



From Data to Decisions:

Using AI to Optimize the Management of Patients with Hematologic Neoplasms

By Adrián Mosquera

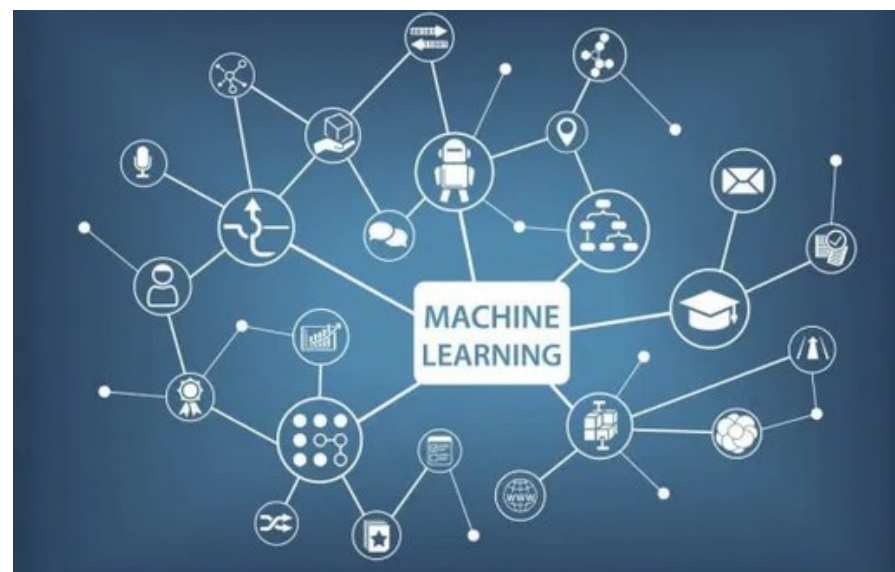
Disclosures

Name of Company	Research support	Employee	Consultant	Stockholder	Speaker's Bureau	Advisory Board	Other
Janessen	X		X		X	X	
AstraZ.			X		X	X	X
Abbvie					X	X	
Pfizer	X						
Roche	X				X		
Takeda					X		
Incyte							X
Novartis							X
GSK	X						
BioDigital Thech				X			

What is AI?

Artificial Intelligence: any device that perceives its environment and takes actions that maximize the possibility of achieving its objectives.

It is traditionally used to refer to systems that simulate human cognitive activities: **learning and problem solving.**



Machine learning is a branch of AI that consists of **the study of algorithms and statistical models for a specific purpose without prior instructions.** It is based on pattern searching and inference

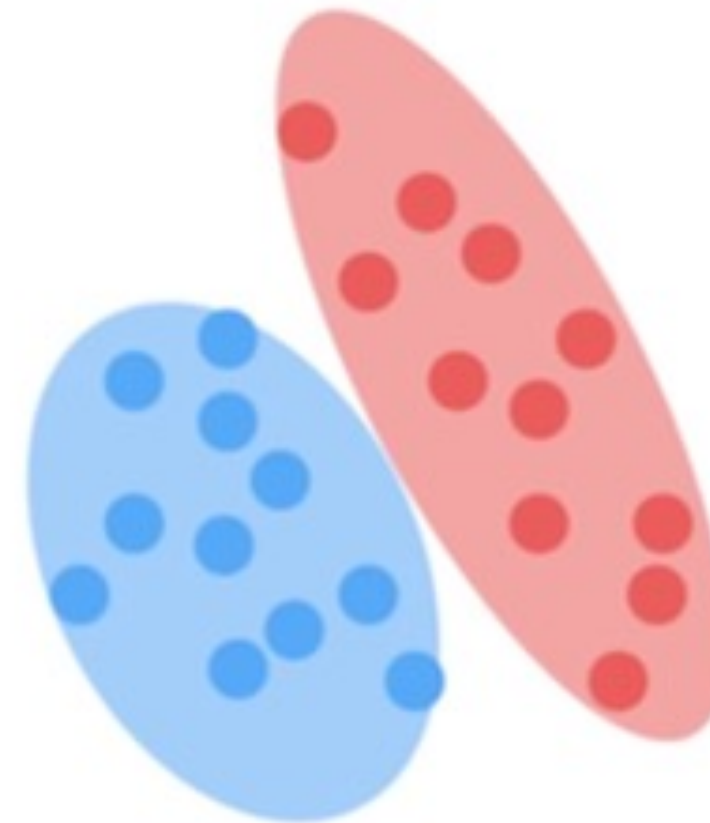
What types of AI exist?

Focus on learning the boundaries.
Attention to events near the boundaries.

Discriminative



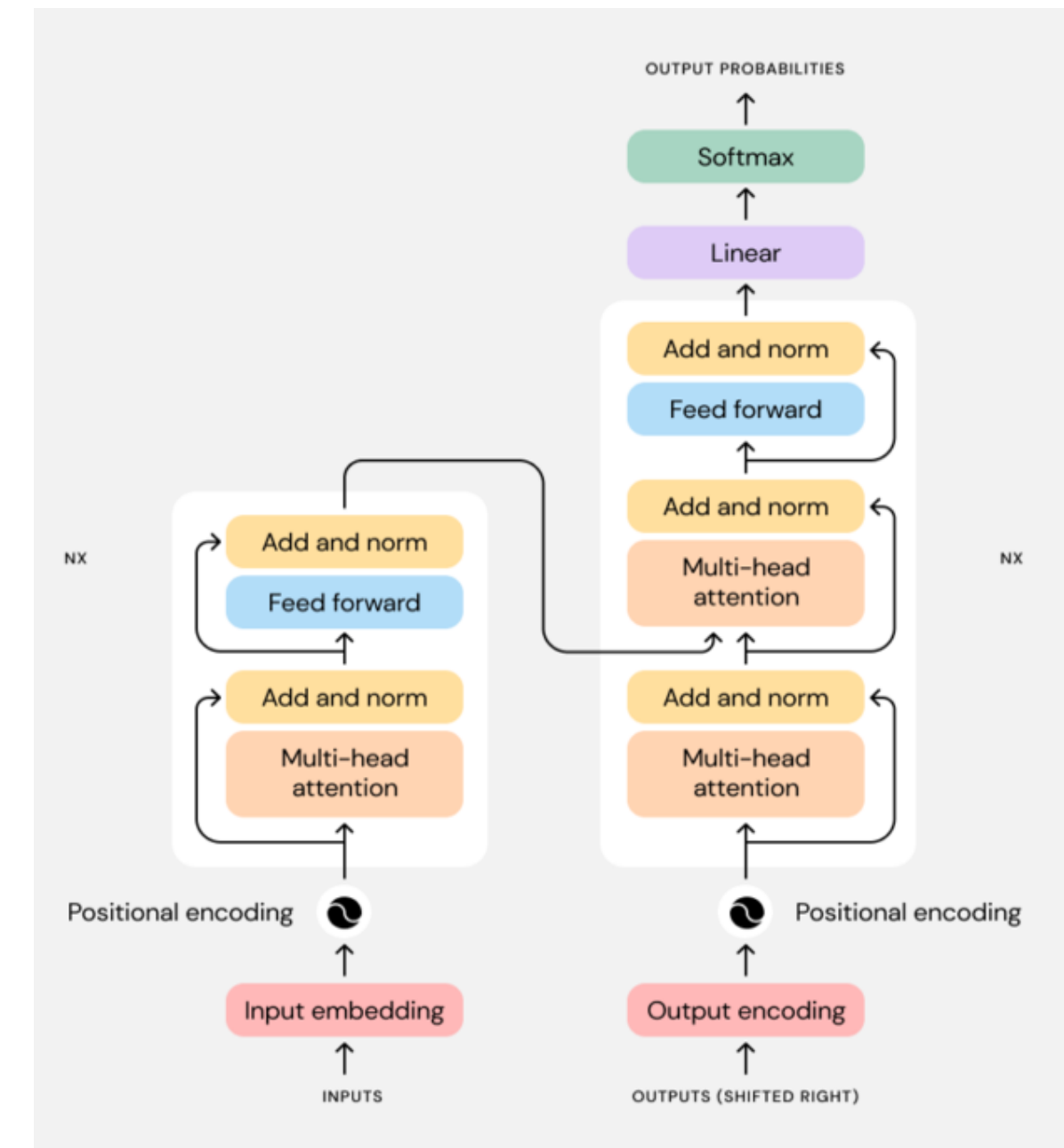
Generative



Probabilistic model of each class.
Focus on representing the data and boundary.

Generative Pre-Trained Transformer (GPT)

- GPT is a NPL model that uses transformer neural networks to generate coherent and contextually relevant text across various tasks.
- It is pre-trained on massive amounts of natural language data, giving it prior knowledge of language structure. This enables GPT to produce grammatically correct and meaningful text in different contexts and languages.
- The transformer architecture, key to GPT, allows the model to understand both local and global relationships in a text through layers of attention, focusing on the most relevant parts for each task.



Brown et al, NIPS'20, 2020



WILL DIGITAL HEALTH TECHNOLOGY REPLACE PHYSICIANS?

DIGITAL HEALTH TECHNOLOGIES WILL PLAY A LIMITED ROLE IN THESE PROFESSIONS MOSTLY SERVING AS AUXILIARY TOOLS.

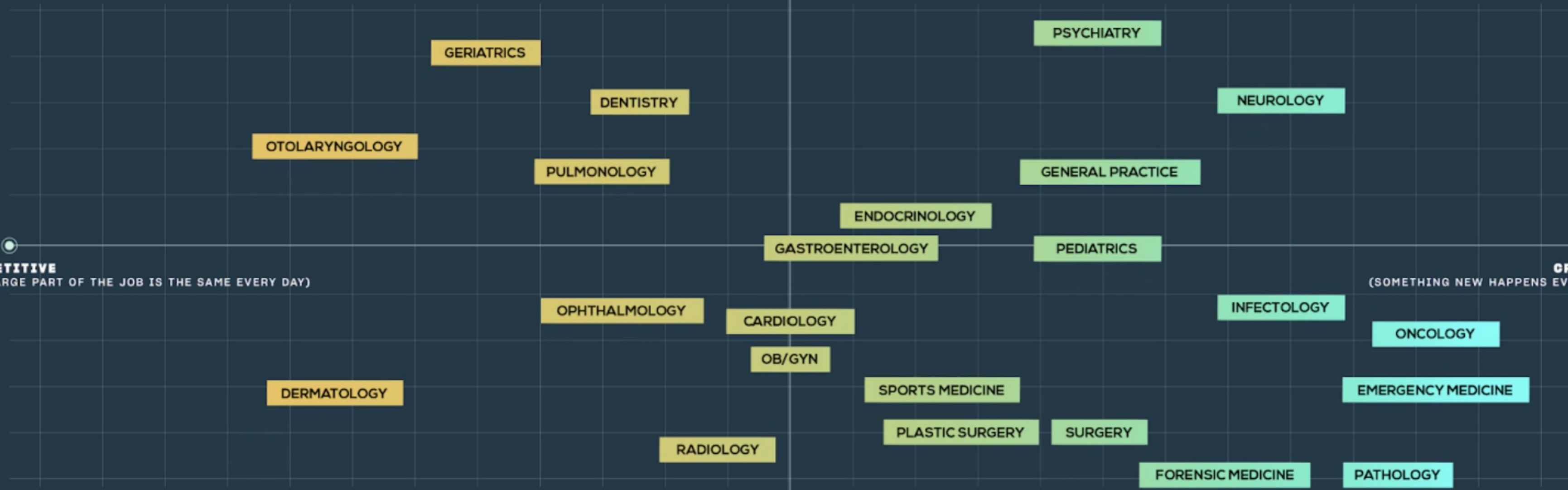
DIGITAL HEALTH TECHNOLOGIES WILL HAVE AN IMPACT ON THESE PROFESSIONS BUT IT WON'T CHANGE THEIR INTERACTION-BASED NATURE.

REPETITIVE
(A LARGE PART OF THE JOB IS THE SAME EVERY DAY)

CREATIVE
(SOMETHING NEW HAPPENS EVERY DAY)

INTERACTION-BASED
(TALKING WITH THE PATIENT IN PERSON OR REMOTELY)

DATA-BASED
(DEALING WITH DATA ABOUT OR DERIVED FROM THE PATIENT)



MANY REPETITIVE COMPONENTS OF THE JOBS WILL BE REPLACED BY TECHNOLOGIES TO CREATE SPACE FOR CREATIVE TASKS.

THESE PROFESSIONS WILL BE HEAVILY DEPENDENT ON DIGITAL HEALTH TECHNOLOGIES, MEDICAL PROFESSIONALS WILL WORK WITH THEM ON A DAILY BASIS.

FUTURE TRENDS



Clinical trial enrichment with AI



EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

Reflection paper on the use of Artificial Intelligence (AI) in
the medicinal product lifecycle

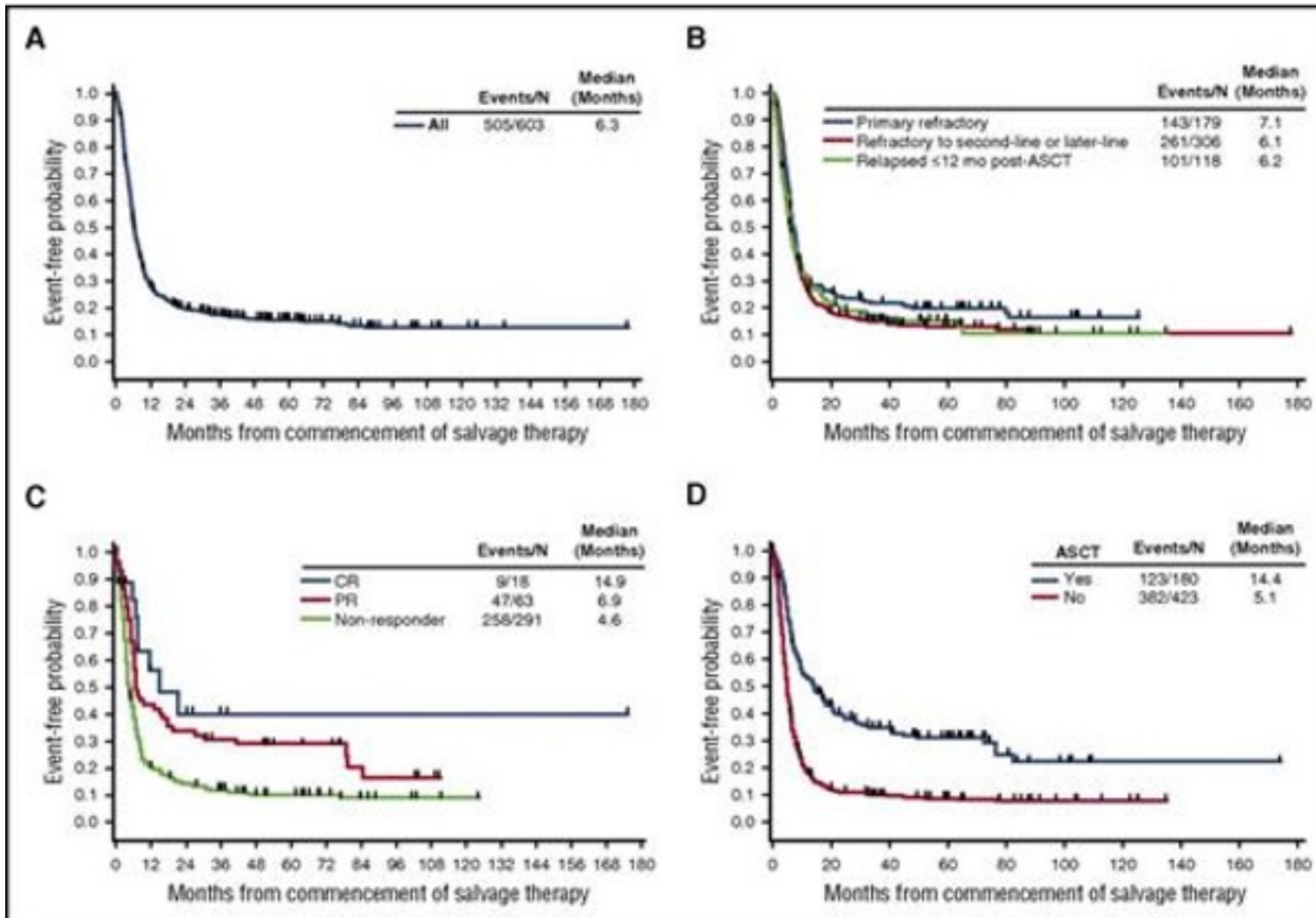
Draft

“All algorithms, models, datasets, and data processing pipelines used are fit for purpose and are in line with ethical, technical, scientific, and regulatory standards as described in GxP standards and current EMA scientific guidelines”

Improving DLBCL risk prediction and treatment choice



DLBCL: A one shot disease



DLBCL relapsing early after ASCT & chemorefractory DLBCL patients have a median survival of 6.3-9.8 months and a 5-year survival of 20-28%.

CAR-T cells are currently the SOC in relapsed and refractory DLBCL. **BITEs** coming after

New targeted drugs taavailable for upfront and relapsing patients ineligible for ASCT (polatuzumab, tafasitamab)

Risk Stratification: Pitfalls

Prognostic stratification of DLBCL based on R-IPI, IPI and NCCN-IPI is suboptimal

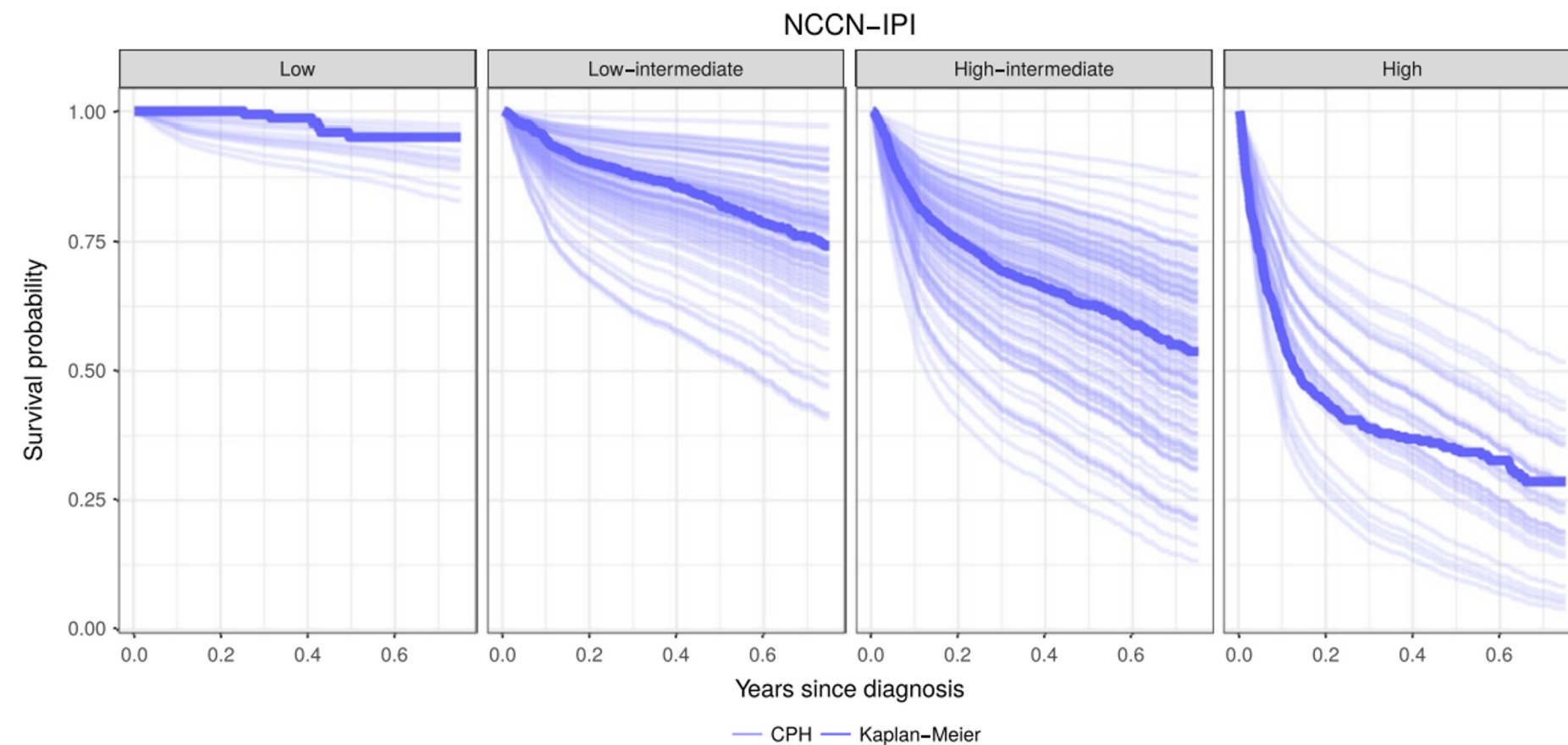
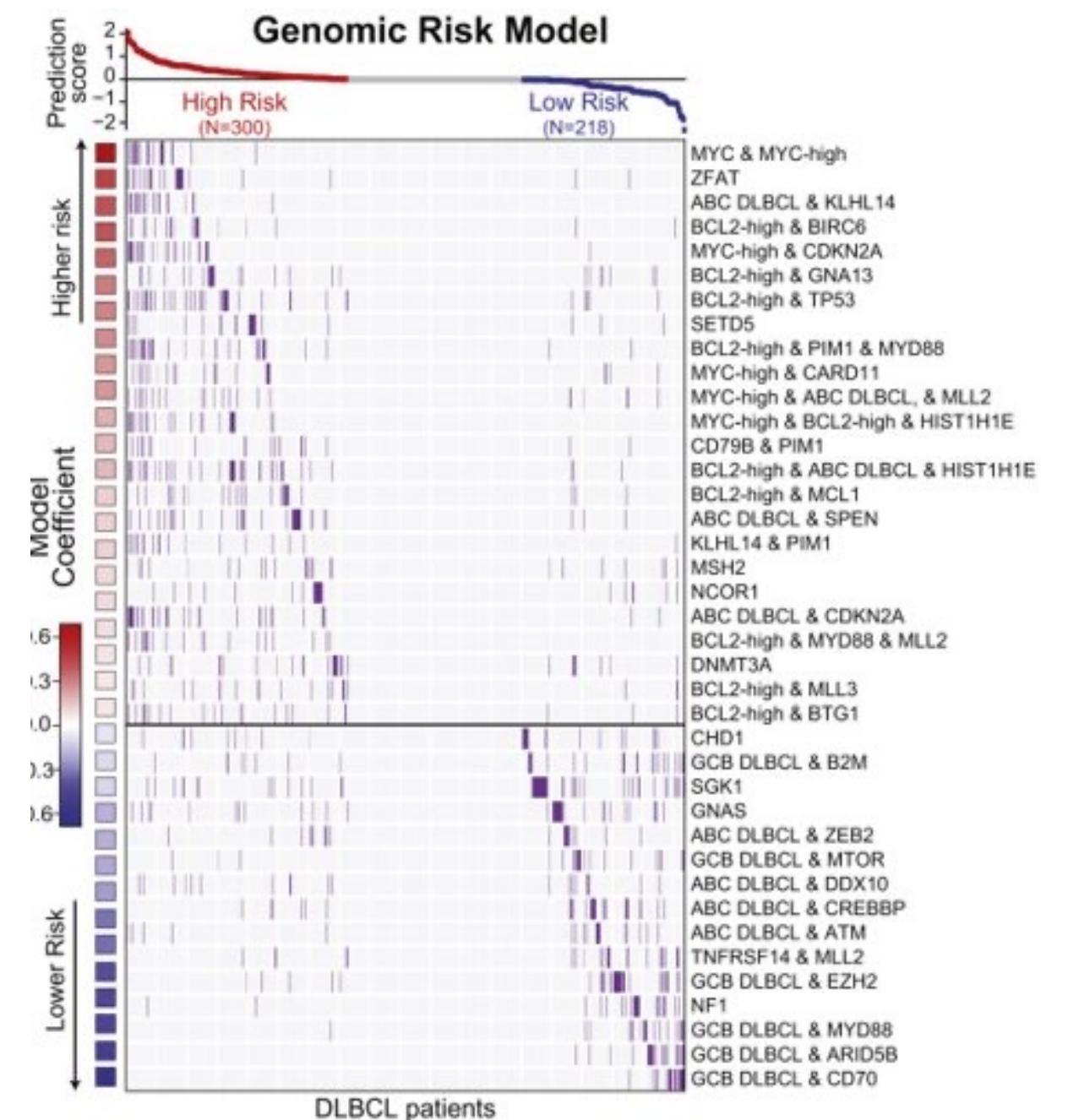


Figure 3. Predicted survival of 250 randomly selected patients in the Danish cohort predicted by the Cox proportional hazards model (CPH) and the Kaplan-Meier method for each National Comprehensive Cancer Network International Prognostic Index (NCCN-IPI) group. There is a notable spread of predicted survival within each risk group and a certain overlap of estimated survival curves between the risk groups.

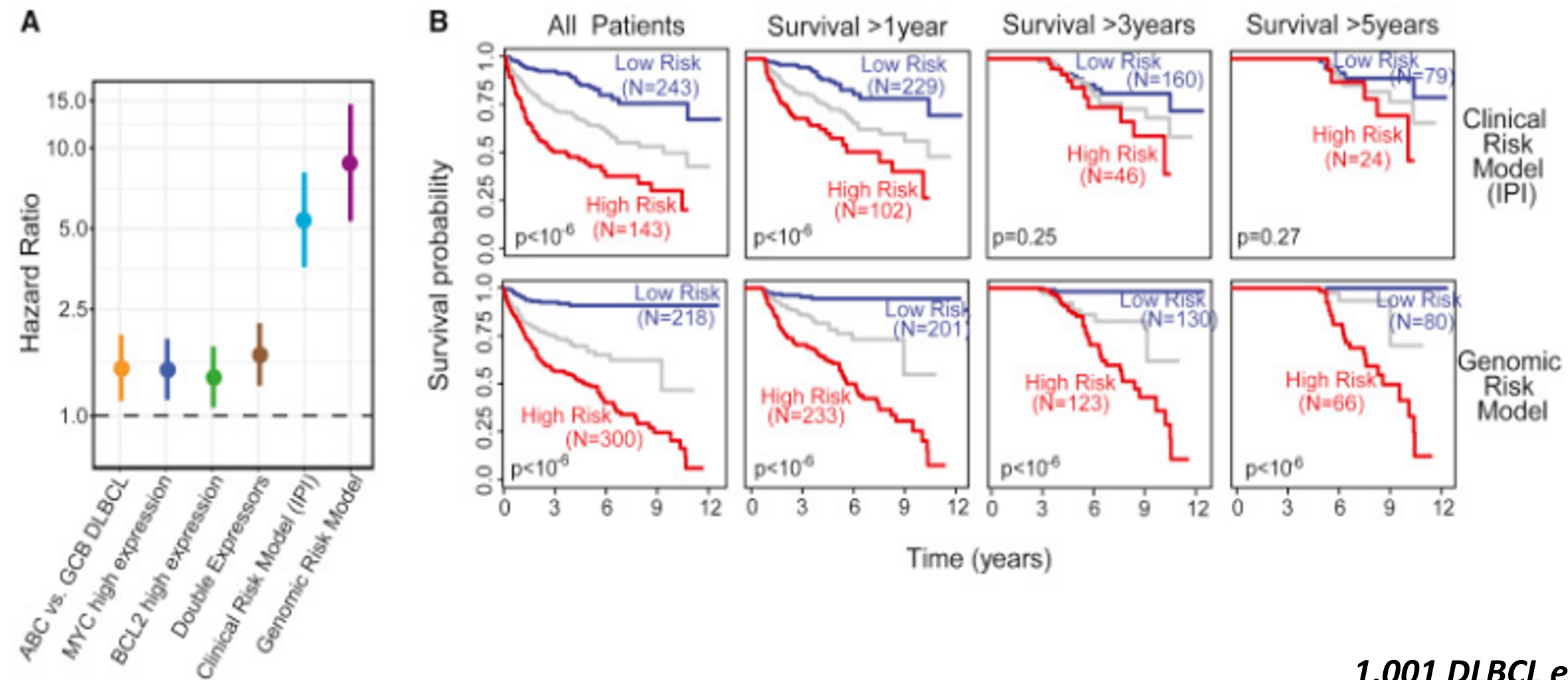
Moving towards genomic risk stratification

- 1,001 DLBCL exomes analyzed
- 150 putative driver genes that were recurrently mutated
- Patterns of differential mutation between GCB and ABC DLBCL subtypes
- A multivariate supervised learning approach for defining the association of survival with combinations of genetic markers (150 genetic driver genes) and gene expression markers (cell of origin, *MYC*, and *BCL2*) was developed.



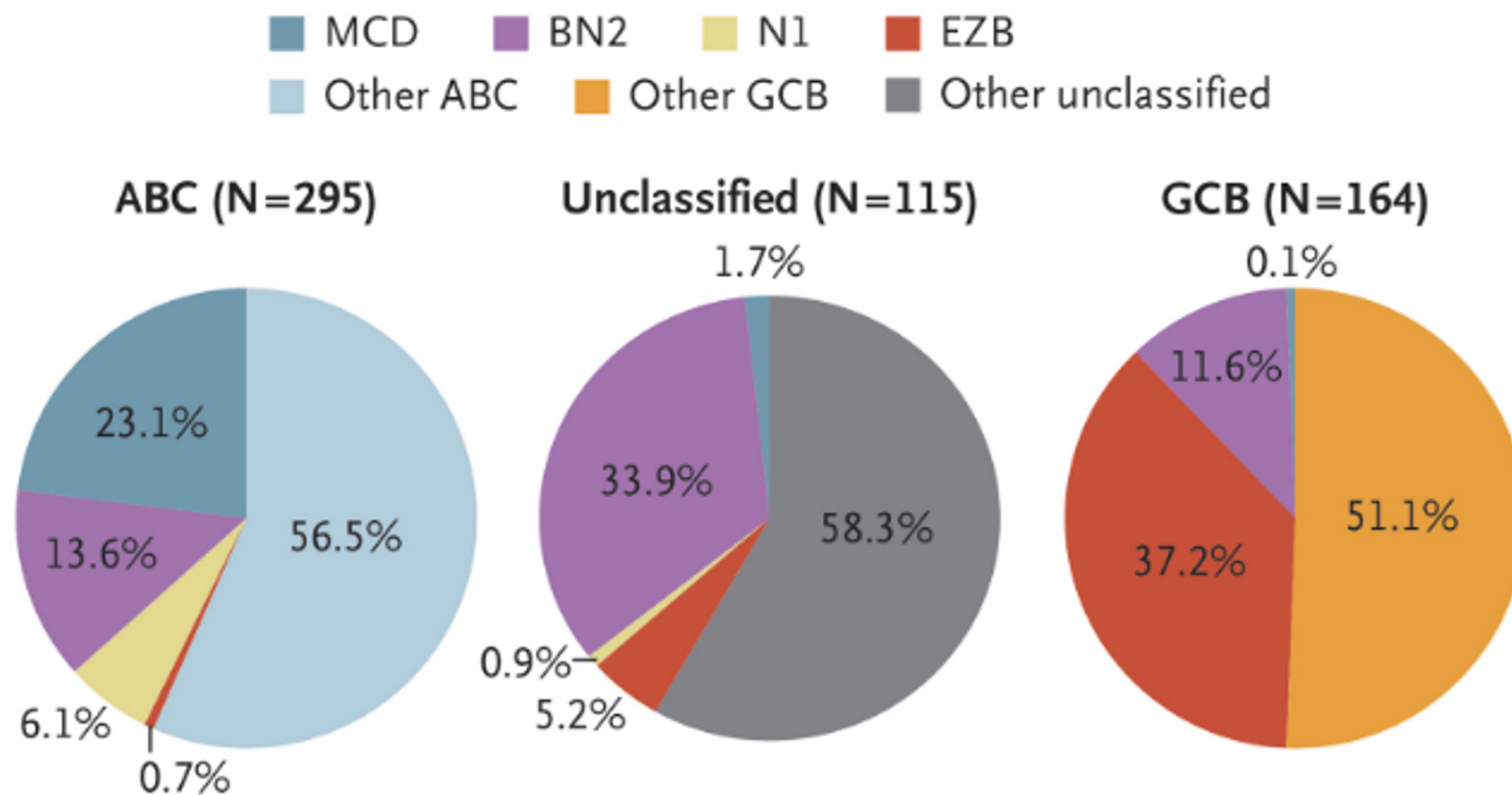
Moving towards genomic risk stratification

Increasing biological characterization of DLBCL improves prognostication



Moving towards genomic risk stratification

B

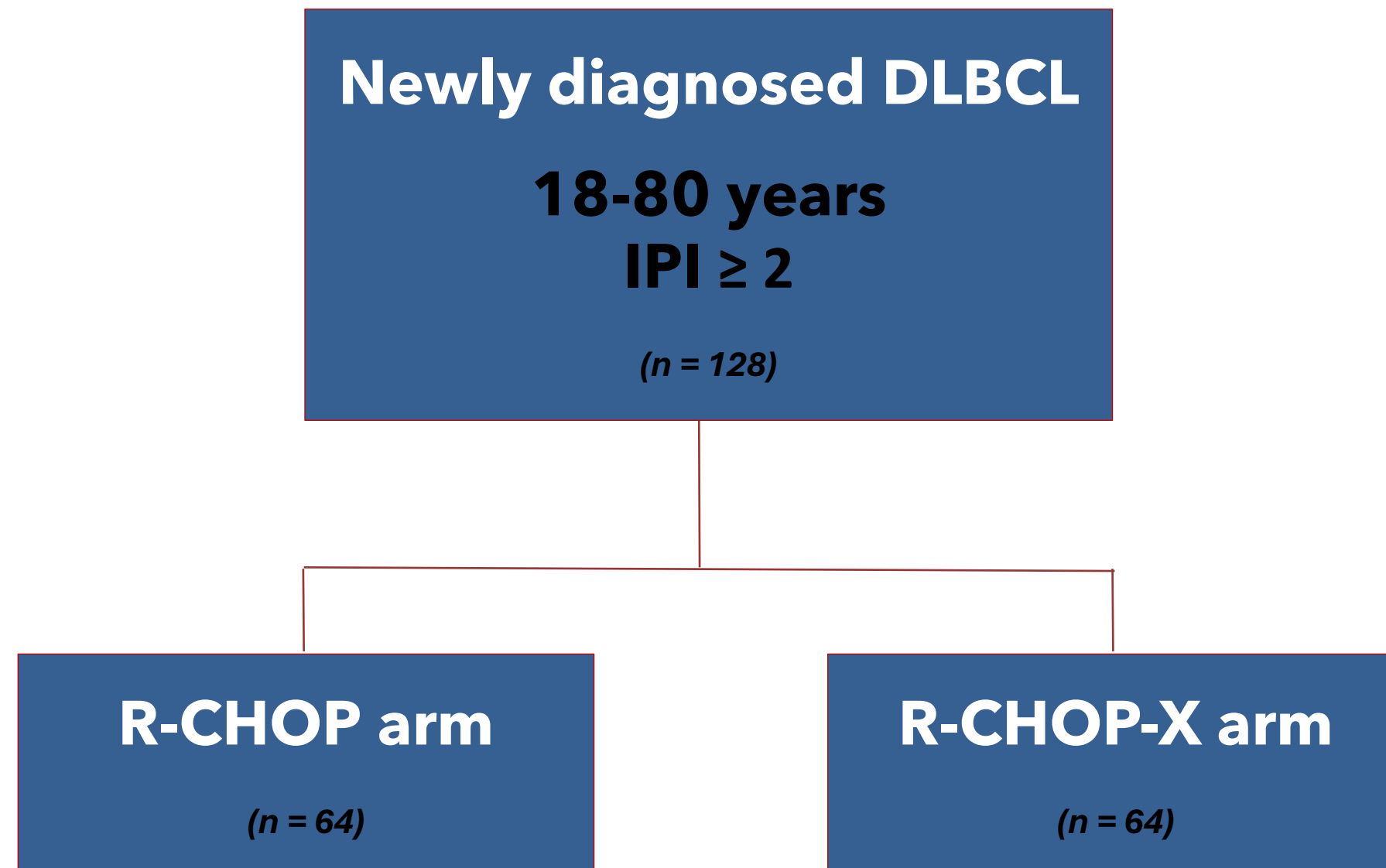


A prognostic classification of DLBCL was proposed based on patterns of co-mutation:

- **MCD** (based on the co-occurrence of *MYD88*^{L265P} and *CD79B* mutations)
- **BN2** (based on *BCL6* fusions and *NOTCH2* mutations)
- **N1** (based on *NOTCH1* mutations)
- **EZB** (based on *EZH2* mutations and *BCL2* translocations)

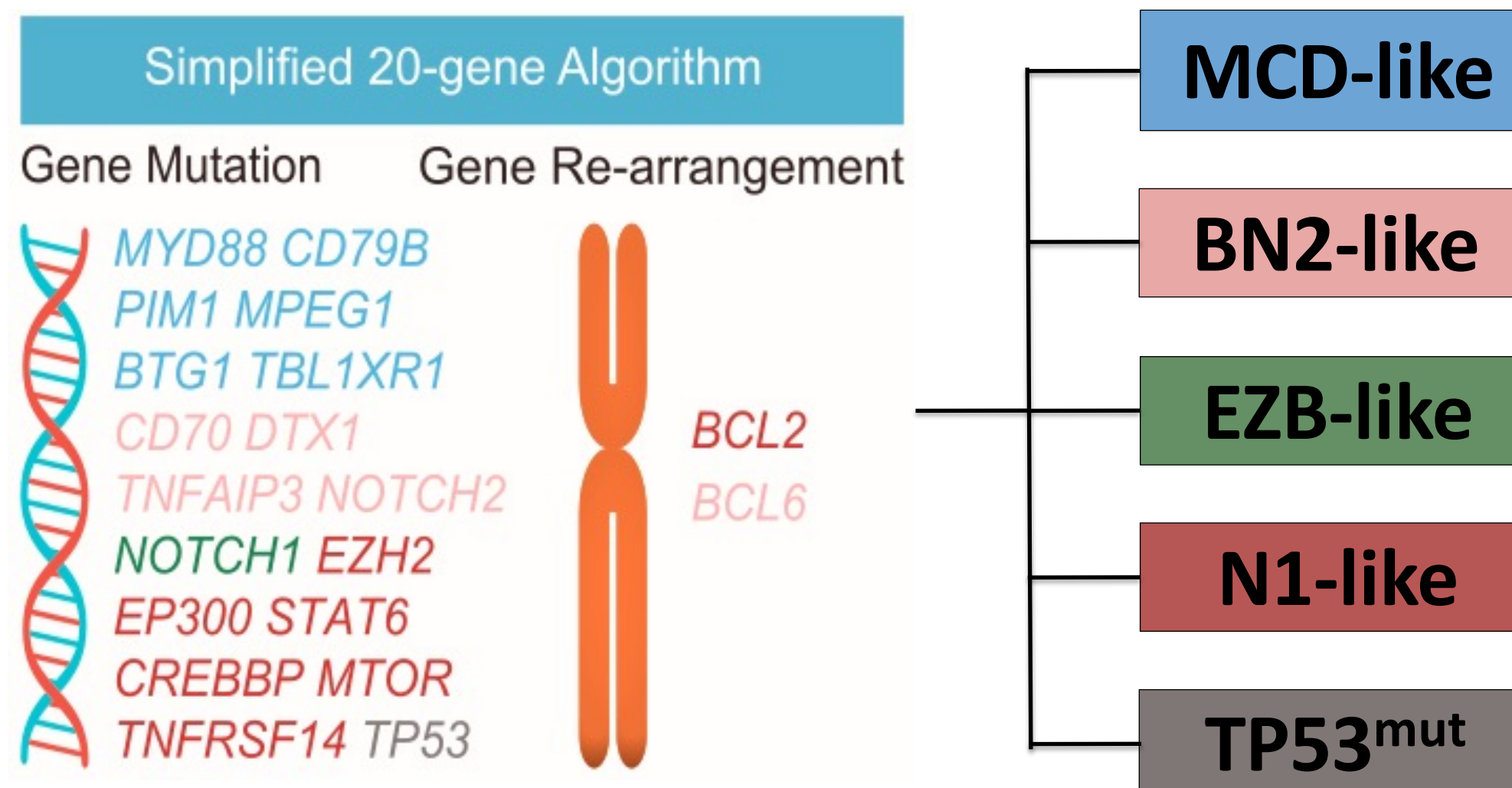
GUIDANCE-01 trial

Combination of R-CHOP immunochemotherapy with novel targeted agents in DLBCL.



GUIDANCE-01 trial: Genetic Subtype Classification

To identify the potential targeted agents, six groups were established based on genetic subtypes classified using the **simplified 20-gene algorithm**.



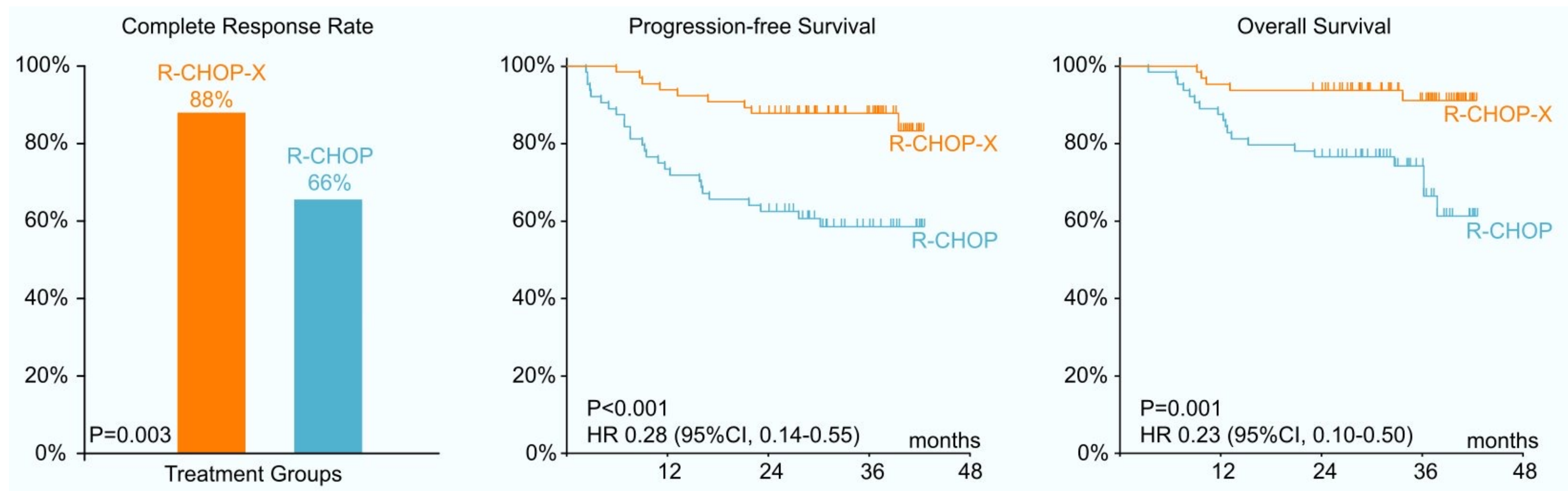
GUIDANCE-01 trial: Treatment Strategies Selection

For each subtype, targeted agents were selected based on the oncogenic signaling alterations driven by specific mutations in each group.

Subtype	Biological Characteristics	Targeted treatment
MCD-like	NF-κB activation	Ibrutinib
BN2-like	NF-κB activation	Ibrutinib
EZB-like	Histone deacetylation signaling pathway upregulation	Tucidinostat
N1-like	No significant oncogenic signaling features were enriched	Lenalidomide
TP53 ^{mut}	Histone methyltransferase activity in H3K9me3 upregulation	Decitabine
NOS (not otherwise specified)	No significant oncogenic signaling features were enriched	Lenalidomide

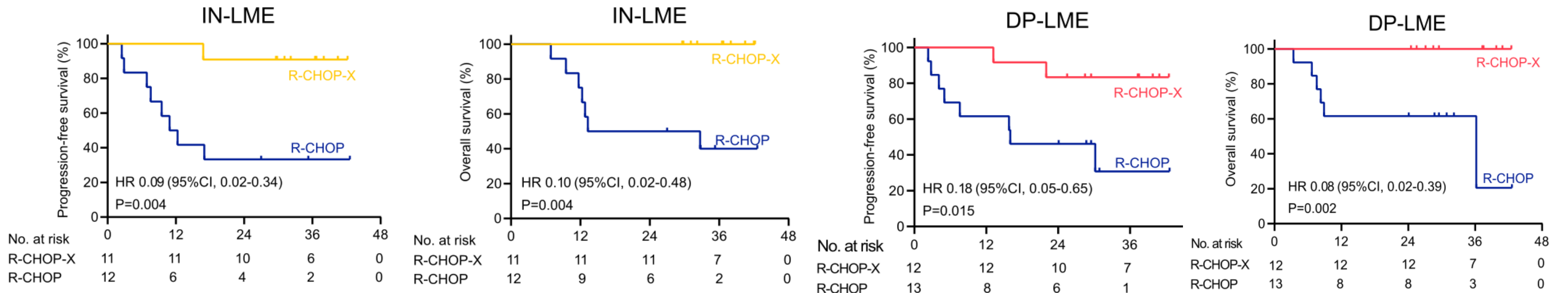
GUIDANCE-01 trial: Treatment Strategies Selection

Genetic subtype-guided immunochemotherapy (R-CHOP-X) significantly improves CRR, PFS, and OS in newly diagnosed DLBCL patients, with a manageable safety profile.

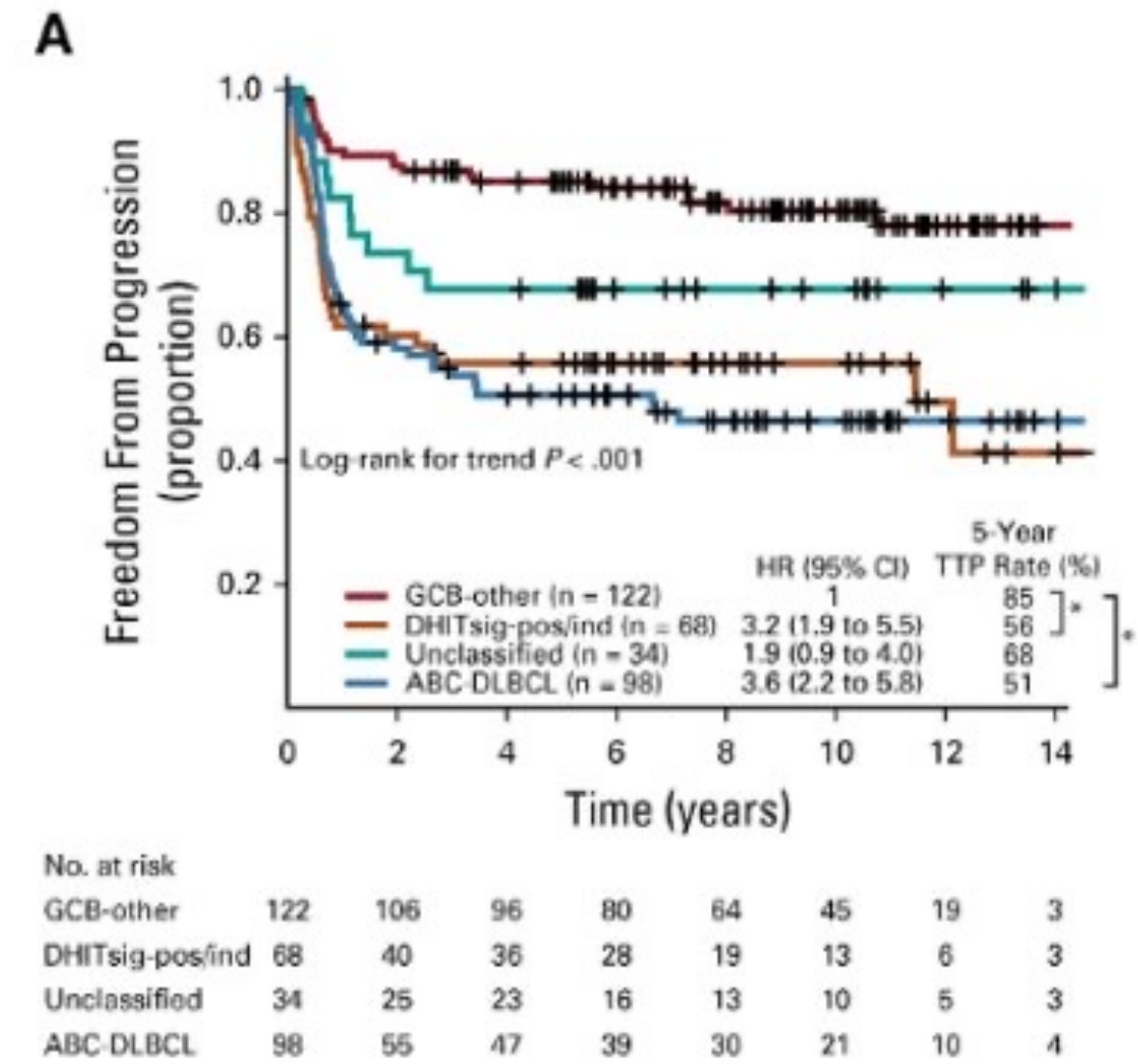
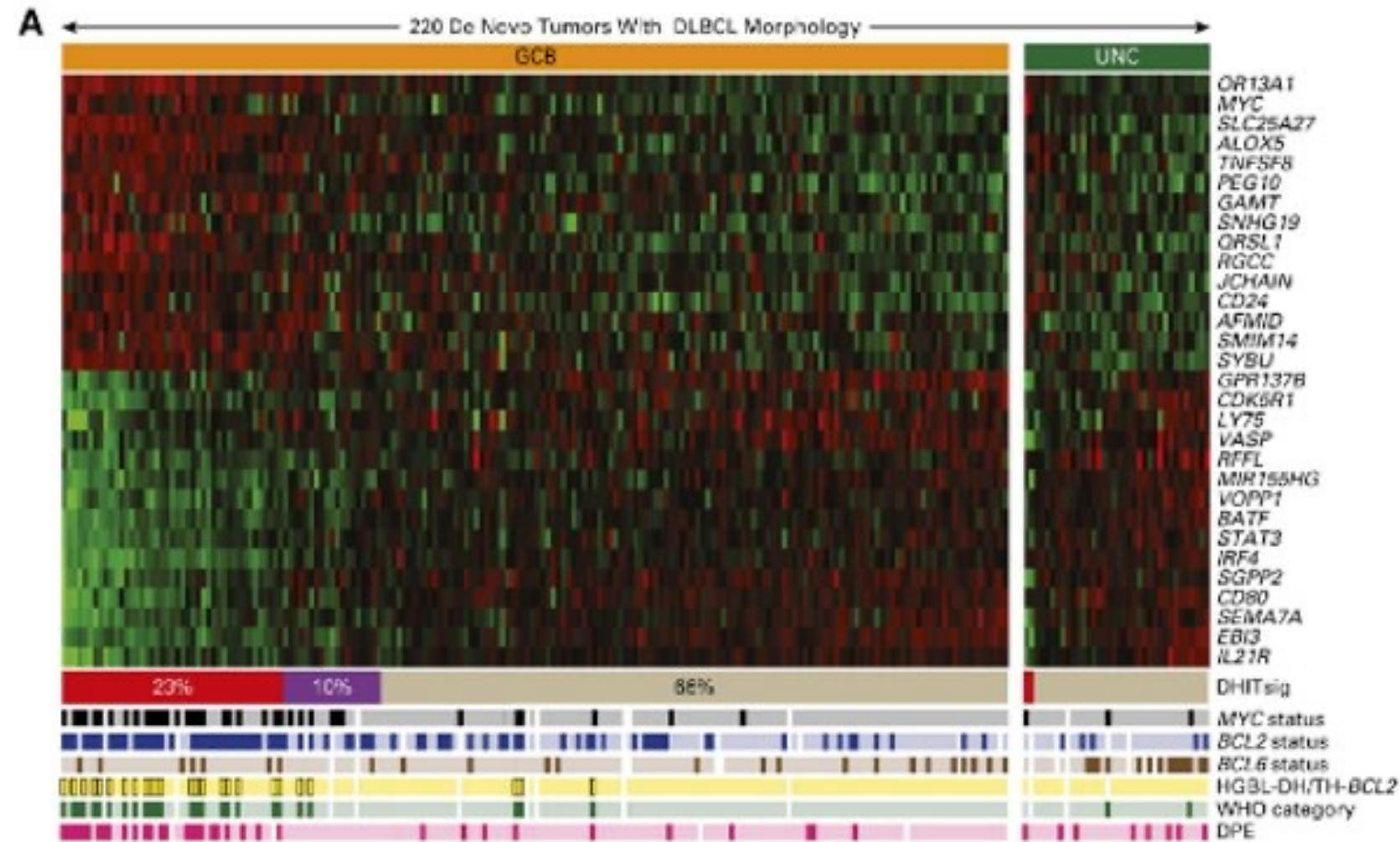


GUIDANCE-01 trial: Tumor Microenvironment

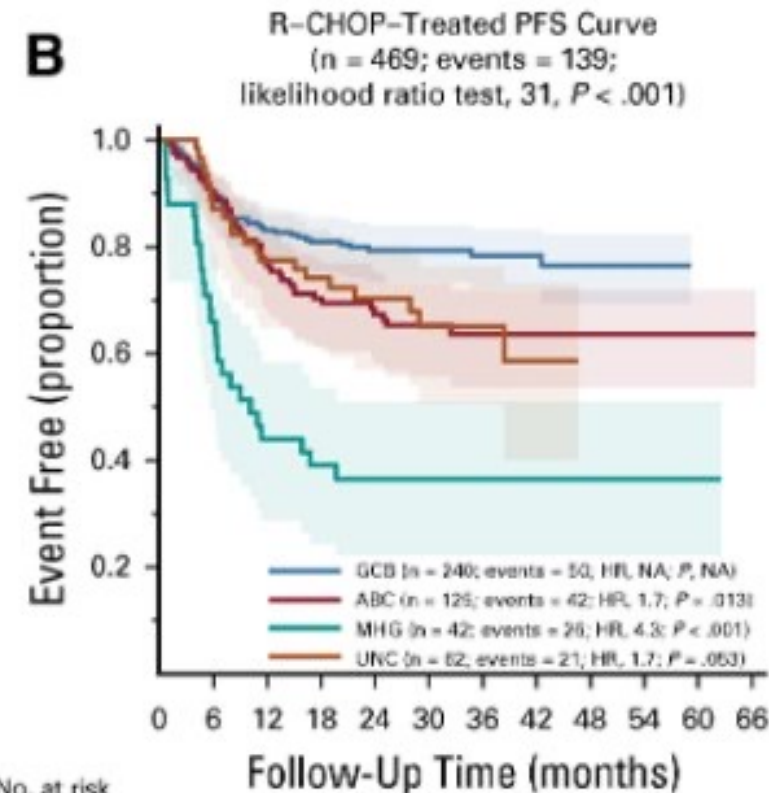
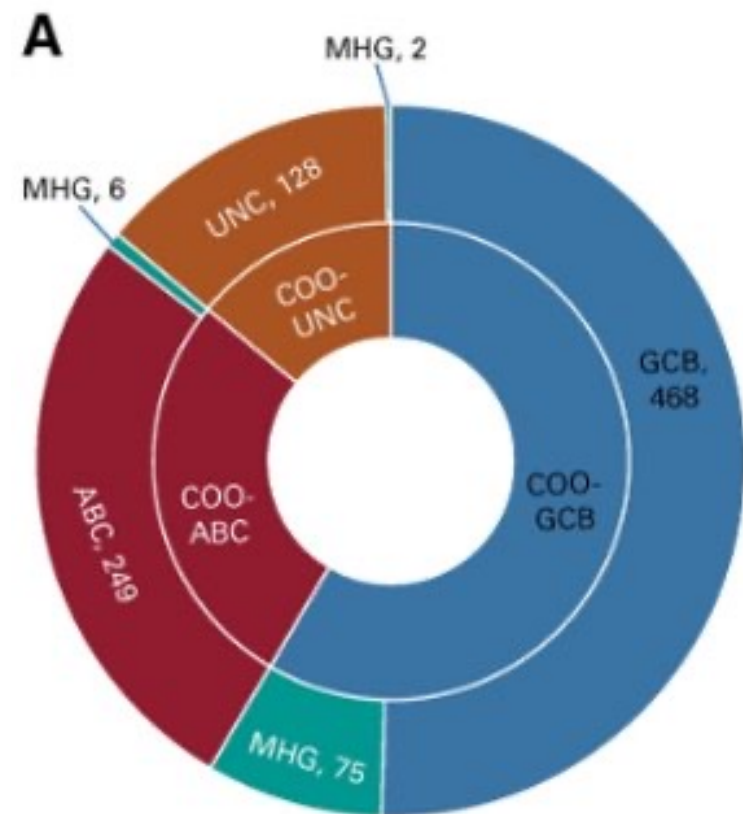
Patients with inflammatory (IN) and depleted (DP) lymphoma microenvironment, originally presented the worst prognosis upon R-CHOP treatment, benefited from R-CHOP-X (mainly treated with ibrutinib and lenalidomide).



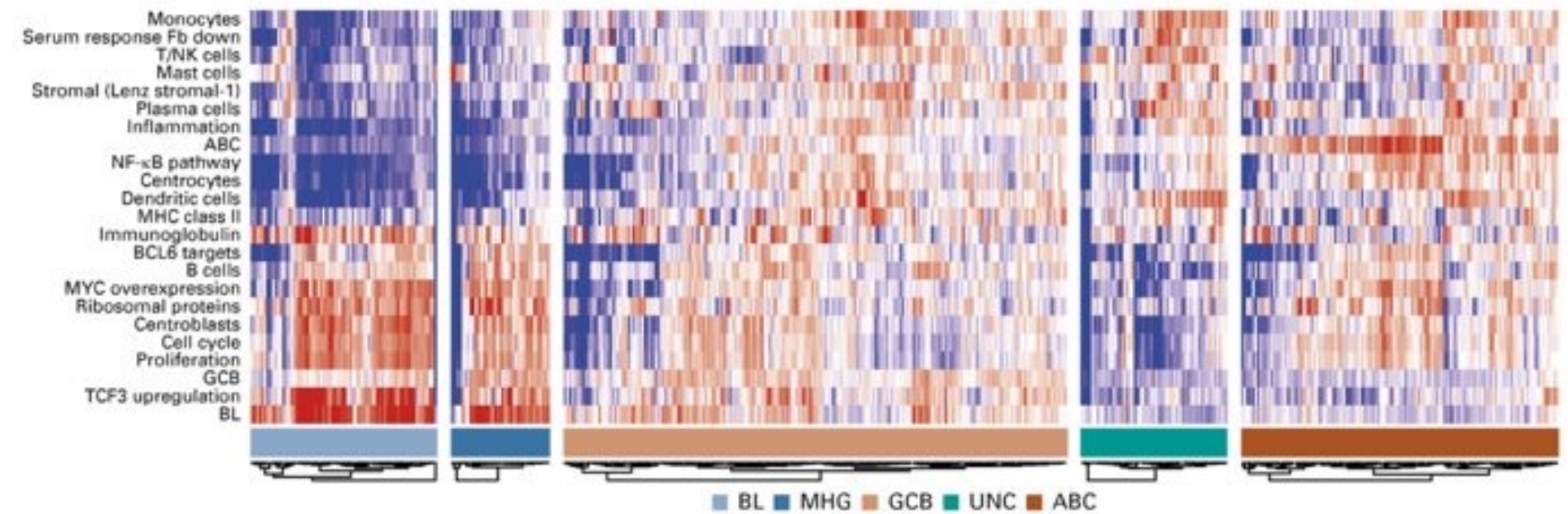
Moving towards genomic risk stratification: GEP



Moving towards genomic risk stratification: GEP



No. at risk	0	6	12	18	24	30	36	42	48	54	60	66
GCB	240	213	195	167	134	94	75	43	22	10		
ABC	125	110	93	79	63	44	28	16	9	4	3	1
MHG	42	27	18	15	13	10	9	5	4	1	1	
UNC	62	54	48	42	33	21	12	4				



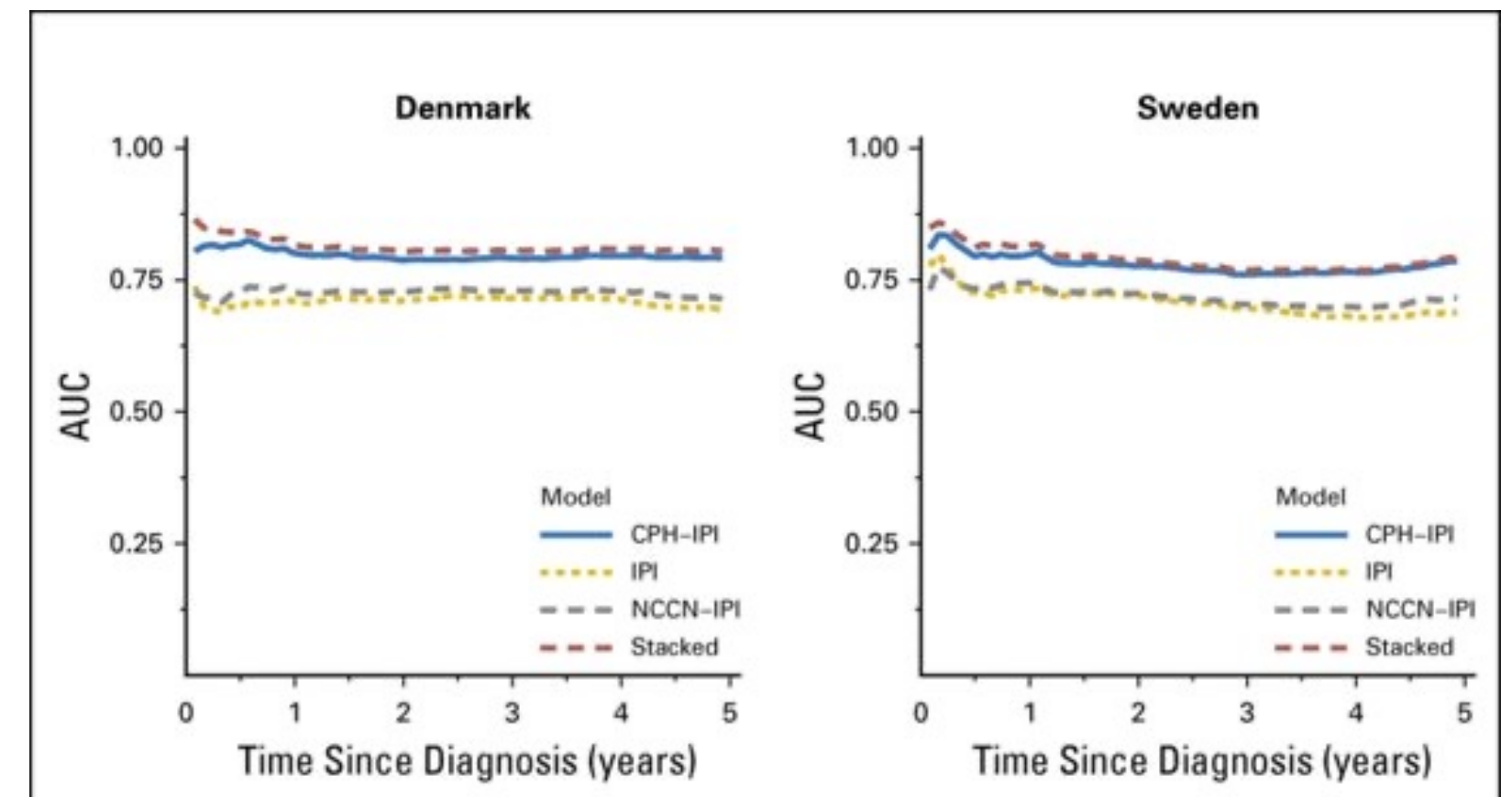
Machine Learning for Risk Prediction

2,759 and 2,414 patients were included from the Danish and Swedish cohorts.

A stacking approach led to the lowest integrated Brier scores & c-indexes: Denmark, 0.756; Sweden, 0.744.

C-indexes for the other prognostic models were lower (IPI: DK, 0.662; SE, 0.661; and NCCN-IPI: DK, 0.681; SE, 0.681).

Variables included were age, gender, ECOG score, Ann Arbor stage, raised LDH and extranodal involvement

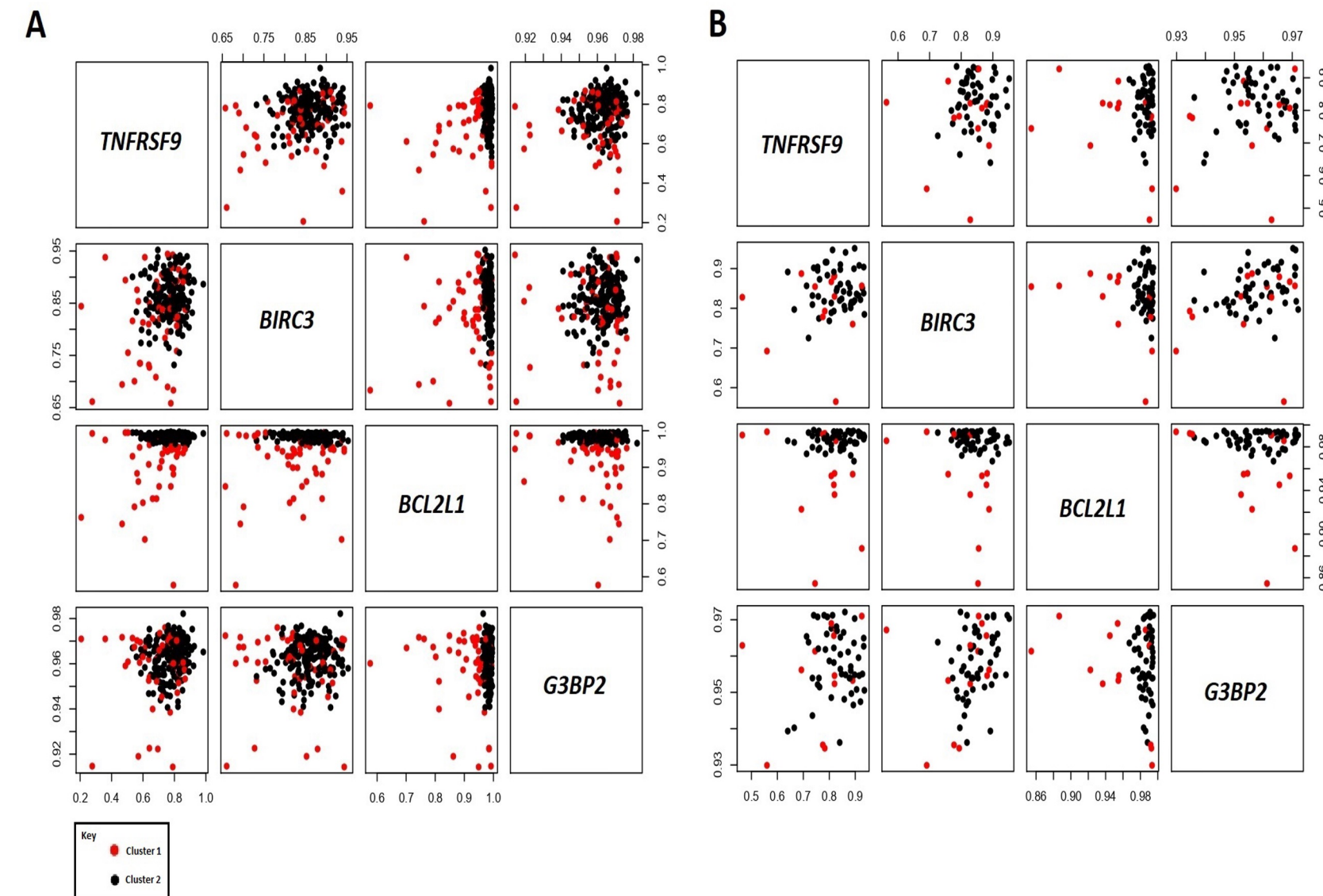


Machine Learning for Risk Prediction

Exploratory study in order to design a machine learning algorithm for personalized survival prediction in DLBCL

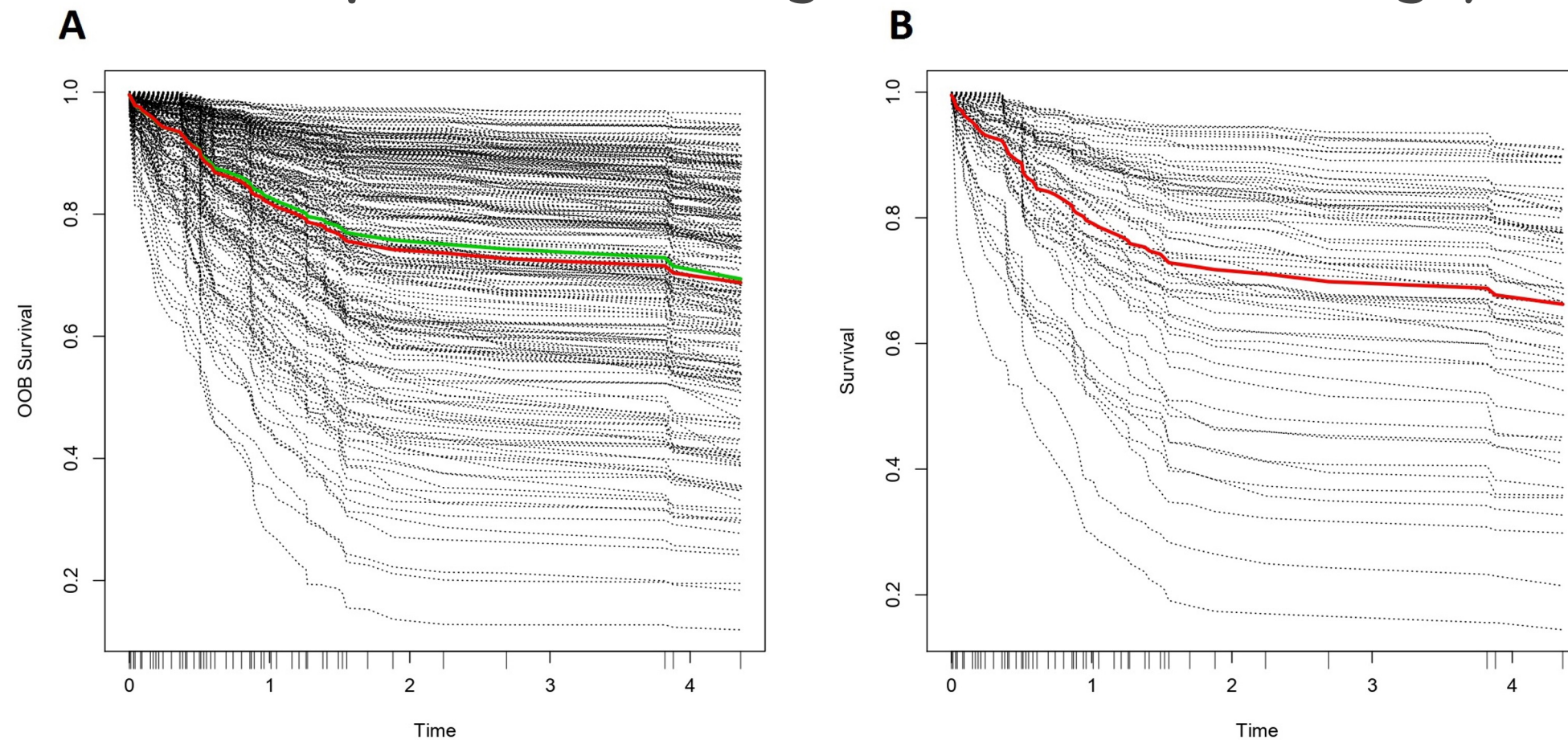
Methods

1. GSE10846: 233 DLBCL patients treated with R-CHOP (training set)
2. GSE23501: 68 patients treated with R-CHOP (validation set)
3. Potential duplicates removed using Spearman's correlation (4 duplicate samples)
4. Microarray gene expression was rank normalized in both cohorts



LymForest-25: integrating ML and genomics for risk prediction

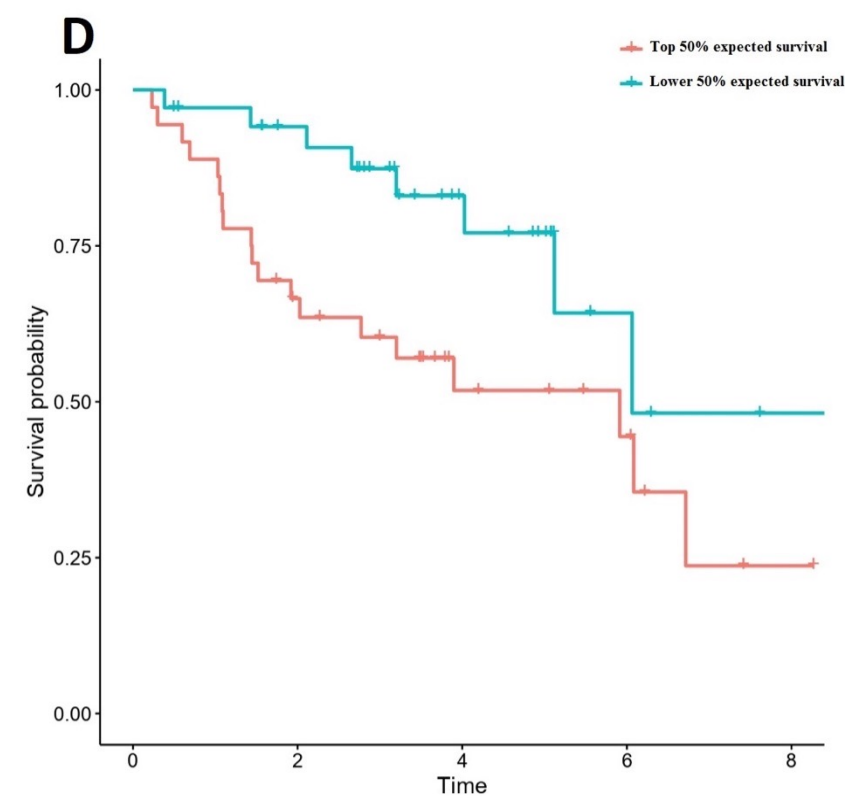
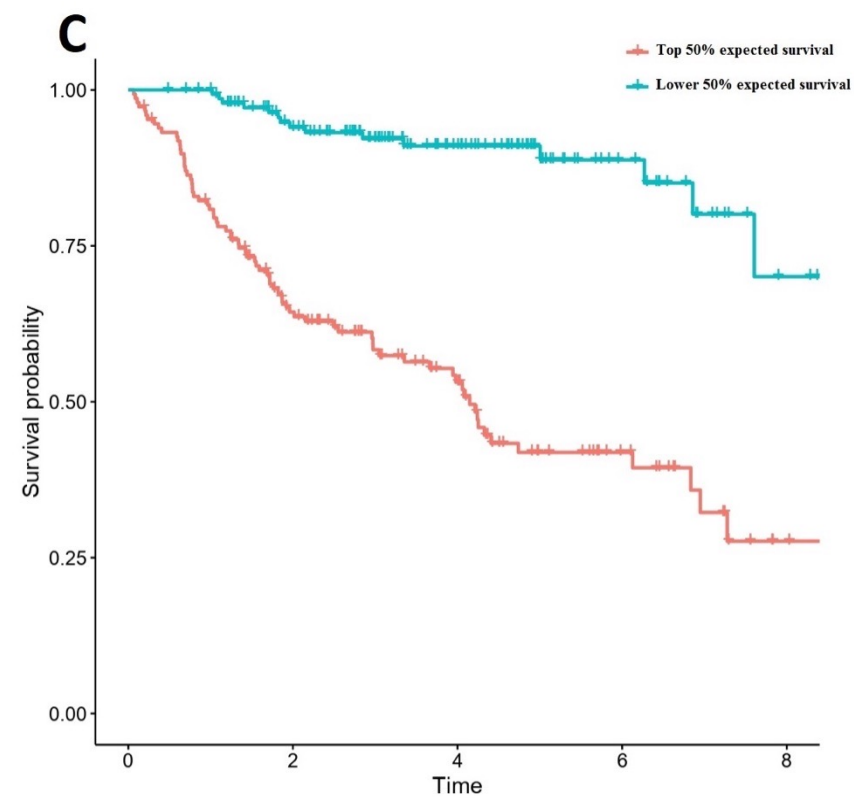
A Random Forest Model predicts survival based on 50 variables (gene expression data, age and Ann Arbor Stage)



Training set c-index: 0.84
Test set c-index: 0.79

Figure. Predicted individual survival curves according to the most accurate random forest model (see text). **A)** Out-of-bag survival curves predicted for patients within the training cohort. The thick red line represents overall ensemble survival and the thick green line indicates the Nelson-Aalen estimator. **B)** Individual survival curves predicted for patients within the test cohort. The thick red line represents overall ensemble survival.

LymForest-25: high-molecular risk in DLCL



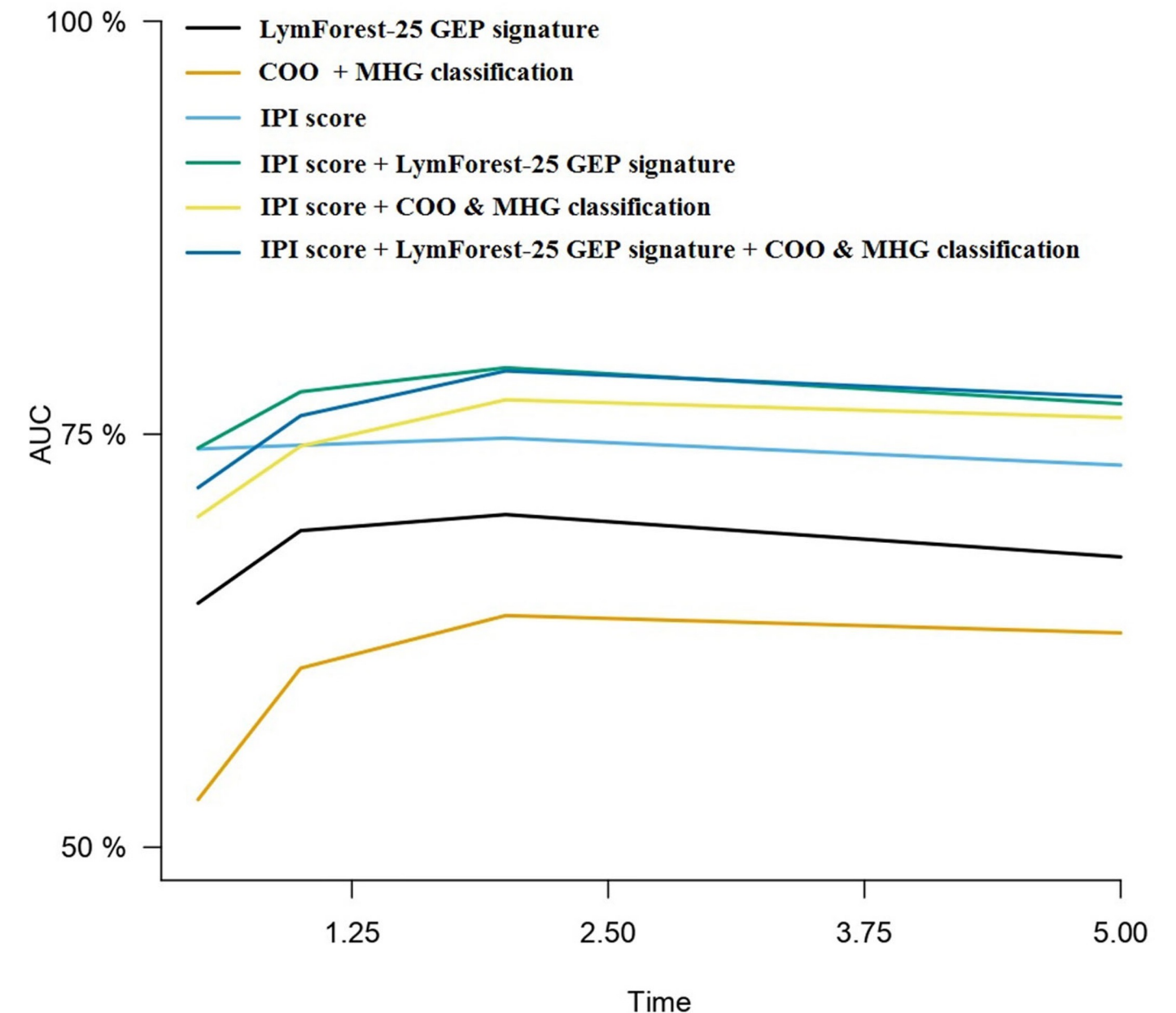
ML algorithm that improves the prediction of survival in DLBCL based on 25 genetic and clinical parameters

Outperforms the main forecasting algorithms available today

Provides personalized predictions

LymForest-25: high-molecular risk in DLCL

- **Validation:** LymForest-25 validated in a UK-based cohort of 481 patients. Higher precision compared to existing models.
- **Sub-Group Accuracy:** Particularly high prediction accuracy in the "unclassified" COO group.
- **Integration:** Best survival predictions when combined with the International Prognostic Index (IPI) score and in patients under 70 years.
- **Mutation-Based Classification:** Potential for further improvement by integrating with some mutations.



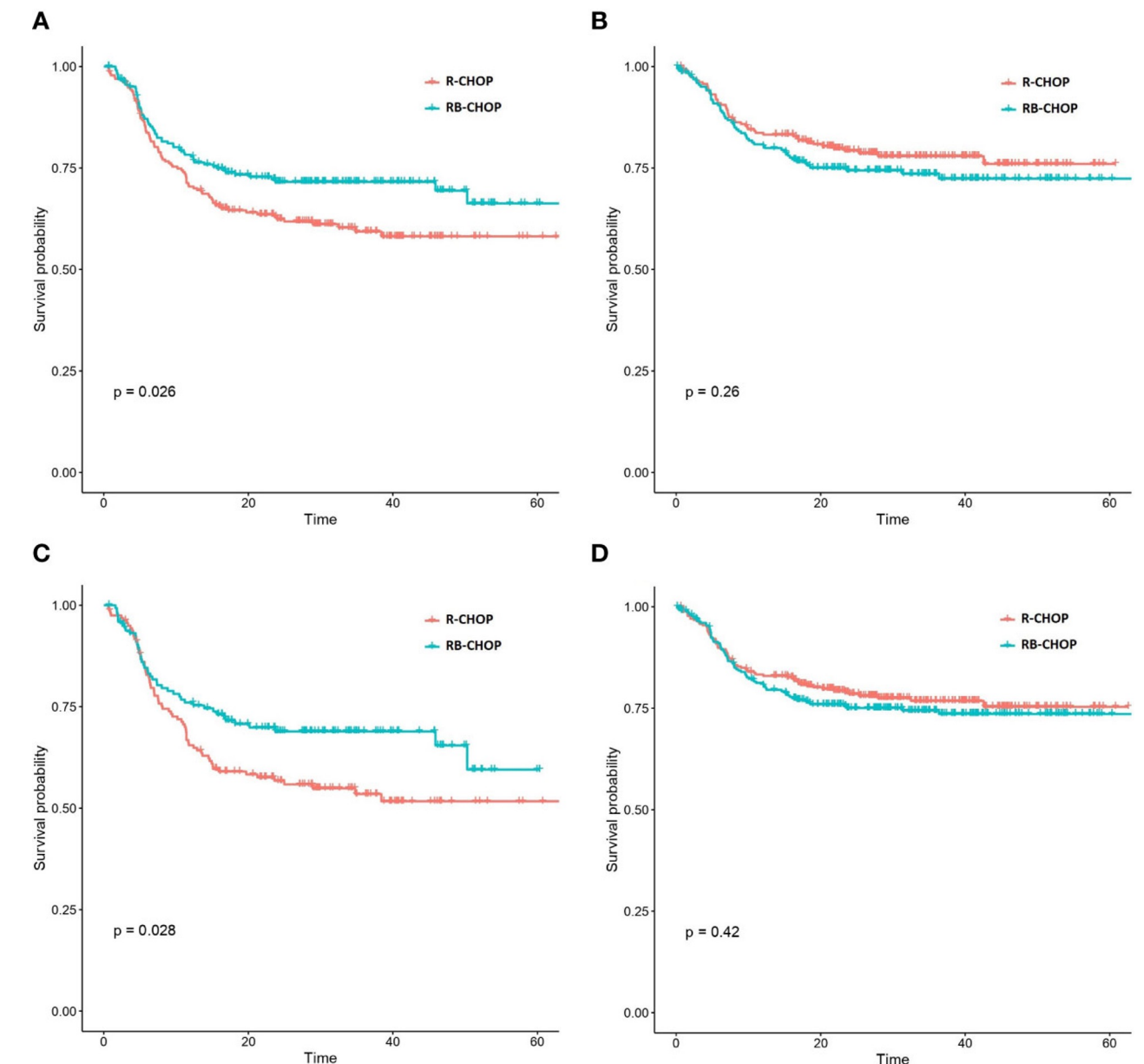
Mosquera et al, Hemasphere, 2022

LymForest-25: high-molecular risk in DLCL

Objective: To examine how LymForest-25 performs in the REMoDL-B trial, which assessed adding bortezomib to standard R-CHOP treatment.

Methodology: Retrained LymForest-25 on 469 patients treated with R-CHOP, then made risk predictions for 459 patients treated with bortezomib + R-CHOP.

Key Findings: For those at higher molecular risk (top 50%), the addition of bortezomib (RB-CHOP) reduced the risk of progression or death by 30% ($p=0.03$).

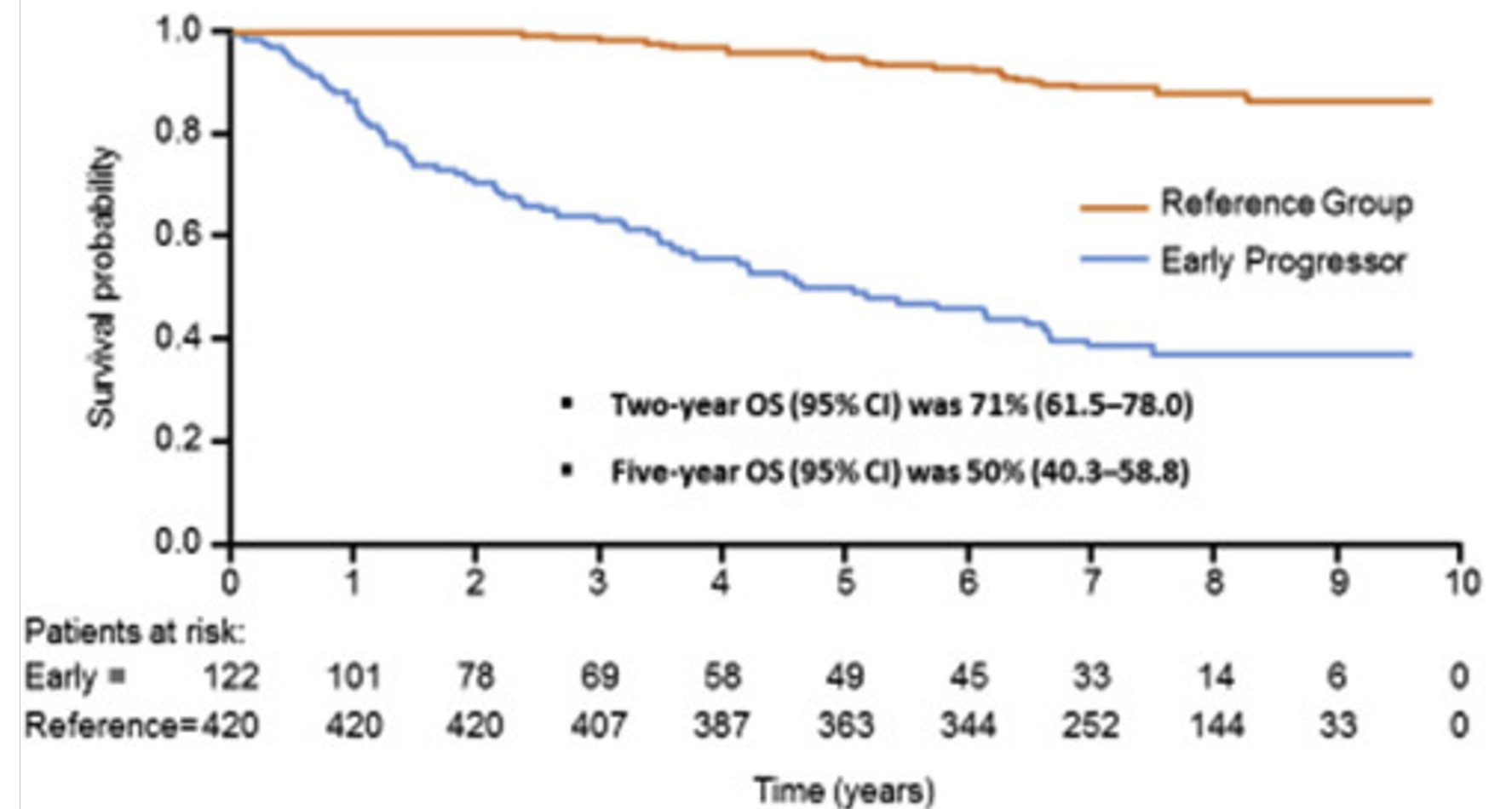


Follicular Lymphoma: is risk prediction needed?

Keys in the management of follicular lymphoma:

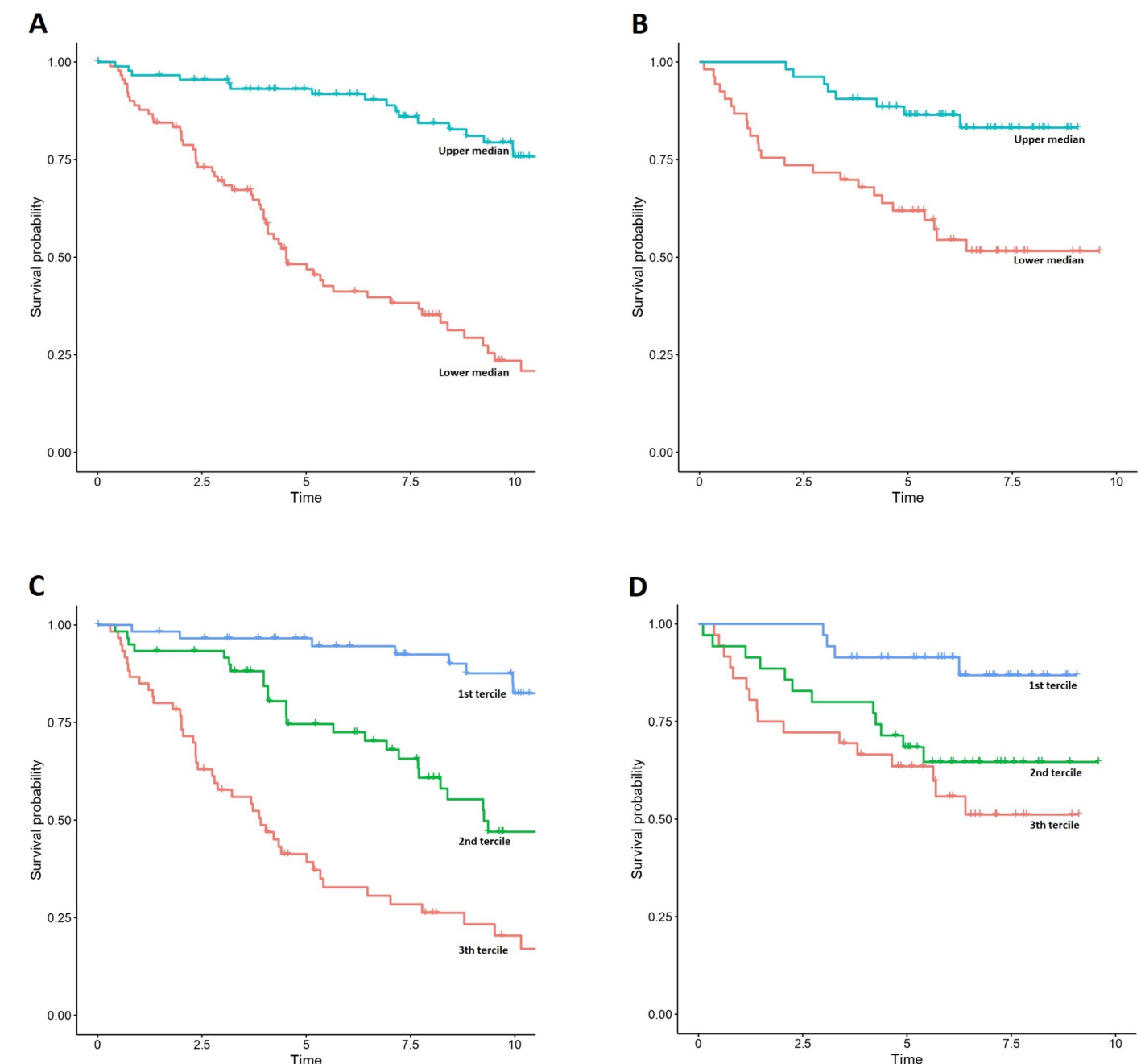
1. Identify those **patients who will be refractory to treatment (early relapse)**
2. Identify which patients will **transform their disease** to a more **aggressive** histological type
3. **Optimize available therapies** according to the molecular profile of the tumor

OS of Patients With FL Who Relapsed Within 2 Years of R-CHOP (“Early POD”)



Iacobus-FL: integration of ML and GEP for risk prediction

- Clinico-genomic AI model that improves prognostic stratification in FL
- Through the modeling of individual survival, it infers the survival of each patient
- Helps to individual risk and to group patients in clusters with divergent outcomes.



LymphoPro-AI development

Diagnostic and prognostic cytogenetic aberrations and mutations

Characterization of rearrangements:

- *BCL2, BCL6, MYC, CCND1*
- *IRF4, BCL2L1*

Identification of prognostic gene mutations:

- *Prognostic mutations in DLBCL:*
 - *CD79B, MYD88 L265P, NOTCH1, NOTCH2, and EZH2*
- *Other relevant prognostic genes:*
 - *TP53, SPEN, SETD2, DTX1*

Characterization of therapy and immune-related tumor biomarkers

Characterization of therapy-oriented genes

- *Biomarker mutation & expression:*
 - *CD19, CD22, BCMA, BTK, CD79B, MYD88 L265P, EZH2, SETD2*
- *Biomarker expression:*
 - *ROR1, CCR7*
- *Immune gene expression profiling:*
 - *PD1, PDL1, PDL2, PVR, PVRL2, TIGIT, LAG2, LAG3, HAVCR2, CD80, CD86, CCR7*

LymphoPro-AI development

Standardization of LymForest and Iacobus-FL molecular predictors

LymForest:

- *19 gene signature for individual risk prediction in DLBCL*

Iacobus-FL:

- *62 gene signature for individual risk prediction in FL*

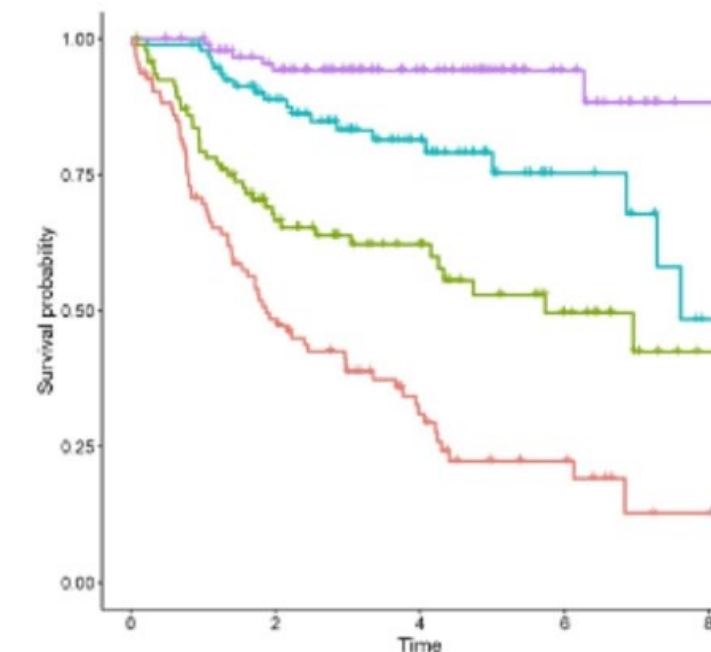
Transfer learning:

- *Application of both signatures to risk stratify other lymphomas (MCL, PTCL...)*

Differential drug response prediction

Use of ML risk models to predict differential drug response at the patient level

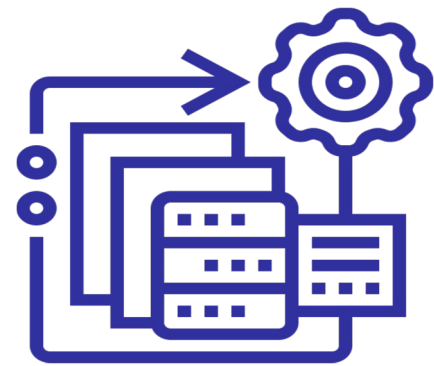
Development of risk-oriented clinical trials



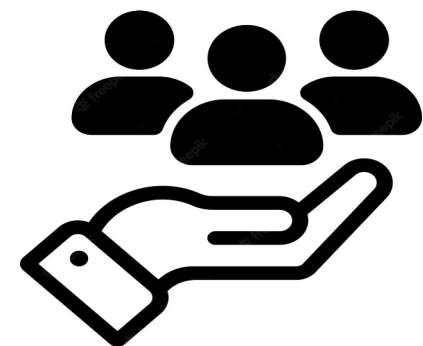
LymForest: an automated DLBCL GEP system for risk prediction



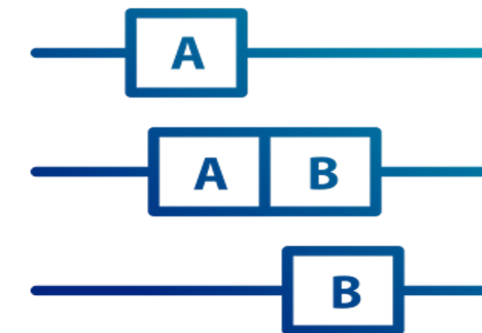
Integration into their platform



Deployment of our panel



Customer service



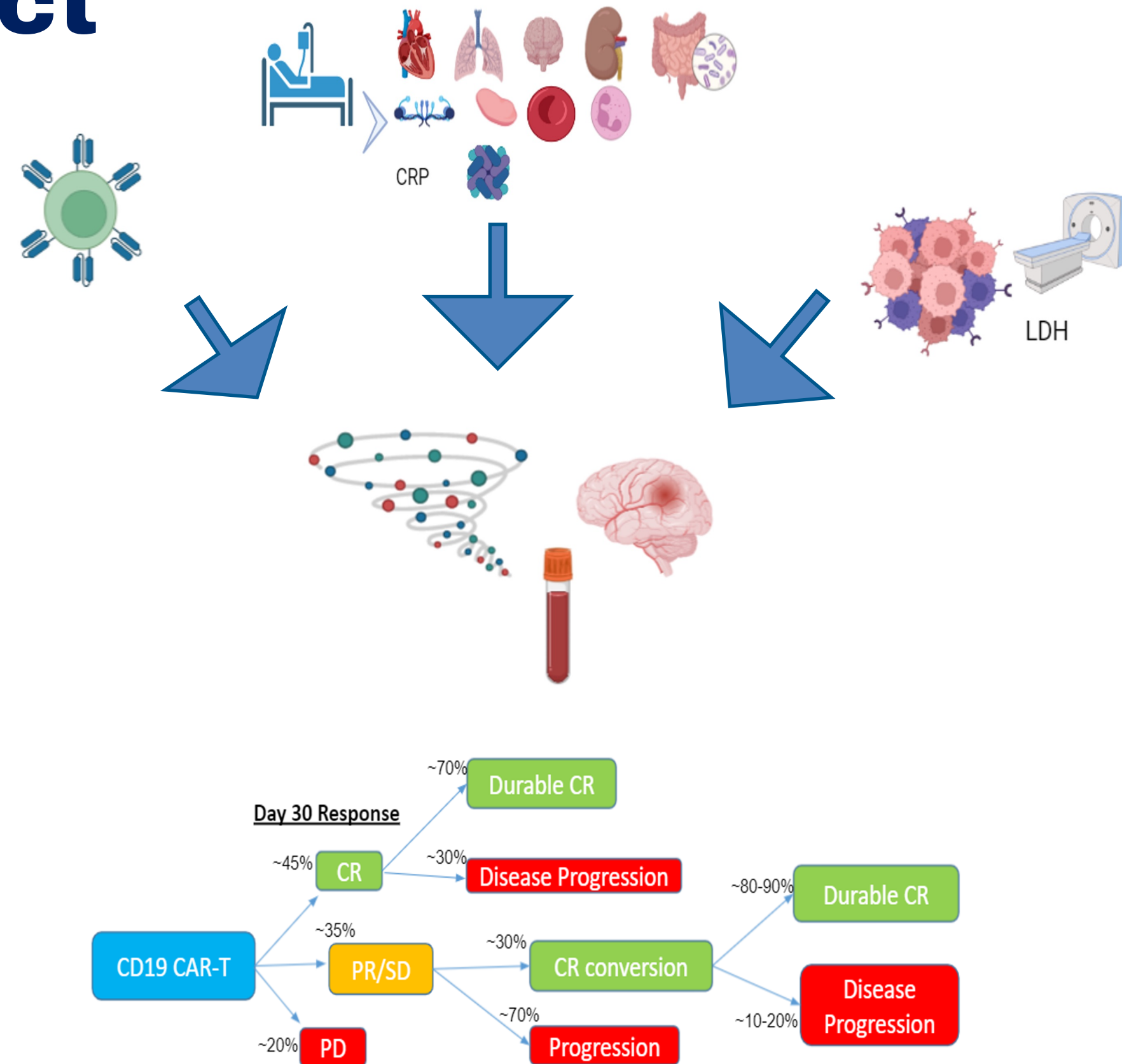
Gene panel for DLBCL



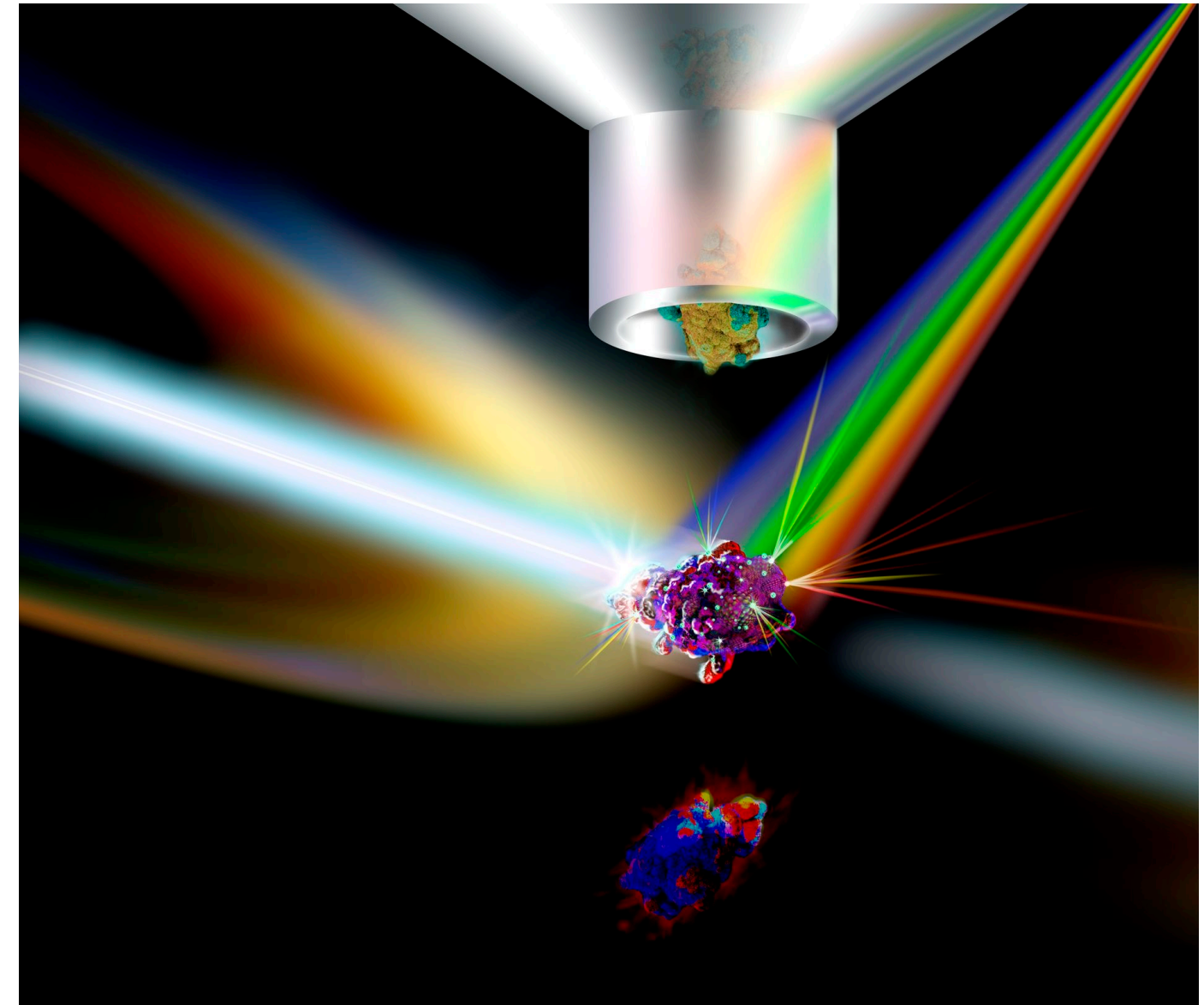
RNA-Seq analysis software

CT22-02 CIBMTR project

- CAR T-cell therapy has become an invaluable treatment in NHL and ALL
- Multiple recent single center studies seeking to predict toxicity or outcome were published.
- Most were with a small population sample, with or without a validation cohort, and all acknowledged that larger studies are needed
- There is a need to integrate real-world data into predictive models for use in practice

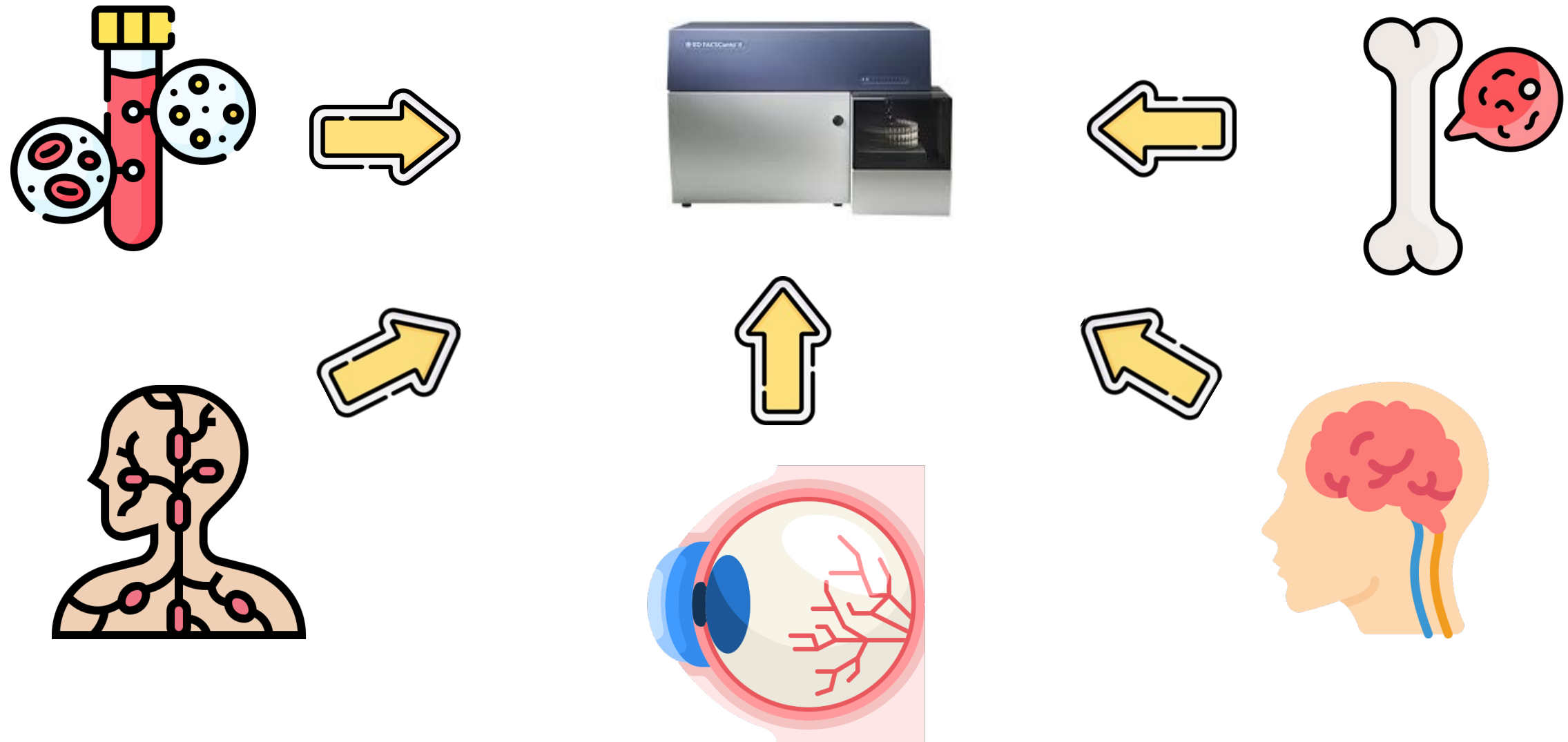


Automatizing Flow Cytometry Diagnosis

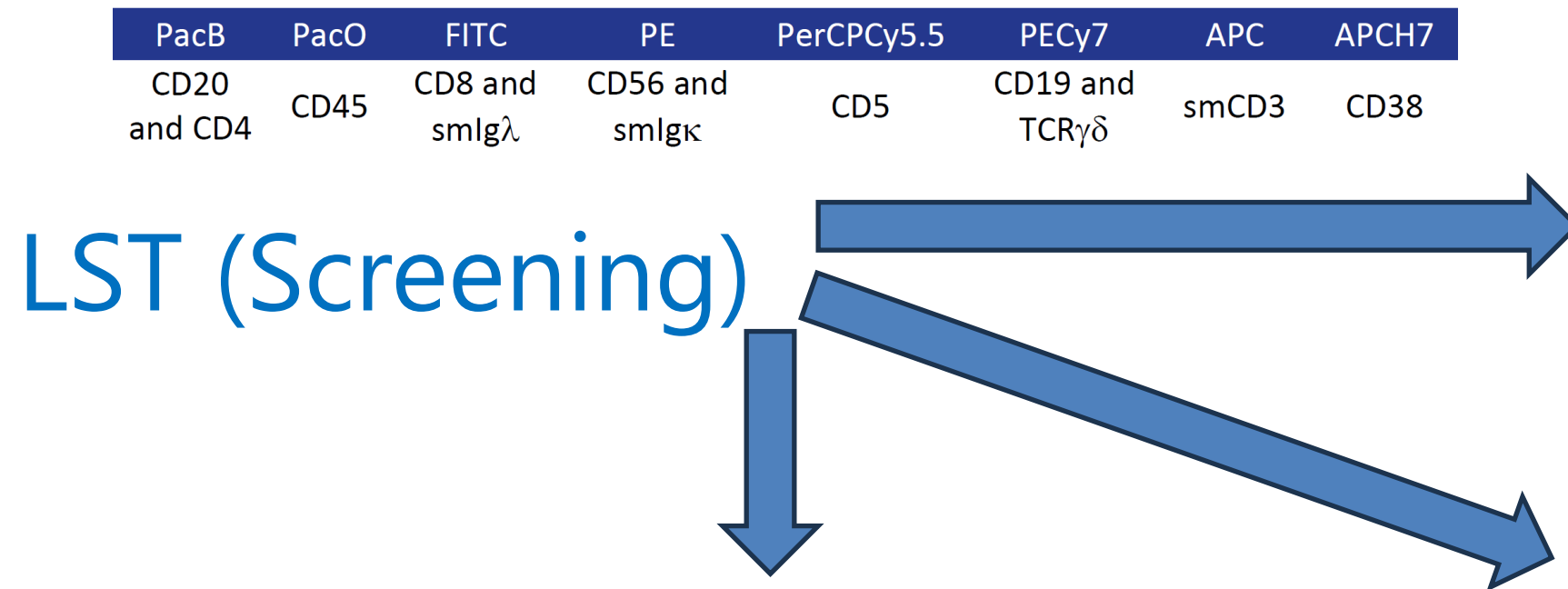


Flow cytometry to diagnose NHL

Flow cytometry investigations in hematological diagnostics typically begin with diverse sample sources, with the majority originating from either blood or bone marrow.



Flow cytometry to diagnose NHL



PacB	PacO	FITC	PE	PerCPCy5.5	PECy7	APC	APCH7
CD20 and CD4	CD45	CD8 and smlgλ	CD56 and smlgκ	CD5	CD19 and TCRγδ	smCD3	CD38

Tube	PacB	PacO	FITC	PE	PerCPCy5.5	PECy7	APC	APCH7
1	CD4	CD45	CD7	CD26	smCD3	CD2	CD28	CD8
2	CD4	CD45	CD27	CD197	smCD3	CD45RO	CD45RA	CD8
3	CD4	CD45	CD5	CD25	smCD3	HLADR	cyTcl1	CD8
4	CD4	CD45	CD57	CD30	smCD3		CD11c	CD8
5	CD4	CD45	cyPerforin	cyGranzyme B	smCD3	CD16	CD94	CD8
6	CD4	CD45		CD279	smCD3			CD8

Tube	PacB	PacO	FITC	PE	PerCPCy5.5	PECy7	APC	APCH7
1	CD20 and CD4	CD45	CD8 and smlgλ	CD56 and smlgκ	CD5	CD19 and TCRγδ	smCD3	CD38
2	CD20	CD45	CD23	CD10	CD79b	CD19	CD200	CD43
3	CD20	CD45	CD31	CD305	CD11c	CD19	smlgM	CD81
4	CD20	CD45	CD103	CD95	CD22	CD19	CD185	CD49d
5	CD20	CD45	CD62L	CD39	HLADR	CD19	CD27	

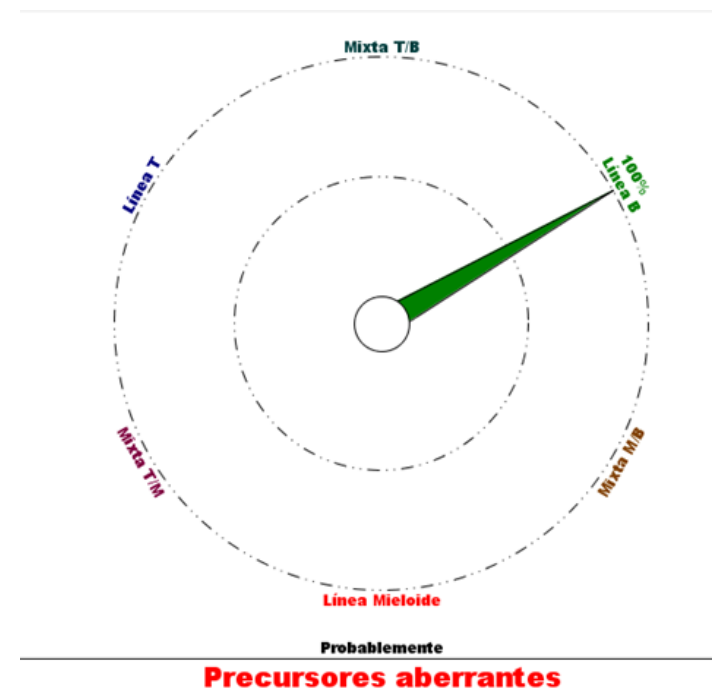
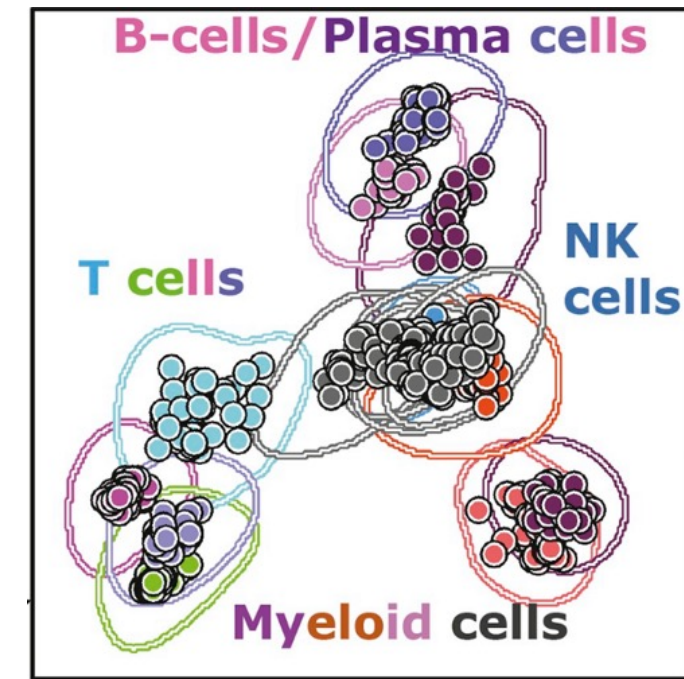
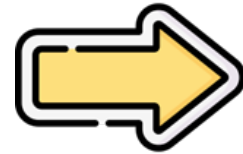
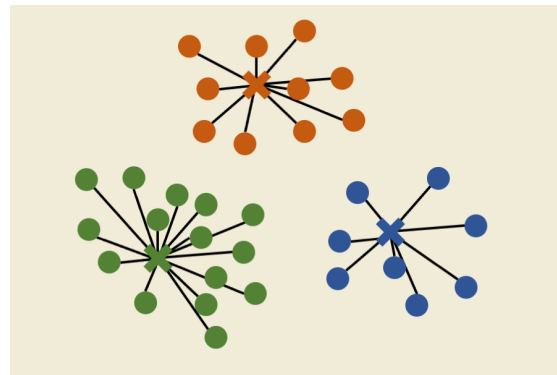
T panel

Tube	PacB	PacO	FITC	PE	PerCPCy5.5	PECy7	APC	APCH7
1	CD2	CD45	CD7	CD26	smCD3	CD56	CD5	CD19
2	CD16	CD45	CD57	CD25	smCD3	CD56	CD11c	CD19
3	HLADR	CD45	cyPerforin	cyGranzyme B	smCD3	CD56	CD94	CD19

B panel

NK panel

Flow cytometry to diagnose NHL



But we needed a local solution adapted to our case

Objective

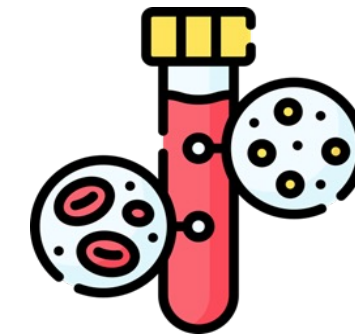
To develop a **fully automated solution** for pathogenicity assessment.

Challenges

- **Human intervention** for cell subclass annotation followed by automated diagnosis.
- Adaptation to local lab conditions, reagents, and cytometer specifications.

Solution

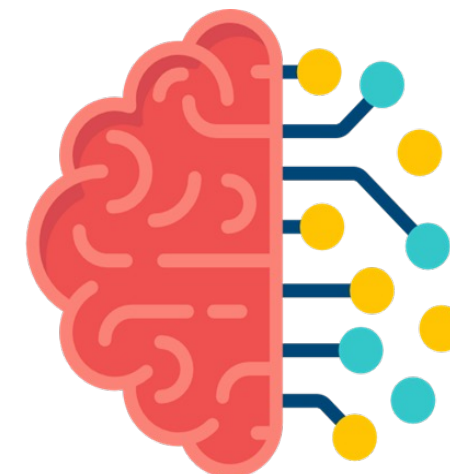
To implement an **AI system trained with local data** to inform experts about pathogenicity likelihood, **tailored to our lab's unique setup**.



>3,500 LST tests

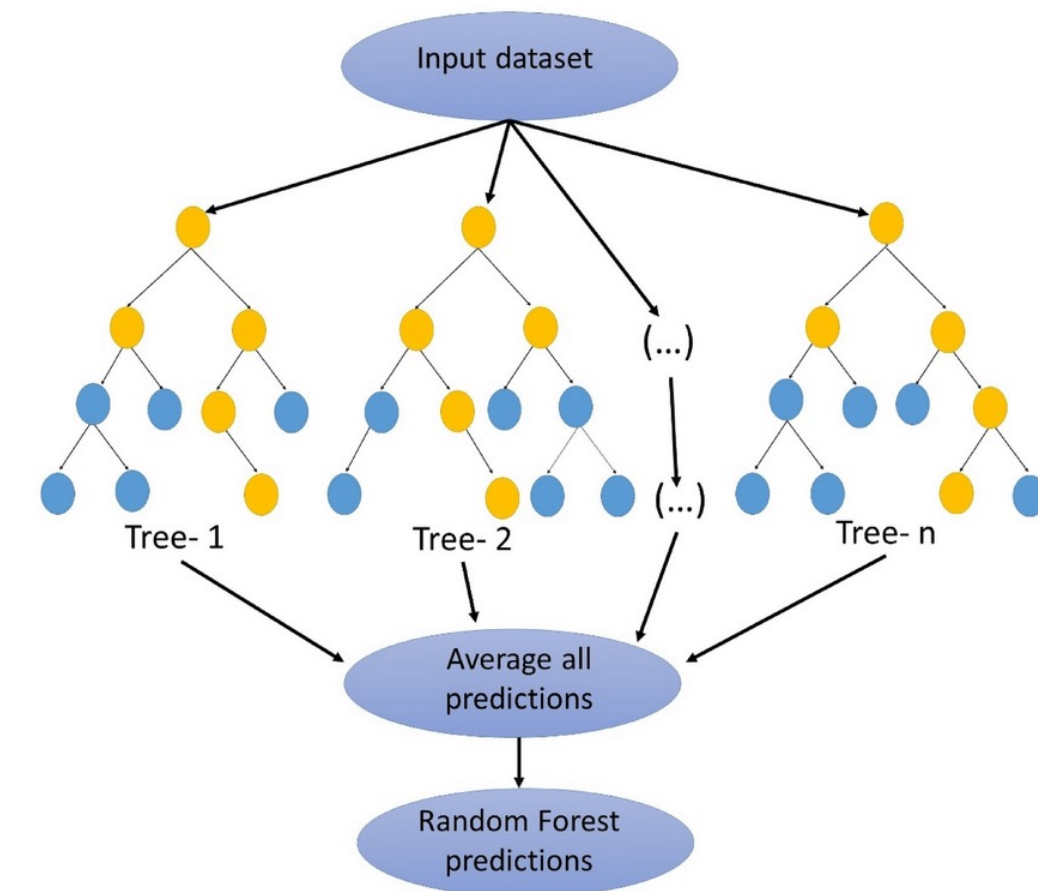
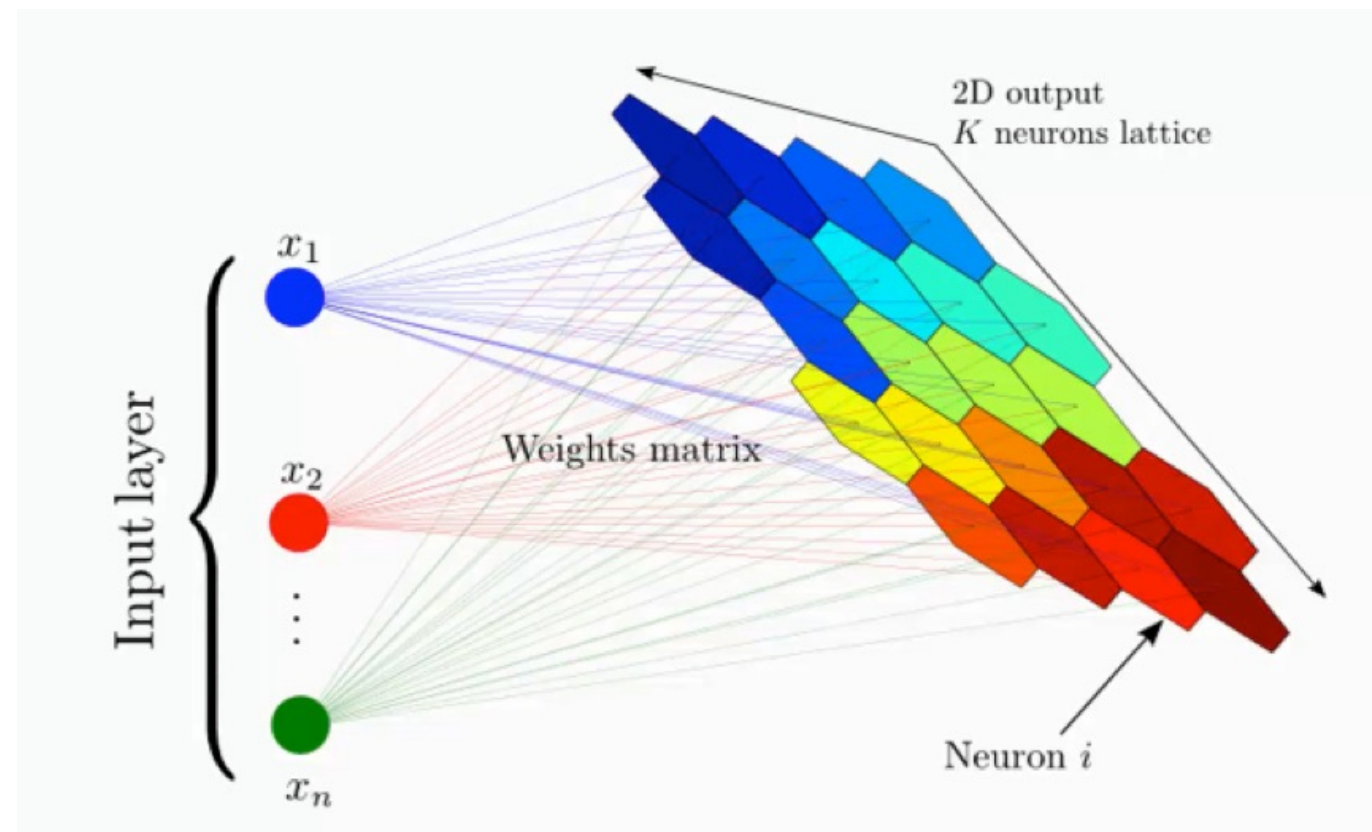


Following EuroFlow standards



Information Technology Training

So we applied a double strategy



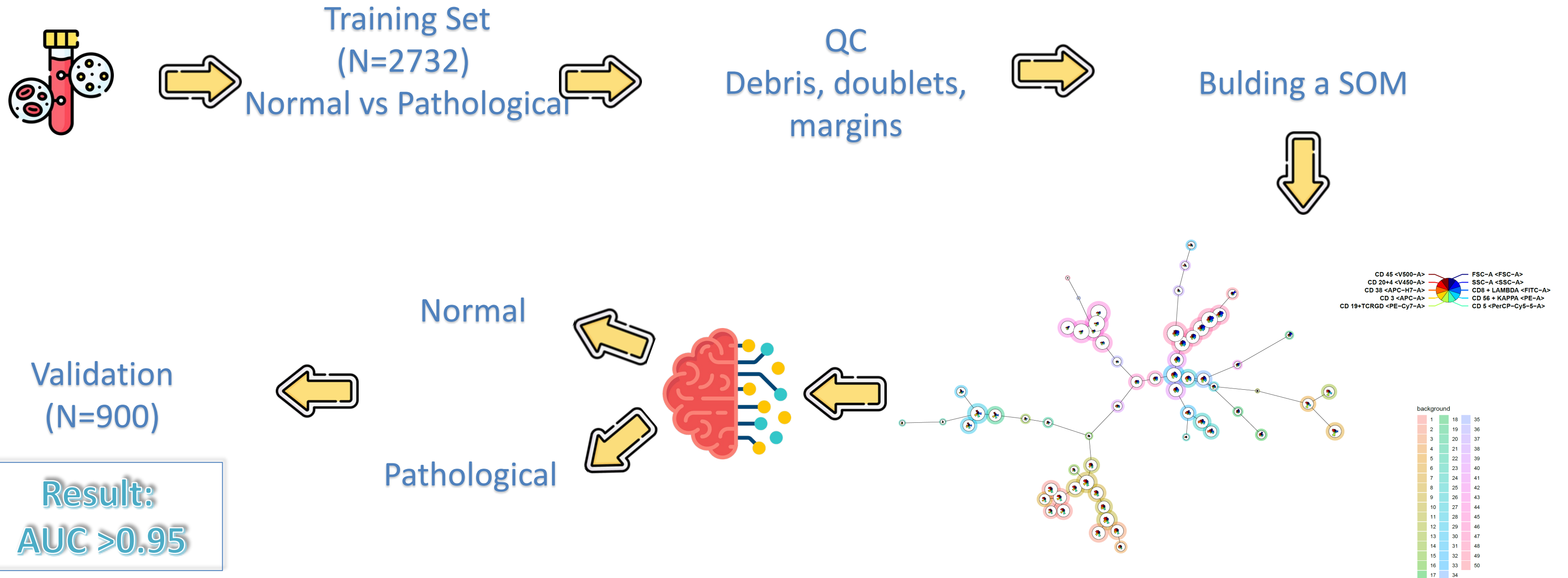
Self Organizing Maps

- Use competitive learning to **project high-dimensional data onto a two-dimensional grid**, preserving data topology.
- This helps to **identify and visualize natural clusters** within the data.

Random Forests

- Utilize an **ensemble of decision trees** to improve prediction accuracy and control overfitting.
- RFs **aggregate the outcomes of individual trees** to determine the most common class, **enhancing the robustness and accuracy of classifications**.

Let's create it: developing the algorithm



Discrepancies in the Test Set Analysis

- **Total of 92 discrepancies identified:**
 - **34 undetected aberrant T or NK cell populations.**
 - **21 cases** with minimal B-cell NHL infiltration (<0.5%).
 - **7 samples** from fine-needle aspiration (FNA), pleural, or ascitic fluid.
- **Normal diagnoses** incorrectly predicted as pathological:
 - **4 cases** from FNA, pleural, or ascitic fluid.
 - **6 cases** affected by artifacts (cryoglobulins, IgM peaks).
- **Other findings:**
 - **10 cases** involved conditions unrelated to NHL.
 - **3 database misentries** where the model was correct.
 - **6 unidentified** discrepancies.
 - **1 unreported** aberrant B-cell population.

AI-Driven Automation for Lymphocyte and CAR-T Population Identification

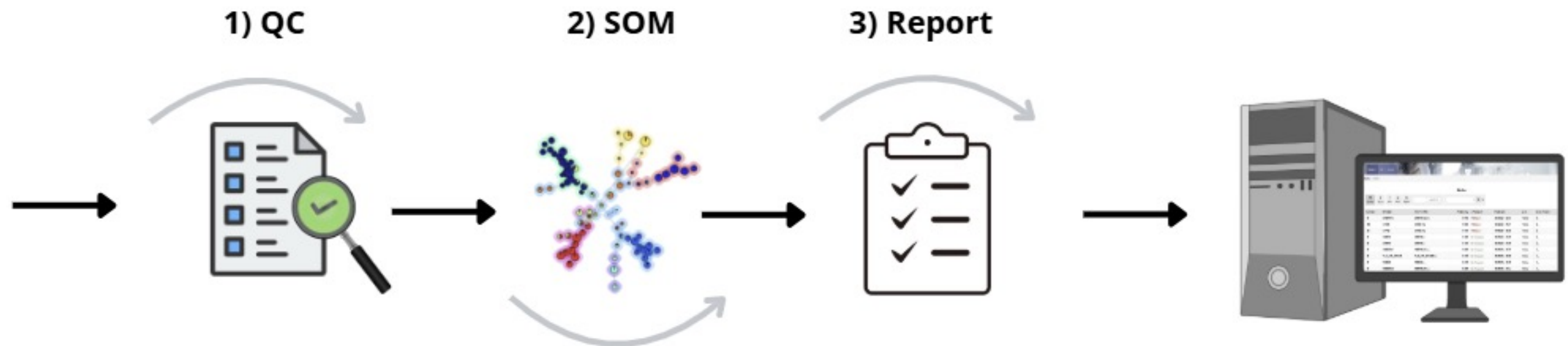
Cohorts

Lymphocyte Population	CART-BCMA	CART-CD19
152 samples	77 samples	47 samples
CD45, CD3, CD4, CD8, CD19, CD56	CD45, CD3, CD4, CD8, CD19, CD56, CD20, BCMA	CD45, CD3, CD4, CD8, CD19, CD56, CD20

Workflow



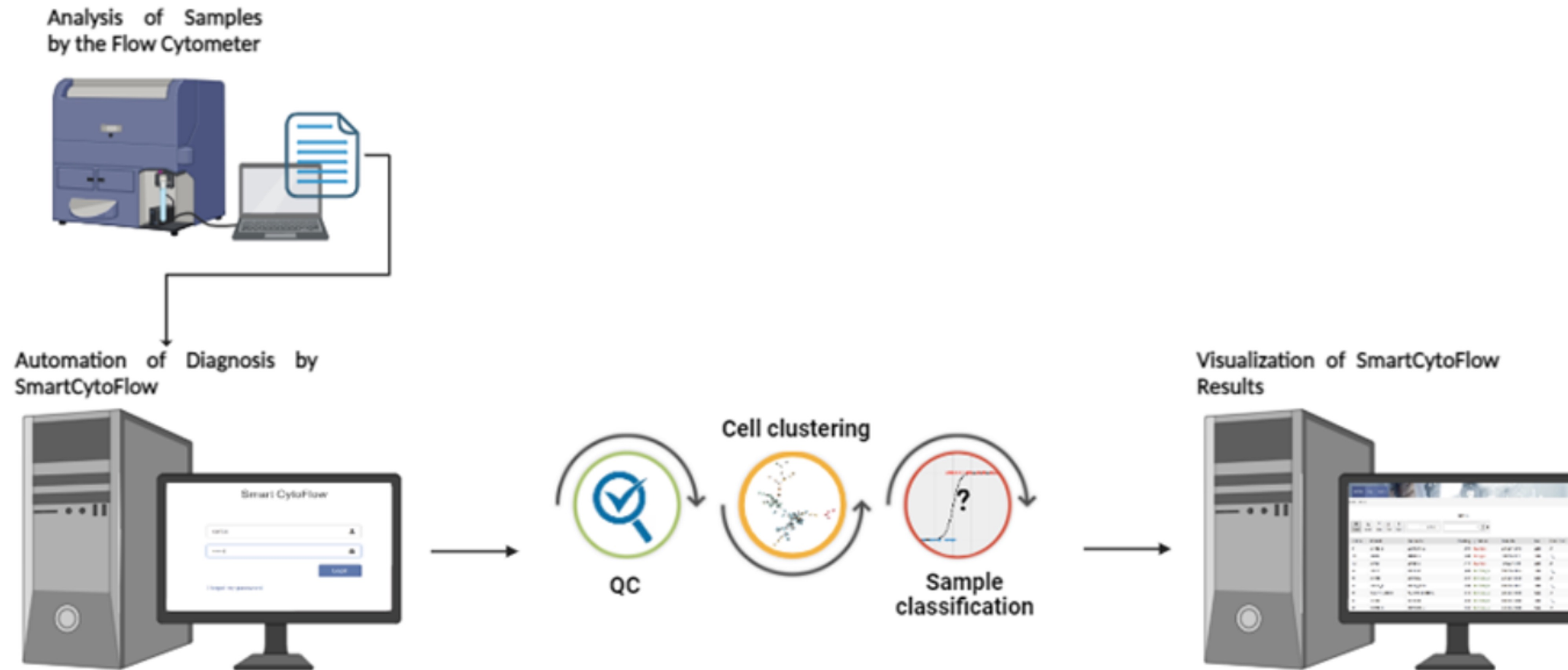
.fcs file



Clustering

Integration into SmartCytoFlow

SmartCytoFlow: A cloud-based tool to automate the diagnostic process



Interpretación automatizada del diagnóstico mediante IA Generativa

La muestra diagnóstica es analizada por nuestro asistente virtual para NHL, que compara los valores de referencia para detectar desviaciones, interpreta los resultados mediante un modelo de lenguaje y diferencia entre patologías para identificar alteraciones hematológicas.

📄 Response:

The model predicts the sample with ID 11-1111 as pathological with a high probability of 0.848. This indicates a strong likelihood of a pathological condition. The prediction is based on the distribution of cells across various clusters (C0 to C100) and metaclusters (MC1 to MC12), which are compared to known patterns in normal and pathological samples, including specific disease subtypes.

Key Observations:

1. **Cell Distribution**:

- Notable percentages in clusters C8 (9.6%), C19 (10.35%), C39 (14.01%), and C81 (8.23%) suggest significant deviations from normal patterns.
- Metacluster MC1 shows a dominant presence (76.39%), which is highly indicative of a specific pathological profile.

2. **Immunophenotypic Analysis**:

- The clusters with high percentages likely correspond to specific cell populations. For instance, the presence of CD19+ CD20+ B-cells could be inferred if these clusters align with known B-cell markers.
- The high percentage in MC1 suggests a dominant cell population that could be linked to a specific disease entity, possibly a B-cell related pathology given the typical markers involved.

3. **Pathological Inference**:

- The immunophenotype and distribution patterns suggest a resemblance to a B-cell neoplasm, possibly a lymphoma or leukemia subtype, given the high probability and specific cluster dominance.
- The presence of CD5+ B cells or monoclonal light chain expression (kappa or lambda) in these clusters would further support this inference.

Uncertainty and Recommendations:

- **Uncertainty**: While the probability is high, there is always a degree of uncertainty in predictions. The model's confidence is strong, but further investigation is warranted to confirm the diagnosis.
- **Further Investigation**: It is recommended to perform additional diagnostic tests, such as flow cytometry with a focus on light chain restriction and CD5 expression, to confirm the presence of a B-cell neoplasm and to rule out other potential conditions.

This analysis should be used in conjunction with clinical findings and other diagnostic tests to arrive at a comprehensive diagnosis.

User Friendly App

Anonimización de muestras antes del envío al servidor
 (No se envía información relacionada con el paciente al servidor)

Sitio web seguro
 (Acceso mediante VPN con credenciales de usuario)

Carlos

Studies

Id. Study	Id. Patient	Tipo Estudio	Cyto Flow File	Probability	Prediction		Correct Result	Result File
546	11-1111	SLPC	11-1111.fcs	0,8480	Patológico			Sample_ID Probabilidad_Patológico Predicción 11-1111 0.848 1
544	25-9999	SLPC	25-9999.fcs	0,2680	No Patológico			Sample_ID Probabilidad_Patológico Predicción 25-9999 0.268 0
543	25-0258	SLPC	25-0258.fcs	0,8300	Patológico			Sample_ID Probabilidad_Patológico Predicción 25-0258 0.83 1
535	25-0529	SLPC	25-0529.fcs	0,2680	No Patológico	21/02/2025 11:53	Carlos	Sample_ID Probabilidad_Patológico Predicción 25-0529 0.268 0
534	25-0298	SLPC	25-0298.fcs	0,9200	Patológico	21/02/2025 11:49	Carlos	Sample_ID Probabilidad_Patológico Predicción 25-0298 0.92 1
533	25-0262	SLPC	25-0262.fcs	0,9840	Patológico	21/02/2025 11:45	Carlos	Sample_ID Probabilidad_Patológico Predicción 25-0262 0.984 1
532	25-0249	SLPC	25-0249.fcs	0,3500	No Patológico	21/02/2025 11:41	Carlos	Sample_ID Probabilidad_Patológico Predicción 25-0249 0.35 0
531	25-0206	SLPC	25-0206.fcs	0,9780	Patológico	21/02/2025 11:37	Carlos	Sample_ID Probabilidad_Patológico Predicción 25-0206 0.978 1
530	25-0555	SLPC	25-0555.fcs	0,9680	Patológico	21/02/2025 11:33	Carlos	Sample_ID Probabilidad_Patológico Predicción 25-0555 0.968 1

Resultados de cada análisis, con envío automatizado al correo electrónico del usuario

Generative AI

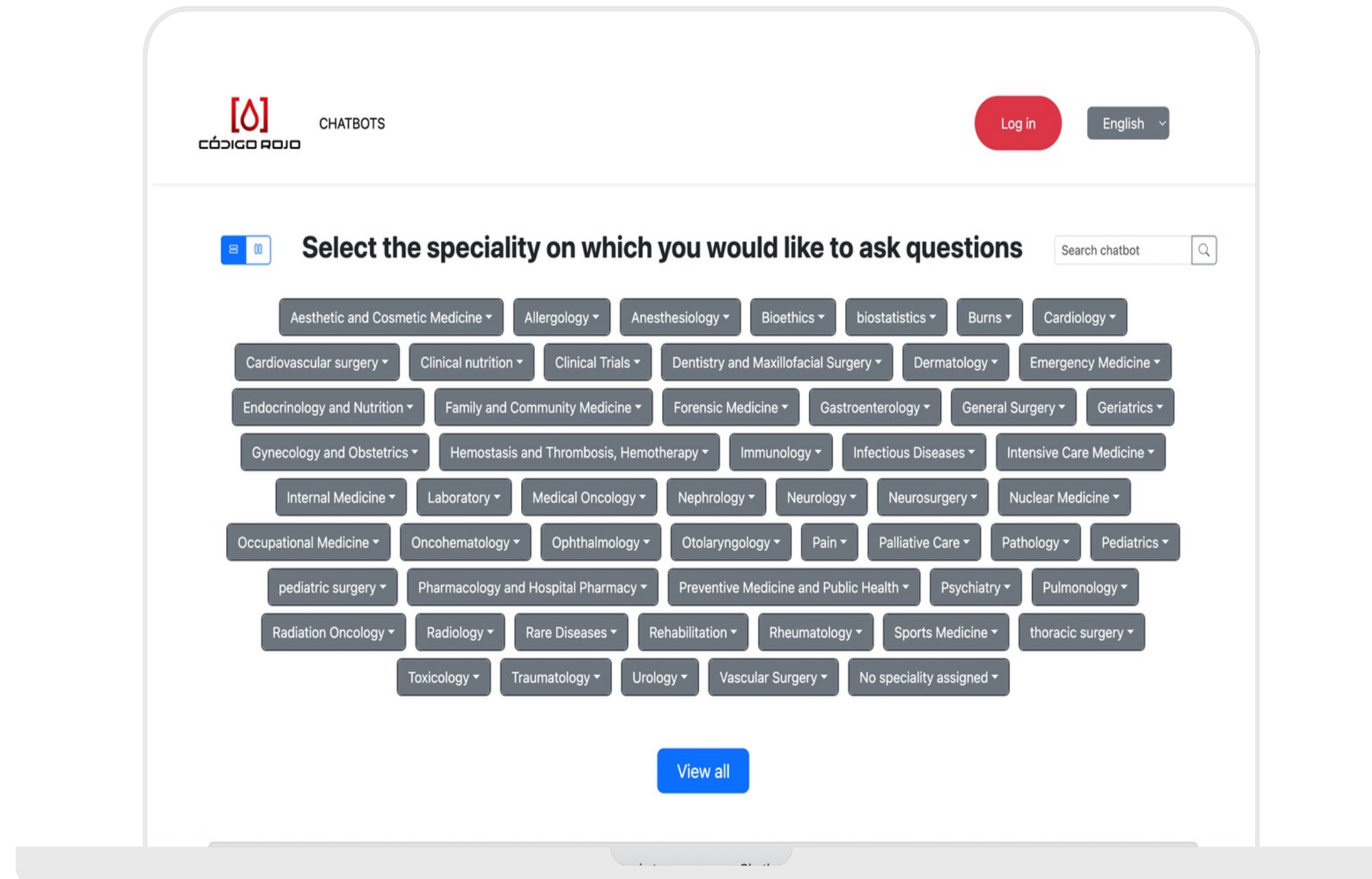


A platform to train healthcare professionals in GenAI



Código Rojo is an educational platform developed to provide healthcare professionals with a secure environment to resolve clinical questions, access up-to-date information, and enhance their understanding of generative artificial intelligence in the medical field.

Through chatbots specifically designed for the care setting, the platform delivers educational, evidence-based responses, facilitating informed decision-making without ever replacing clinical judgment. This approach ensures full alignment



The Risk of General AI

- 40M+ people/day consult chatbots such as ChatGPT for health information, despite these tools not being regulated or clinically validated.
- Google AI Overviews reach ~2 billion users/month. **This tool cites YouTube more than any medical site for health queries.**
- ECRI ranks the misuse of LLM-powered chatbots as **the #1 health technology risk for 2026.**
- A meta-analysis of medical evaluations for ChatGPT showed **an overall medical query accuracy of ~56%**, meaning nearly half of responses may be incorrect or suboptimal in clinical contexts.
- There are reported deaths linked to chatbot interactions, including a case where a chatbot's responses contributed to a user's suicide.

The Guardian

Google AI Overviews put people at risk of harm with misleading health advice

rtve

Dos de cada tres personas acuden a la IA para consultar temas sanitarios y casi el 25% se autodiagnostica

► Entre los jóvenes de 16 a 19 años la cifra aumenta: nueve de cada diez consulta la IA para dolencias de salud

The Guardian

Mind launches inquiry into AI and mental health after Guardian investigation

Exclusive: England and Wales charity to examine safeguards after Guardian exposed 'very dangerous' advice on Google AI Overviews

The New York Times

Health Advice From A.I. Chatbots Is Frequently Wrong Study Shows

BBC

AI chatbots pose 'dangerous' risk when giving medical advice, study suggests

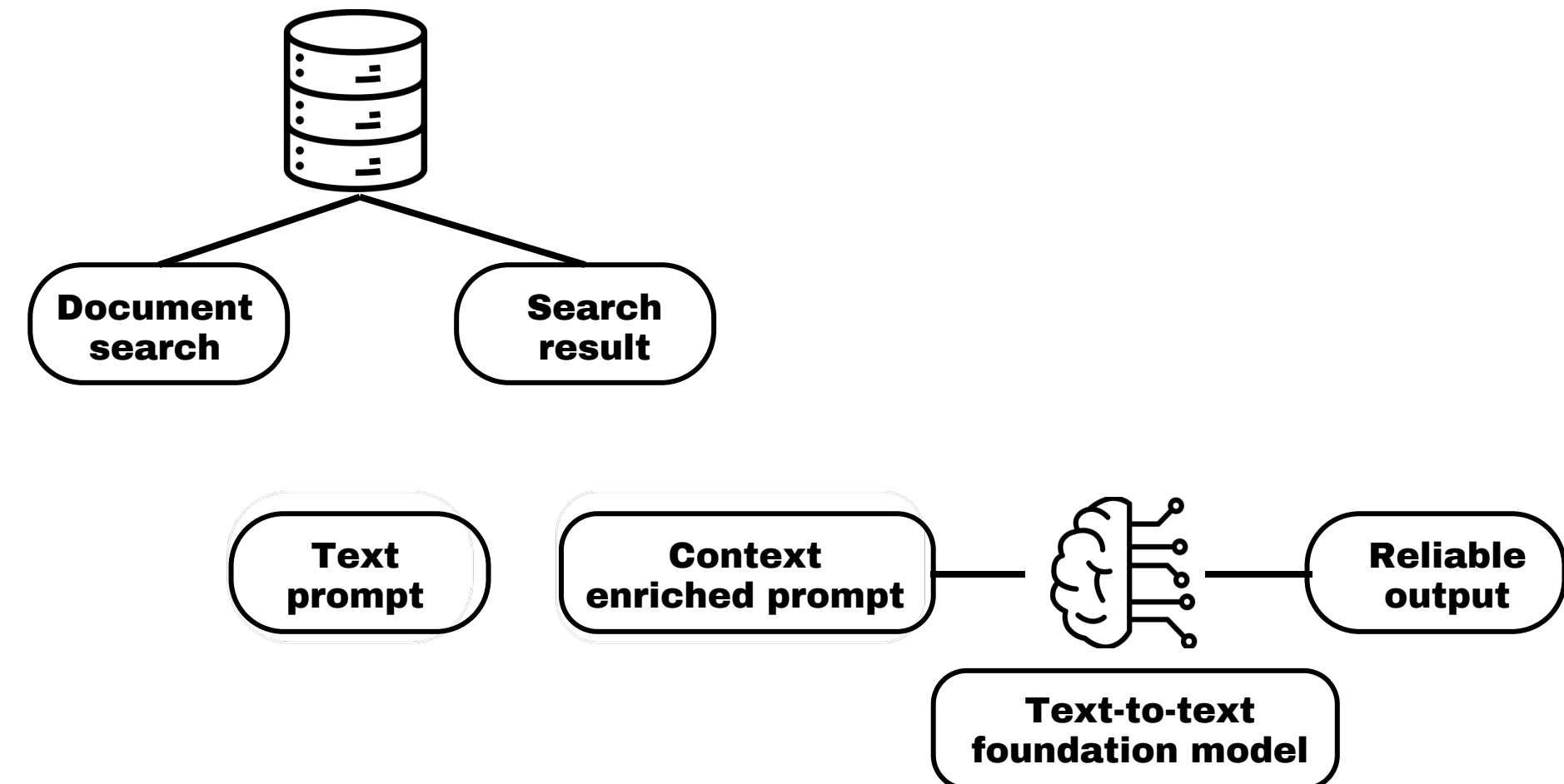
Retrieval-Augmented Generation (RAG)

RAG is a method that **combines** two key AI capabilities: **information retrieval** and **text generation**.

Instead of relying solely on pre-trained data, RAG allows a model to search external documents or databases during the generation process.

This helps produce **more accurate and up-to-date responses** by retrieving relevant information in real time, which is then integrated into the generated text.

It **enhances the model's ability to provide fact-based answers** and reduces the reliance on static knowledge.

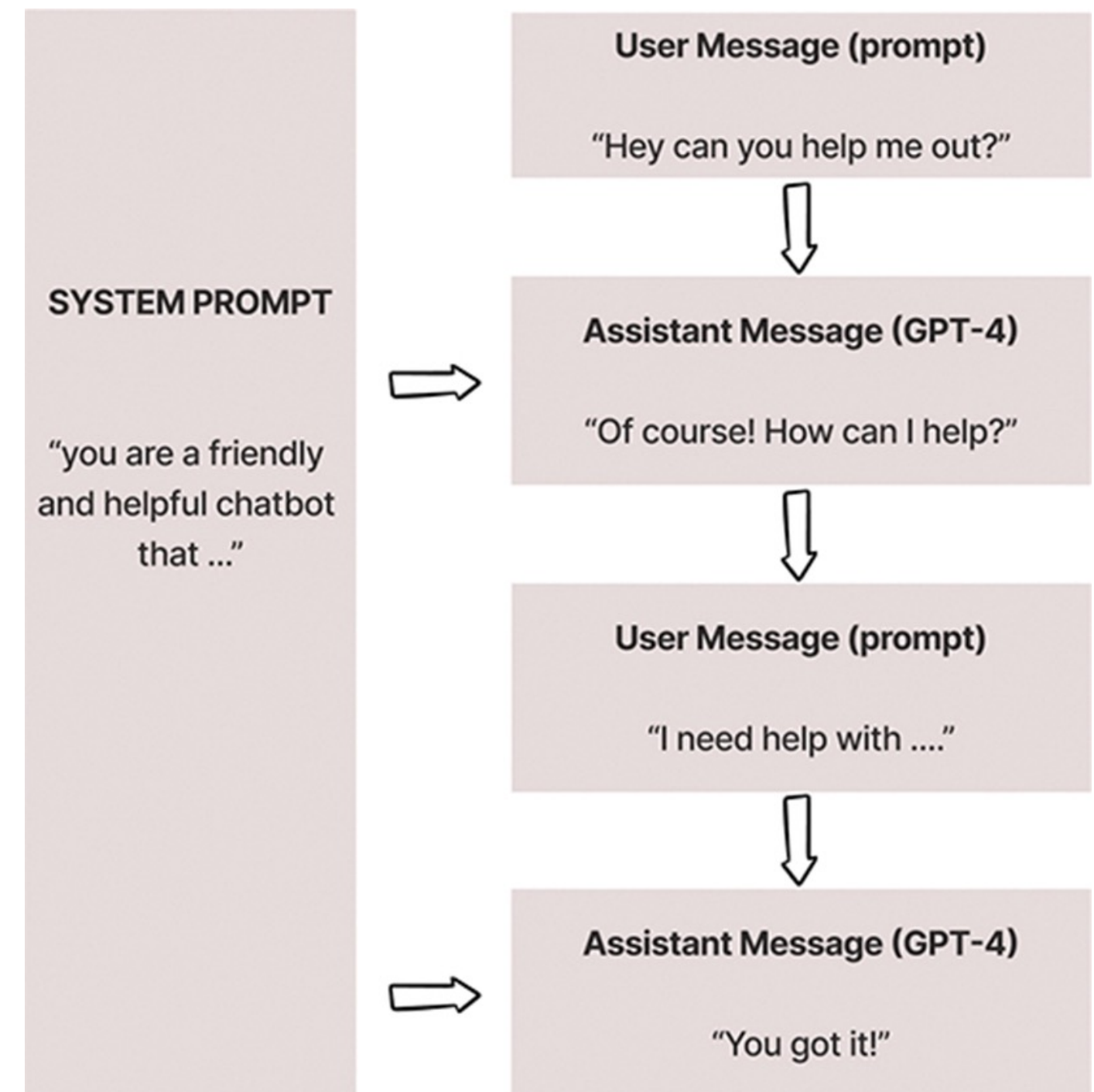


System Prompting

A system prompt is the **model's governing instruction set**—the “rules of the road” that define role, goals, tone, safety, and formatting before user input.

Optimized through .json configs, it encodes debiasing strategies such as enforcing neutrality, forbidding demographic generalizations, requiring balanced viewpoints and citations, and flagging uncertainty.

Because it operates upstream, **the system prompt shapes query interpretation, source use, and allowed outputs**—reducing stereotypes, improving factual grounding, and aligning responses with policies. Regular A/B reviews and automated checks help maintain fairness and reliability.



Reasoning Models: Chain of Thought

Reasoning-enabled models decompose problems into **intermediate steps** (planning, subgoals, calculations, self-checks) before answering, boosting accuracy on multi-step tasks like math, diagnosis, and logical inference.

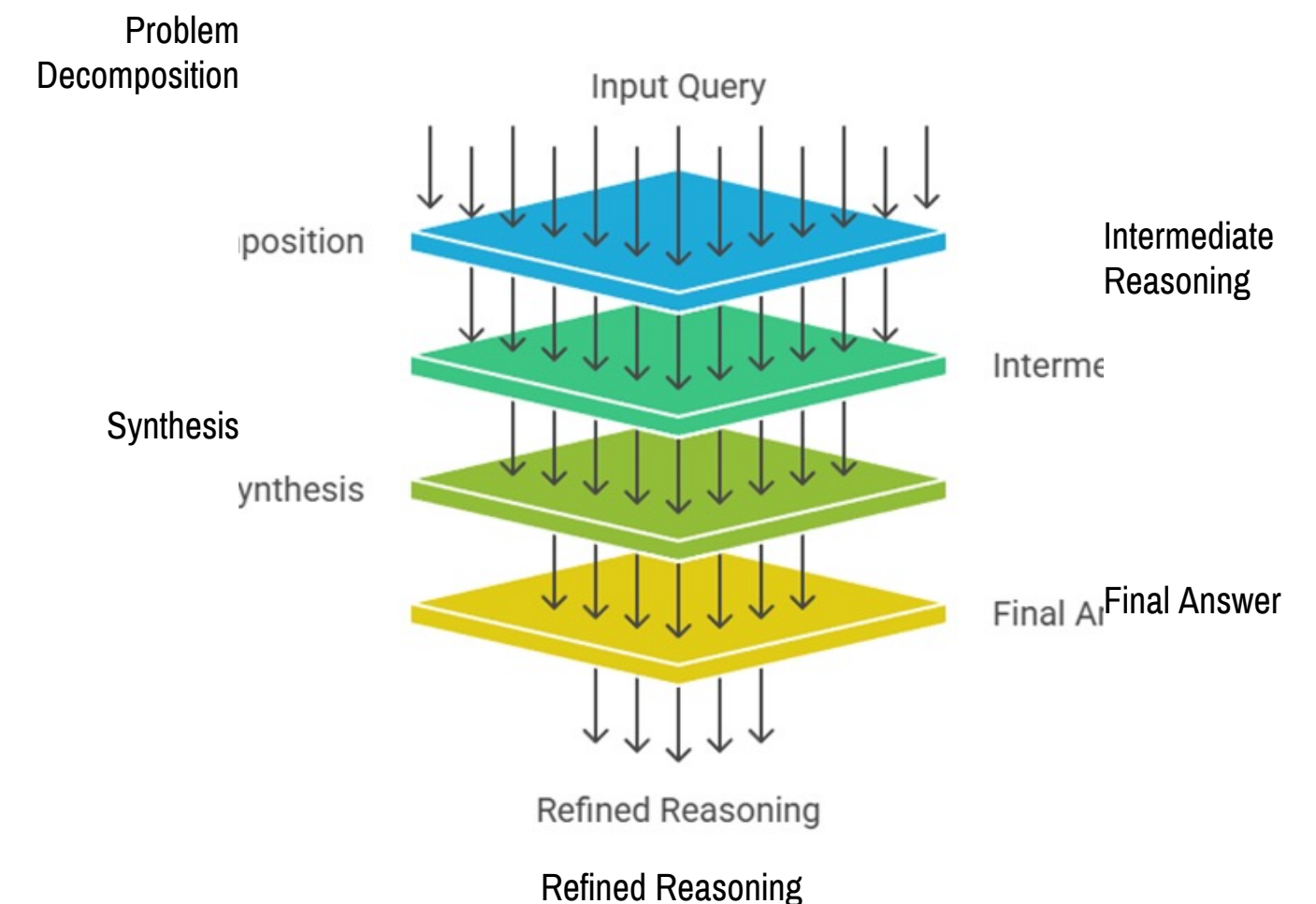
The chain of thought is an internal trace; for safety and clarity, it should be guided with light scaffolds (brief plans, equations, tool calls) while returning concise, outcome-focused answers—not step-by-step transcript.

This approach improves correctness and consistency, reduces bias and hallucinations, and maintains privacy and latency discipline.

Chain of Thought Reasoning Process

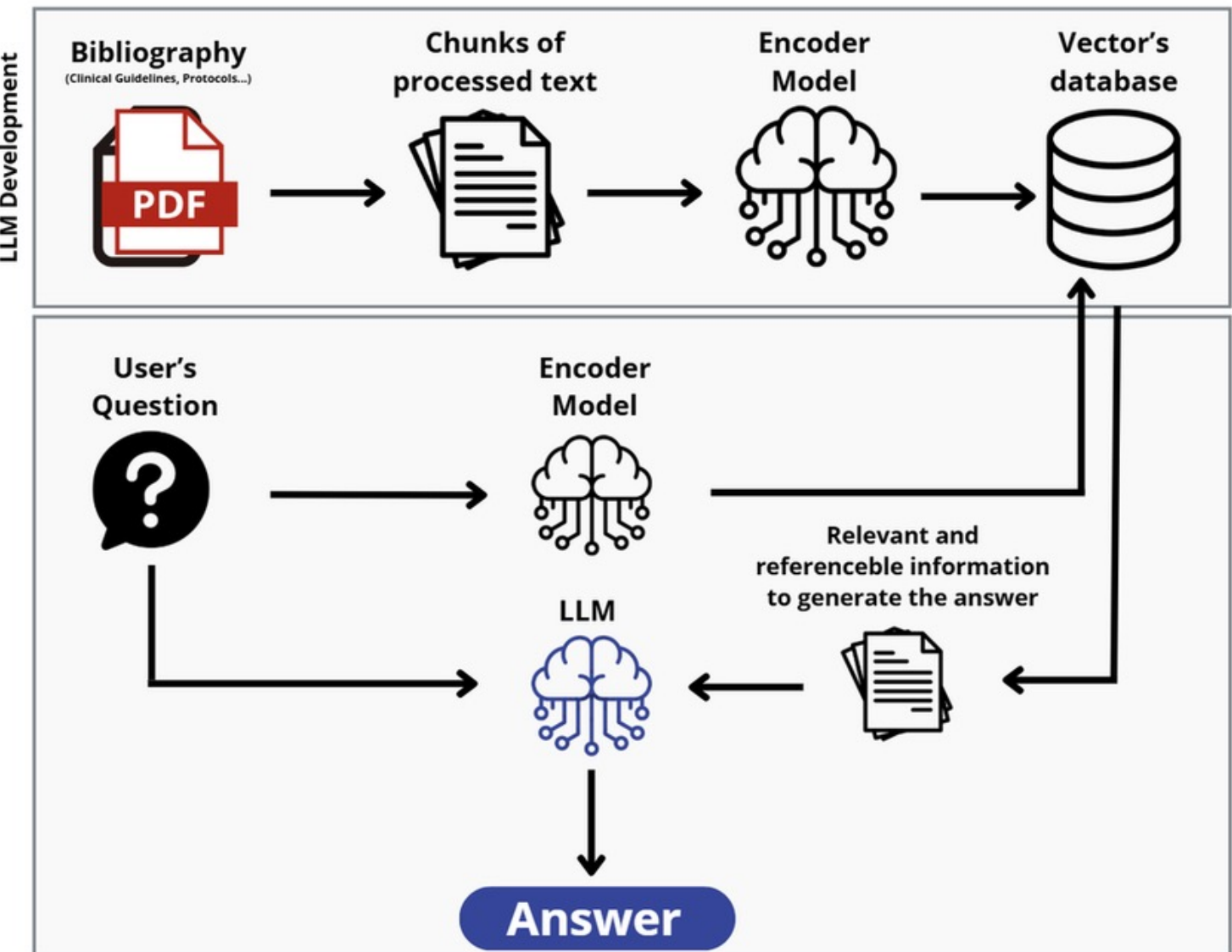
Input Query

Chain of Thought Reasoning Process



From Concept to Deployment: How We Build the Assistants

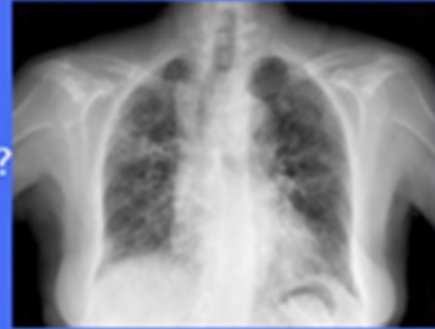
- 01** Selection of the medical specialty for the development of the specialized assistant
e.g., Myeloma, Epilepsy, Liver Failure
- 02** An expert panel identifies and curates the relevant scientific and medical documentation to feed the model
Clinical Guidelines, Medical Protocols, Scientific Papers, etc.
- 03** Integration into the selected model (GPT-4o / GPT-4.1)
Using a Retrieval-Augmented Generation (RAG) system
- 04** Definition of the assistant's behavioral framework
Ensuring accurate, consistent, and context-appropriate responses



Multimodal Integration

An AML patient with allogeneic stem cell transplantation, month +2, on active immunosuppression comes to the emergency department because of dyspnea

and has this x ray. Possible diagnosis?



1 de abril de 2025, 10:00:02

The chest X-ray you provided shows several significant features that could be relevant for a patient with hematological malignancy:

- 1. Bilateral Infiltrates:** There are bilateral infiltrates evident in both lungs. This can be associated with various causes, including infections such as *Pneumocystis jirovecii* pneumonia (PJP), which is common in immunocompromised patients, including those with hematologic cancers.
- 2. Interstitial/Diffuse Pattern:** The observed pattern suggests interstitial involvement, characteristic of viral infections like cytomegalovirus (CMV) or could indicate the dissemination of fungi such as *Aspergillus*, which tends to have a more nodular pattern in its early stages.
- 3. Nodular/Air Space Densities:** There do not appear to be well-defined lesions with cavitation or other features typically associated with bacterial lung infections or advanced fungal infections.

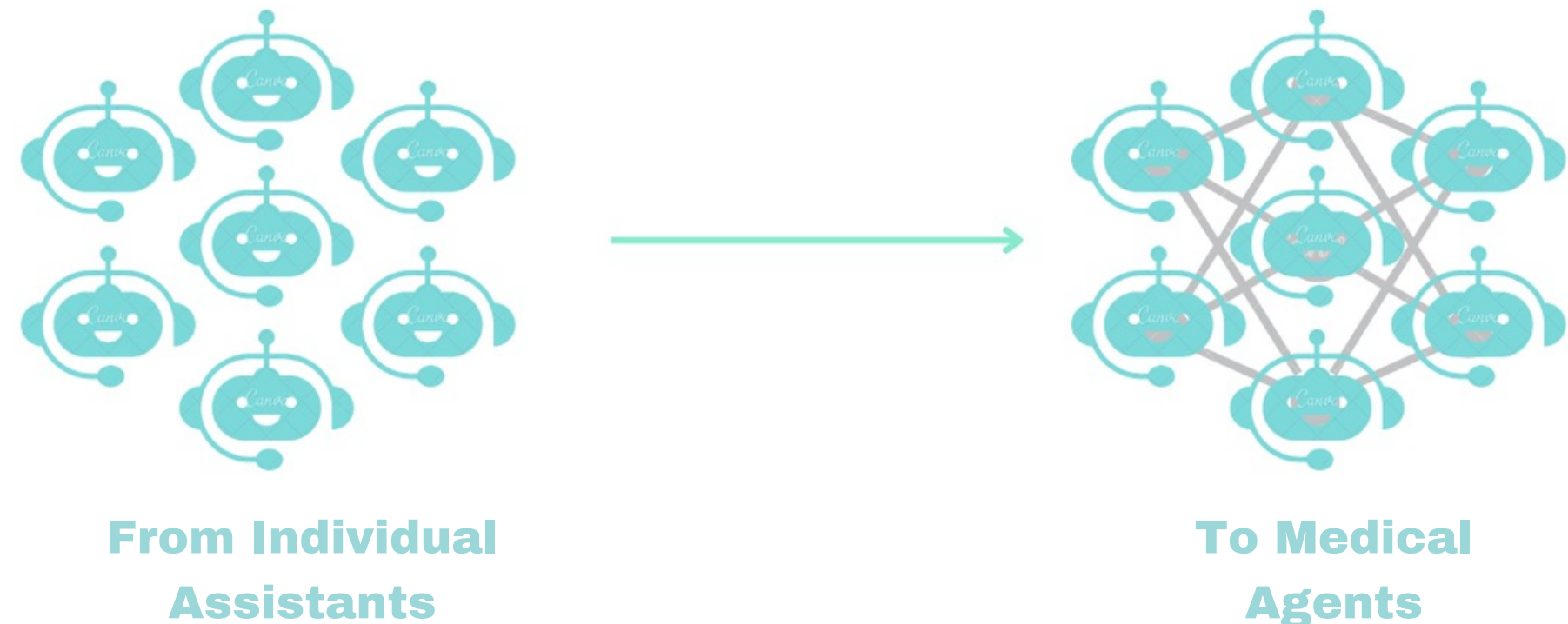
Given the clinical context of oncological hematological patients, it is important to correlate these radiological findings with the patient's clinical symptoms, such as fever, dyspnea, or any particular signs of infection. Additionally, it would be advisable to conduct further diagnostic tests, such as blood tests for specific markers, microbiological studies (cultures, PCR), and potentially a bronchoalveolar lavage for a more precise diagnosis.

In summary, these findings are suggestive of a potential opportunistic infection and should be further investigated for appropriate intervention

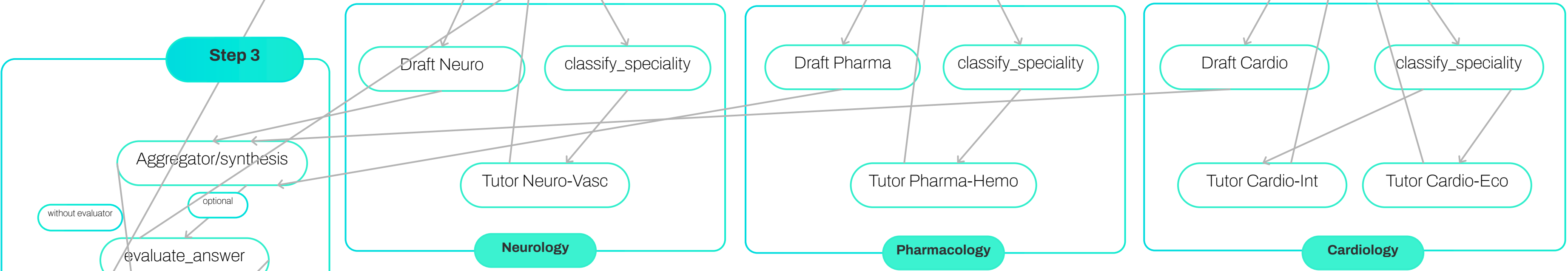
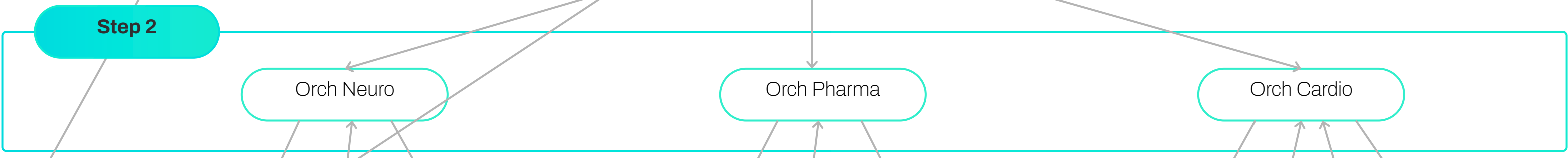
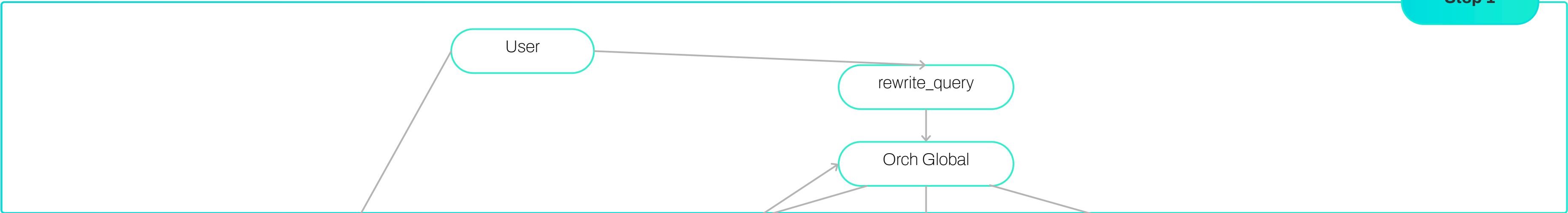
Código Rojo: From Specialized Expertise to a Connected Intelligence

Each specialty-specific virtual assistant is part of an integrated ecosystem, interconnected through intelligent agents that enable collaboration, information exchange, and coordinated responses.

This agent architecture enhances accuracy, broadens scope, and delivers seamless medical support across specialties.



Step 1



- Step 1:** Input rewrite and global routing
- Step 2:** Domain orchestration and specialist activation
- Step 3:** Answer synthesis and validation

incomplete

without evaluator

optional

complete

Why specialized medical AI

	General-purpose AI	Specialized medical AI
Consistency	Responses vary depending on prompt/user	Standardized workflows and criteria
Safety under adversarial use	More exposed to prompt injection and drift if not tightly constrained	Designed with safeguards, limits, and governance
Evidence and citations	Risk of incorrect/fabricated citations and poor traceability	Curated, controlled, and auditable evidence
Auditability	Difficult to reconstruct “why it said X”	QA + traceability (what, how, why)
Continuous improvement	No institutional correction loop	Feedback + change control (continuous improvement)
Hospital fit	Useful for exploration, hard to institutionalize	Built for institutional adoption

Medication safety (less risk, more consistency)

Safer and more consistent pharmacological decisions, especially under clinical pressure.

- **Reduces avoidable risk:** detection and explanation of drug–drug interactions (DDI), contraindications, toxicology issues, and renal/hepatic dose adjustments.
- **Provides traceability:** clear reasoning and criteria for clinical review, QA, and institutional learning.
- **Useful for committees:** supports decisions and recurring reviews (e.g., high-risk medications, therapeutic appropriateness, monitoring criteria).

74-year-old patient Day +15 of the 1st DRd cycle in a patient with IgA lambda MM, ISS stage 3+, in first relapse; lung adenocarcinoma (status post surgery), pTq1bN0M0. 34 months since diagnosis.

14:23 05/02/2026

CA

Clinical Integration Report

1. Motive for Consultation

74-year-old man, day +15 of cycle 1 with daratumumab-lenalidomide-dexamethasone (DRd) for first relapse of IgA-λ multiple myeloma, ISS-III, 34 months after initial diagnosis. History of completely resected stage I (pT1b N0 M0) lung adenocarcinoma.

Request: Day-15 check-up and short-term management plan.

2. Key Findings to Confirm Today

- Complete blood count with differential, creatinine/eGFR, calcium, LDH, β2-microglobulin.
- Myeloma panel: quantitative IgA, SPEP/IFE, serum free light chains ± 24-hour urine to establish a biochemical baseline.
- Infection screen only if febrile or symptomatic (SARS-CoV-2, influenza/RSV PCR, blood cultures).
- Frailty assessment (IMWG or GAH) to guide steroid/lenalidomide dose for cycle 2.
- Verify prophylaxis: antiviral (acyclovir/valacyclovir), VTE (ASA vs DOAC/LMWH), bone protection, vaccinations.
- Document infusion-reaction history after the second daratumumab dose.
- Specifically ask for respiratory symptoms given prior lung cancer and DRd-related pneumonitis/infection risk.

3. Management Plan (Day 15 → Start of Cycle 2)

3.1 Monitoring & Toxicity Mitigation

- Weekly CBC during cycle 1; add G-CSF if ANC < $1.0 \times 10^9/L$ or any febrile neutropenia.
- Vigilance for Grade ≥3 thrombocytopenia—delay or reduce lenalidomide if platelets < $30 \times 10^9/L$.
- Maintain standard pre-/post-medications for daratumumab and ensure rescue drugs are available.
- Educate on steroid side effects (insomnia, hyperglycemia, mood changes) and infection warning signs.
- Low threshold for HR-CT and infectious work-up if new cough, dyspnea, or fever.

3.2 Dose Strategy for Cycle 2 (Provisional; Adjust Once Labs Are Back)

- Daratumumab 16 mg/kg weekly to week 8 unless Grade ≥3 toxicity occurs.
- Lenalidomide dosing based on eGFR and frailty:
 - eGFR ≥ 60 mL/min → 25 mg daily days 1–21.
 - eGFR 30–59 mL/min or age-related frailty → 15 mg daily.
 - eGFR < 30 mL/min → 10 mg every other day (or 5 mg daily on dialysis).
- Dexamethasone: patients ≥ 70 years or frail → 20 mg once weekly; consider 12 mg if Cushingoid, diabetic or intolerant.
- “Lite” schedule (lenalidomide days 1 & 15; dexamethasone day 1) only if persistent Grade ≥3 non-hematologic toxicity despite reductions.

Living evidence and trials (less friction, more viable research)

Fast access to evidence and trial opportunities, without turning clinicians into “part-time searchers.”

- **Evidence in minutes:** targeted PubMed searches with relevant, recent results and actionable summaries (what changes and why).
- **More efficient research:** ClinicalTrials pre-screening to identify actively recruiting studies and filter viability before investing team time.
- **Traceability and learning:** sources and criteria are recorded, reducing variability in how evidence is consulted.

Pubmed

Histórico
30/01/2026 11:02

Resultados obtenidos:

La evidencia actual sobre la terapia en mieloma múltiple (MM) y su manejo en contextos de recaída y nuevas terapias muestra que las estrategias dirigidas a inmunoterapia, particularmente los anticuerpos bispecíficos y las terapias CAR-T dirigidas a BCMA, ofrecen un potencial significativo en la prolongación de la supervivencia y el control de la enfermedad, aunque con perfiles de toxicidad manejables en el marco adecuado [3], [4], [5]. En pacientes con recaída tras terapias de primera línea que incluyen regímenes estándar como Dara-VRd, el uso de bispecíficos anti-BCMA, como teclistamab, ha demostrado respuestas objetivas en estudios observacionales y ensayos clínicos, con tasas de respuesta relevantes y una mediana de supervivencia libre de progresión (SLP) en torno a 11 meses, aunque es necesario considerar los efectos adversos como CRS y neurotoxicidad, que requieren manejo especializado y vigilancia [3], [4], [5].

El riesgo de infecciones en pacientes tratados con terapias bispecíficas, especialmente en aquellos con niveles bajos de inmunoglobulinas, ha impulsado revisiones sistemáticas que sugieren que la terapia de reemplazo con inmunoglobulinas puede reducir infecciones severas, pero con la necesidad de más estudios prospectivos para definir su uso rutinario en estos escenarios [3]. Además, nuevos biomarcadores relacionados con perfiles inmunitarios, como la expresión de proteínas en plasma y perfiles genéticos, permiten estratificar la respuesta y el pronóstico, favoreciendo estrategias personalizadas, aunque aún son requeridos procesos de validación clínica [4], [6].

En la selección de terapias, la consideración de la biología molecular, como mutaciones en KMT2D, y la utilización de perfiles inmunológicos de riesgo en tumores sólidos (como carcinoma gástrico o NSCLC) proporcionan perspectivas complementarias, en particular para pacientes que poseen características como TMB alto en tumores sólidos, que podrían beneficiarse de inmunoterapia, incluso en contextos de MSS (micro satelital inestabilidad) en tumores sólidos.

Clinical trials

Histórico
30/01/2026 11:02

Resultados obtenidos:

Aquí tienes una lista de dos ensayos clínicos relacionados con la evaluación y tratamiento de pacientes mayores con mieloma múltiple mediante terapias innovadoras con anticuerpos bispecíficos y CAR-T:

1. ****NCT07309497 — Estudio de Evaluación Geriátrica Pragmática Antes de Terapias con CAR-T o Anticuerpos Bispecíficos para Predecir Efectos Secundarios y Resultados en Pacientes Mayores (GA-ACT)****
 - ****Estado:**** En reclutamiento activo (RECRUITING; verificado diciembre 2025) y fecha de inicio diciembre 2025. La finalización estimada de la fase principal en diciembre 2027 y conclusión en febrero 2028.
 - ****Población y criterios:**** Adultos mayores de 65 años, evaluados con métodos clínicos simples para determinar la tolerabilidad a CAR-T o bispecíficos, incluyendo evaluación de movilidad, memoria, autocuidado y estado nutricional. Se excluyen pacientes con deterioro neurológico severo, infecciones activas o condiciones que comprometan la salud. Se estima un reclutamiento de 208 pacientes en centros en Suiza.
 - ****Intervenciones:**** Evaluación gerontológica no intervenida, con análisis prospectivo de toxicidad y resultados funcionales en pacientes sometidos a terapia con CAR-T o bispecíficos.
 - ****Objetivo:**** Determinar si la evaluación geriátrica preliminar puede predecir efectos adversos severos, toxicidades y resultados en la calidad de vida.
 - ****Contacto:**** Dr. Wiebke Röslér, Universität Zürich (email y teléfono) en Zurich y Bern.
 - ****Condiciones:**** Mieloma múltiple, linfoma, disfunción inmunológica en pacientes mayores.
2. ****NCT05972135 — Administración Ambulatoria de Teclistamab o Talquetamab para Mieloma Múltiple****
 - ****Estado:**** En reclutamiento activo (RECRUITING; verificado enero 2026), con inicio en octubre 2023. La fase prevista es fase 2, con finalización estimada en agosto 2027.
 - ****Población y criterios:**** Adultos \geq 18 años con mieloma múltiple recurrente y refractario previo a al

Search again Manual search Cerrar

Real-time access intelligence and continuously refreshed evidence

Up-to-date visibility on drug funding status in Spain and relevant medical news, without adding extra research burden to clinical teams.

- **Funding status in context:** clear visibility into the reimbursement and financing status of medicines in Spain, helping teams understand access conditions, positioning, and practical feasibility before considering therapeutic options.
- **Relevant medical news updates:** curated, topic-specific medical news integrated directly into the workflow, highlighting regulatory changes, safety alerts, market movements, and emerging developments that may impact care pathways.

BIFIMED - Financiación de Medicamentos

×

1 Contexto clínico

Paciente varón de 58 años con diabetes tipo 2 e hipertensión arterial, con un LDL de 162 mg/dL a pesar de tratamiento con atorvastatina 40 mg/día. Se busca optimizar el tratamiento para alcanzar las metas de LDL según guías actuales.

2 Análisis de financiación

Atorvastatina

- **Indicación en BIFIMED:** No se especifican indicaciones financiadas específicas en el extracto proporcionado.
- **Estado de resolución:** La atorvastatina está financiada en varias presentaciones y dosis.
- **Restricciones clave:** No constan restricciones adicionales en el extracto proporcionado.
- **Análisis del caso:** El paciente está recibiendo atorvastatina 40 mg/día, que está financiada. Sin embargo, el LDL sigue elevado, lo que sugiere la necesidad de intensificar el tratamiento.

Atorvastatina + Ezetimiba

- **Indicación en BIFIMED:** Ezetimiba/Atorvastatina está indicada como tratamiento complementario a la dieta para hipercolesterolemia primaria o hiperlipidemia mixta.
- **Estado de resolución:** Financiada.
- **Restricciones clave:** No constan restricciones adicionales en el extracto proporcionado.
- **Análisis del caso:** La combinación de atorvastatina con ezetimiba podría ser una opción adecuada para intensificar el tratamiento y alcanzar las metas de LDL.

3 Conclusión

- **FINANCIADO** — La combinación de atorvastatina con ezetimiba está financiada y es adecuada para intensificar el tratamiento en este paciente, dado que el LDL sigue elevado a pesar de la monoterapia con atorvastatina.

4 Avisos

- Interpretación basada en los datos extraídos de BIFIMED.
- Requiere validación por Farmacia Hospitalaria según la normativa.
- Esta información no sustituye el criterio profesional ni la consulta.

Consulta el estado de financiación en BIFIMED:

[ATORVASTATINA](#)

Últimas noticias médicas relevantes

×

Optimización del tratamiento para paciente con DM2, HTA y LDL 162 mg/dL pese a atorvastatina 40 mg/día

- El paciente presenta un LDL elevado (162 mg/dL) a pesar de una **estatina de alta intensidad** (atorvastatina 40 mg), lo que indica la necesidad de intensificar la terapia para alcanzar la meta recomendada de LDL <70 mg/dL, dado su alto riesgo cardiovascular por diabetes e hipertensión (guías ESC/EAS 2025).

- La **adición de ezetimiba** es la siguiente recomendación estándar: este fármaco inhibe la absorción intestinal de colesterol y puede reducir el LDL en un 15-20% adicional cuando se combina con estatinas.

- Si con estatina + ezetimiba el LDL sigue >70 mg/dL, se recomienda considerar un inhibidor de PCSK9.

- Recientemente se ha reportado un **inhibidor oral de PCSK9, enlicotide**, que reduce el LDL en un 57% a las 24 semanas en pacientes con riesgo cardiovascular, lo que podría ser una alternativa eficaz a los anticuerpos inyectables tradicionales ([AJMC](#)) ([Medical Dialogues](#)).

- El monitoreo del perfil lipídico debe realizarse a las 4-8 semanas tras cualquier cambio para evaluar la respuesta y ajustar la terapia.

- Además, es recomendable valorar colesterol no HDL y apolipoproteína B para una mejor estratificación del riesgo y seguimiento.

Perspectiva clínica

- La combinación precoz de estatinas con ezetimiba es clave para alcanzar objetivos en pacientes con alto riesgo como este.

- La disponibilidad de inhibidores orales de PCSK9 podría facilitar la adherencia y ampliar opciones terapéuticas en el futuro próximo.

- Se debe vigilar la tolerancia a los fármacos, especialmente síntomas musculares o hepáticos, y mantener un enfoque integral con control estricto de diabetes, HTA y hábitos de vida.

Deep Search (continuously refreshed scientific intelligence)

Up-to-date scientific evidence embedded directly into responses.

- **Evidence beyond the static knowledge base:** Deep Search dynamically queries the latest scientific literature, incorporating newly published studies into the response layer and reducing the risk of relying on outdated information.
- **Context-aware enrichment:** instead of returning isolated papers, the system integrates recent findings into the clinical context — highlighting what is new, what has changed, and why it may matter.
- **Higher confidence answers:** by refreshing the RAG layer with current evidence at query time, responses are strengthened with the most relevant and recent data available.



Evidencia científica reciente

Actualización dirigida

- Las guías **2025 ACC/AHA para síndromes coronarios agudos** enfatizan un enfoque más temprano e intensivo en la reducción del LDL-C, manteniendo el objetivo por debajo de 70 mg/dL, especialmente en pacientes con diabetes y factores de riesgo adicionales, lo que confirma y refuerza la necesidad de optimizar el tratamiento en este paciente [Peer-reviewed study] **Maturation of Lipid Management in the 2025 ACC/AHA Acute Coronary ...** — JACC — 2025 — <https://www.jacc.org/doi/10.1016/j.jacc.2025.04.024>.
- La **guía clínica 2025 para el manejo farmacológico de la dislipidemia** recomienda el uso de un enfoque basado en la evaluación del riesgo cardiovascular global y apoya la adición de fármacos no estatínicos (como ezetimiba o inhibidores de PCSK9) cuando las metas de LDL-C no se alcanzan con estatinas, lo que matiza la estrategia de tratamiento escalonado [Guideline/Consensus] **2025 Clinical Practice Guideline for the Pharmacologic Management of ...** — AACE — 2025 — <https://pro.aace.com/clinical-guidance/2025-clinical-practice-guideline-pharmacologic-management-adults-dyslipidemia>.
- La actualización focalizada 2025 de las guías ESC/EAS destaca que la combinación temprana de ezetimiba con estatinas tras eventos cardiovasculares agudos mejora la reducción del LDL-C y reduce eventos adversos, lo que apoya la consideración precoz de terapia combinada en pacientes con alto riesgo como el descrito [Peer-reviewed study] **2025 Focused Update of the 2019 ESC/EAS Guidelines for the management ...** — Eur Heart J — 2025 — <https://academic.oup.com/eurheartj/article/46/42/4359/8234482>.
- Se reconoce la importancia de medir no solo el LDL-C, sino también el colesterol no HDL y la apolipoproteína B en pacientes con diabetes para evaluar mejor la carga aterogénica y ajustar el tratamiento, lo que amplía el enfoque diagnóstico y terapéutico [Peer-reviewed study] **Updated Guidelines for Management of Dyslipidemias** — Lipid Journal — fecha no confirmada — [https://www.lipidjournal.com/article/S1933-2874\(25\)00478-7/fulltext](https://www.lipidjournal.com/article/S1933-2874(25)00478-7/fulltext).

Evidencia reciente

- Estudios recientes confirman que la adición de inhibidores de PCSK9 en pacientes con LDL-C persistentemente elevado a pesar de estatinas y ezetimiba puede reducir el LDL-C hasta en un 60%, con beneficio cardiovascular significativo, especialmente en pacientes con diabetes y antecedentes de enfermedad cardiovascular [Peer-reviewed study] **AACE Dyslipidemia Guidelines (2025 Updates)** — Clinical Advisor — 2025 — <https://www.clinicaladvisor.com/news/aace-dyslipidemia-guidelines-2025/>.
- Nuevos algoritmos de manejo personalizados enfatizan la importancia de la evaluación continua del riesgo cardiovascular y la adaptación dinámica del tratamiento, incluyendo la incorporación de biomarcadores y factores genéticos en casos seleccionados [Peer-reviewed study] **American Association of Clinical Endocrinology Consensus Statement** — Endocrine Practice — 2025 — [https://www.endocrinepractice.org/article/S1530-891X\(25\)00972-3/fulltext](https://www.endocrinepractice.org/article/S1530-891X(25)00972-3/fulltext).

Señales y tendencias (no concluyentes)

- Algunos reportes preliminares sugieren que la combinación temprana de estatinas con ezetimiba podría ser más efectiva que el escalonamiento secuencial en ciertos subgrupos de pacientes con diabetes, pero se requieren ensayos clínicos más amplios para confirmarlo [Conference abstract] fecha no confirmada.
- Se observa un interés creciente en terapias emergentes que modulan el metabolismo lipídico a nivel genético o mediante ARN interferente, aunque aún están en fases experimentales y no forman parte de las recomendaciones actuales [News] fecha no confirmada.

Implicaciones prácticas

- La meta de LDL-C <70 mg/dL sigue siendo el estándar para pacientes con diabetes e hipertensión, pero la evidencia actual apoya iniciar combinaciones terapéuticas más tempranas si la estatina sola no es suficiente.
- La incorporación de ezetimiba debe considerarse rápidamente tras no alcanzar metas con estatinas, y los inhibidores de PCSK9 son una opción eficaz para casos refractarios o muy alto riesgo.
- Es recomendable ampliar el perfil lipídico incluyendo colesterol no HDL y apolipoproteína B para una mejor estratificación del riesgo y ajuste terapéutico.
- La monitorización periódica y la evaluación del riesgo cardiovascular global deben guiar la intensificación o modificación del tratamiento.

Limitaciones

- Algunas recomendaciones recientes provienen de guías y consensos publicados en 2025, por lo que la implementación clínica puede variar según disponibilidad y acceso a fármacos.
- Los abstracts y reportes preliminares mencionados no cuentan con revisión por pares, por lo que sus conclusiones deben interpretarse con cautela hasta confirmación en estudios definitivos.
- La evidencia sobre terapias emergentes es aún experimental y no debe influir en la práctica clínica actual sin respaldo robusto.

Simulation for medical training

BioDigital Health goes beyond a medical AI assistant. The platform integrates a clinical case simulator that allows users to engage with realistic scenarios, analyze clinical information, and make decisions.

This approach transforms interaction into an active learning and training experience, supporting the development of clinical reasoning and decision-making skills in a controlled, educational environment.



Configura tu simulación

Personaliza los parámetros para generar una simulación adaptada a tus necesidades

📄 Especialidad
Seleccione una especialidad

📄 Dificultad

Sencillo Intermedio Difícil Aleatorio

☰ Tipo de simulación

Abordaje clínico Tipo test Pregunta académica

⚙️ Personalización (opcional)

Ejemplo: Enfócate en diagnóstico diferencial, incluye preguntas sobre farmacología...

Añade matices para personalizar tu simulación

📎 Adjuntar documento PDF, DOC, DOCX

▶ Iniciar simulación

Revisión bibliográfica inteligente

Describe tu consulta...

I need a description about the latest tendencies in management strategies in advanced healthcare facilities

Formato de salida

Introducción de artículo



Enfoque de evidencia

Mixto



Profundidad

Profundo



Longitud objetivo (palabras)

1000

Idioma

Español



Densidad de citas

Alta



 Generar revisión

Revisión generada

[Ver búsqueda en PubMed](#)

La literatura reciente en el ámbito de las estrategias de gestión en instalaciones de atención médica avanzada refleja una tendencia hacia la integración de tecnologías innovadoras, la evaluación centrada en el paciente y la optimización de recursos para mejorar la calidad, eficiencia y satisfacción de los pacientes, además de la seguridad clínica. La revisión de los estudios sistemáticos publicados hasta abril de 2024 evidencia que diversos enfoques están siendo explorados para adaptar las estrategias de gestión a las complejidades contemporáneas del cuidado de la salud, permitiendo una respuesta más ajustada a las necesidades específicas de los pacientes y a los desafíos organizacionales [1-20].

Un aspecto recurrente en esta tendencia es el aprovechamiento de la inteligencia artificial (IA) para la toma de decisiones clínicas y administrativas, especialmente en contextos de trauma polytraumático, donde la predicción y gestión de riesgos mediante algoritmos ha mostrado resultados prometedores en la mejora de la precisión diagnóstica y en la optimización de intervenciones rápidas [6]. Este uso de la IA, si bien aún en fases iniciales, apunta hacia una gestión más proactiva y personalizada en situaciones críticas, facilitando decisiones apoyadas en datos en tiempo real.

Otra línea relevante en las estrategias de gestión moderna se centra en la incorporación de la perspectiva del paciente mediante la utilización de resultados reportados por los propios pacientes (PROs). La evaluación de la calidad de vida relacionada con la salud (HRQoL), satisfacción y otros indicadores de resultados centrados en el paciente están siendo integrados en los registros clínicos y en la evaluación de intervenciones tanto en oncología como en cirugía ortopédica, reforzando un modelo de atención más centrado en los resultados reportados por los pacientes y en la calidad de vida [3,8,13,14,16,18].

Asimismo, la adopción de telemedicina como estrategia de gestión clínica en reproducción asistida, oncología y atención mental ha incrementado la accesibilidad y la satisfacción del paciente, además de reducir los tiempos de espera y apoyar modelos de atención más flexibles y sostenibles [4,6,14,15]. Estos cambios reflejan una tendencia hacia modelos híbridos que combinan atención presencial y remota, permitiendo una gestión más eficiente de los recursos y una mayor cobertura poblacional.

La atención a emergencias y hospitalización ha visto innovaciones en el uso de unidades de decisión psiquiátrica, que buscan reducir hospitalizaciones innecesarias y mejorar la calidad del cuidado en salud mental, alineándose con principios de eficiencia y seguridad clínica [18]. Igualmente, los avances en cirugía mínimamente invasiva, como la tiroidectomía robotizada y las técnicas de reparación de lesiones en el hombro, ejemplifican una gestión orientada a la seguridad, la eficacia y la satisfacción estética y funcional del paciente, integrando la innovación tecnológica con un enfoque centrado en resultados clínicos y reportados por los pacientes [7,11,17].

Por otro lado, la gestión en atención comunitaria y de salud pública también evoluciona mediante estrategias que apuntan a la prevención, control y gestión de problemas específicos, como la intoxicación en niños en países de bajos ingresos, donde las intervenciones educativas y regulatorias pueden reducir la morbilidad y mortalidad [12]. La prevención en este escenario requiere enfoques multisectoriales y contextualizados, que respondan a las particularidades socioeconómicas y culturales.

Finalmente, el análisis crítico de las tendencias revela además que la incorporación de medidas de satisfacción, la evaluación de la carga psicosocial y el impacto en la calidad de vida son cada vez más esenciales para evaluar el éxito de las estrategias de gestión, proponiendo un paradigma que integra la eficacia clínica con el bienestar del paciente, y fomenta la implementación de centros de atención especializados y protocolos estandarizados con enfoque en la seguridad y la calidad [2,9,19,20].

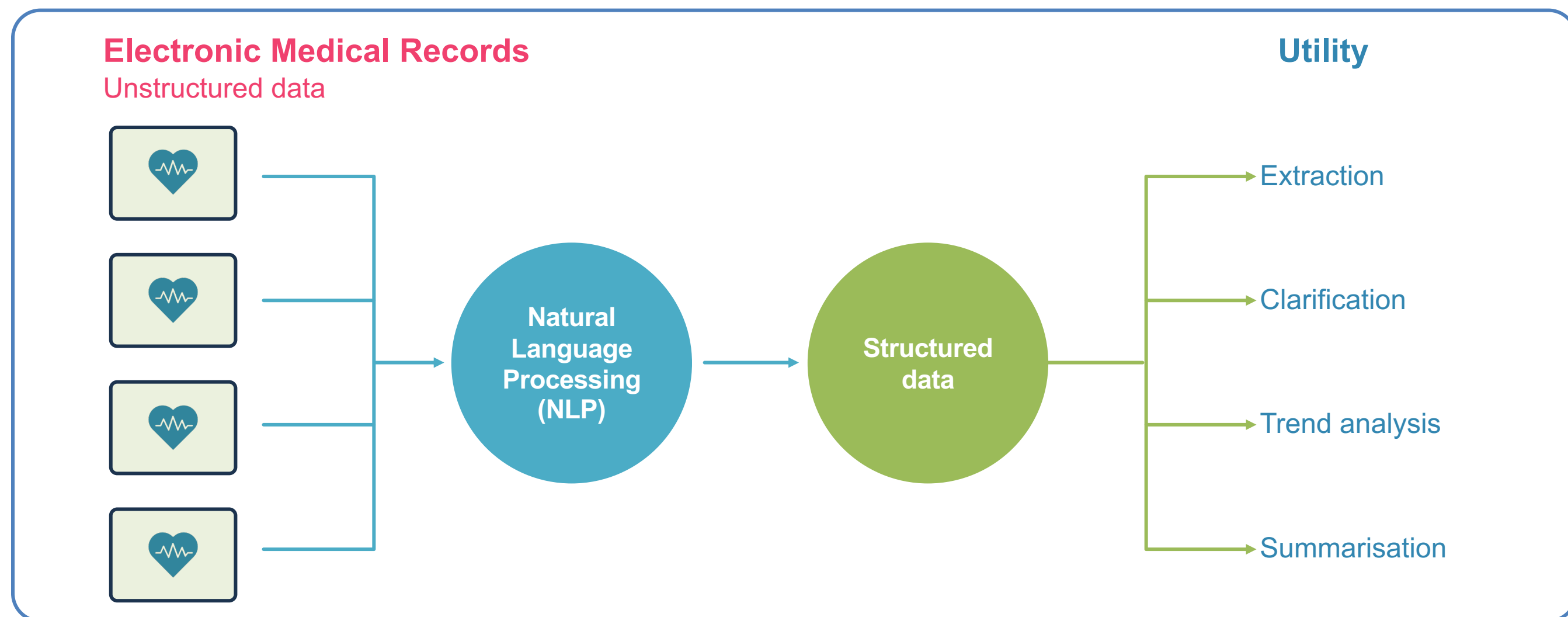
En síntesis, la tendencia actual en gestión en instalaciones de atención sanitaria avanzada se caracteriza por un enfoque multidimensional que combina tecnologías emergentes, atención centrada en el paciente y estrategias de optimización de recursos, con el objetivo de transformar los modelos tradicionales hacia sistemas más eficientes, seguros, sostenibles y orientados al valor, en línea con los desafíos de la atención médica moderna y las expectativas sociales. Estos enfoques están todavía en fase de desarrollo y validación, pero indican un camino hacia la redefinición de la gestión de la salud en un contexto cada vez más complejo y tecnológicamente avanzado.

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Retrieving real-world data with natural language processing

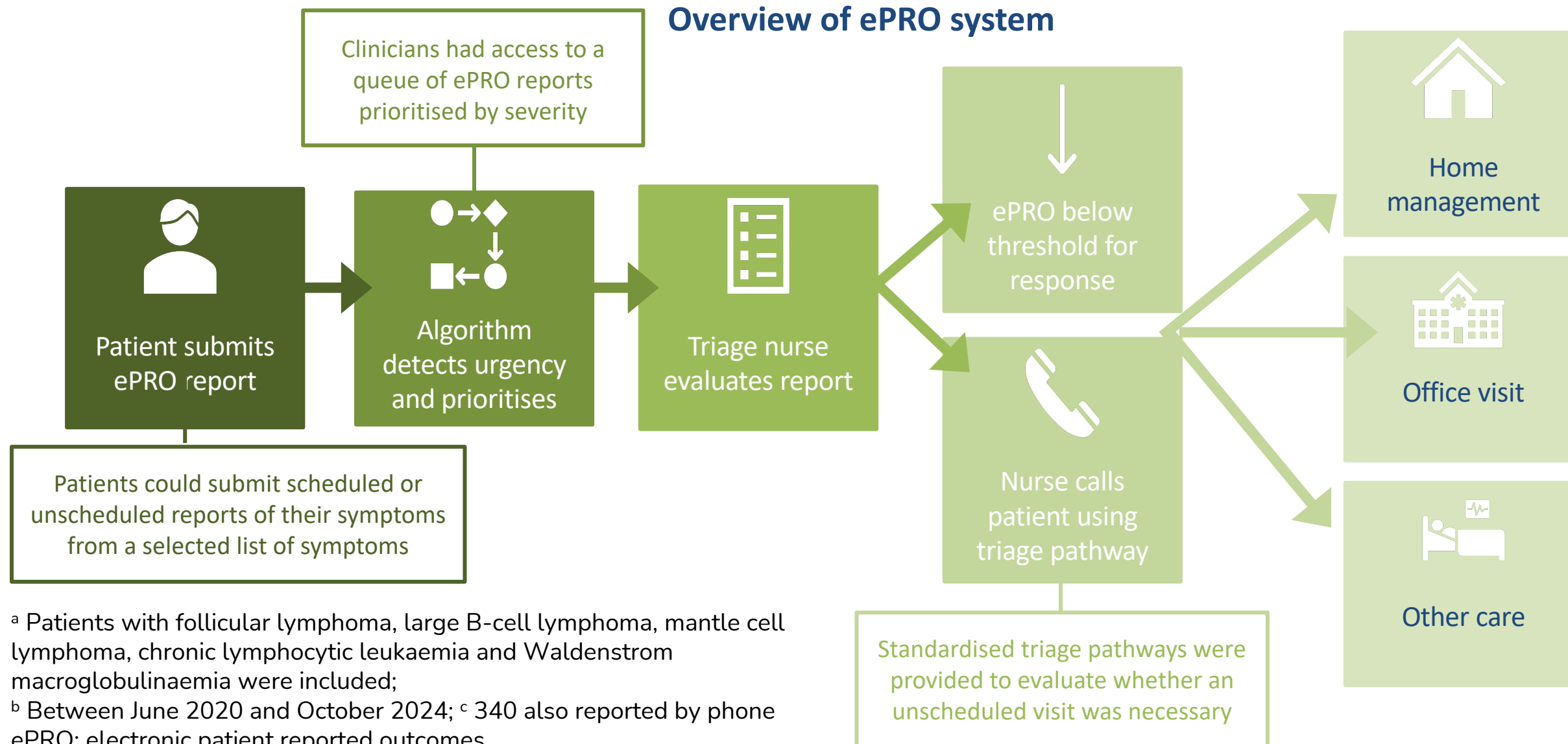
Real-world data can be extracted and analysed by AI



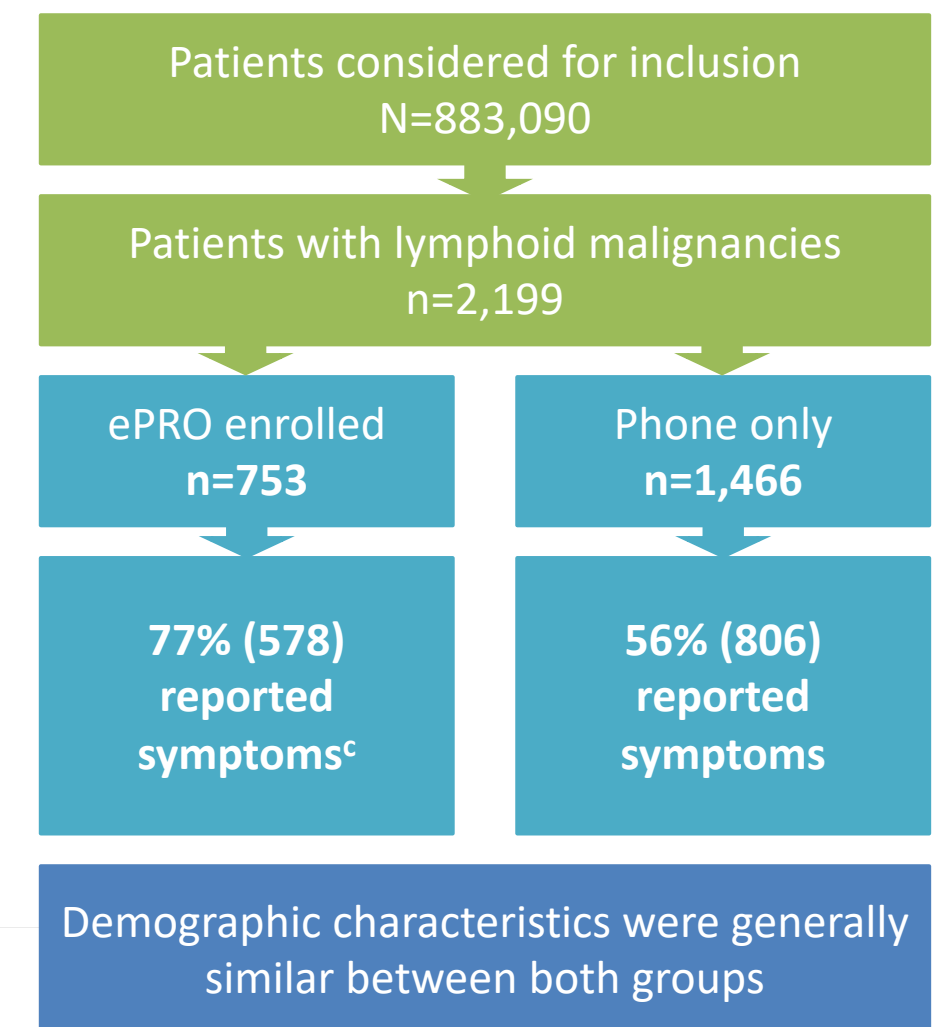
Evaluation of an ePRO system in patients with lymphoid malignancies^a across 6 community practices^b

AI analyses of patients' digital devices may allow HCPs to rapidly identify potential toxicities and prioritise those needing timely intervention

Overview of ePRO system



Patient inclusion and reporting



^a Patients with follicular lymphoma, large B-cell lymphoma, mantle cell lymphoma, chronic lymphocytic leukaemia and Waldenstrom macroglobulinaemia were included;

^b Between June 2020 and October 2024; ^c 340 also reported by phone

ePRO: electronic patient reported outcomes

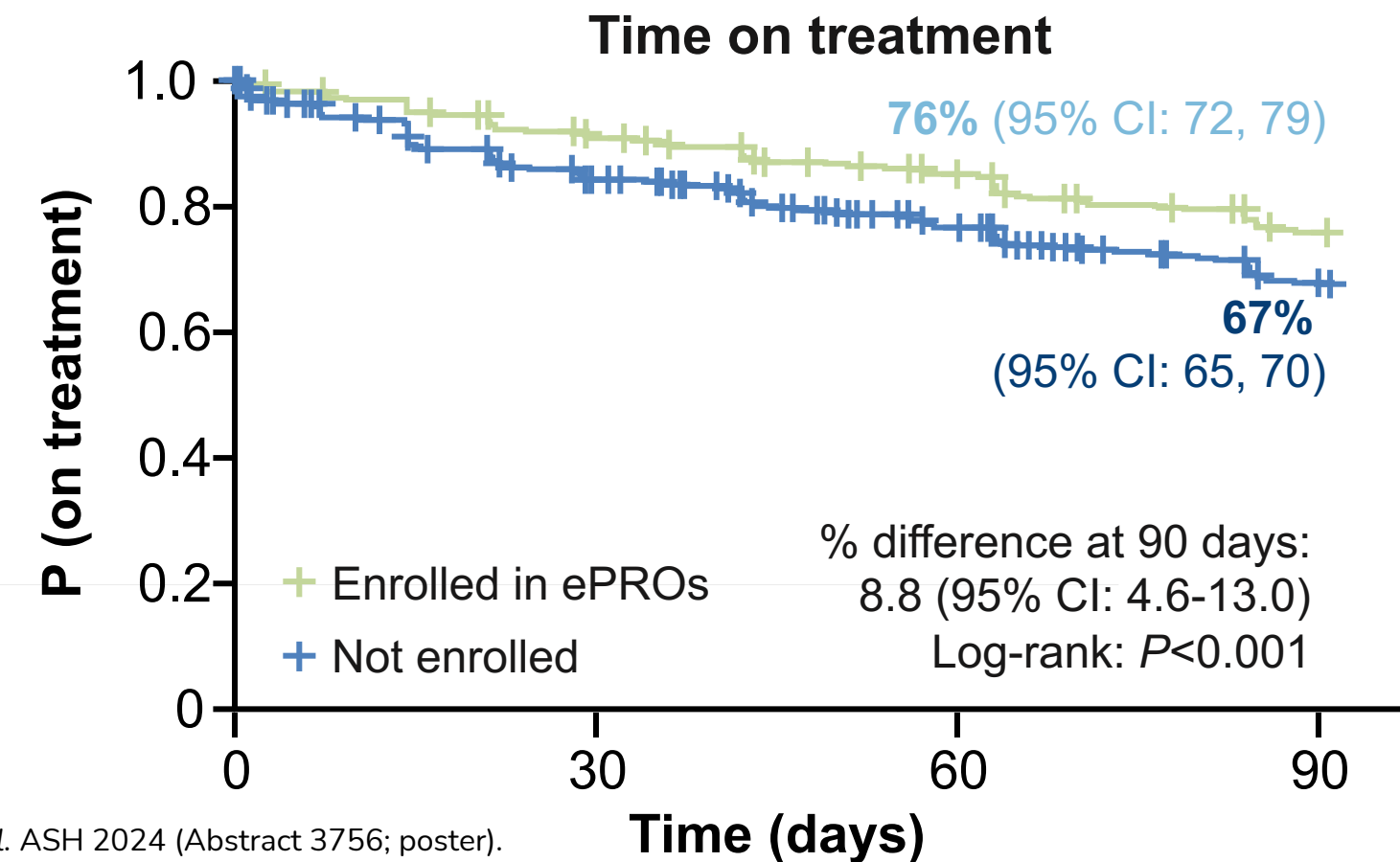
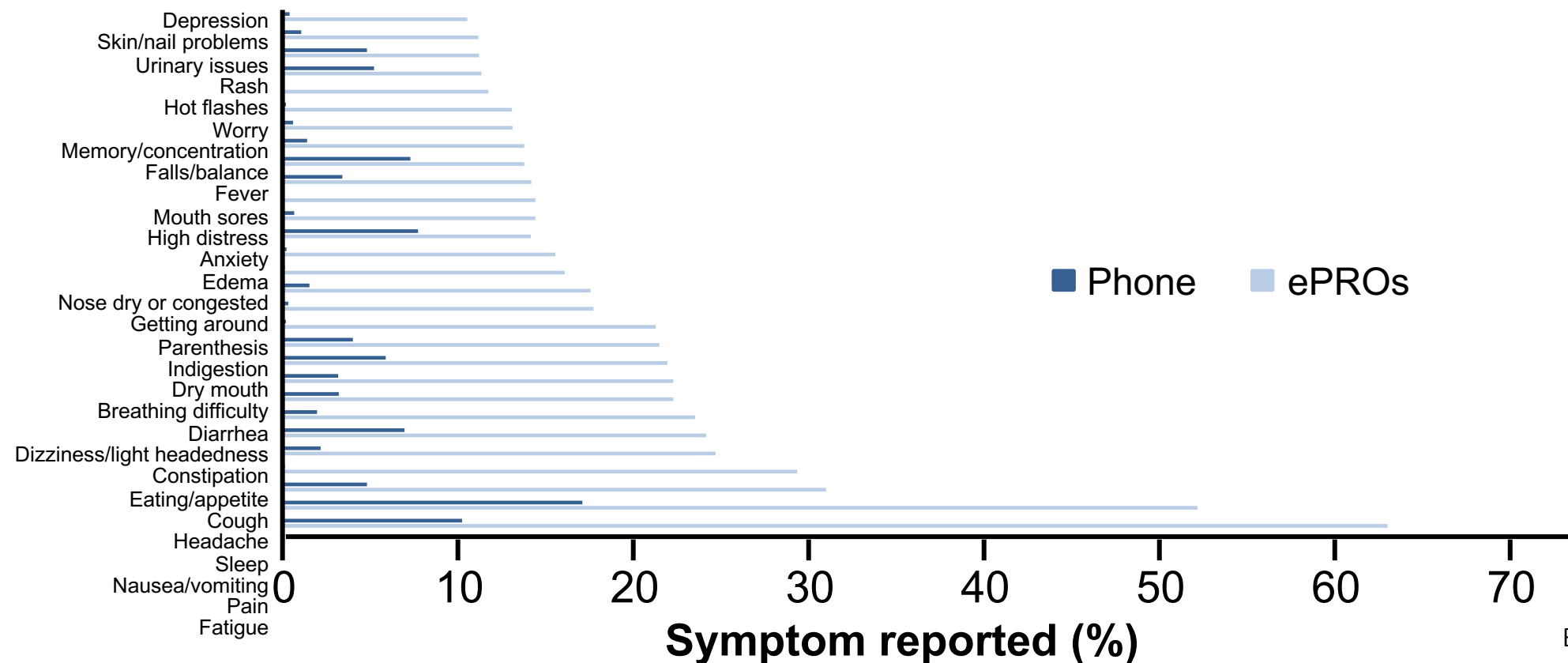
Essell JH, et al. ASH 2024 (Abstract 3756; poster).

Evaluation of an ePRO system in patients with lymphoid malignancies^a across 6 community practices^b

This approach can enable faster clinical action and potentially improve patient outcomes

- Patients reporting via ePRO system **reported symptoms more frequently** vs. phone only
- During the first 90 days of treatment, patients reporting via ePRO system **reported symptoms quicker** vs. phone only (average of 27 days before those reporting by phone [95% CI=24, 31; p<0.001])
- **Initiation of clinical action was quicker** (where necessary) for patients reporting via ePRO system vs. reporting via phone (46 minutes vs. 99 minutes)
- At 90 days following initiation of treatment, **76%** (95% CI=72,79) of patients **reporting via ePRO system** (who enrolled in ePRO system prior to first treatment) **remained on treatment vs. 67%** (95% CI=65, 70) of patients who **reported via phone only**

Symptoms reported in >10% of patients by ePRO or phone



For interoperability to interconnectivity

Current Status

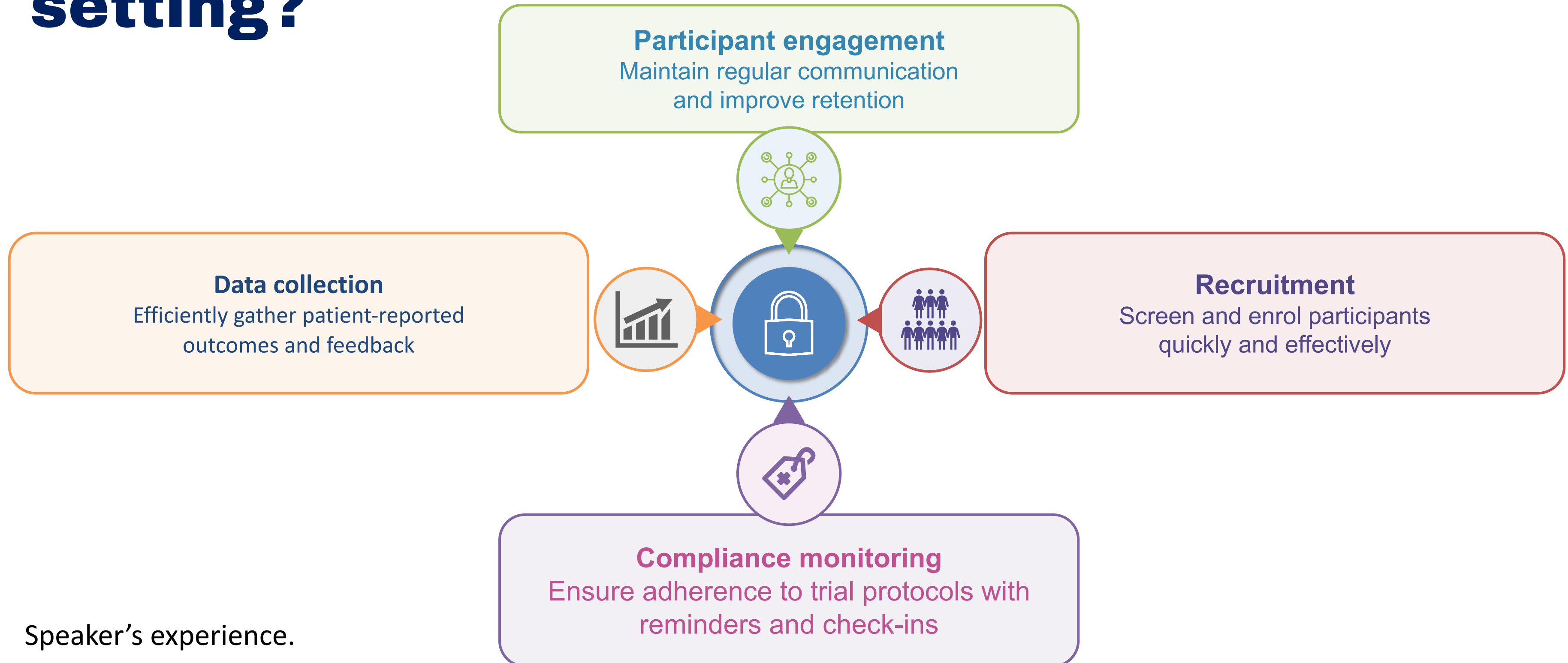
- Home devices collect symptoms, vitals, and PROs
- Data flows into telemonitoring platform
- Threshold-based alerts are generated
- Clinicians manually review notifications

Future: AI-Interconnected Ecosystem

- Continuous longitudinal analysis & contextual interpretation
- Dynamic risk stratification & intelligent alert prioritization
- Automated clinical insight generation
- Protocol-aligned recommendations & personalized communication



Could AI play a role in the clinical trial setting?



Speaker's experience.

Is there a potential role for chatbots in patient selection for clinical trials?

Analysing patient data

- Analyses patient-specific data (medical history, current symptoms, current conditions, etc.) to recommend relevant clinical trials

Real-time information

- Provides real-time information on available clinical trials, including new experimental treatment opportunities

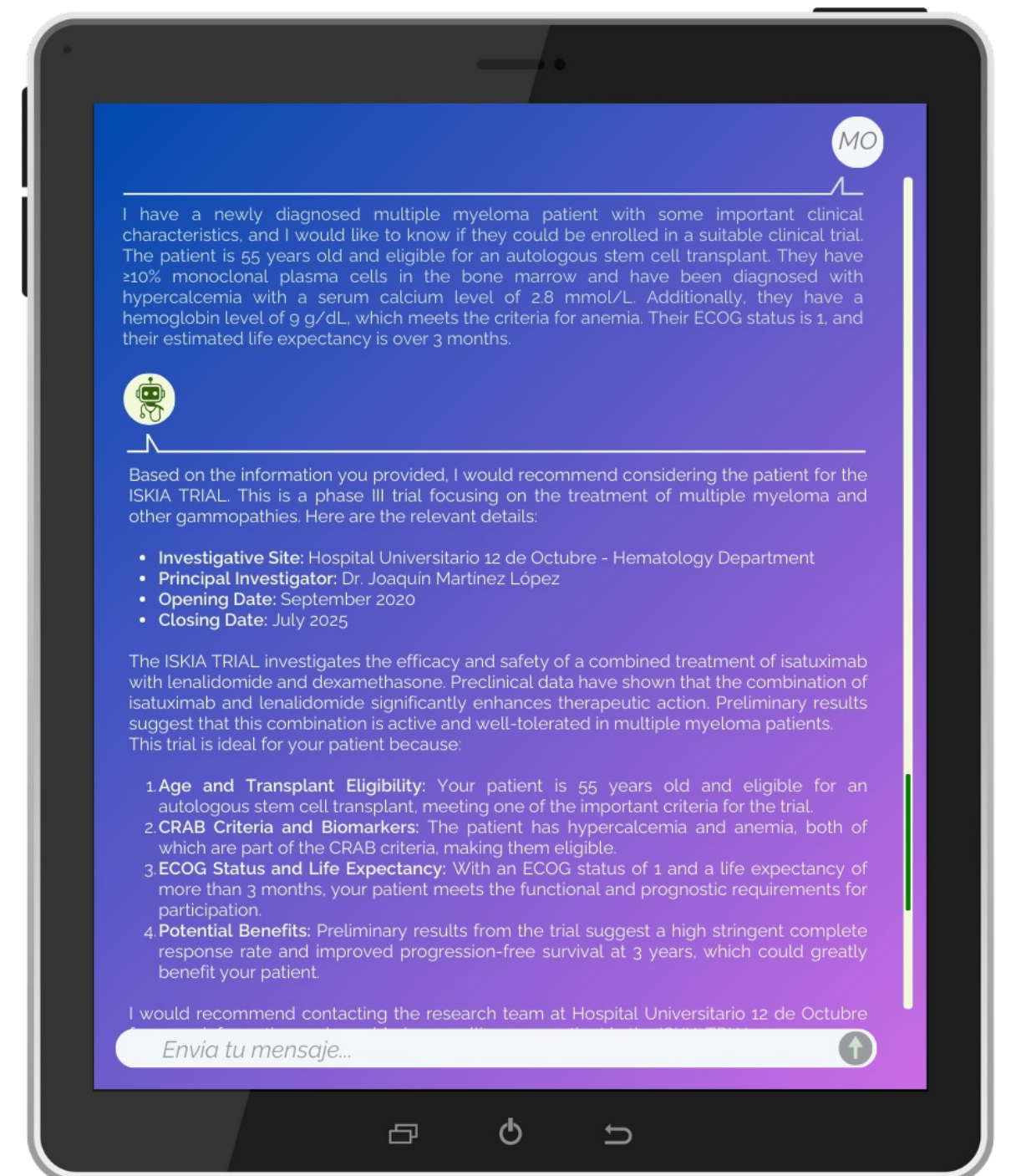
Efficiency

- Reduces the time and effort required to search and evaluate clinical trials manually, speeding up the inclusion process in suitable studies

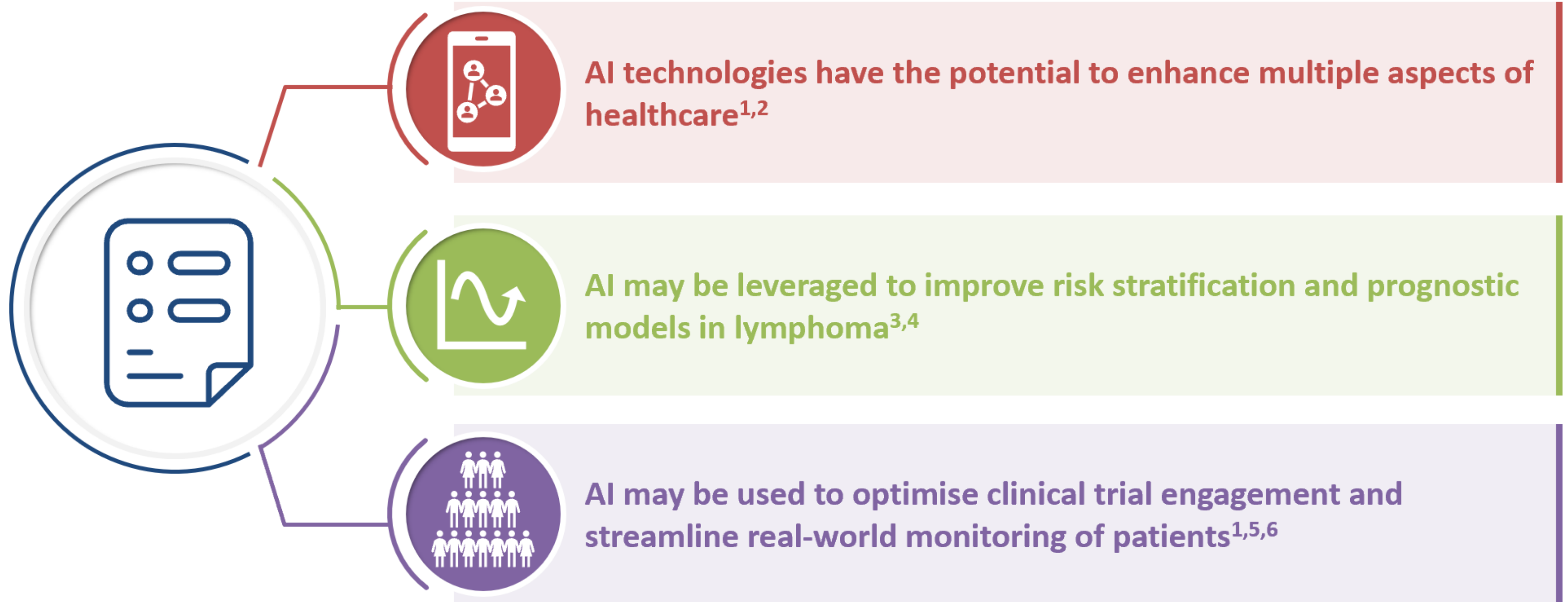
Minimising errors

- Minimises the risk of errors in trial selection by using precise, data-driven algorithms

Speaker's experience.



Summary



1. Using Artificial Intelligence & Machine Learning in the Development of Drug and Biological Products (available at <https://www.fda.gov/media/167973/download?attachment>).

2. Intelligent clinical trials Transforming through AI-enabled engagement (2020; available at https://www2.deloitte.com/content/dam/insights/us/articles/22934_intelligent-clinical-trials/DI_Intelligent-clinical-trials.pdf). 3. Biccler J, et al. Cancer Med 2017; 7:114–122. 4. Wang M, et al. ASH 2024 (Abstract 390; oral).

5. <https://www.xpertdox.com/blog/nlp-in-medical-coding-benefits/> (accessed Mar 2025).

6. Essell JH, et al. ASH 2024 (Abstract 3756; poster).



Thanks!

By Adrián Mosquera



adrianmosquera



@MosqueraOrgeira



team.principal@grheco.com