in different parts of the health system or indeed different clinics/hospitals depending on what data were measured, how they were collected and when. Who will drive the capability to federate? The state-wide nature of European health systems (with datasets) has meant the emergence of a combination of bottom-up local pilots and top-down initiatives, the latter essential for system-wide federation, the development of quality standards, the investment required to upgrade platforms. The European context contrasts with the disparateness of other regions such as the USA which have a higher proportion of private health systems that can innovate nimbly (but with limited reach data-wise and non-representative demographics). To illustrate as examples, progress in Horizon 2020 and IMI programmes that have sought to improve data federation can be highlighted by the project.
- Interoperability of datasets needs measures to be standardised (especially clinical measures); Interoperability of machine-learning platforms, particularly if there are proprietary concerns needs to be addressed.
- Privacy and security of personal data. The ability to demonstrate that personal data cannot be identifiable and is held securely with strict access restrictions, will be important to retain public trust. A role for enforceable regulation to minimise risk should be considered.
- The convergence of two sectors: AI – deep technology advancing at rapid pace, and public health – diverse and itself comprising subsectors, brings a complexity in the range of actors potentially involved in AI for healthcare. Complexities surface in how the different sectors interface, outsourcing/in-contracting dependencies (e.g. software developers), the strength of handover points, oversight and reach through responsibilities. Gaps are apparent in:
    - Who holds responsibility throughout the lifetime of the product/ service.
    - Patient/ consumer after-care when provider of the product/ service no longer exists.
    - Responsibility and recourse in case of failure such as diagnostic error discovered in retrospect and if associated with an unfavourable clinical outcome.
    - Balance and risk reduction in clinical decision-making, cross-checks and other readouts.
    - Strong cross-sector collaboration throughout and right from the earliest stages is key to the quality of innovation and ultimately its clinically meaningful application.

*[Cross-border transfer of health data – within and out of EU – is acknowledged as an important area but will not be explored in this project as the matter has been covered separately and applies broadly beyond AI]*

Therefore,

1) The project will explore how the added benefit of AI-incorporated health products / services can be evaluated for <u>adoption</u> into healthcare use. Salient areas for exploration include evidence measurement, RCTs (randomised clinical trials), and health systems research. The report's description of use-cases may also serve to illustrate the added value.
2) The project will determine where new guidance or regulation is desirable (taking into account existing regulation and the new revised EU regulations on medical devices, and in vitro diagnostics), and make recommendations on new regulation currently in development (e.g. AI Framework, European Health Data Space) or revision (e.g. Product Liability Directive).
3) Recommendations may emerge on dealing with the federation and interoperability barriers across healthcare systems.
4) Ethical considerations and trustworthy AI. The project will emphasise the importance of data protection and privacy (also incorporating de-identification, use of trusted research environments), transparency, engendering public trust, lay communication, equity of health

access, and model explainability. The importance of consent governance (prospective and/or retrospective) should be reaffirmed.

5) Education and capacity building: Separate to a general shortage of data scientists as they are in competitive demand across all sectors, there is an urgent need to upskill the broader workforce in digital awareness and simultaneously build this into early education.

**Relevance to Europe:**

The topic straddles two live priority areas of the European Commission:

- EU Digital strategy (2019-24), which emphasises "strengthening its digital sovereignty and setting standards, rather than following those of others – with a clear focus on data, technology, and infrastructure". The strategy encompasses trustworthy AI, security, skills, to achieve the EU Digital Decade's objectives by 2030.

- EU's Health Strategy (2020-24) which includes Digital Health, establishment of the European Health Union, and Europe's Beating Cancer Plan. The strategy focuses on both urgent, and long-term health priorities. Operationally, limited cross-border data exchange is in development. Several years ago, individual hospital trusts-initiated clusters with specific trusts in other European countries, e.g. Cancer Core Europe.

- Regulation:
    - The revised EU Medical Devices Regulation and the In Vitro Diagnostics Regulation were postponed due to the pandemic, and will be implemented in the next couple of years, having been published in late 2021. As the last revision was ~20 years ago, newer technologies such as AI have been brought into scope. In parallel, a horizontal pan-sectors AI Framework (not specific to health) is in development. Care must be taken that the vertical and horizontal regulations are not in conflict, nor that AI in health is overlooked in the horizontal AI Framework.
    - Regulatory guidances may be a target where the work identifies crucial gaps. It may be relevant to include consideration of experience in other regions such as the US, Asia.
    - There will be areas in the broader AI health ecosystem falling outwith the remit of the EMA (European Medicines Agency), such as health research, healthcare systems (member state level). Nonetheless ensuring public trust will be essential for continued and enhanced deployment of AI. How much concerns about the use of personal data or AI in other spheres might influence activities in the health ecosystem is unknown, since health is clearly a public benefit. However there have been instances of health data collection and reuse halted by citizens' concerns.

- Finally, AI has the potential to reduce the energy and carbon footprint of the healthcare sector, contributing towards the EU's NetZero agenda.

**Policy customers:**

EC: DG Sante, EMA, DG Informatics. (Commissioner M Vestager is the Executive Vice-President for *Europe Fit for the Digital Age*).

EP: AI is a priority area for STOA (EP Panel for the Future of Science & Technology), who launched a Centre for AI (ethical, legal, socio-economic aspects) which produces studies and holds public events. It set up an alliance with the OECD (the Organisation for Economic Cooperation & Development). STOA is forming an international advisory board running for the remaining term of the EP 2022 to 2024.

The EP ENVI Committee on the Environment, Public Health & Food Safety – AI may be perceived to bring a positive environmental impact. ENVI also has looked at access to healthcare this year (medicinal products), and cancer prevention through identifying risk-modifiable factors.

**Outputs:**

- Report with recommendations
- Article(s) in relevant scientific, professional, and policy journal(s) – international and national
- Comms plan will include press/media releases, other channels (social feeds etc), direct letters. Optionally a launch event or meetings.
- *Other dissemination TBD once the priority focus(es) are agreed*
- Potentially a multi-disciplinary workshop, *if* required to inform findings of the report. Could include clinicians, data scientists, product developer (software), medical regulator, healthcare system representative (MS), social scientist, an informatics ethicist.

**Who else is active, what has been done, potential partners, other regions.**

SAPEA (Science Advice for Policy by European Academies) – no interest has been formally publicised, nor informally revealed.

As this is a very active topic, we will take note of work in other sectors such as med tech.

Examples of guidances that have been developed by others:

- Welcome — The Turing Way (the-turing-way.netlify.app)
- Microsoft Word - 20 Questions Complete.docx (arxiv.org)
- Guidelines and quality criteria for artificial intelligence-based prediction models in healthcare: a scoping review - PubMed (nih.gov)
- Leidraad kwaliteit AI in de zorg opgeleverd door en voor het veld | Nieuwsbericht | Data voor gezondheid

*Updated 05 January 2023*