La investigación
y la protección de la
salud en la era del
Bigdata:
¿Oportunidad o Mito?

3ª MESA: ¿QUÉ UTILIDAD OFRECE EL BIG DATA?

21marzo2017
Ministerio de Sanidad, Servicios Sociales e Igualdad
Salón de Actos Ernest Lluch

Jesús M. Hernández Rivas
Instituto de Investigación Biomédica de Salamanca. Universidad de Salamanca.
Servicio de Hematología. Hospital Universitario de Salamanca.
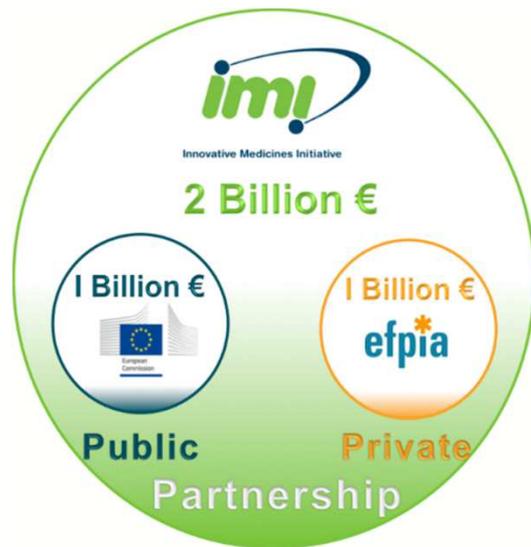**Sanidad de Castilla y León (Sacyl)**
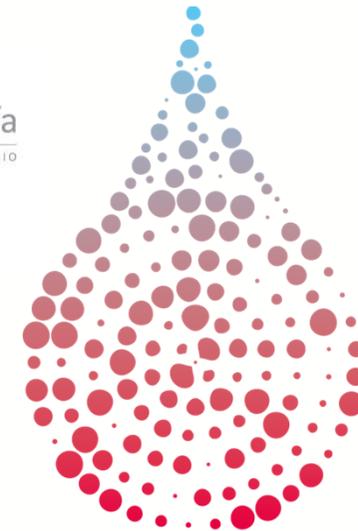
IMI: Largest EU Public Private Partnership for Health R&D

IMI2

- 1:1 funding, joint decision making

- All EU funds go to SMEs, academia, patient organisations

- Pharmaceutical industry matches contribution **in-kind**

- 3.400 M€ in IMI-2

- IMI-2 not limited to pharmaceutical industry (NGS, IT, medical devices, diagnostics)

HARMONY, Ministerio de Sanidad, Big Data, Madrid 21 Marzo 2017

IMI2 Scientific Program: Initial Five Big Themes

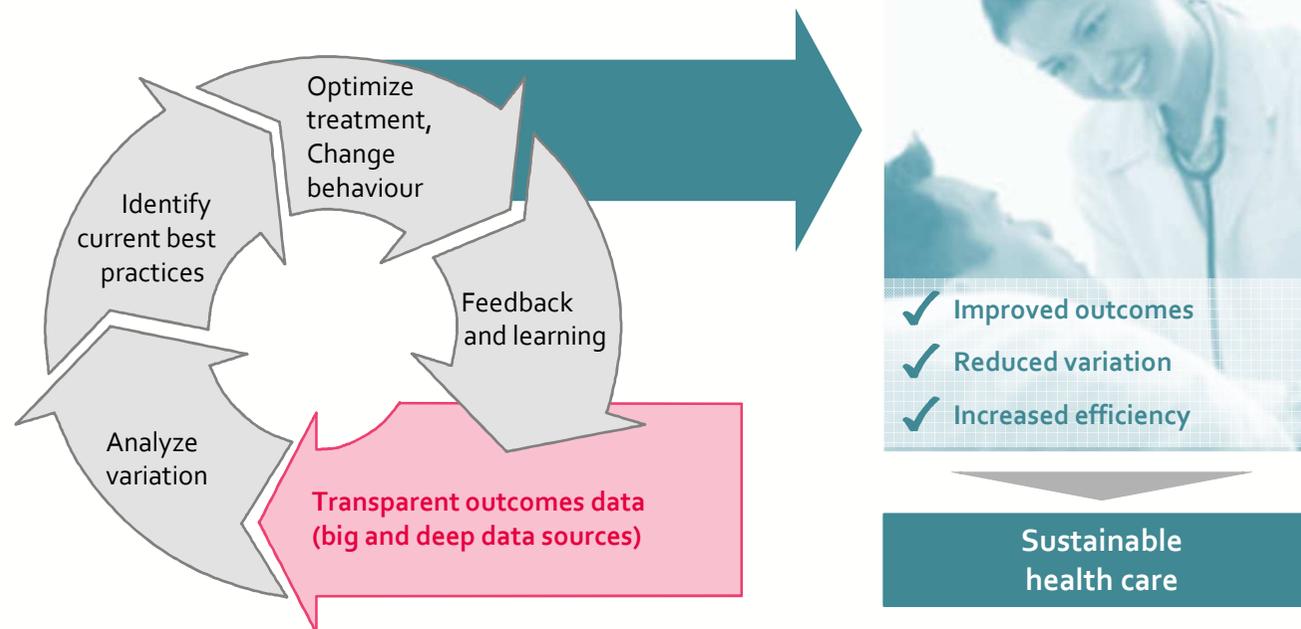| Therapeutic Areas and Cross-cutting Themes	Differentiating Enablers for all themes
1. Neuro-degeneration 2. Prevention and treatment of immune mediated disease 3. Metabolic disorders 4. Infection control 5. Translational Safety	**Towards early and effective patient access to innovative prevention and treatment solutions (MAPPs):** •Target validation based on human biology •Stratified medicine, precision medicine •Innovation in clinical trials •Data generation and interpretation (knowledge management) •Prevention, disease interception, patient adherence (incl. societal acceptance of vaccines) •Effect on medical practice and outcomes (health/disease management) •Regulatory framework (including pharmacovigilance) •Patient access

Within IMI2, big data is a key topic as it holds significant potential to improve outcomes and drive healthcare efficiency

Optimize treatment, Change behaviour

Identify current best practices

Feedback and learning

Analyze variation

Transparent outcomes data (big and deep data sources)

✓ Improved outcomes

✓ Reduced variation

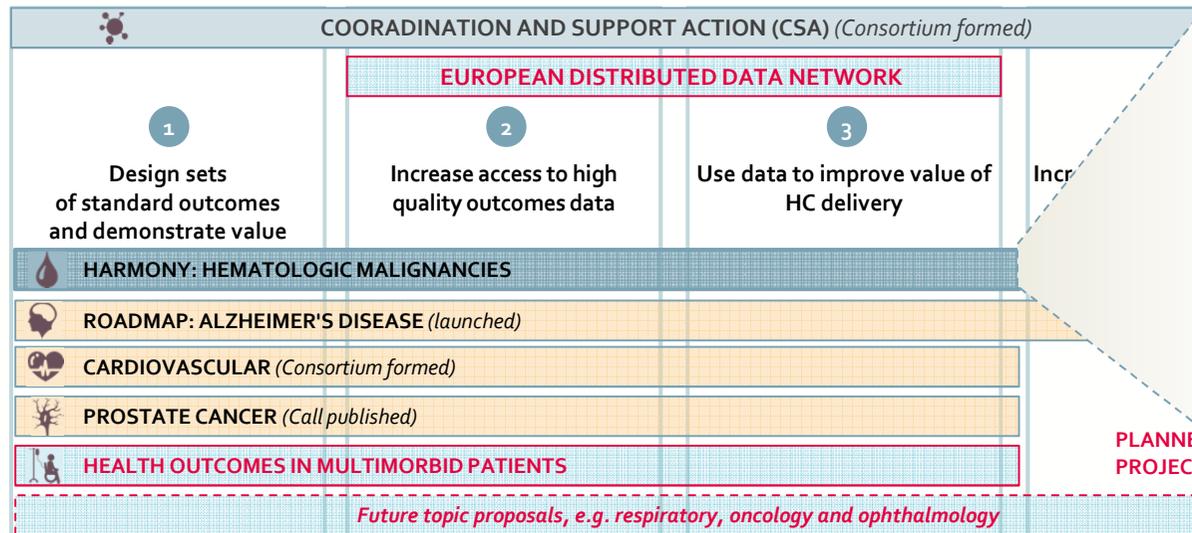✓ Increased efficiency

Sustainable health care

HARMONY is currently the largest program under the IMI "Big Data for Better Outcomes" umbrella

"Big data for better outcomes"

Goal: Support the evolution towards outcomes-focused and sustainable healthcare systems, exploiting the opportunities offered by large data sets from variable sources

COORADINATION AND SUPPORT ACTION (CSA) (Consortium formed)			
	EUROPEAN DISTRIBUTED DATA NETWORK		
1 Design sets of standard outcomes and demonstrate value	**2** Increase access to high quality outcomes data	**3** Use data to improve value of HC delivery	Incr

HARMONY: HEMATOLOGIC MALIGNANCIES

ROADMAP: ALZHEIMER'S DISEASE *(launched)*

CARDIOVASCULAR *(Consortium formed)*

PROSTATE CANCER *(Call published)*

HEALTH OUTCOMES IN MULTIMORBID PATIENTS

Future topic proposals, e.g. respiratory, oncology and ophthalmology

PLANNED PROJECTS

NOVARTIS

Celgene

Bayer

Janssen

AMGEN

Takeda

HARMONY

innovative medicines initiative

efpia

Hematological Malignancies are Leading Causes of Death

Other Causes 22.0%

All Malignant Cancers 19.2%

Pneumonia and Influenza 2.9%

Accidents 5.4%

Chronic Lung Disease 2.3%

Cerebrovascular Diseases 10.3%

Heart Disease 37.8%

1975

Other Causes 36.0%

All Malignant Cancers 22.5%

Pneumonia and Influenza 2.2%

Accidents 5.0%

Chronic Lung Disease 5.7%

Heart Disease 23.5%

Cerebrovascular Diseases 5.0%

2013

Ages Less Than 65

Heart Disease 26% of deaths in 1975

Neoplasms 22% of deaths in 1975

Neoplasms 26% of deaths in 2013

Heart Disease 18% of deaths in 2013

Year of Death

Ages 65 and Over

Rate per 100,000

Heart Disease 44% of deaths in 1975

Heart Disease 26% of deaths in 2013

Neoplasms 18% of deaths in 1975

Neoplasms 21% of deaths in 2013
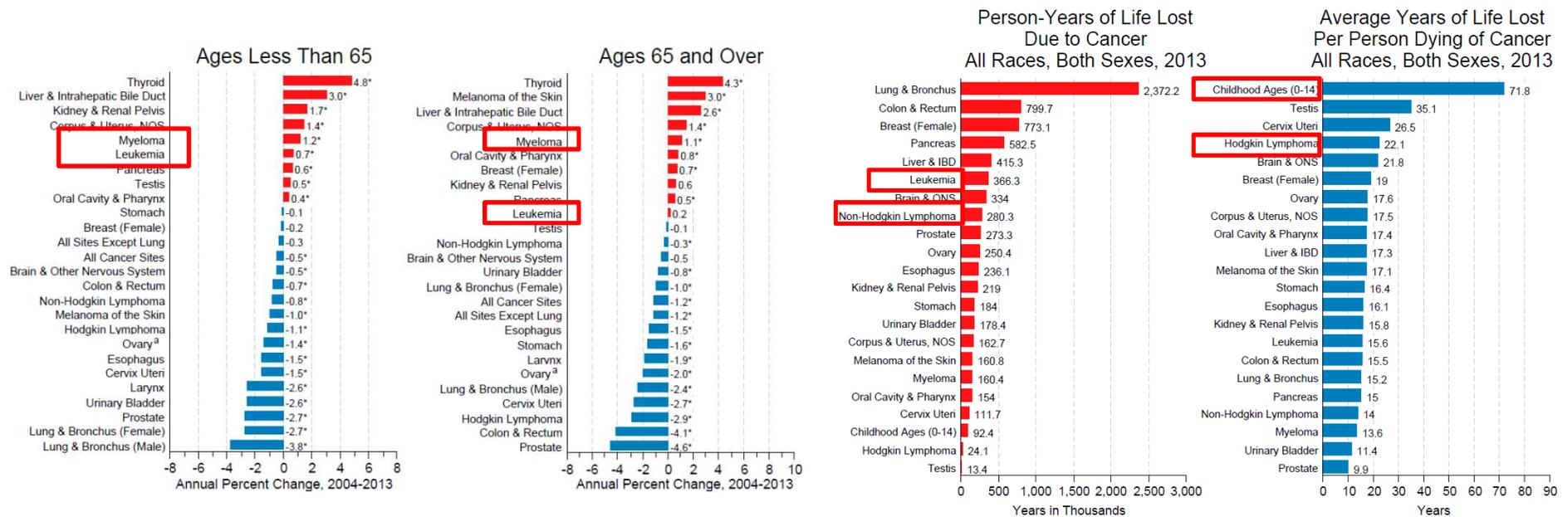
Year of Death

Source: US Mortality Files, National Center for Health Statistics, Centers for Disease Control and Prevention

Trends in SEER incidence rates and Life Lost
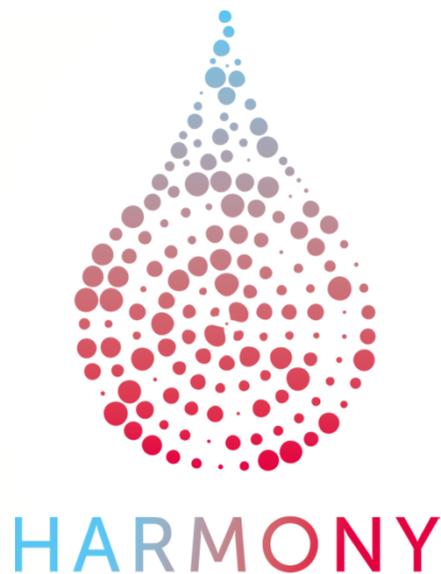

Ages Less Than 65

Site	Annual Percent Change, 2004-2013
Thyroid	4.8*
Liver & Intrahepatic Bile Duct	3.0*
Kidney & Renal Pelvis	1.7*
Corpus & Uterus, NOS	1.4*
Myeloma	1.2*
Leukemia	0.7*
Pancreas	0.6*
Testis	0.5*
Oral Cavity & Pharynx	0.4*
Stomach	-0.1
Breast (Female)	-0.2
All Sites Except Lung	-0.3
All Cancer Sites	-0.5*
Brain & Other Nervous System	-0.5*
Colon & Rectum	-0.7*
Non-Hodgkin Lymphoma	-0.8*
Melanoma of the Skin	-1.0*
Hodgkin Lymphoma	-1.1*
Ovary[a]	-1.4*
Esophagus	-1.5*
Cervix Uteri	-1.5*
Larynx	-2.6*
Urinary Bladder	-2.6*
Prostate	-2.7*
Lung & Bronchus (Female)	-2.7*
Lung & Bronchus (Male)	-3.8*

Ages 65 and Over

Site	Annual Percent Change, 2004-2013
Thyroid	4.3*
Melanoma of the Skin	3.0*
Liver & Intrahepatic Bile Duct	2.6*
Corpus & Uterus, NOS	1.4*
Myeloma	1.1*
Oral Cavity & Pharynx	0.8*
Breast (Female)	0.7*
Kidney & Renal Pelvis	0.6
Pancreas	0.5*
Leukemia	0.2
Testis	-0.1
Non-Hodgkin Lymphoma	-0.3*
Brain & Other Nervous System	-0.5
Urinary Bladder	-0.8*
Lung & Bronchus (Female)	-1.0*
All Cancer Sites	-1.2*
All Sites Except Lung	-1.2*
Esophagus	-1.5*
Stomach	-1.6*
Larynx	-1.9*
Ovary[a]	-2.0*
Lung & Bronchus (Male)	-2.4*
Cervix Uteri	-2.7*
Hodgkin Lymphoma	-2.9*
Colon & Rectum	-4.1*
Prostate	-4.6*

Person-Years of Life Lost Due to Cancer — All Races, Both Sexes, 2013

Site	Years in Thousands
Lung & Bronchus	2,372.2
Colon & Rectum	799.7
Breast (Female)	773.1
Pancreas	582.5
Liver & IBD	415.3
Leukemia	366.3
Brain & ONS	334
Non-Hodgkin Lymphoma	280.3
Prostate	273.3
Ovary	250.4
Esophagus	236.1
Kidney & Renal Pelvis	219
Stomach	184
Urinary Bladder	178.4
Corpus & Uterus, NOS	162.7
Melanoma of the Skin	160.8
Myeloma	160.4
Oral Cavity & Pharynx	154
Cervix Uteri	111.7
Childhood Ages (0-14)	92.4
Hodgkin Lymphoma	24.1
Testis	13.4

Average Years of Life Lost Per Person Dying of Cancer — All Races, Both Sexes, 2013

Site	Years
Childhood Ages (0-14)	71.8
Testis	35.1
Cervix Uteri	26.5
Hodgkin Lymphoma	22.1
Brain & ONS	21.8
Breast (Female)	19
Ovary	17.6
Corpus & Uterus, NOS	17.5
Oral Cavity & Pharynx	17.4
Liver & IBD	17.3
Melanoma of the Skin	17.1
Stomach	16.4
Esophagus	16.1
Kidney & Renal Pelvis	15.8
Leukemia	15.6
Colon & Rectum	15.5
Lung & Bronchus	15.2
Pancreas	15
Non-Hodgkin Lymphoma	14
Myeloma	13.6
Urinary Bladder	11.4
Prostate	9.9

Source: US Mortality Files, National Center for Health Statistics, Centers for Disease Control and Prevention

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HARMONY aims to meet major unmet needs in HMs

Increasing omics data available,
but limited **application** in clinical practice

Need for harmonization of outcome measures and endpoint definitions for HMs at European level

Need for speeding up drug development, access pathways and "bench-to-bedside" process

HARMONY

Healthcare **A**lliance for **R**esourceful **M**edicines **O**ffensive against **N**eoplasms in Hematolog**Y**

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efpia*

HARMONY, Ministerio de Sanidad, Big Data, Madrid 21 Marzo 2017

HARMONY: public-private partnership

51 partners, including 44 public partners, from 11 different European countries
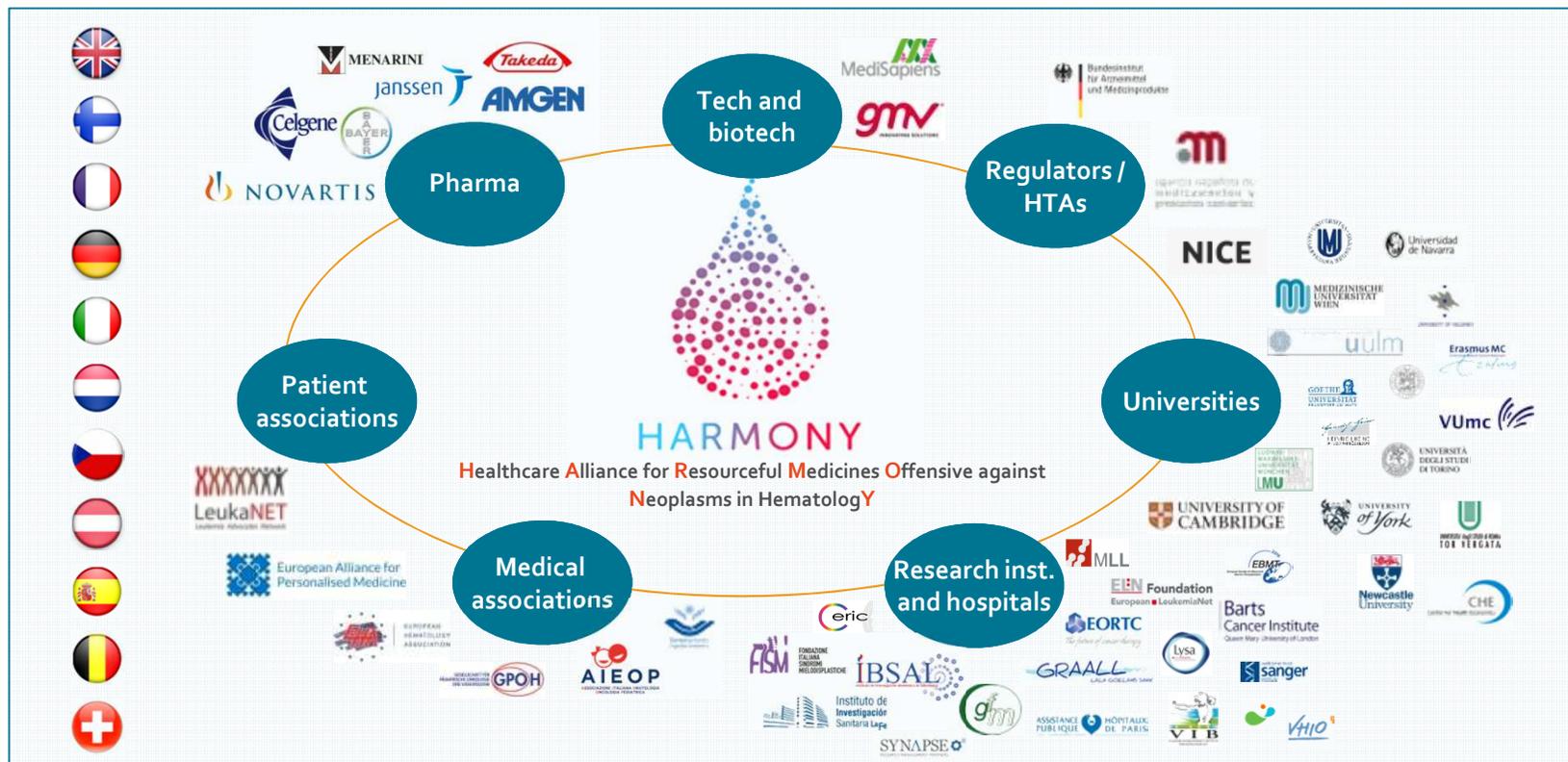
The patient is at the center of HARMONY:
## Collaboration of all stakeholders needed to meet patients' needs
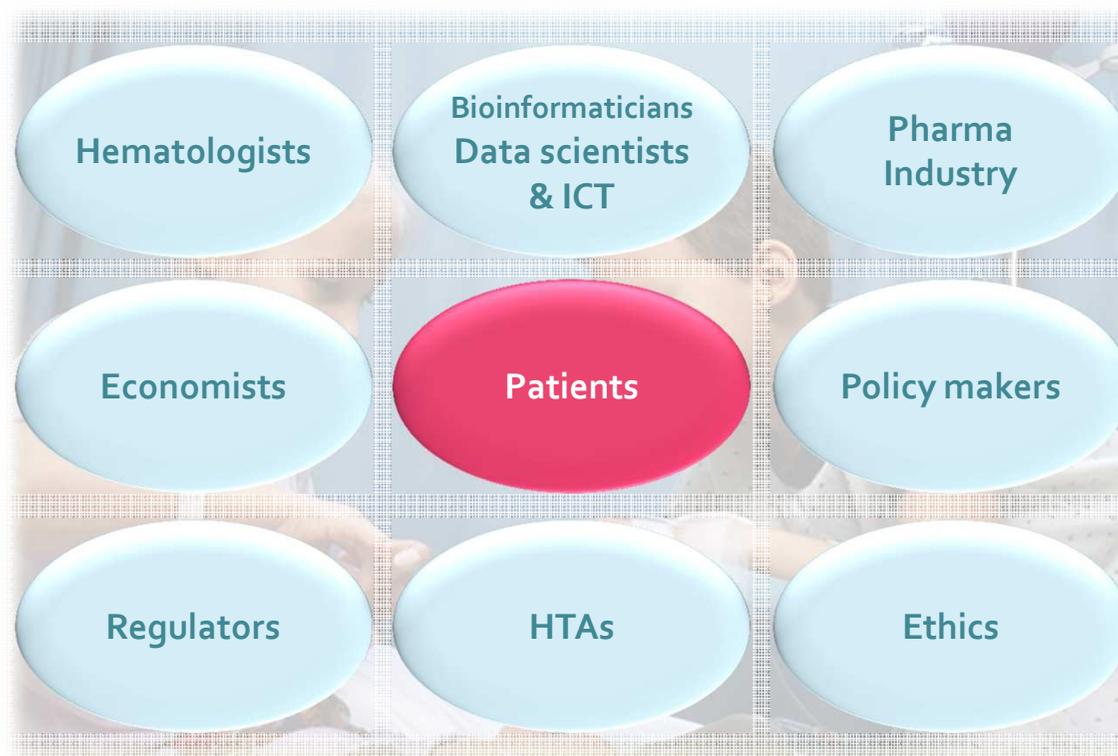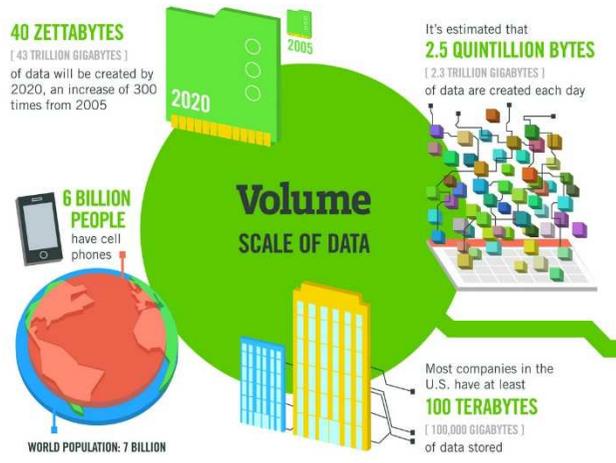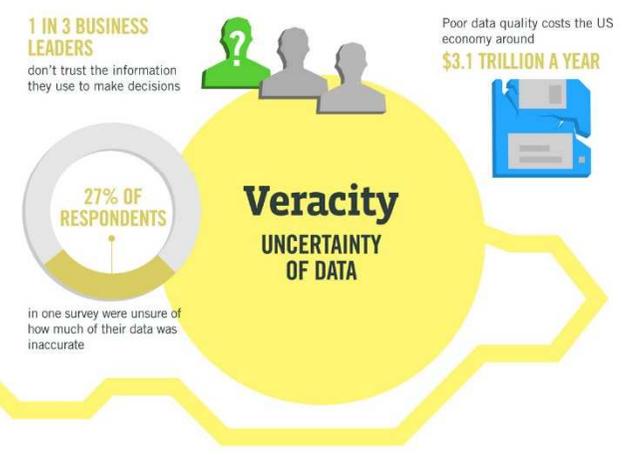
The FOUR V's of Big Data

From traffic patterns and music downloads to web history and medical records, data is recorded, stored, and analyzed to enable the technology and services that the world relies on every day. But what exactly is big data, and how can these massive amounts of data be used?

As a leader in the sector, IBM data scientists break big data into four dimensions: **Volume, Velocity, Variety and Veracity**
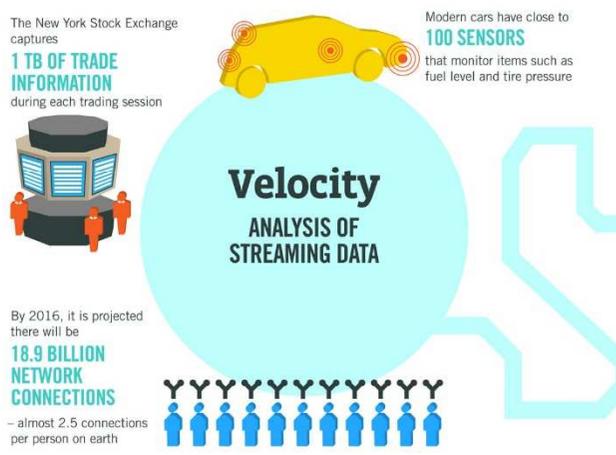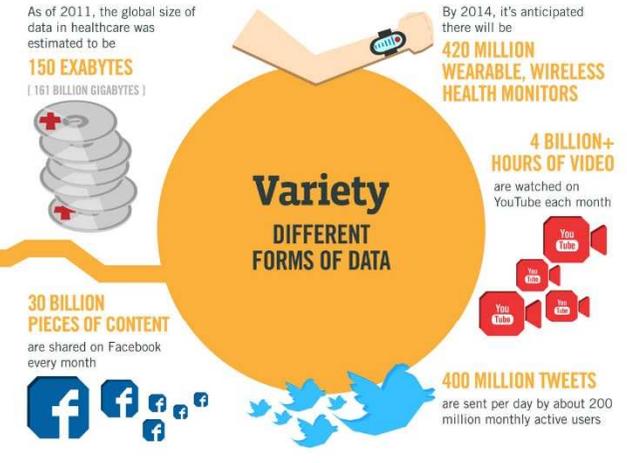
Depending on the industry and organization, big data encompasses information from multiple internal and external sources such as transactions, social media, enterprise content, sensors and mobile devices. Companies can leverage data to adapt their products and services to better meet customer needs, optimize operations and infrastructure, and find new sources of revenue.

By 2015
4.4 MILLION IT JOBS
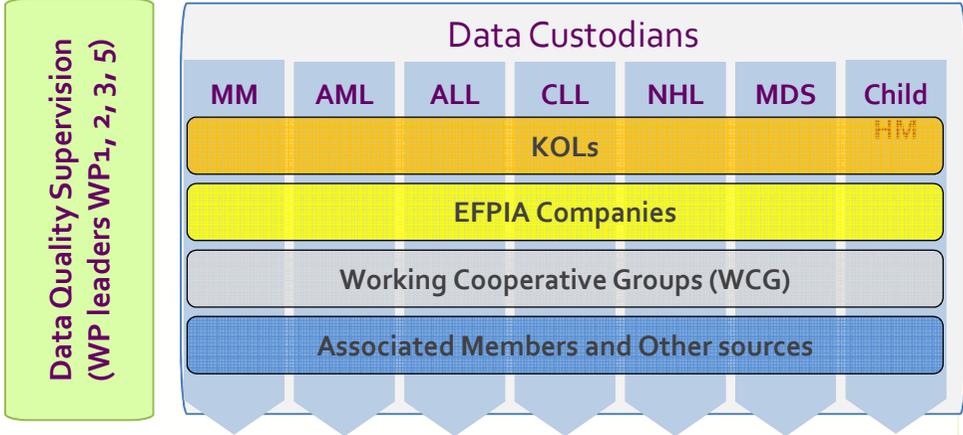will be created globally to support big data, with 1.9 million in the United States

Volume
SCALE OF DATA

40 ZETTABYTES
[43 TRILLION GIGABYTES]
of data will be created by 2020, an increase of 300 times from 2005

6 BILLION PEOPLE
have cell phones

WORLD POPULATION: 7 BILLION

It's estimated that
2.5 QUINTILLION BYTES
[2.3 TRILLION GIGABYTES]
of data are created each day

Most companies in the U.S. have at least
100 TERABYTES
[100,000 GIGABYTES]
of data stored

Velocity
ANALYSIS OF STREAMING DATA

The New York Stock Exchange captures
1 TB OF TRADE INFORMATION
during each trading session

Modern cars have close to
100 SENSORS
that monitor items such as fuel level and tire pressure

By 2016, it is projected there will be
18.9 BILLION NETWORK CONNECTIONS
– almost 2.5 connections per person on earth

Variety
DIFFERENT FORMS OF DATA

As of 2011, the global size of data in healthcare was estimated to be
150 EXABYTES
[161 BILLION GIGABYTES]

30 BILLION PIECES OF CONTENT
are shared on Facebook every month

By 2014, it's anticipated there will be
420 MILLION WEARABLE, WIRELESS HEALTH MONITORS

4 BILLION+ HOURS OF VIDEO
are watched on YouTube each month

400 MILLION TWEETS
are sent per day by about 200 million monthly active users

Veracity
UNCERTAINTY OF DATA

1 IN 3 BUSINESS LEADERS
don't trust the information they use to make decisions

27% OF RESPONDENTS
in one survey were unsure of how much of their data was inaccurate

Poor data quality costs the US economy around
$3.1 TRILLION A YEAR

Sources: McKinsey Global Institute, Twitter, Cisco, Gartner, EMC, SAS, IBM, MEPTEC, QAS

IBM.

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What makes HARMONY a Big Data project?

1 **Volume: Big Data**

Data Quality Supervision (WP leaders WP1, 2, 3, 5)

Data Custodians

	MM	AML	ALL	CLL	NHL	MDS	Child
KOLs							HM
EFPIA Companies							
Working Cooperative Groups (WCG)							
Associated Members and Other sources							

	MM	AML	ALL	CLL	NHL	MDS	Child
Clinical data	7000	7500	4000	5600	5500	6000	8000
Immunofluorescence	4000	1500	3750	2000	3000		5000
Cytogenetics	5000	4500	3750	4000	1000	4000	4000
"Omics"	2800	2800	1200	1700	1600	1500	3000

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What makes HARMONY a Big Data project?

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MM	**AML**	**ALL**	**CLL**	**NHL**	**MDS**	**Child** HM
KOLs						
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Associated Members and Other sources						

	MM	AML	ALL	CLL	NHL	MDS	Child
Clinical data	7000	7500	4000	5600	5500	6000	8000
Immunofluorescence	4000	1500	3750	2000	3000		5000
Cytogenetics	5000	4500	3750	4000	1000	4000	4000
"Omics"	2800	2800	1200	1700	1600	1500	3000

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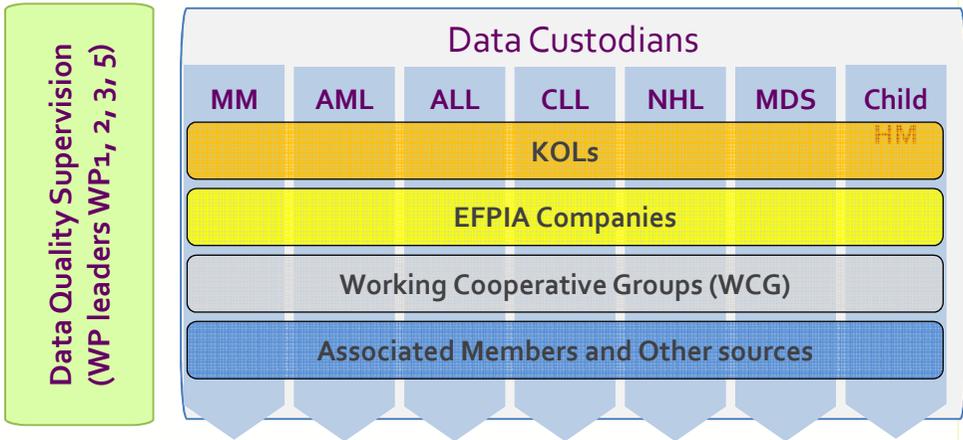
What makes HARMONY a Big Data project?

1 Volume: Big Data

2 Variety: Associated members
& variable budget

20 countries, 65+ members, 6.4 M€ budget

La investigación
y la protección de la
salud en la era del
Bigdata:
¿Oportunidad o Mito?

What makes HARMONY a Big Data project?

1 Volume: Big Data

2 Variety: Associated members

3 **Velocity: Streaming & High-Quality of Data**

REAL TIME STREAM BIG DATA PROCES

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What makes HARMONY a Big Data project?

1 Volume: Big Data

2 Variety: Associated members

3 Velocity: Streaming

4 Veracity: Stakeholders (patients, regulators, HTA, policy makers)

Dedicated WP6 to HTA, EMA, patients alignment & optimisation

- Constitution of a **Policy Health Stakeholder Feedback Forum** (PHSFF)

- Development of a **Clinical Value Framework**

- Development of set of **outcomes relevant for decision-makers**

- **Health literacy**: communication strategy for transfer and adoption of project results

- **Patients perspective** incorporated – link with EUPATI

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Bigdata:
¿Oportunidad o Mito?

What makes HARMONY a Big Data project?

1 **Big Data: volume**

2 **Variety: Associated members**
& variable budget

3 **Velocity: Streaming &**
High-Quality of Data

4 **Veracity: Stakeholders** (patients,
regulators, HTA, policy makers)

Value

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HARMONY, Ministerio de Sanidad, Big Data, Madrid 21 Marzo 2017

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¿Oportunidad o Mito?

HARMONY: Value

- **facilitate drug development pipelines, accelerate the "bench-to-bedside"** process in drug development by identifying appropriate targets/disease cohorts

- provide the **evidence base for large co-operative studies** to identify the most appropriate patient cohorts for future trial designs

- create a **holistic and timely approach for innovative clinical practice** by involving all **stakeholders** across the spectrum, from basic researchers to policy makers, in each stage of the project

- **facilitate reimbursement decisions**, by providing solid data and tools obtained across EU member states

- enable **broader and improved collaboration between the diagnostic test developers**, who are focusing on efforts for targeting early drug development, and the pharmaceutical companies

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medicines
initiative

efpia

HARMONY Kick Off, Salamanca, January 16TH-17th 2017

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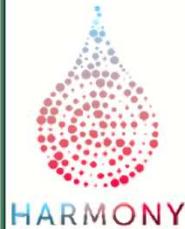
150 Participants

18 Countries

>45 Partners

**>40** Associated Members & Observers

Participation of key stakeholders

NICE — agencia española medicamentos productos sanitarios — Federal Institute for Drugs and Medical Devices

ELN Foundation European LeukemiaNet — LeukaNET Leukemia Advocates Network

+ leading European KOLs highly engaged, with defined projects & seeking collaboration with Pharma

Press coverage internationally and in Spain
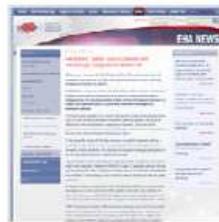
PR Newswire   EHA   🇪🇸 LA VANGUARDIA

Interviews with leadership

"Combining data available from clinical trials as well as real world patients allows us to do more advanced analyses on possible treatment options that could be effective for individual patient or categories of patients"
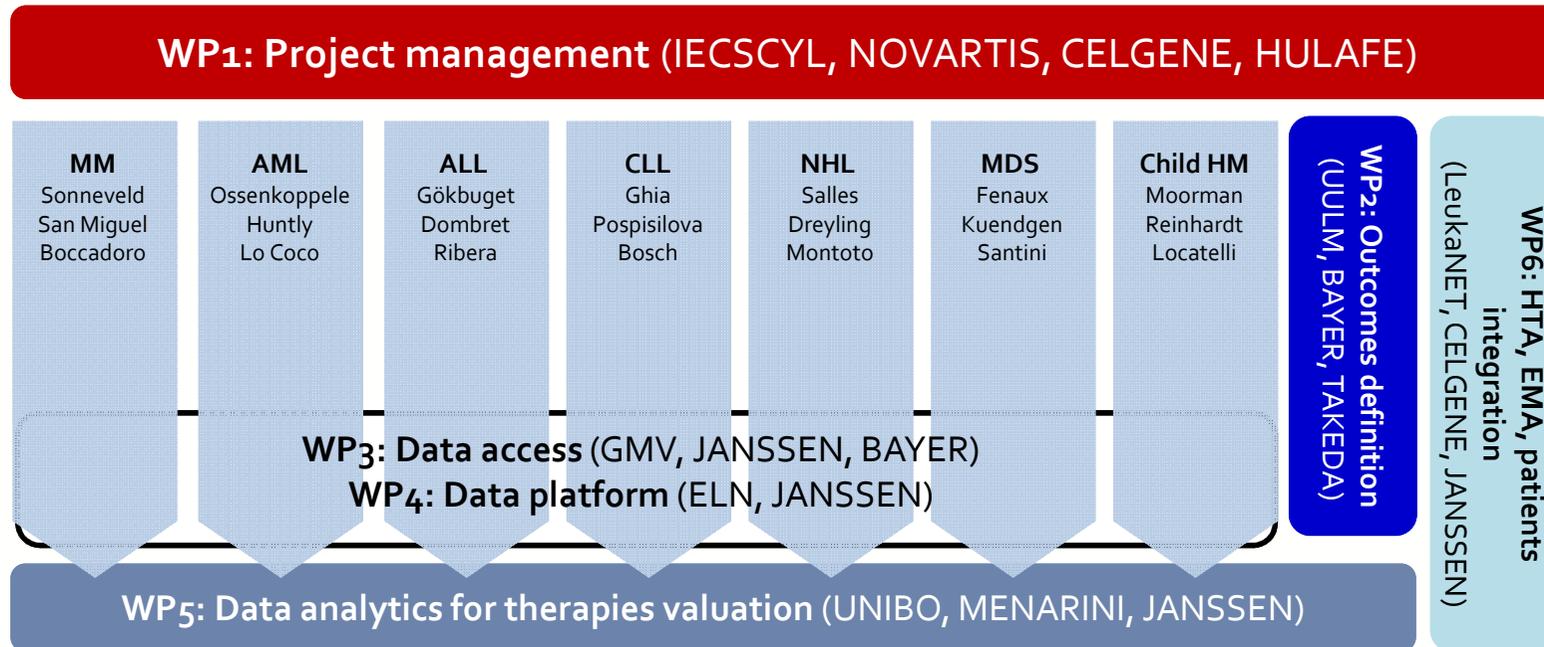
Jesús M. Hernández Rivas (Project Coordinator)

"Big Data doesn't mean collecting only large quantities. The quality of the data is much more important. Therefore HARMONY is open to associate partners that can provide high quality data"

Guillermo Sanz (Project Co-Coordinator)

HARMONY — imi innovative medicines initiative — efpia

HARMONY: 8 Work Packages across 7 diseases

WP1: Project management (IECSCYL, NOVARTIS, CELGENE, HULAFE)

| **MM**
Sonneveld
San Miguel
Boccadoro | **AML**
Ossenkoppele
Huntly
Lo Coco | **ALL**
Gökbuget
Dombret
Ribera | **CLL**
Ghia
Pospisilova
Bosch | **NHL**
Salles
Dreyling
Montoto | **MDS**
Fenaux
Kuendgen
Santini | **Child HM**
Moorman
Reinhardt
Locatelli |

WP2: Outcomes definition (UULM, BAYER, TAKEDA)

WP6: HTA, EMA, patients integration (LeukaNET, CELGENE, JANSSEN)

WP3: Data access (GMV, JANSSEN, BAYER)
WP4: Data platform (ELN, JANSSEN)

WP5: Data analytics for therapies valuation (UNIBO, MENARINI, JANSSEN)

Specific questions by disease Involvement of KOL + Working Groups OMICs + Clinical Data

AML Proof-of-Principle Study

Objectives:

1.   **Identification of additional gene-gene interactions and impact on outcome**

     & validation and further refinement of novel genomic classification

2.   **Evaluate the impact of "intensive therapy" on "overlap cases", i.e. aggressive MDS cases (RAEB II) that are treated like AML**

3.   Evaluate genomic information with regard on chemotherapy side effects, infectious complications, etc.
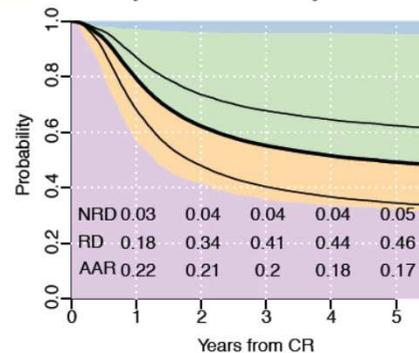
4.   Determine impact on allogeneic transplantation

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AML "Knowledge Database"
WP2 - WP5 interaction

Prototype:

⇒ **Individual risk prediction depending on different treatment options**
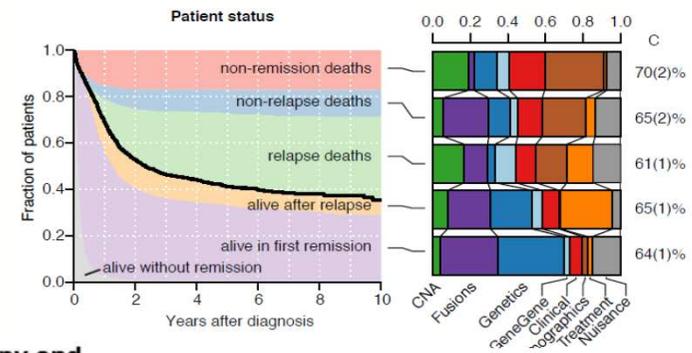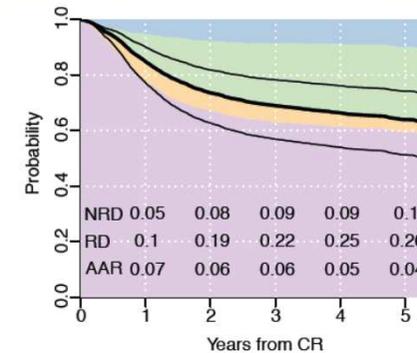
49yr old
male
NK
NPM1,
DNMT3A,
IDH1

Gerstung/Papaemmanuil et al. Nat Genet 2017

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y la protección de la
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Projects in HARMONY

Prognostic factors of treatment with **hypomethylating agents (HMAs) in high-risk MDS**

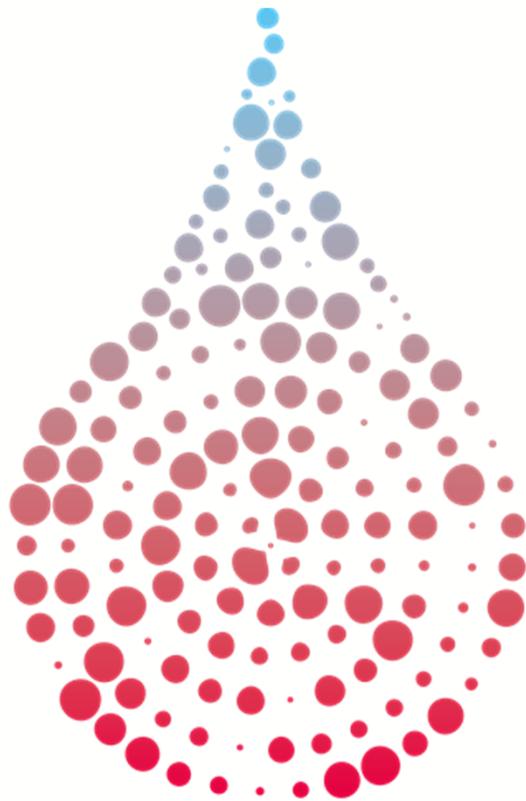**CLL** Create novel prognostic/predictive scheme for **improved risk stratification** aimed at **personalized medicine**

Pediatrics What is the most efficient way to **integrate risk factors to improve patient risk stratification?**

MM **Curable** Multiple Myeloma

NHL **T-Cell NHL**

HARMONY Summary

i. **First IMI Project in Hematological Malignancies**

ii. Volume: **A comprehensive** Project integrating **omics data**

iii. Variety: **Associated** members & **Real-Life** data

iv. Velocity: **Streaming** and **high-quality data**

v. Veracity: **Stakeholders involvement:** Payers, HTAs, Regulators and Patients

vi. Value: **accelerate the "bench-to-bedside"** process in drug development

vii. **Open project: Pharmaceutical companies,** Working Cooperative Groups and Hospitals are welcome.

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ngiyabonga
danke 謝謝 teşekkür ederim
спасибо dank je tapadh leat
bedankt hvala mauruuru thank you gracias
dziękuję mochchakkeram
obrigado sagolun sukriya kop khun krap go raibh maith agat
terima kasih grazie arigatō takk dakujem
감사합니다 ευχαριστώ merci мерси

HARMONY

HARMONY, Kick-Off Meeting, Salamanca, Jan, 2017