



Welkom
bij het **KIVI-**
jaarcongres 2025

Jildau Bouwman, TNO



KIVI

AI maakt preventieve zorg mogelijk

Prof. Dr. J. Bouwman

[Start presentation](#)

Generatieve AI

15min introductie

- Preventie met (generatieve) AI
- Rapport generatieve AI in de zorg

Stellingen

- Lagerhuis opzet



Generatieve AI

15min introductie

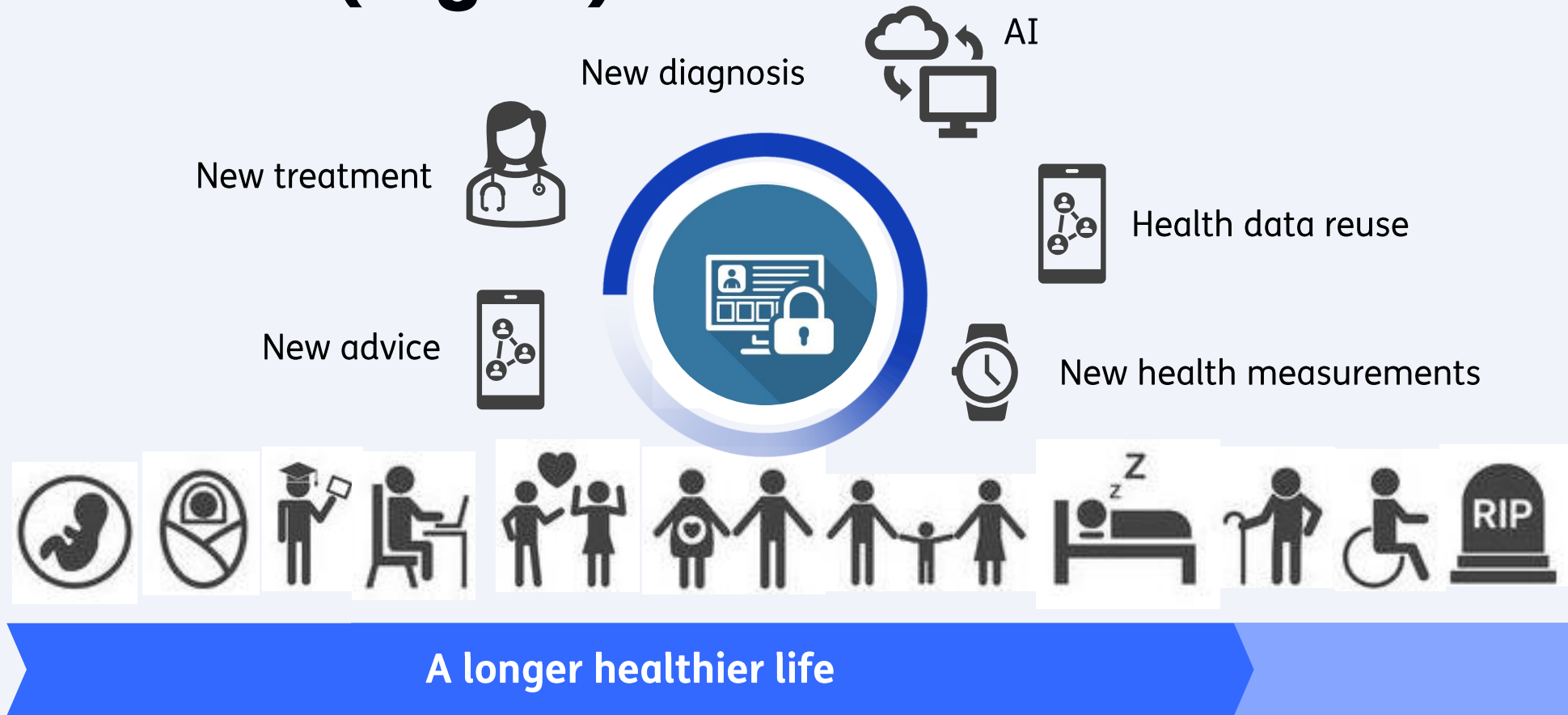
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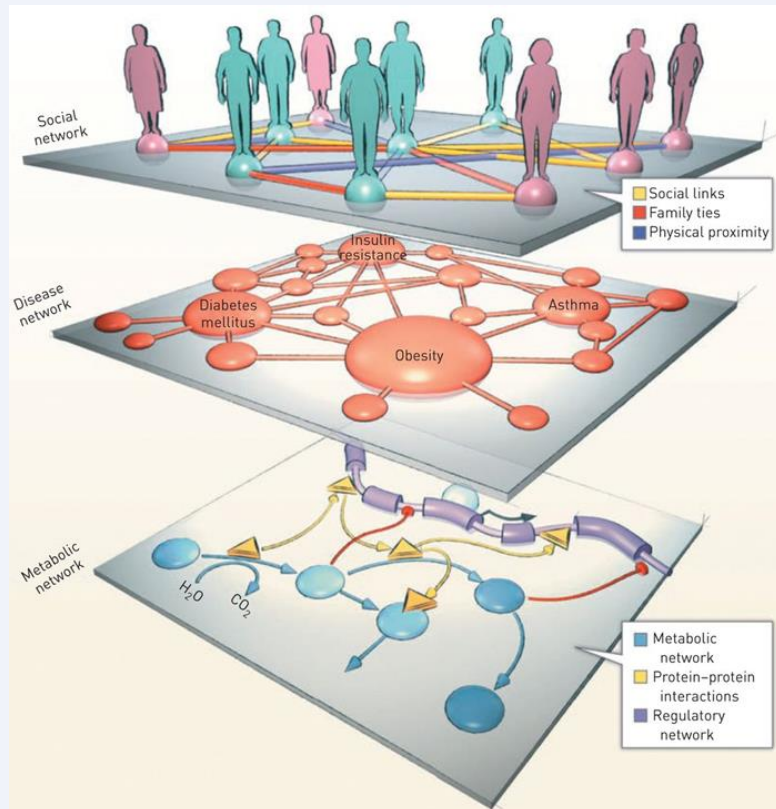


The future of (Digital) Health

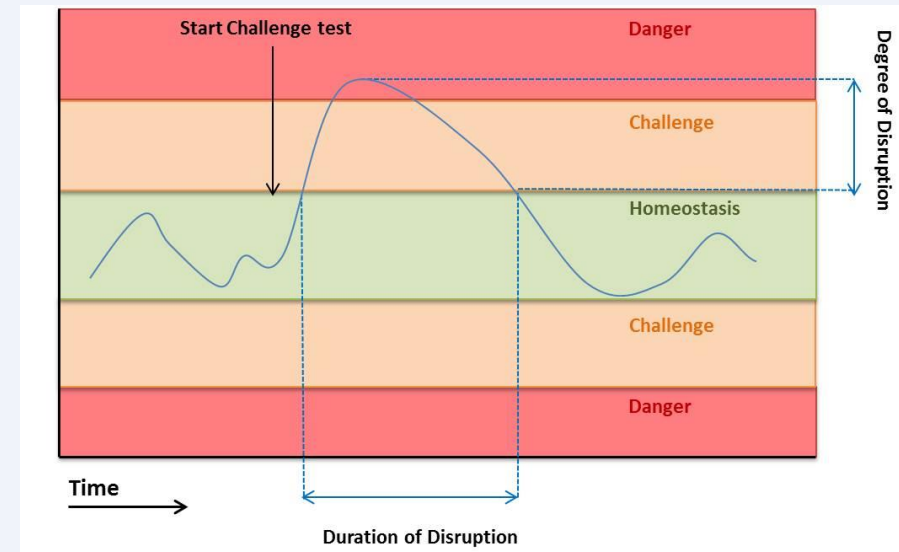


What information is needed for personal advice?

HEALTH IS A SYSTEM



HEALTH IS RESILIENCE



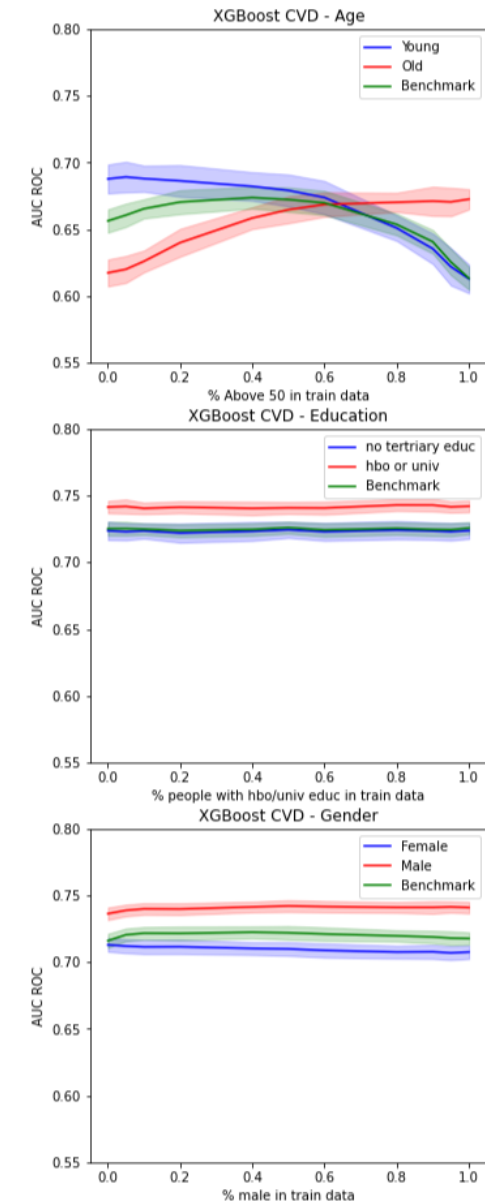
- Omics type of data needed (to measure the system)
- Continuous data needed (to measure the response)
- Prevention & wellbeing: nutrition & lifestyle

Kansen voor AI: data-person

Role in advice	Data quality & data access & data combination					Integration & interpretation of data: personal diagnosis, prediction and advice				Engaging & user aware advice	
Challenge	Unstructured data	Privacy & legislation	Burden of data combination	Burden of data collection	Interoperability & standardization	Black box models	Knowledge access	(Health) inequity	Continuous data interpretation	Engagement	Lack of agency
Solution	Large language models (generative A.I.)	Federated learning & S-MPC	Automated data standardization (LLMs)	Speech to data (LLMs)	Automated FAIRification	Explainable and trustworthy AI	Large language models	Bias aware AI/ assessability of A.I.	n=1 statistics	AI for Engagement	Personalized advice models LLM's -> comprehensive advices/ language

Visual Aid

- For different compositions in the train set, we show subgroup specific performances with a 2D line chart.
- A band-width with standard errors shows the uncertainty of the estimation.
- **Age:** Subgroup performance differs and depends on the representation
- **Education and Gender:** Slight subgroup specific performance differences, but no clear dependency on representation.



Discussion

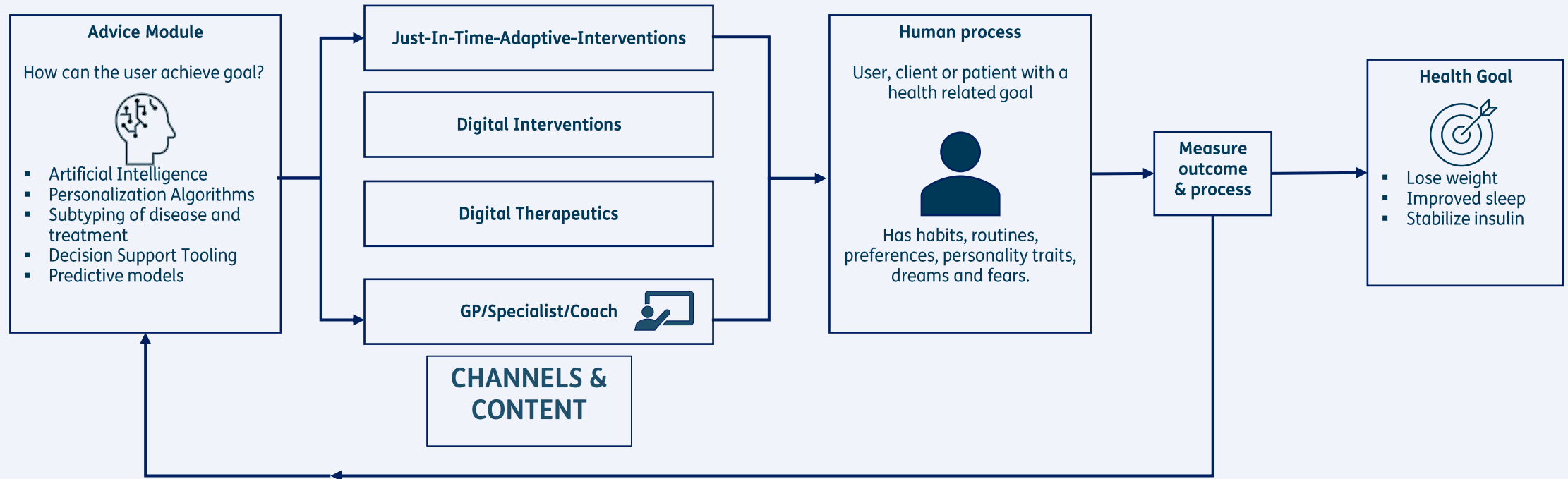
- Answers for:
 - What are relevant subgroups for my treatment or medical discovery?
 - Can I serve more subgroups if I improve their representation or do I search elsewhere for a solution?
 - Should I focus in general on more data, or is diversity in data more important?



Perspective on the use of AI

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Currently digital interventions little engaging



Feedback loops needed based on behaviour and progress using micro-interventions

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LLM-based recommender

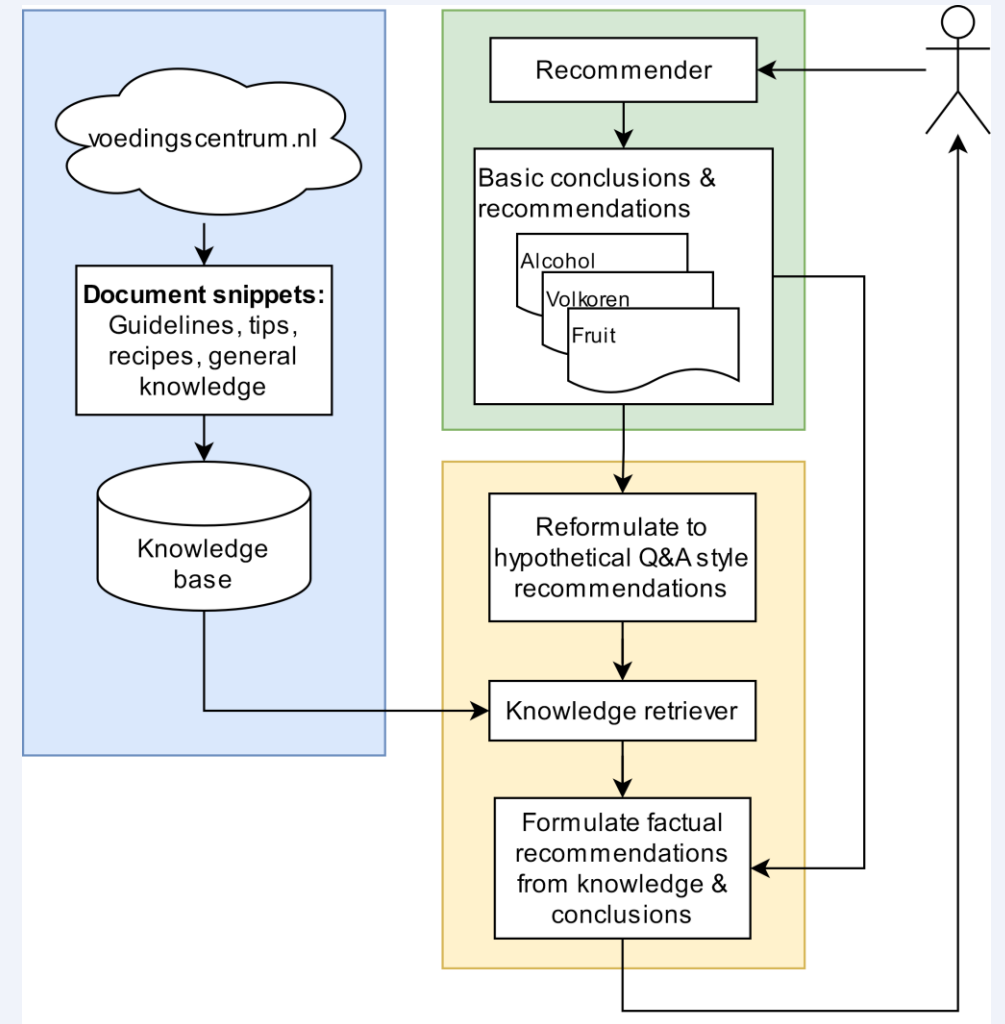
Generate recommendations that:

- Combine existing recommender with 'Retrieval-augmented generation'
- Use rule-based diagnosis
- Leverage content from Dutch nutritional guidelines

Three parts:

- Recommender (existing)
- Knowledge base
- Synthesizer

Next: Add a fitting tone of voice



Generatieve AI

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Visie

- GAI de potentie heeft bij te dragen aan betaalbare, toegankelijke en kwalitatieve zorg
- Belangrijk om Nederlandse waarden, zoals rechtvaardigheid, transparantie, veiligheid, verantwoording en duurzaamheid te blijven borgen in wetgeving en beleid
- Afhankelijkheid van een klein aantal buitenlandse partijen tegen te gaan door meer in AI-innovaties binnen Nederland te investeren



Uitdagingen en belemmeringen

- Hallucinaties en misleidende uitkomsten → juist geformuleerde prompt, juiste trainingsdata, bron vermelding
- Auteursrechten op trainingsdata
- Versterking van bias (synthetische data)
- Transparantie en openheid modellen
- Verstoring beroepsgeheim (data lekken)
- Verstoring behandelrelatie en verlies menselijkheid zorg
- Kosten en baten Gen AI niet altijd bij dezelfde partij
- Macht grote tech bedrijven (met name VS)



Aanbevelingen (1)

- Implementeer Gen AI met arts en patiënt
- Vrijmaken tijd zorgprofessionals
- Continue feedback en samenwerking tussen technologen en zorgverleners
- Leidraad Gen AI
- Zorgverleners te voorzien van gerichte trainingen
 - ✓ effectief inzetten
 - ✓ vergroten van het bewustzijn over de ethische aspecten en privacyoverwegingen
- Benchmarks ontwikkelen
- Testen modellen aan breed scala aan demografische kenmerken en medische aandoeningen (check op bias)



Aanbevelingen (2)

- Versnippering van inspanningen verminderen
- Mankracht en mandaat om regie te voeren
- Nieuwe kosten-batenanalyse van AI in de zorg
- Prikkels voor de zorg om te digitaliseren
- Onderzoek naar een gezonde economie voor zorg Gen AI
- Onderzoek hoe Gen AI de patiënten-reis kan ondersteunen
- Onderzoek hoe Gen AI regie en zelfmanagement kan ondersteunen
- Her-evalueer de MDR voor (Gen) AI
- Vergroot het aantal notified bodies



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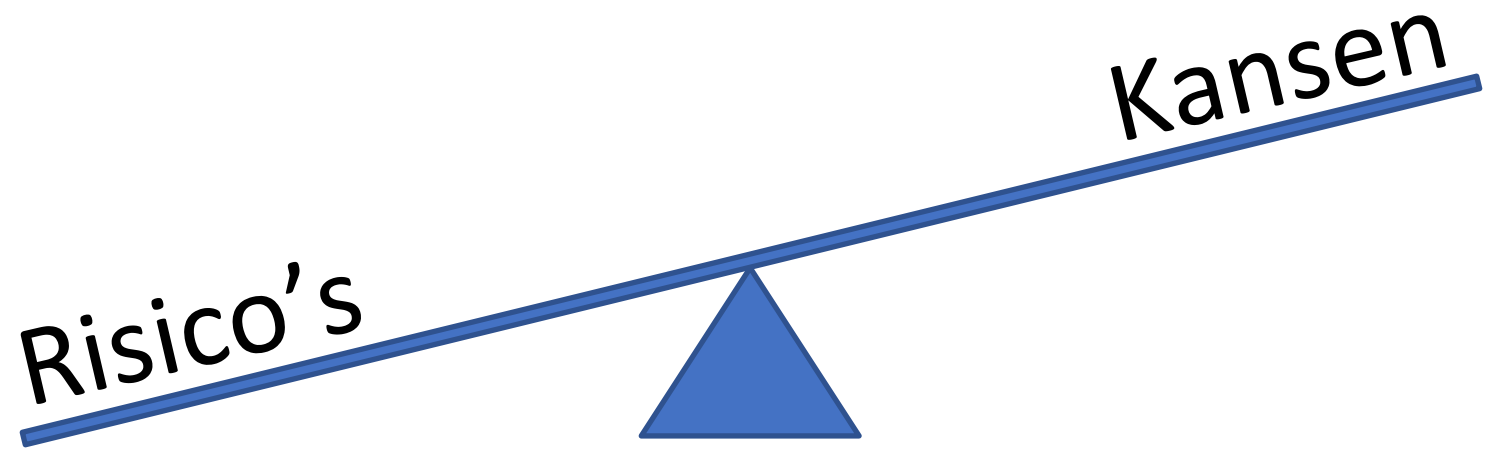
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Hoe balanceren we tussen de risico's en kansen?



Stelling 1: Leren over data moet prioriteit krijgen over privacy

- LINKS:

Privacy

- RECHTS

Data reuse

Stelling 2: De zorg wordt beter als we Gen AI toepassen

- LINKS:

Mee eens

- RECHTS

Niet mee eens

Stelling 3: De huidige Gen AI modellen kan ik gebruiken voor mijn werk

- LINKS:

Mee eens

- RECHTS

Niet mee eens

**Stelling 4:
Tools voor
preventie
zijn geen
medical
device (en
dus geldt de
MDR niet)**

- LINKS:

Mee eens

- RECHTS

Niet mee eens

**Stelling 5:
Ik heb
kennis om
Gen AI
effectief toe
te passen in
Nederland**

• LINKS:

Ja

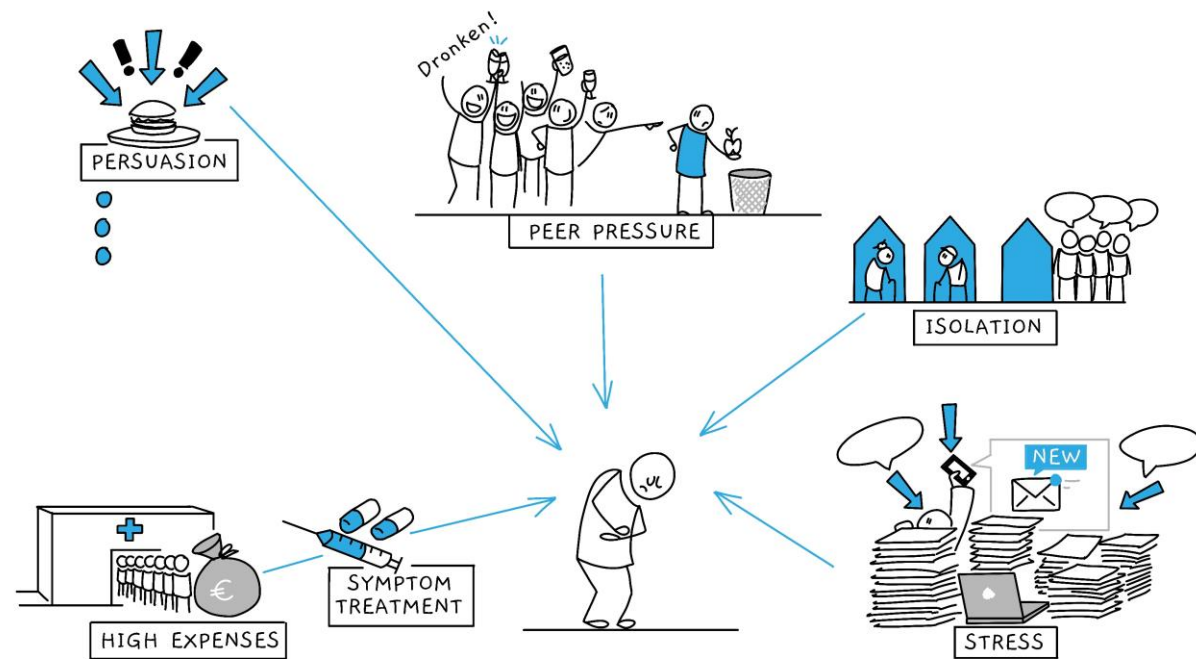
• RECHTS

Nee

Dank u voor uw aandacht

KIVI-jaarcongres 2025

Jildau.bouwman@tno.nl



CURRENT CHALLENGES IN HEALTH

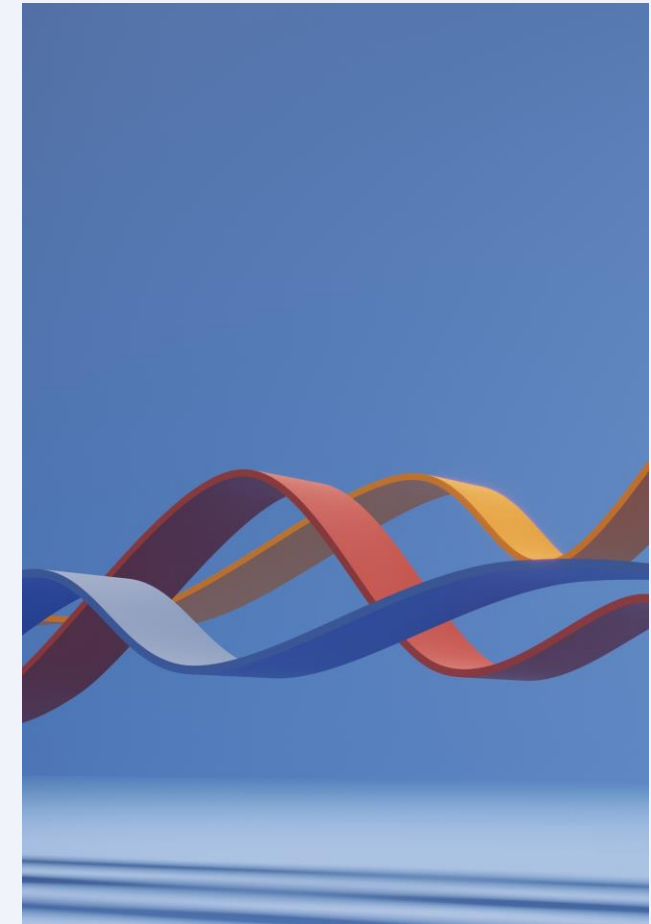
Generatieve AI

- Rapport generatieve AI in de zorg
- **Waarom GPT-NL?**
- Preventie met generatieve AI



Health Inequity





- Calls for action to improve representation and to improve measurement of subgroup-specific results!
- Methodological reform is needed. The following questions remain:
 1. To what extent is (under-)representation related to subgroup-specific performance?
 2. If (under-)representation influences performance disparities, is there a minimal or ideal level of representation?
 3. To what extent does adding more data of one group benefit or hurt performance on another group?
- We propose an actionable methodology for a representation-subgroup exploration that via two visual aids supports answering these questions.
 - Demonstrated with early onset detection of Type 2 Diabetes and Cardiovascular Disease



As compliant as possible

Grading Foundation Model Providers' Compliance with the Draft EU AI

Source: Stanford Center for Research on Foundation Models (CRFM), Institute for Human-Centered Artificial Intelligence (HAI)

	 OpenAI	 cohere	 stability.ai	 ANTHROPIC	 Google	 BigScience	 Meta	 AI21labs	 ALEPH ALPHA	 EleutherAI
Draft AI Act Requirements	GPT-4	Cohere Command	Stable Diffusion v2	Claude 1	PaLM 2	BLOOM	LLaMA	Jurassic-2	Luminous	GPT-NeoX
Data sources	● ○ ○ ○	● ● ● ○	● ● ● ●	○ ○ ○ ○	● ● ● ○	● ● ● ●	● ● ● ●	○ ○ ○ ○	○ ○ ○ ○	● ● ● ●
Data governance	● ● ○ ○	● ● ● ○	● ● ● ○	○ ○ ○ ○	● ● ● ○	● ● ● ●	● ● ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ● ● ○
Copyrighted data	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ● ● ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ● ● ●
Compute	○ ○ ○ ○	○ ○ ○ ○	● ● ● ●	○ ○ ○ ○	○ ○ ○ ○	● ● ● ●	● ● ● ●	○ ○ ○ ○	● ○ ○ ○	● ● ● ●
Energy	○ ○ ○ ○	● ○ ○ ○	● ● ● ○	○ ○ ○ ○	○ ○ ○ ○	● ● ● ●	● ● ● ●	○ ○ ○ ○	○ ○ ○ ○	● ● ● ●
Capabilities & limitations	● ● ● ●	● ● ● ○	● ● ● ●	● ○ ○ ○	● ● ● ●	● ● ● ○	● ● ○ ○	● ● ○ ○	● ○ ○ ○	● ● ● ○
Risks & mitigations	● ● ● ○	● ● ● ○	● ○ ○ ○	● ○ ○ ○	● ● ● ○	● ● ○ ○	● ○ ○ ○	● ● ○ ○	○ ○ ○ ○	● ○ ○ ○
Evaluations	● ● ● ●	● ● ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ● ○ ○	● ● ● ○	● ● ○ ○	○ ○ ○ ○	● ○ ○ ○	● ○ ○ ○
Testing	● ● ● ○	● ● ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ● ○ ○	● ● ○ ○	○ ○ ○ ○	● ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
Machine-generated content	● ● ● ○	● ● ● ○	○ ○ ○ ○	● ● ● ●	● ● ● ○	● ● ● ○	○ ○ ○ ○	● ● ● ○	● ○ ○ ○	● ● ● ○
Member states	● ● ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ● ○ ○	● ● ● ●	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ○ ○ ○	● ● ○ ○
Downstream documentation	● ● ● ○	● ● ● ●	● ● ● ●	○ ○ ○ ○	● ● ● ●	● ● ● ●	● ● ○ ○	○ ○ ○ ○	○ ○ ○ ○	● ● ● ○
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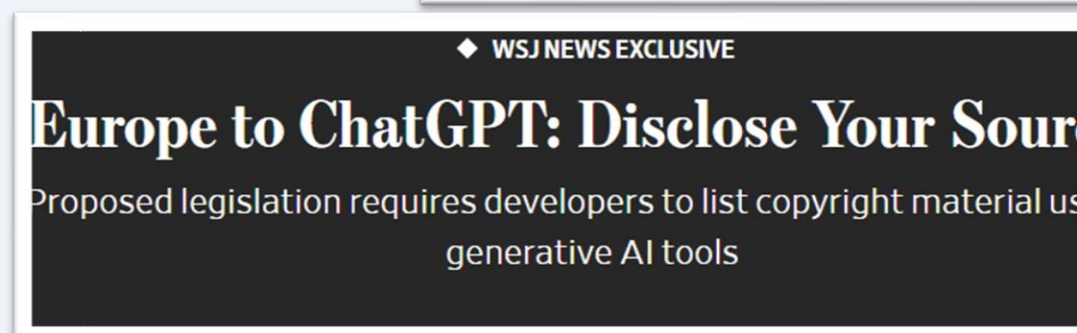
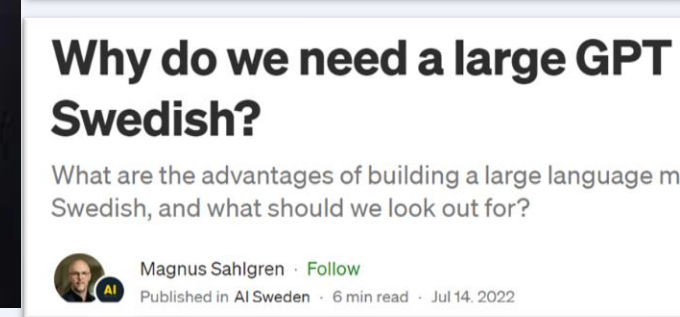
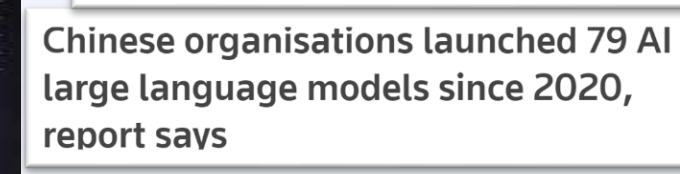
Source: Stanford Center for Research on Foundation Models (CRFM), Institute for Human-Centered Artificial Intelligence (HAI)

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Copyrighted data	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
Compute	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
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Capabilities & limitations	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
Risk	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
Mach...	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
M...	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
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"Impossible": OpenAI admits ChatGPT can't exist without pinching copyrighted work

Why a Dutch LLM from scratch?

- Many of the current language models are trained on datasets that contain **no or very little Dutch data**
- **European values around bias, inclusivity and explainability** are insufficiently guaranteed in current solutions
- **Digital sovereignty** of European language and speech technology, no dependence on foreign multinationals
- **Privacy and IP**



WHAT?

We will build our own Dutch-English (50%-50%) language models from scratch,

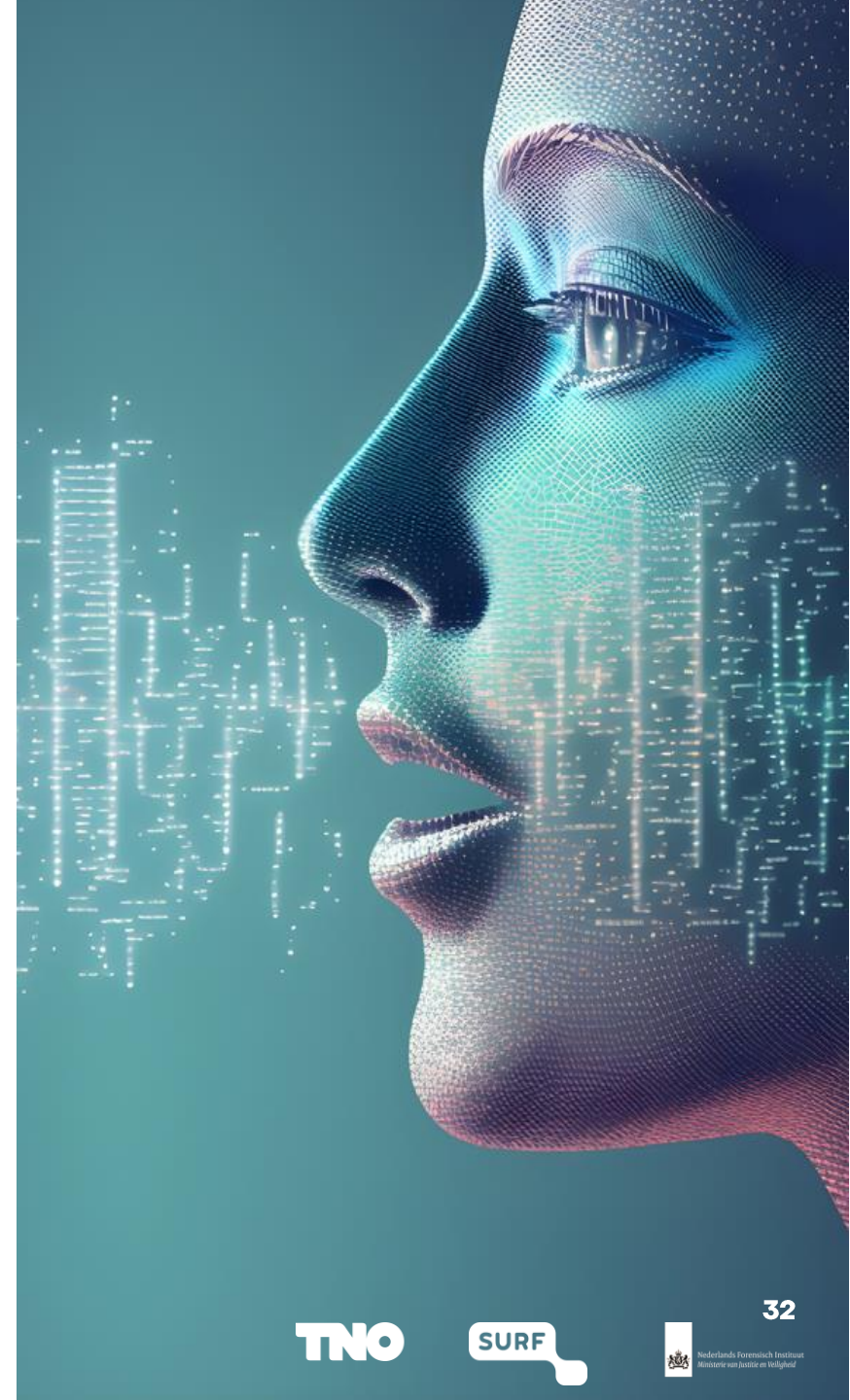
*using data that we are allowed to use,
with privacy information removed,
with full transparency in our choices*

Where we strive to be as transparent and compliant as possible

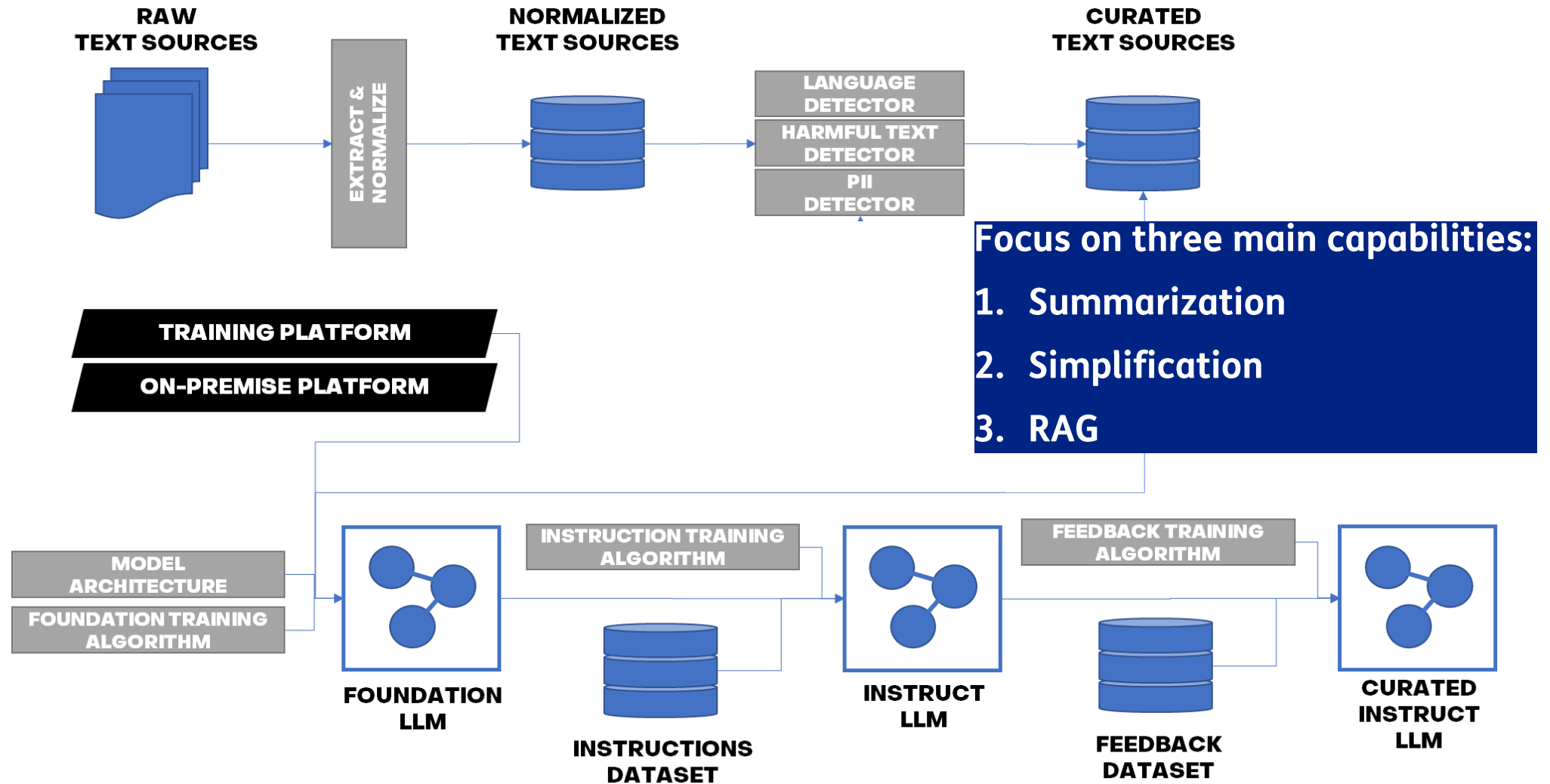
Small and large trained language models

On-premise fine-tuning cluster

Open code



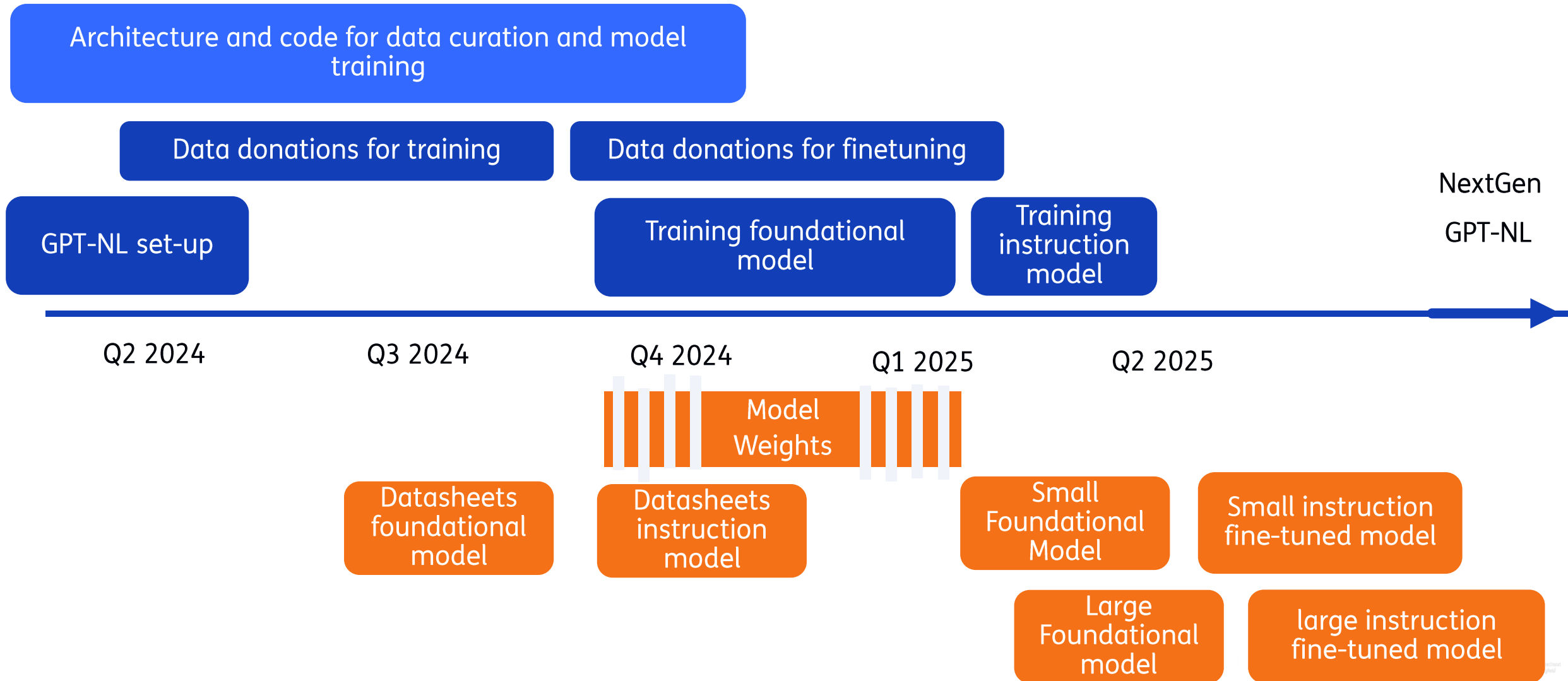
HOW?



Main capabilities and use case

	Summarization	Simplification	RAG
Main capabilities	<ul style="list-style-type: none"> • Regulations • Compliance requirements 	<ul style="list-style-type: none"> • Simplify complex jargon without compromising on factualness • Language levels specified to user 	<ul style="list-style-type: none"> • Access to and integration of organizational specific (sensitive) information • Provide interface for Q&A to users
Use cases	<ul style="list-style-type: none"> • Case law documents • Arbeidsrichtlijnen • Insurance policies • Driving licence guidelines • Medicine prescription explanations • Etc. 		

Planning



Participate!

Data Providers

To train GPT-NL we need enormous amounts of data to ensure a diverse and inclusive language model which is widely applicable. Therefore each data donation is much valued and will ensure relevance of GPT-NL in your sector.

Use-case provider

to validate GPT-NL we want to test the model on several use-cases. By sharing your use-case you contribute to the quality of GPT-NL. Meanwhile you can check the relevance of GPT-NL for your use-case and get specific advice on what the model can mean for you.

Current challenges in health

The Dutch situation: Intergraal Zorg Akkoord

- Pressure on the accessibility of care (balance supply and demand)
- Pressure on the quality of care
- Lack of collaboration between fields
- Pressure on health professional



Infographic IZA

Current developments in health

IZA solutions

- Fitting care and support
- Together with the individual (patient)
- At the right place
- Focus on health

‘Do it yourself, at home and digital if possible’



Waar gaan we naartoe?



Meerwaarde voor de patiënt of cliënt
Zorg is aantoonbaar effectief



Samen met de patiënt of cliënt
Patiënt en zorgprofessional staan samen aan het roer



Juiste zorg op de juiste plek
Dichtbij huis waar het kan, verder van huis voor complexe zorg



Gericht op gezondheid i.p.v. ziekte
Kwaliteit van leven staat centraal



Goede werkomgeving voor zorgprofessionals
Verminderen werkdruk en administratief gedoe

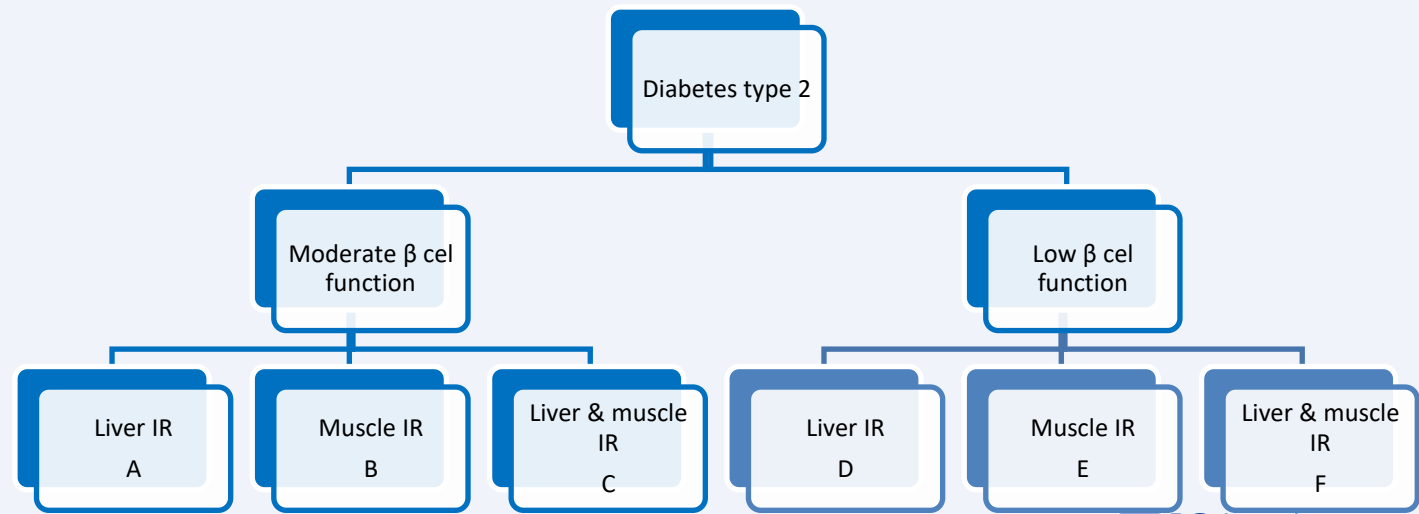
Infographic IZA

Perspective on the use of AI

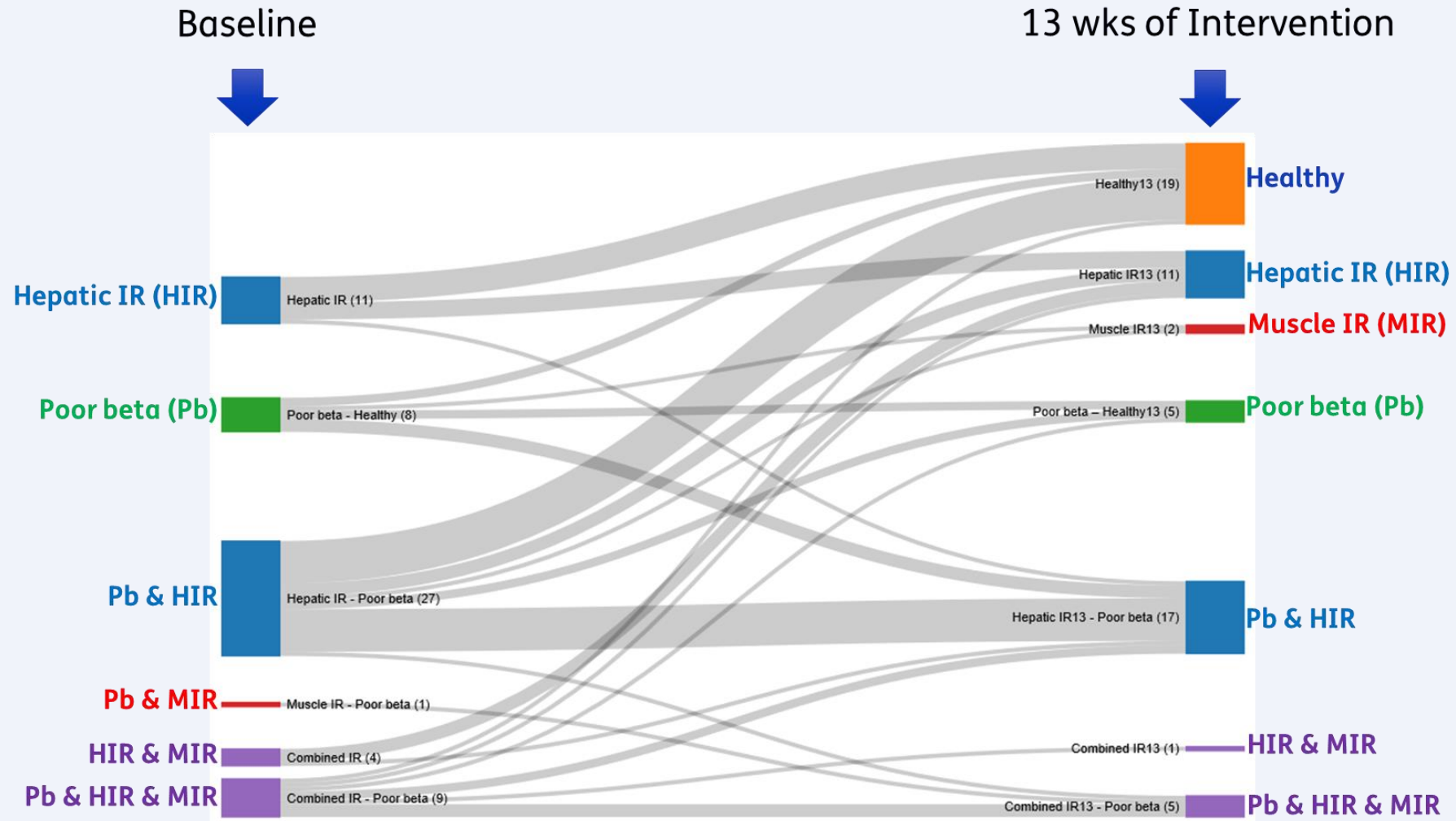
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Prospective Diabetes Field lab in Hillegom

- **Aim:**
 - reduce diabetes incidence and complications
- **Approach:**
 - tackle newly diagnosed diabetes type 2 with lifestyle changes
- **Method:**
 - personalized diagnosis and advice
 - use OGTT (oral glucose tolerance test) to stratify



Positive effect of personalized treatment



Nutritional recommendations

Rules-based systems

Rules formulated by experts. Assessment using questionnaires, blood & body measures

Strong points of rule-based system

- Knowledge driven & predictable
- Fully transparent & interpretable

Drawbacks of rule-based system

- Simple rules, simple recommendations
- High complexity even for simple systems
- Adding factors dramatically increases rule number & complexity

LLM-based system

Not suitable out-of-the box

- Can hallucinate, providing wrong responses
- Cannot use our expert knowledge for assessment

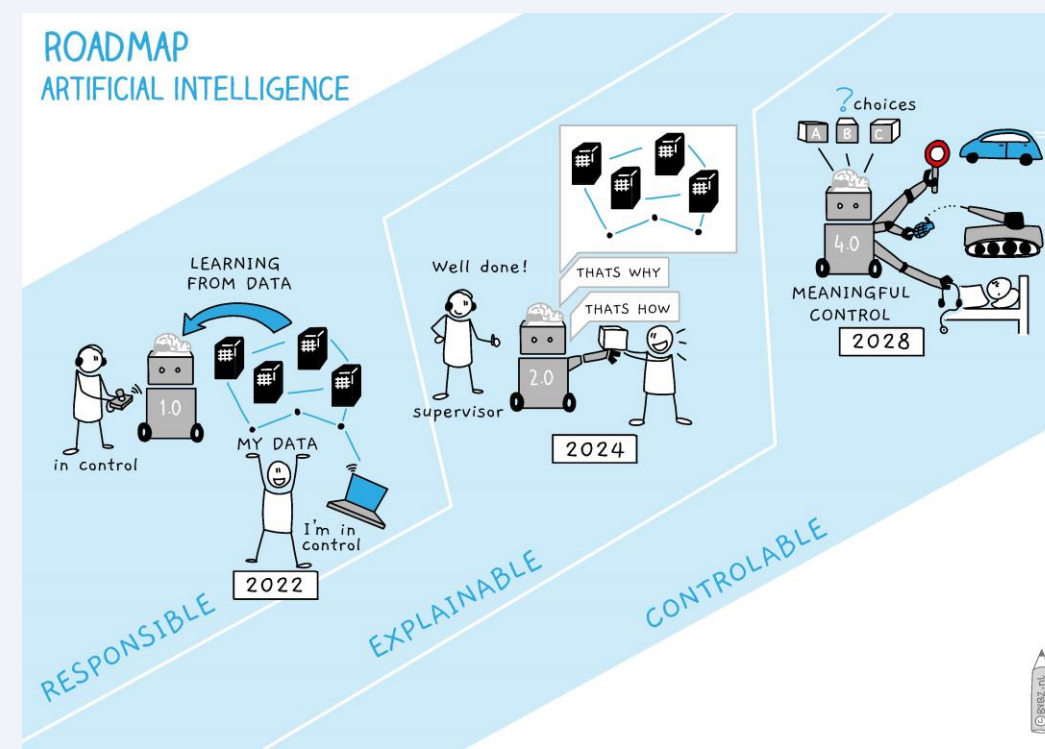
Needed: Creating guardrails

- Rely on existing systems for assessment
- Preventing hallucinations
- Use factual knowledge for recommendations

		<i>Rule 1</i>	<i>Rule 2</i>	<i>Rule 3</i>	<i>Rule 4</i>
<i>IF</i>	Condition 1	Y	Y	N	N
AND	Condition 2	Y	N	Y	Y
AND	Condition 3	-	N	Y	-
AND	Condition 4	-	-	Y	N
<i>THEN</i>	Action 1	X		X	
AND	Action 2	X			X
AND	Action 3		X		
AND	Action 4		X	X	

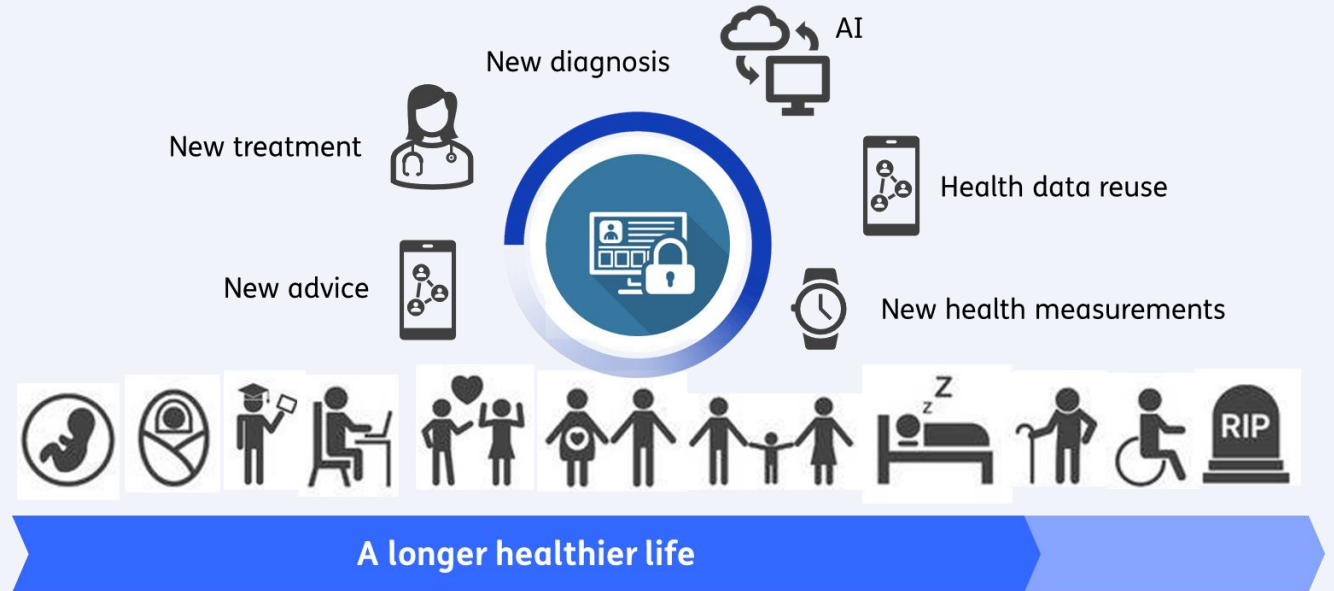
Conclusions on AI –based advice systems

- Accurate
 - ✓ Grounded in voedingscentrum knowledge; no hallucinations
- Comprehensive, concise, well structured & friendly
- Can provide additional relevant information on demand
- Retrieval-augmented generation works well in constrained context
- Slow; unsuitable for real-time purposes



Conclusions & perspectives

- Many components are needed for personal health advice
- Systems approaches are needed for fitting advice
- Health care can become more preventive
- Health care can be more fun to work in



AI en Gen AI

- Generatieve AI is artificiële intelligentie dat in staat is nieuwe inhoud te creëren.
- Meer klassieke AI is gericht is op het leren herkennen en voorspellen van patronen (machine learning), het begrijpen van tekst (natural language processing) en beeld (computer vision)
- Drie vormen van GAI:
 - ✓ het genereren van beelden
 - ✓ genereren van teksten
 - ✓ genereren van synthetische data



Gen AI

Onderscheidende eigenschappen:

- Generatieve AI-systemen beter in taal dan andere AI-systemen
- Werken met verschillende ‘modaliteiten’, zoals beeld, geluid, video, spraak, en zelfs zaken als eiwitstructuren en chemische verbindingen
- Wordt algemeen getraind en specifiek toegepast
- Kan verschillende taken uitvoeren



Concepten en samenvatten

- Patiënt-vragen beantwoorden - concept antwoorden klaarzetten, voor te leggen aan de arts en versturen
- Samenvatten van patiënt-dossiers als voorbereiding op spreekuur



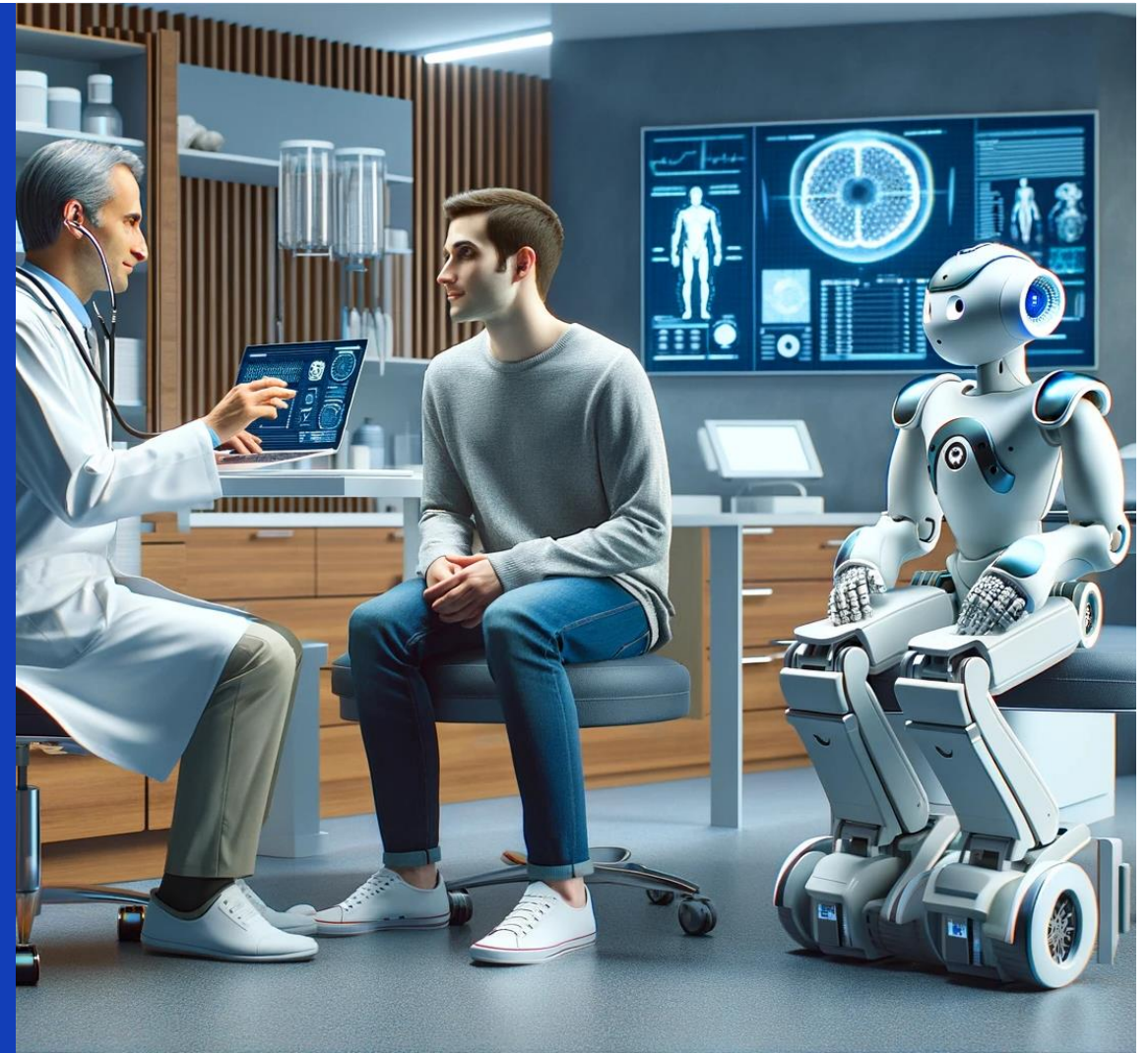
Risico's

- Missen cruciale gegevens → juist geformuleerde prompt
- Gegevens noemen die niet voorkomen in dossier (hallucinaties) → benchmark



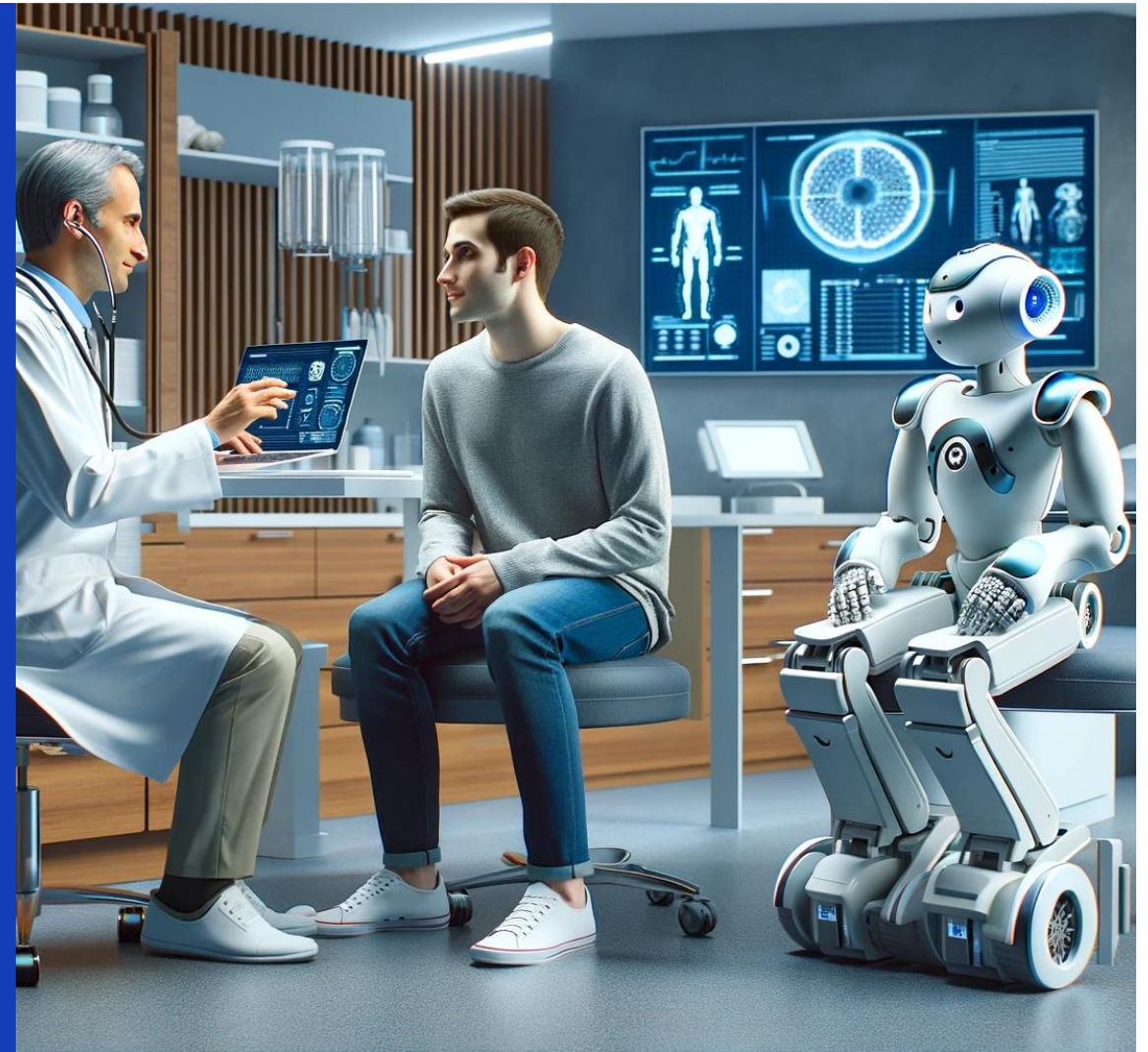
Administratie door transcripties

- Meeluisteren en patiëntdossier vullen, verdere verlaging administratieve last
 - ✓ registratie aan de bron automatiseren
 - ✓ ondersteuning van zorgverlener en patiënt



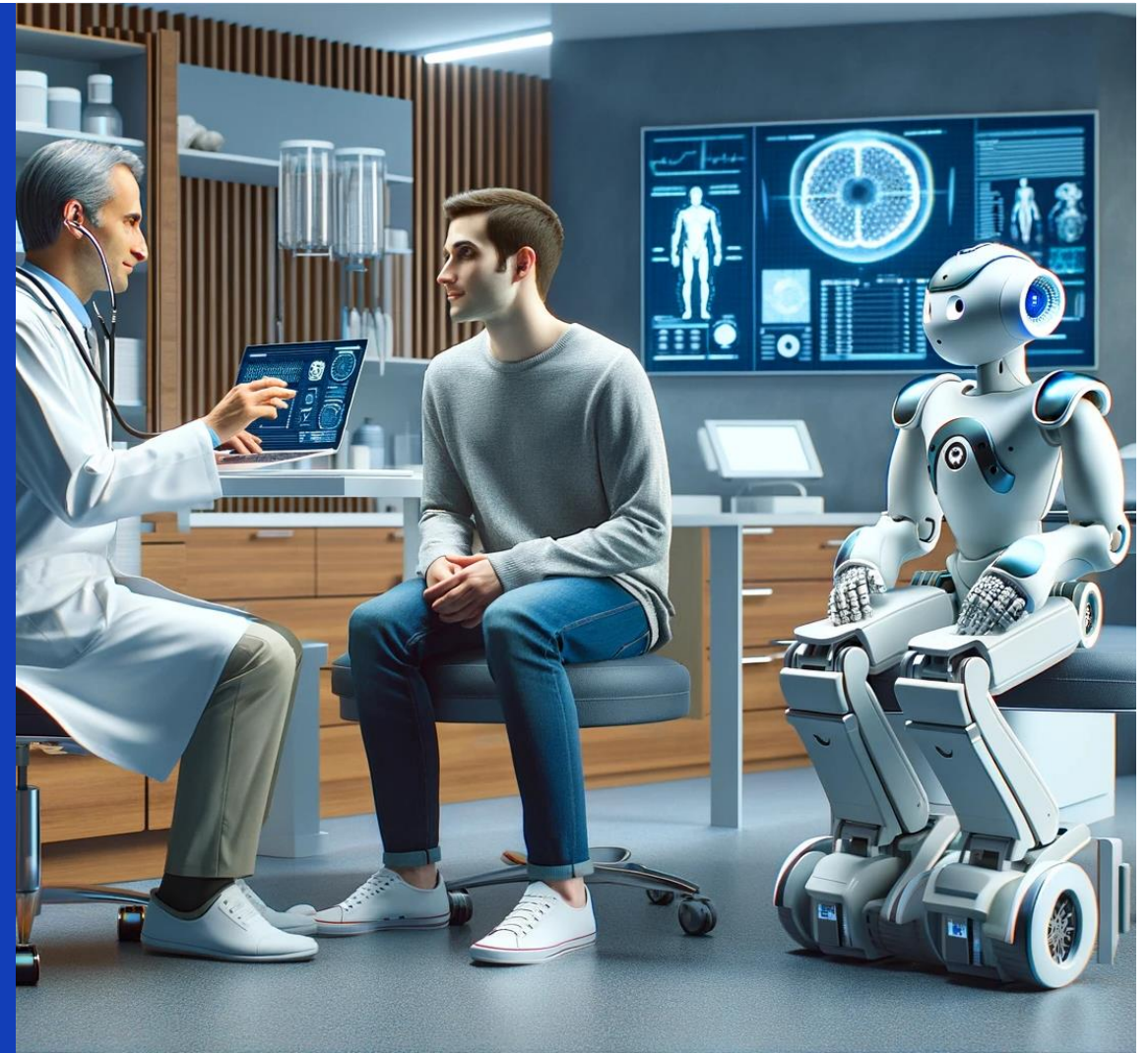
Diagnose en behandeling

- Richtlijnen en medische kennis bijeen te brengen en te bevragen
 - ✓ Arts altijd als eindverantwoordelijke
 - ✓ Effectiviteit voor complexe situaties
behoeft onderzoek



Geneesmiddelen ontwikkeling

- Klinische uitkomsten te voorspellen
- Herpositionering van medicijnen voor alternatieve klinische domeinen
- Vinden van nieuwe eigenschappen van bestaande moleculen
- Generen van mogelijke relevante nieuwe molecuulstructuren



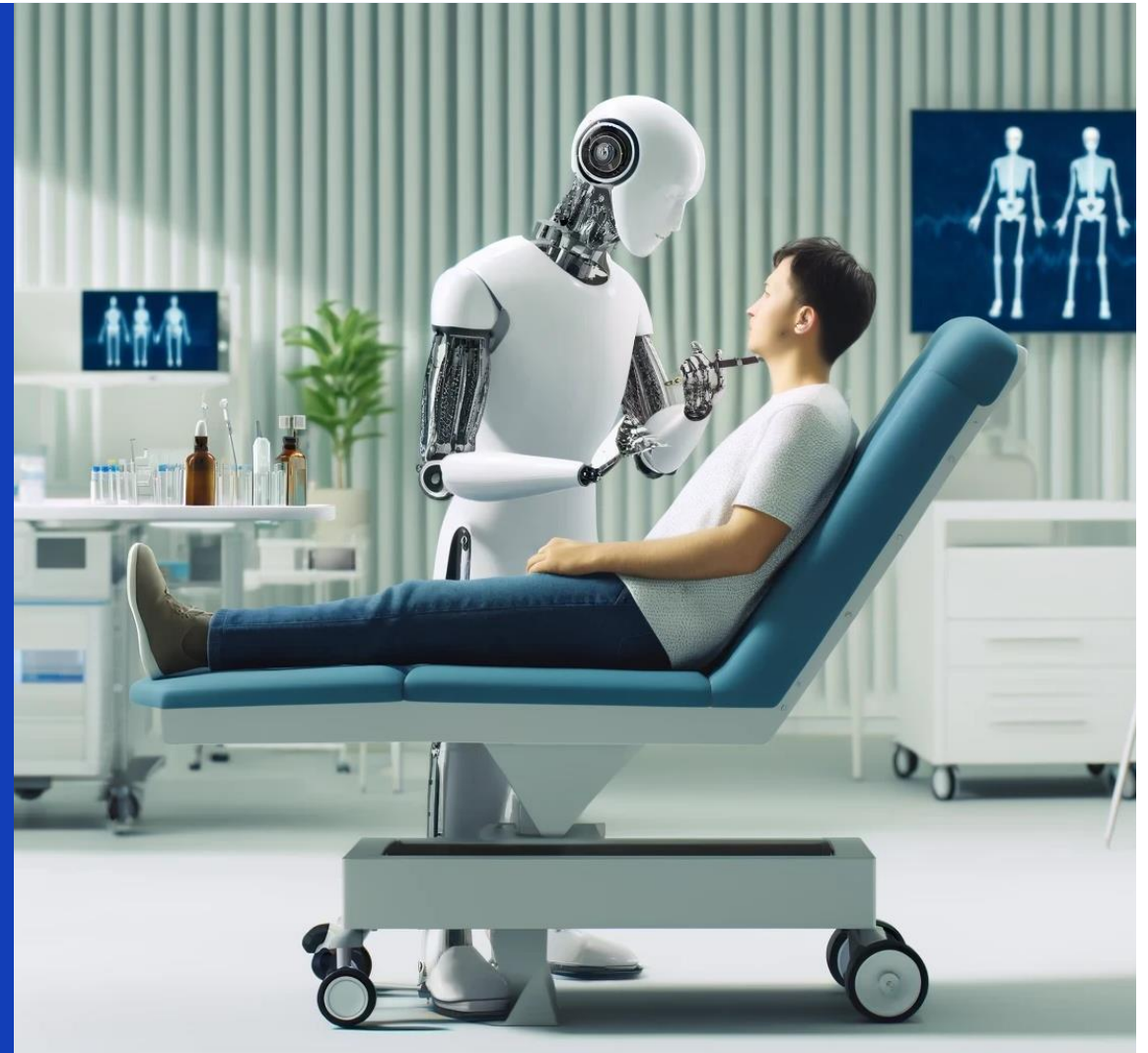
Zelf management & ondersteuning

- De patiënt thuis ondersteunen met triage, adviezen en antwoorden.
- Potentie om veel werk van de zorgverlener uit de zorgpraktijk te nemen naar de thuissetting.
- Vooraf aan consult beter in kaart brengen waar patiënt last van heeft



Autonome behandeling door GAI

- Diagnoses en triage ondersteunen (zonder zorg verlener) zoals Hippocrates van Nvidia
 - ✓ (maar wat dan met die eed van....).



Risico toepassingsgebieden van GAI

Toepassing	Risico Niveau	Potentie Niveau	Reden
Automatisering van administratieve taken	Laag tot gemiddeld risico	Hoog	<p>Draagt direct bij aan vrijmaken capaciteit van zorgpersoneel zonder grote risico's rondom hallucinaties en controle. Eenvoudig om samen met expert te laten werken. Risico hang af van de mate waarin model medisch gerelateerde handelingen verricht.</p>
Virtuele gezondheidsassistenten en telemedicine	Gemiddeld tot Hoog risico	Gemiddeld tot Hoog	<p>Potentie om veel werk van de zorgverlener uit de zorgpraktijk te nemen naar de thuissetting. Risico is hoger dan vorige toepassing vanwege mogelijke medische aard. Hoog risico als het met medische en biometrische gegevens werkt.</p>
Diagnose en behandelplanning	Hoog risico	Hoog	<p>Potentie hoog om werk van zorgverlener te ondersteunen en uit handen te nemen. Hoog risico als mens niet eindverantwoordelijk is en omdat er met biometrische gegevens wordt gewerkt.</p>

Daadwerkelijke risiconiveau zal use-case afhankelijk zijn