#Standards4AI

‘Putting Science Into Standards’ workshop

Welcome!
We will start soon

AI for Medicine and Healthcare

9 June, 10:45-12:00

Panel discussion
AI for Medicine and Healthcare

Roundtable speakers

Alpo Värri
Convenor CEN/TC 251
Health Informatics WG2

Koen Cobbaert
Philips

Sandra Coecke
JRC

Thorsten Prinz
VDE Health

Rapporteur/ moderator : Claudius Griesinger (JRC)

Audience interaction

slido.com

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- Select the **Medicine and Healthcare** room on Slido
- Zoom chat - only technical questions to host
- Camera and audio OFF

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Claudius Griesinger

EC Joint Research Centre

Professional background

- Dr. Claudius Griesinger - European Commission's Joint Research Centre (JRC) = horizontal science service
  - **PhD in Neurosciences** (Max Planck Society / Tübingen University) development of pattern recognition & processing in visual cortex.
  - Hippocampal plasticity, fast synaptic transmission in Cochlea

At JRC:

- **Focus on innovation in health & life sciences**
- **Focus on AI, data, cybersecurity in health**
  Systematic review on AI systems for COVID detection: highlight in EJR 2021
- **Science for policy experiences** on (novel) health technologies:
  - ***Commission expert panels*** *on high risk medical devices and IVDs – handed over to EMA*
  - ***Innovativeness & health impact:*** *development of Commission expert guidance:*
  - ***Globally applicable adverse event terminology*** *(IMDRF) for medical device problem reporting + EU reporting tools*
  - ***Signal detection*** *methods &* ***automated exploitation of real-world data***
  - ***Cybersecurity guidance*** *for medical devices*

Challenges Faced & Solutions

Challenges

- **Health is high-risk and high-opportunity** application for Artificial Intelligence.
  Find right balance: ensure trustworthiness while not stifling innovation.
  Find **"sweet spot":** maintain EU's strong position in health technology innovation
- **Sufficient coordination** key to determine need for standards & guidance with a view on trustworthiness, innovation-friendly ecosystem, fundamental rights

Solutions

- Consider entire **evidence pathway along innovation cycle**
- Develop **clear framework** for assessment of (novel) **risks** and **opportunities** of AI in medicine, health research and health(care)
- **Stratification of requirements** in relation to risks
- **Guidance documents** through multi-stakeholder process as **first-line solution** to enhance clarity and ensure global influence

Way Forward, Next Steps

Way forward - principles

- **Horizontal standard(s) on AI technology**, **sectorial guidance** (could grow into standards)
- **Innovation friendly!** Consider trustworthiness vs burden
- **Consider global use**: HIC + LMIC

Next steps

- **Bridging communities** (e.g. HLEG, WHO …)
- **Broader coordination** to construct **framework** and **pragmatic roadmap** (guidance, standards, reports)
- **Ensure EU participation** in standardisation efforts

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Alpo Värri

Tampere University, Finland & CEN/TC251 Health Informatics

Professional background

Alpo Värri, Research Director, Dr.Tech., Tampere University

- Member of CEN/TC251 Health informatics since 1994
- WG Convener in CEN/TC251 since 2009
- Member of ISO/TC215 health Informatics, IEEE 11073 Personal Health Devices, JTC1/SC42 Artificial Intelligence
- Member of the Finnish Artificial Intelligence Society since 1988
- Researcher in various pattern recognition projects in medicine in the past, nowadays a project manager
- Ongoing EU funded projects: ENVISION, COVend, DiHECO

Challenges Faced & Solutions

Detecting Artificial Intelligence Algorithm Bias in Cancer Treatment

Poorly trained artificial intelligence can introduce biases into cancer treatment.

HEALTH IT ANALYTICS

Predictive Analytics Algorithm Displays Bias, Drives Inequity

The predictive analytics algorithm perpetuated some implicit racial bias and health inequity, the UC Berkeley researchers found.

Bias a Chief Barrier to Artificial Intelligence in Healthcare

The potential for algorithms to perpetuate bias and exacerbate disparities is a critical hurdle for artificial intelligence in healthcare.

New Framework to Evaluate Bias in COVID-19 Prediction Models

Researchers have developed a framework designed to evaluate bias within medical artificial intelligence models and help users address it.

AI Can Detect Race When Clinicians Cannot, Increasing Risk of Bias

New research shows that artificial intelligence can accurately predict race using various medical images, but clinicians cannot do the same, indicating significant risks for AI use in healthcare.

Healthcare Artificial Intelligence Faces Concerns Over Bias

Artificial intelligence in healthcare must still confront bias encoded in many existing systems.

SME perspective

University researcher thinks: "Should I try to commercialize this little AI system I developed?"

SME’s dream

Challenges Faced, SME perspective

Challenges Faced, SME perspective

Did GDPR kill off millions of Android apps?

By Anthony Spadafora published 10.5.2022

A new research paper seems to suggest so

https://www.techradar.com/news/did-gdpr-kill-off-millions-of-android-apps

In a paper titled, "GDPR and the Lost Generation of Innovative Apps", economic researchers Rebecca Janßen (ZEW Mannheim, Germany), Reinhold Kesler (University of Zurich, Switzerland), Michael Kummer (University of East Anglia, UK) & Joel Waldfogel (University of Minnesota, USA) examined the impact of Europe's General Data Protection Regulation (GDPR) on the mobile app business.

The paper, distributed via the US-based National Bureau of Economic Research, finds, "Whatever the benefits of GDPR's privacy protection, it appears to have been accompanied by substantial costs to consumers, from a diminished choice set, and to producers from depressed revenue and increased costs."

https://www.theregister.com/2022/05/09/gdpr_europe_apps/

Solutions

Open access Protocol

BMJ Open

To cite: Collins GS, Dhiman P, Andaur Navarro CL, *et al*. Protocol for development of a reporting guideline (TRIPOD-AI) and risk of bias tool (PROBAST-AI) for diagnostic and prognostic prediction model studies based on artificial intelligence. *BMJ Open* 2021;**11**:e048008. doi:10.1136/bmjopen-2020-048008

Protocol for development of a reporting guideline (TRIPOD-AI) and risk of bias tool (PROBAST-AI) for diagnostic and prognostic prediction model studies based on artificial intelligence

Gary S Collins [1,2] Paula Dhiman [1,2] Constanza L Andaur Navarro [3] Jie Ma [1] Lotty Hooft,[3,4] Johannes B Reitsma,[3] Patricia Logullo [1,2] Andrew L Beam [5,6] Lily Peng,[7] Ben Van Calster [8,9,10] Maarten van Smeden [3] Richard D Riley [11] Karel GM Moons[3,4]

Solutions

TRIPOD Checklist: Prediction Model Development and Validation

Section/Topic	Item		Checklist Item	Page
Title and abstract				
Title	1	D;V	Identify the study as developing and/or validating a multivariable prediction model, the target population, and the outcome to be predicted.	
Abstract	2	D;V	Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions.	
Introduction				
Background and objectives	3a	D;V	Explain the medical context (including whether diagnostic or prognostic) and rationale for developing or validating the multivariable prediction model, including references to existing models.	
	3b	D;V	Specify the objectives, including whether the study describes the development or validation of the model or both.	
Methods				
Source of data	4a	D;V	Describe the study design or source of data (e.g., randomized trial, cohort, or registry data), separately for the development and validation data sets, if applicable.	
	4b	D;V	Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up.	
Participants	5a	D;V	Specify key elements of the study setting (e.g., primary care, secondary care, general population) including number and location of centres.	
	5b	D;V	Describe eligibility criteria for participants.	
	5c	D;V	Give details of treatments received, if relevant.	
Outcome	6a	D;V	Clearly define the outcome that is predicted by the prediction model, including how and when assessed.	
	6b	D;V	Report any actions to blind assessment of the outcome to be predicted.	
Predictors	7a	D;V	Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured.	
	7b	D;V	Report any actions to blind assessment of predictors for the outcome and other predictors.	

Way Forward, ~Quality label?

Reporting of machine learning training material

Example by

John Halamka

President, Mayo Clinic Platform, 9.5.2022

Synopsis of System XYZ

Summary

Machine Learning-based decision support software to augment medical imaging-related diagnosis of abdominal CT scans

Type of algorithms employed

Convolutional neural network

Population composition

Ethnic composition

Non-Hispanic White 60 %

Hispanic and Latino 18 %

Black or African American 13 %

Asian 6 %

Other 3 %

Gender balance

Male/Female 55/45 %

Way Forward, Next Steps

- COMMISSION IMPLEMENTING DECISION of XXX on a standardisation request to the European Standardisation Organisations in support of safe and trustworthy artificial intelligence
- => AI standards to be produced in 10 areas
- CEN/TC251 Health Informatics is thinking about the need to produce “vertical healthcare-specific AI standards” to supplement the horizontal standards to be produced by CEN&CENELEC/JTC21 Artificial Intelligence

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Koen Cobbaert
Philips

Koen Cobbaert

Education

- MSc Electrical Engineering & MSc Safety Risk Management

Professional Experience

- **Philips** – Senior Manager – Quality, Standards & Regulations (4 years)
- Agfa HealthCare RA Manager, software for radiology, oncology, orthopedics and cardiology (13 years)
- Data Innovations - PGP Regulatory Compliance Manager, laboratory information systems (2 years)
- GE Medical Systems – Lunar Service and Application Specialist bone densitometers, RA & Safety Officer (3y)

Technical Affiliations

- **Trade associations**:
    - **COCIR** Chair Software focus group (>10 years). Koen represents the COCIR membership at EU Commission medical device coordination groups:
        - MDCG Borderline & Classification
        - MDCG New Technologies
    - **DITTA** Chair Software focus group. Koen represents the DITTA membership at the IMDRF work group on artificial intelligence
    - **MedTech Europe**
    - **Medical Device Innovation Coalition** (MDIC)
    - **ADVAMED, MITA, Digital Europe**
- **National trade associations** in **Belgium** (Agoria & BeMedTech) and **UK** (AHBI)
- **AI advisor/expert** at Global Harmonization Working Party (**GHWP**)
- **Standardization** expert delegated through Belgian SDO (NBN, CEB-BEC, Agoria) at:
    - **IEC/TC62** Electrical equipment in medical practice, including IEC TC 62 advisory group on Software, Networks and AI (SNAIG)
    - **ISO/TC215** Health Informatics
    - **ISO/TC210** Quality management and corresponding general aspects for medical devices
    - **ISO/IEC JTC 1/SC 42** Artificial Intelligence
    - **CEN/CENELEC JTC21** Artificial Intelligence
    - …
- **Member of CEN-CENELEC Industry Advisory Forum**

the advent of

personalized healthcare

using computer-brain interfaces, a patient will be able to train a bionic arm with the micro-movements needed to drink a cup of coffee without spilling

Machine learning can be used to train and calibrate the bionic arm to a specific patient

Machine Learning-enabled Medical Device
A medical device that uses machine learning, in part or in whole, to achieve its intended medical purpose.

Source: IMDRF N67

MLMD learn during runtime/use

Challenges

- **Data needed to assess bias, representativeness and robustness is often identifiable data**, i.e., subject to international data protection standards
- **Providers lack access to sufficient data**
- **Proposed AI Act[1] requires providers to give authorities and notified bodies access to training, development and testing data**

  This is problematic where:

  (1) **providers have no direct access to the data, e.g., because the data resides with the patient or at the healthcare institution** behind security and privacy shields (data vaults, federated learning). Such requirement will force providers to put contracts in place with doctors and patients to allow the transfer of sensitive data to the authorities via the provider, compromising patient privacy and copyright restrictions. The proposed requirement implies that patients using MLMD may need to give up their privacy to use such device, potentially damaging trust and hindering the development of personalized healthcare.

  (2) **where the quantity of data is so vast that storing it causes a disproportionate cost and impact on the environment** (cf. GPT-3 which was trained on the entire internet)

  (3) **where third country data protection legislation prohibits transfer of personal data from a third country to the Union**. The latter may create the perverse side effect that AI systems intended for the Union will be trained using less data, making those systems potentially less robust, and less suitable for minority populations, rare diseases or specific clinical settings.

[1] Proposed AIA Article 64 and Annex VII

Solution

Change/interpret the proposed AI Act requirement to provide authorities/notified bodies "access to the [raw] training, development and testing data" so it reads "access to training, development and testing data [metrics]"

Considerations

from the global **->** **to the personal**

Data protection practices generally do not allow providers to transfer personal data away from the patient's legally designated data custodian or outside the country of origin.

To comply with international data protection standards and copyright restrictions, providers can:

- vault the data per jurisdiction/legally designated data custodian
- leave the data with the patient or healthcare institution and bring the algorithm to the data, rather than bring the data to the algorithm. This is however hard to do at scale. Tradeoff against reduced network bandwidth, environmental impact and cost. e.g., transferring a deep learning algorithm of 10^9 parameters of 10 digits each, takes ~7GB or 10 CD-ROMs

Standardization Priorities

Good Data Management Practices that

a) comply with international data protection and privacy standards
   - while accommodating the considerations on the previous slide

b) enable sub-group selection
   - with acceptable “overhead/noise”, i.e., no overhead/noise would mean we identify and use only edge cases. No overhead/noise may not always be possible. Edge cases may need to be “hidden” in less critical ones for privacy reasons
   - with sub-group metrics that can be *combined* into overall metrics

c) enable the calculation of metrics on raw (sensitive) data
   - when the provider has no direct access to the raw (sensitive) data, the standards should allow third parties to perform the calculation, e.g., data custodians, healthcare professionals, testing and experimentation facilities, …
   - goal of the metrics
     - allow the provider to identify bias and aspects where further training is needed or to warn users for possible sources of bias and as such meet legislative requirements
     - allow authorities/notified bodies to establish compliance

d) provide an overview of possible metrics, methods and considerations for determining appropriate metrics, metric thresholds and their confidence levels
   - due to the wide variety and fast changing-nature of AI system technologies, applications, use methods and state-of-the-art standards do not appear suited to specify actual metric thresholds as these are likely to be incomplete or out of date by the time the standard is published

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Thank you!

Koen Cobbaert

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Sandra Coecke

EC Joint Research Centre

Professional background

- Dr. Sandra COECKE (EC JRC, Italy) Belgian, has a STEM Education - Engineer Biotechnology (Free University Brussels) complemented with a PhD in the faculty of Medicine and Pharmacy.
- Coordinated the European Member State Network of 35 high quality company and organisation Laboratories for the Validation of Standard Methods (EU-NETVAL) and its activities advising on novel deep learning AI methods.
  (*ELECTRAMed: a new pre-trained language representation model for biomedical NLP 2021*).
- Coordinates activities on globally harmonised (OECD level) good scientific cell and tissue culture standard method practices and promotes mathematical & AI methods applied to food safety and pathogen treats.
  (SAB of ONTOX: Ontology-driven and artificial intelligence-based repeated dose toxicity testing of chemicals for next generation risk assessment).

Challenges Faced & Solutions

- **"Black box" problem causing serious trust issues** regarding AI's recommendations or findings.
- **AI does it all problem.** Ever since AI made its way into our lives, there is a notion that all tasks, minute or gigantic, can be managed by AI's increasing efficiency and productivity. However, this is only true to a certain extent: **AI human interface** stays the critical bottleneck.
- **Tackling bias in artificial intelligence (and in humans).**
  In pre-clinical efficacy or toxicology processes we have seen the ability of AI to accelerate incredible tasks when the development is done with a multi-disciplinary team reducing, for several aspects, reliance on most of the human interface.
- **Standards to guide AI human interface process** with key focus on reducing bias via acting on the Human and Technological interface by eliminating prejudiced assumptions made during the algorithm development process and prejudices in the training data.

Way Forward, Next Steps

- *To unlock the full technological potential of AI in health, medicine and life science systems standardisation/regulation of AI is proposed: **Driver** or **Stifler** for Innovation – **Big** or **Small** enterprises?*
- *Organ-on-a-chip example: Technological barriers can be overcome with **standardisation & collaboration of all stakeholders in the ecosystem**.*
- *Does AI require QC transformational technology standards to tackle more complex health life science problems?* https://www.nature.com/articles/s41592-020-01004-3
- *Artificial Intelligence (AI) offers enormous potential but AI systems are created and trained using human generated data. Bad methods give bad data that can contain implicit racial, gender, ideological biases and a plenitude of other biases. **Building inclusive AI health models devoid of biases and discrimination is a priority aided by applying standard principles to achieve this goal.***

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Thank you!

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Thorsten Prinz
VDE Health

Professional background

- Dr. Thorsten Prinz (VDE, Germany) is consulting medical device manufacturers with AI-based software products regarding the regulatory requirements of the regulation (EU) 2017/745 and future legislations as the EU Artificial Intelligence Act.
- He is supporting the preparation of technical documentation for AI-based software medical devices and the implementation of quality management system processes for AI model development and evaluation, as well as the extension of existing regulatory processes by AI-specific aspects.

Challenges Faced & Solutions

- Sector-specific standards are not available addressing the following challenges regarding data for AI models: absence of bias, balancedness, completeness, correctness, currentness, inter-/intra-consistency, representativeness, and train/test independence.
- A current solution is documenting respective state-of-the-art measures in a data management document as part of the AI-model development process in the quality management system of the manufacturer.

Way Forward, Next Steps

- AI standards must fit into the landscape of already established standards in the health sector. In the field of medical devices, this means that the relevant standards IEC 62304 and IEC 82304-1 must be considered, for example regarding the safety classification of software.
- AI standards for medical devices must contain clear requirements without unnecessarily increasing the already very high requirements imposed by the Medical Devices Regulation (MDR).

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Thank you!

Session “AI in medicine and healthcare”

PSIS workshop on data quality requirements for inclusive, non-biased & trustworthy AI

Dr. Claudius B. Griesinger

European Commission - Joint Research Centre (JRC)

High-risk AI applications & critical sectors

The EU's approach to Artificial Intelligence (AI), based on trust and excellence, will give citizens the confidence to embrace these technologies while encouraging businesses to develop them.

What is a high-risk AI application?

- When it concerns a critical use in a critical sector

CRITICAL SECTORS

- healthcare
- transport
- police
- legal system

CRITICAL USE

- legal effects
- risks of death
- damage or injury

- For example: medical equipment, automated driving, decisions on social security payments;
- Some uses are critical in all sectors, for example use of AI in recruitment processes.

AI Act risk classification and health

AI Act – Article 6

Classification rules for high-risk AI

(a) **AI system** intended to be used as a safety component or a product, or is itself a product, **covered by the EU harmonisation legislation (Annex II)**

AND

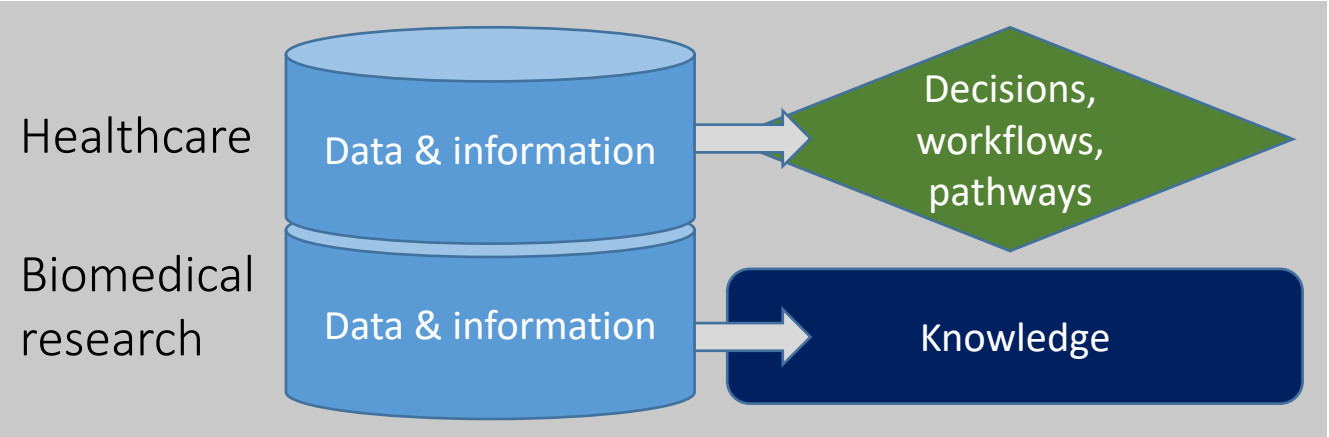
(b) **Product** (of which AI system is safety component) or the **AI system** itself need to undergo **conformity assessment** under Annex II listed legislations

Health relevant

MDR	(EU)2017/745
IVDR	(EU)2017/746
PPRR	(EU)2016/425

AI in medicine and healthcare: many diverse applications

- Medicine / healthcare:
  currently sector with
  highest number of
  AI application cases



1) Healthcare

- Diagnosis & prediction-based diagnosis
- Clinical care
  risk identification, therapy optimisation…
- Robotic surgery

2) Health systems management

- Administrative workflow
- Logistics
- Support decision making
- …ots & virtual nursing assistants
- …icine

Data

3) Public health & surveillance

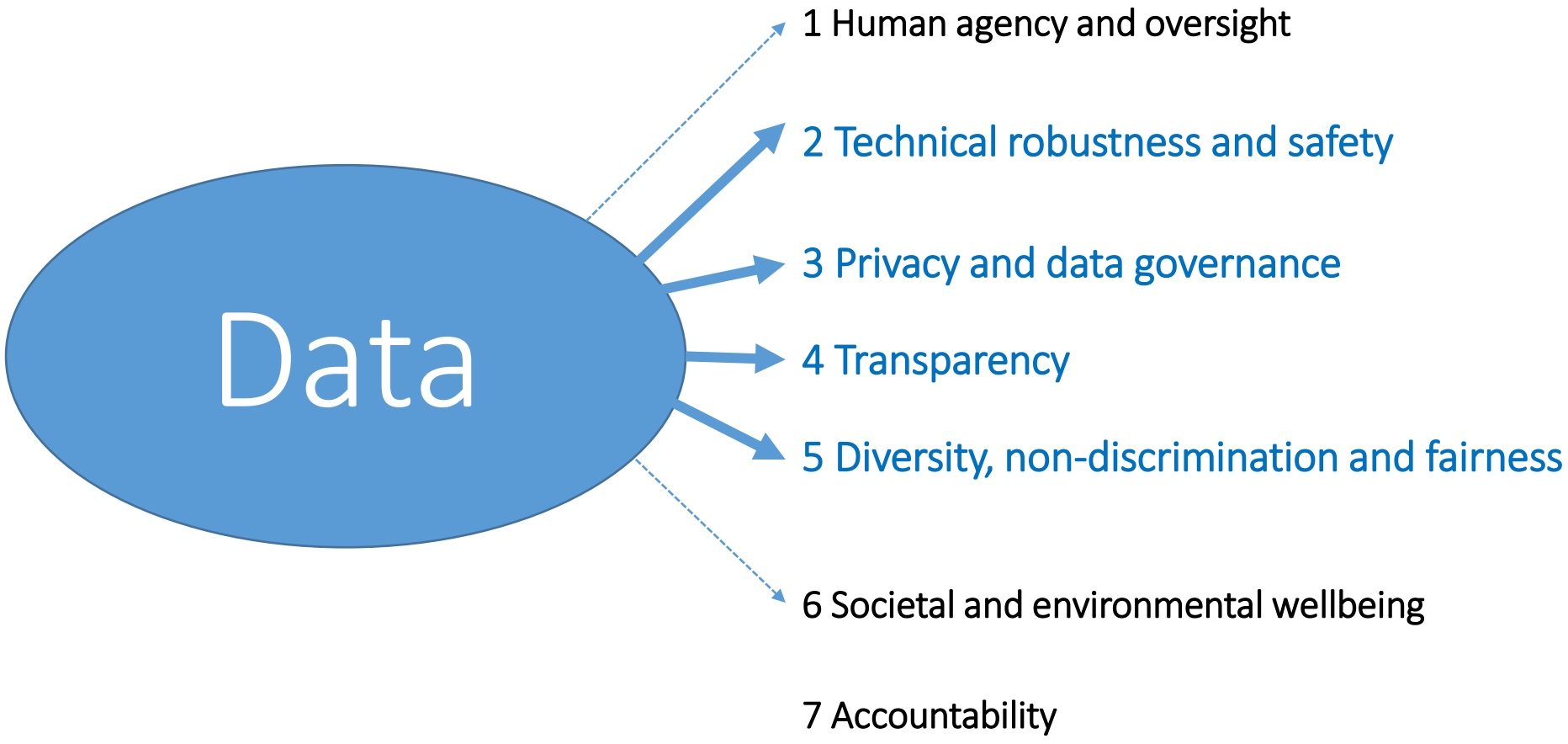
- Disease outbreaks
- Pandemic preparedness
- Health promotion & disease prevention

…th research

- …ealth data for research
- Electronic health records:
  optimisation of clinical care
- Drug development & repurposing
- Genomic medicine & personalised medicine

Data quality and the trustworthiness

7 key requirements of trustworthy AI



Session questions & mural

1 Overview

Challenges, topics, gaps & needs

Ongoing Standardisation Activities

Committees, communities, groups

Standards (of relevance)

2 Mapping

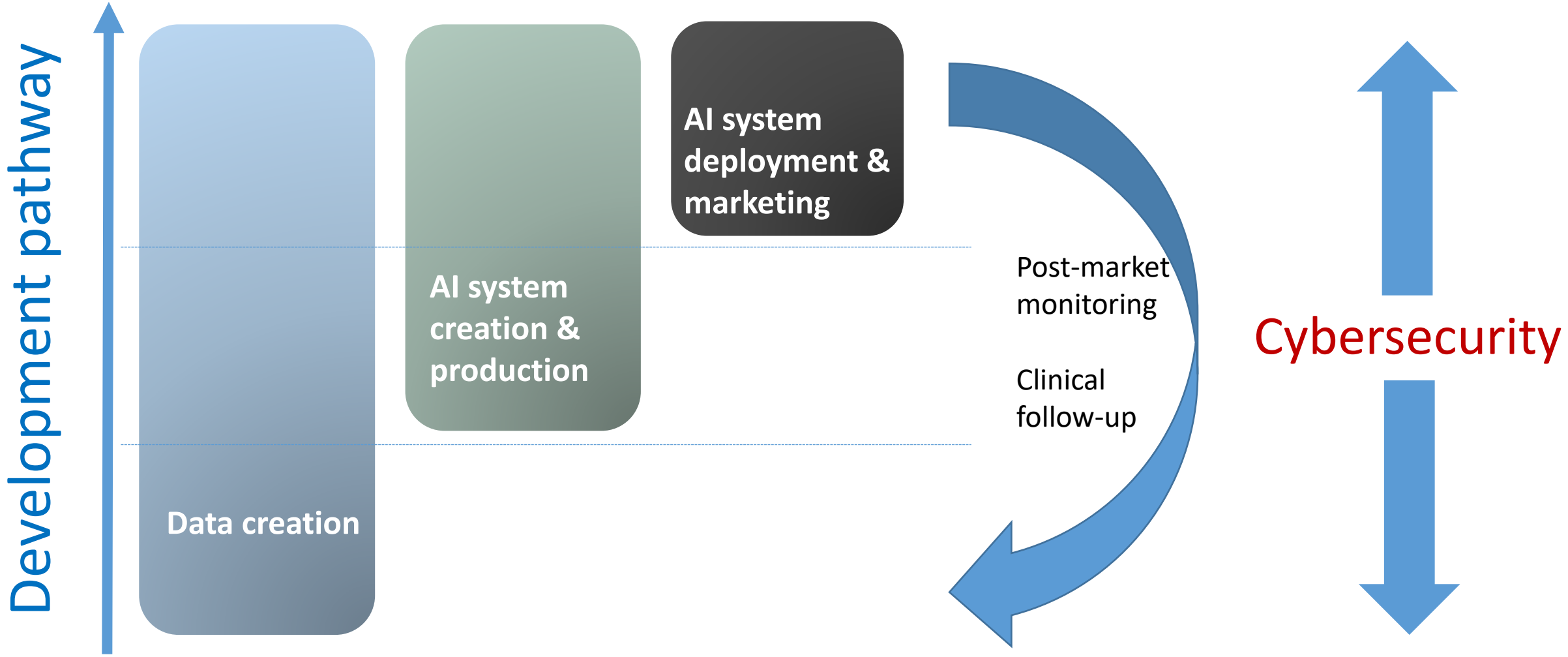
Mapping items over development pathway

- *Standards, guidance, technical reports, frameworks*

3 Priorities

Prioritisation

Development pathway & product cycle of AI systems



Kick-off questions

Challenges, topics, gaps & needs …

- What are **key challenges** that need to be addressed, specific to medicine and healthcare?
- What are **key aspects of standardization / guidance** that would need to be tackled? – in particular in view of **data quality throughout the development pathway of the product.**

How to do it …

- Can the **diversity of application cases** be appropriately served by horizontal standards?
- What is the **role of specific guidance** – e.g. prior to standardization ?

Programme – what's next?

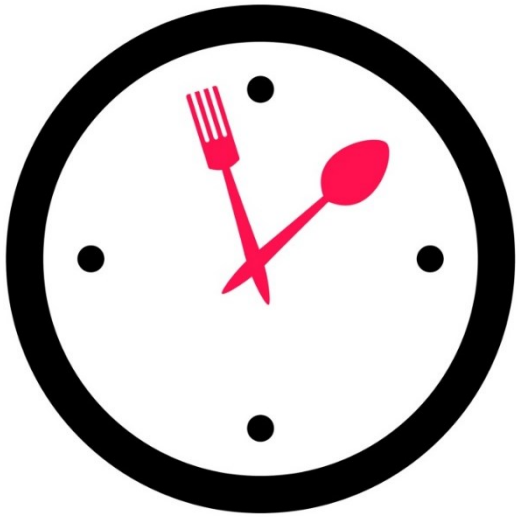
Main Plenary room

12:00 - 13:30	*Lunch break*
13:30 - 14:15	**Flash Summaries of parallel sessions**
14:15 - 15:45	**Panel discussion on ways forward**
15:45 - 16:00	**Concluding remarks**

Please check your confirmation email for the links to access main plenary room

The link will also be published on Slido and Zoom chat

Let’s take a break!



LUNCH BREAK

See you in the plenary room at 13:30!