Sciences Economiques et Sociales de la Santé
& Traitement de l'Information Médicale

sesstim.univ-amu.fr

Anita BURGUN

MD, PhD
School of Medicine René Descartes University (Paris 5)
Georges Pompidou European Hospital (HEGP) - Necker Children's Hospital
Centre de Recherche des Cordeliers (UMR 1138) Equipe 22

Enjeux des entrepôts de données de santé

janvier 2018

Cliquez ici pour voir l'intégralité des ressources associées à ce document

Enjeux des entrepôts de données de santé

Anita Burgun, MD, PhD

School of Medicine René Descartes University (Paris 5)
Georges Pompidou European Hospital (HEGP)
Necker Children's Hospital

Centre de Recherche des Cordeliers (UMR 1138) Equipe 22

Webinar SESSTIM 19 Jan 2018

Plan

- Eléments de contexte
- La recherche sur les EDS
- Les EDS en support/complément de la recherche clinique
- Les EDS en support de la décision clinique

Hôpital Européen Georges Pompidou

Ouverture en **2000**
Hôpital de l'AP-HP

700 lits
Spécialisation en **oncologie**, **maladies cardio-vasculaires** et **polytraumatisés**

Très impliqué dans le numérique:

- Electronic Health Record depuis 2000
- Prescription de médicaments (CPOE)
- Examens de laboratoire (robot)
- EDS i2b2 depuis 2008

HIMMS level 6
(http://www.himss.eu/node/1116)

2013

European EMR Adoption Model

Stage	Cumulative Capabilities
Stage 7	Complete EMR; CCD transactions to share data; Data warehousing feeding outcomes reports, quality assurance, and business intelligence; Data continuity with ED, ambulatory, OP.
Stage 6	Physician documentation interaction with full CDSS (structured templates related to clinical protocols trigger variance & compliance alerts) and Closed loop medication administration.
Stage 5	Full complement of PACS displaces all film-based images.
Stage 4	CPOE in at least one clinical service area and/or for medication (i.e. e-Prescribing); may have Clinical Decision Support based on clinical protocols.
Stage 3	Nursing/clinical documentation (flow sheets); may have Clinical Decision Support for error checking during order entry and/or PACS available outside Radiology.
Stage 2	Clinical Data Repository (CDR) / Electronic Patient Record; may have Controlled Medical Vocabulary, Clinical Decision Support (CDS) for rudimentary conflict checking, Document Imaging and health information exchange (HIE) capability.
Stage 1	Ancillaries – Lab, Radiology, Pharmacy – All Installed OR processing LIS, RIS, PHIS data output online from external service providers.
Stage 0	All Three Ancillaries (LIS, RIS, PHIS) Not Installed OR Not processing Lab, Radiology, Pharmacy data output online from external service providers.

Hôpital Necker et Institut Imagine

adulte AP-HP association cardiologie chirurgie
développement durable hôpital Droit école
éducation thérapeutique enfant Espace Plein
Ciel greffe de rein halte garderie Hôpital
Necker Laboratoires loisir
maladies rares maternité mécénat
Necker Necker-Enfants malades
néphrologie noël Paris pédiatrie Plan d'accès
radiologie rein soin transplantation

« hôpital translationnel »

Institut Imagine
Maladies génétiques
410 personnes
25 laboratoires

La recherche sur les EDS

Tiré de Thomas McMurphy, repris dans la thèse de N. Garcelon

Published in final edited form as:
Clin Pharmacol Ther. 2011 July ; 90(1): 133–142. doi:10.1038/clpt.2011.83.

Detecting Drug Interactions From Adverse-Event Reports: Interaction Between Paroxetine and Pravastatin Increases Blood Glucose Levels

NP Tatonetti[1,2,3], **JC Denny**[4,5], **SN Murphy**[6,7], **GH Fernald**[1,2,3], **G Krishnan**[8], **V Castro**[6], **P Yue**[9], **PS Tsau**[9], **I Kohane**[7,10,11], **DM Roden**[5], and **RB Altman**[2,3]

[1]Biomedical Informatics Training Program, Stanford University, Stanford, California, USA

[2]Department of Bioengineering, Stanford University, Stanford, California, USA

[3]Department of Genetics, Stanford University, Stanford, California, USA

[4]Department of Biomedical Informatics, Vanderbilt University, Nashville, Tennessee, USA

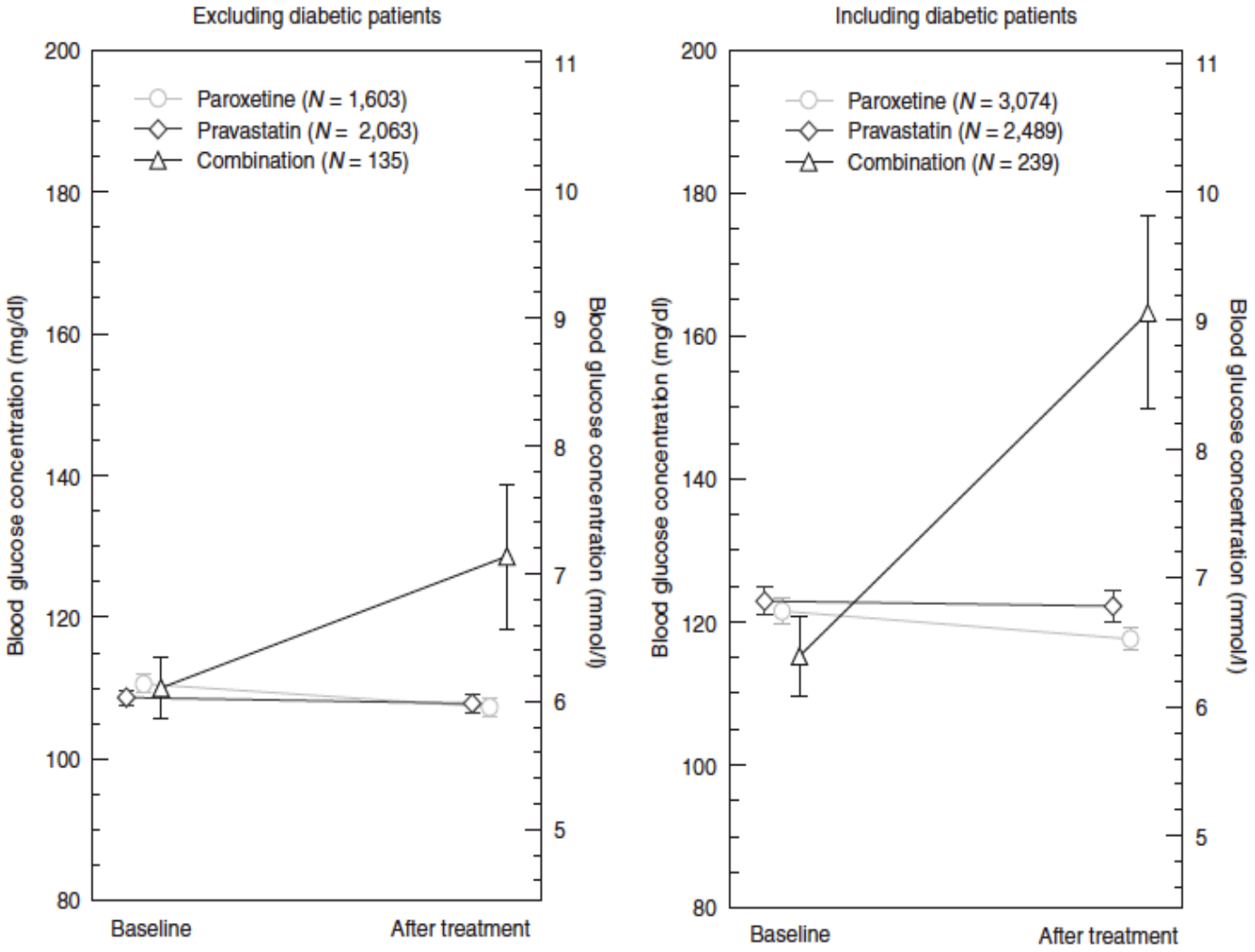
[5]Department of Medicine, Vanderbilt University, Nashville, Tennessee, USA

[6]Laboratory of Computer Science, Massachusetts General Hospital, Boston, Massachusetts, USA

[7]Harvard Medical School, Boston, Massachusetts, USA

[8]Stanford Center for Clinical Informatics, Stanford University, Stanford, California, USA

- Data mining FDA's Adverse Event Reporting System (FAERS) pour les effets adverses sur la glycémie
- Detection d'un signal avec l'association pravastatine et paroxetine.
- Dossiers patients de 3 hôpitaux
- Entrepôt i2b2
- Recherche l'augmentation de la glycémie sous paroxetine + pravastatine



Augmentation de 19 mg/dl (1.0 mmol/l)
Augmentation de 48 mg/dl (2.7 mmol/l) chez les diabétiques
Pas d'effet pour chaque médicament pris isolément
Pas d'effet connu pour les associations SSRI – statine

Contents lists available at ScienceDirect

International Journal of Medical Informatics

journal homepage: www.ijmijournal.com

The Georges Pompidou University Hospital Clinical Data Warehouse: A 8-years follow-up experience

Anne-Sophie Jannot[a,b,c,*], Eric Zapletal[c], Paul Avillach[d], Marie-France Mamzer[a,e], Anita Burgun[a,b,c], Patrice Degoulet[a,b,c]

- 74 projets de recherche approuvés par le Comité d'Ethique (Institutional Review Board) entre Janvier 2011 et Décembre 2015.
- 25 nouveaux projets in 2017
- 54% épidémiologie clinique
- 41% health service research
- 5% support à la recherche clinique
- 2 ANRs (pharmacogénétique, coeliaque), 2 PREPS et 4 projets soumis
- Nouveaux projets collaboratifs en radiothérapie et radiomique
- 1 EU Flag-ERA : ITfoC
- 1 projet AP-HP sur la transition dans les maladies chroniques

- Planche, V., et al. (2014). Etiologies and diagnostic workup of extreme macrocytosis defined by an erythrocyte mean corpuscular volume over 130◦ fL: A study of 109 patients. American journal of hematology, 89(6), 665–666.
- Sahut, D. I..et al. (2012). Risk factors and clinical outcome of unsuspected pulmonary embolism in cancer patients: a case-control study. Journal of thrombosis and haemostasis: JTH, 10(10), 2032–2038.
- Neuraz, A., et al. (2013)**. Phenome-wide association studies on a quantitative trait: application to TPMT** enzyme activity and thiopurine therapy in pharmacogenomics. PLoS Comput Biol, 9(12), e1003405.
- Girardeau, Y., et al. (2015). Detection of Drug–Drug Interactions Inducing Acute Kidney Injury by Electronic Health Records Mining. Drug safety, 38(9), 799–809.
- Pallet, N., et al. (2014). Urinary retinol binding protein is a marker of the extent of interstitial kidney fibrosis. PloS one, 9(1), e84708.
- Pham, A. D., et al. (2014). Natural language processing of radiology reports for the detection of thromboembolic diseases and clinically relevant incidental findings. BMC bioinformatics, 15(1), 1.
- Pettenati, C., et al.. (2016). Prostate Cancer Characteristics and Outcome in Renal Transplant Recipients: Results from a Contemporary Monocentric Study. Clinical transplantation.
- Escudié, J. B., et al. (2015). Reviewing 741 patients records in two hours with FASTVISU. In AMIA Annual Symposium Proceedings (Vol. 2015, p. 553). American Medical Informatics Association.
- Deborde, T., et al. (2016). [OP. 2A. 07] Trends in patients attending a tertiary hypertension unit: patient's characteristics and treatment strategies strongly evolved over the last 15 years. Journal of Hypertension, 34, e17.
- Cheminet, G., et al. (2016). Causes associées aux hypomagnésiémies chez 5000 patients hospitalisés: étude cas-témoins. La Revue de Médecine Interne, 37, A105.
- Faucon, A. L., et al. (2016). Infarctus rénal: analyse rétrospective des causes d'une série de 186 cas sur 15 ans. Néphrologie & Thérapeutique, 12(5), 356.
- Jannot AS, Burgun A, Thervet E, Pallet N. **The Diagnosis-Wide Landscape of Hospital-Acquired AKI**. Clin J Am Soc Nephrol. 2017 May 11. pii: CJN.10981016. doi: 10.2215/CJN.10981016

Deborde et al. **Sex differences in antihypertensive treatment in France among 17 856 patients in a tertiary hypertension unit.** J Hypertens. 2018 Jan 4

- Recommandations nationales et internationales pour le traitement de l'hypertension.
- Centre de référence HTA
- Quelles sont les pratiques?

- 17856 patients à la 1ère consultation
- Les femmes ont plus souvent que les hommes des prescriptions de diurétiques de l'anse ou thiazidiques, des antagonistes du récepteur de l'aldostérone et des bêta-bloquants
- Sans bénéfice sur le contrôle de la tension (après ajustement)

Reviewing Translational Research Platforms

Briefings in Bioinformatics Advance Access published March 7, 2014
BRIEFINGS IN BIOINFORMATICS. page 1 of 11 doi:10.1093/bib/bbu006

Translational research platforms integrating clinical and omics data: a review of publicly available solutions

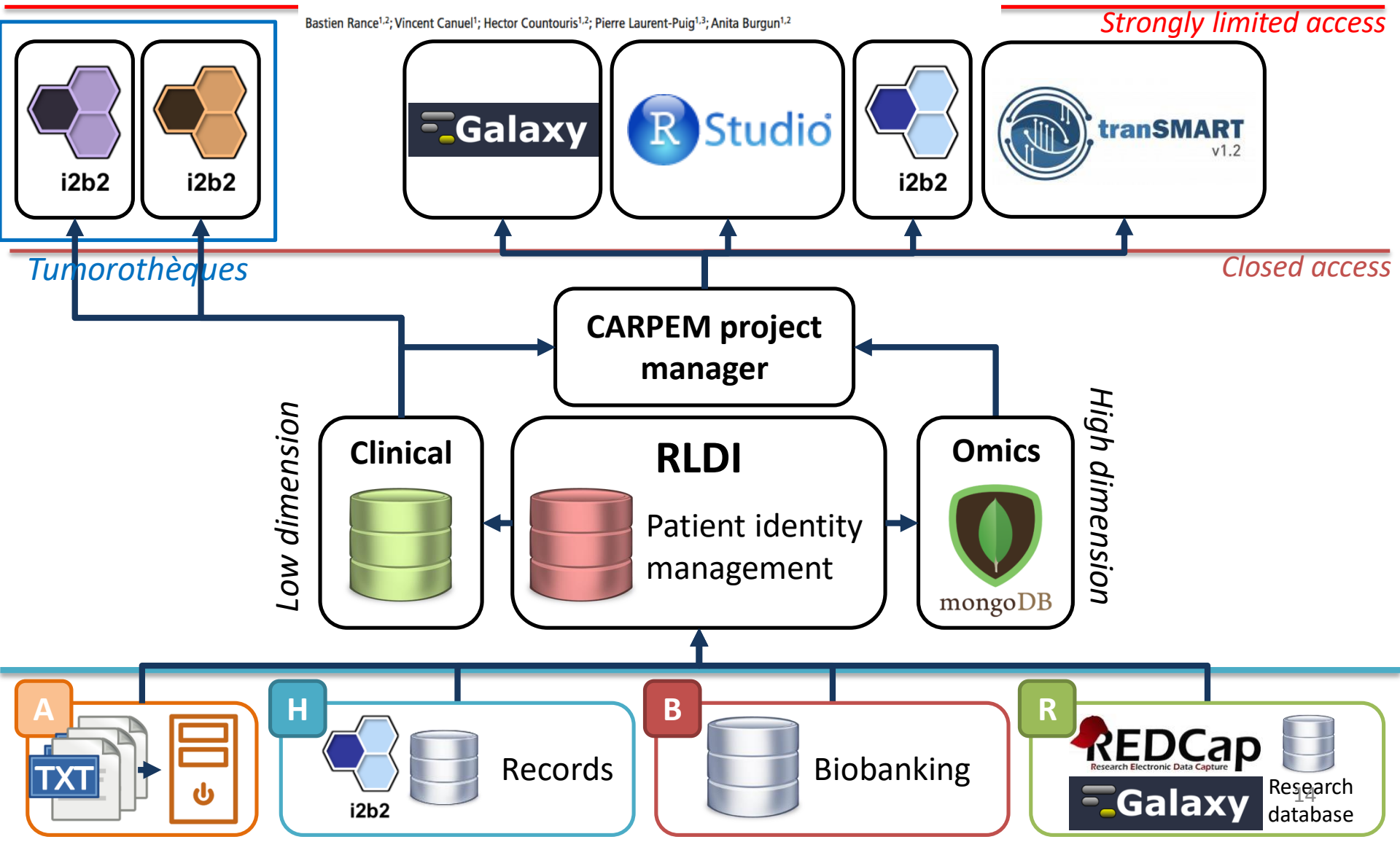
Vincent Canuel, Bastien Rance*, Paul Avillach, Patrice Degoulet and Anita Burgun*

Submitted: 11th November 2013; Received (in revised form): 3rd February 2014

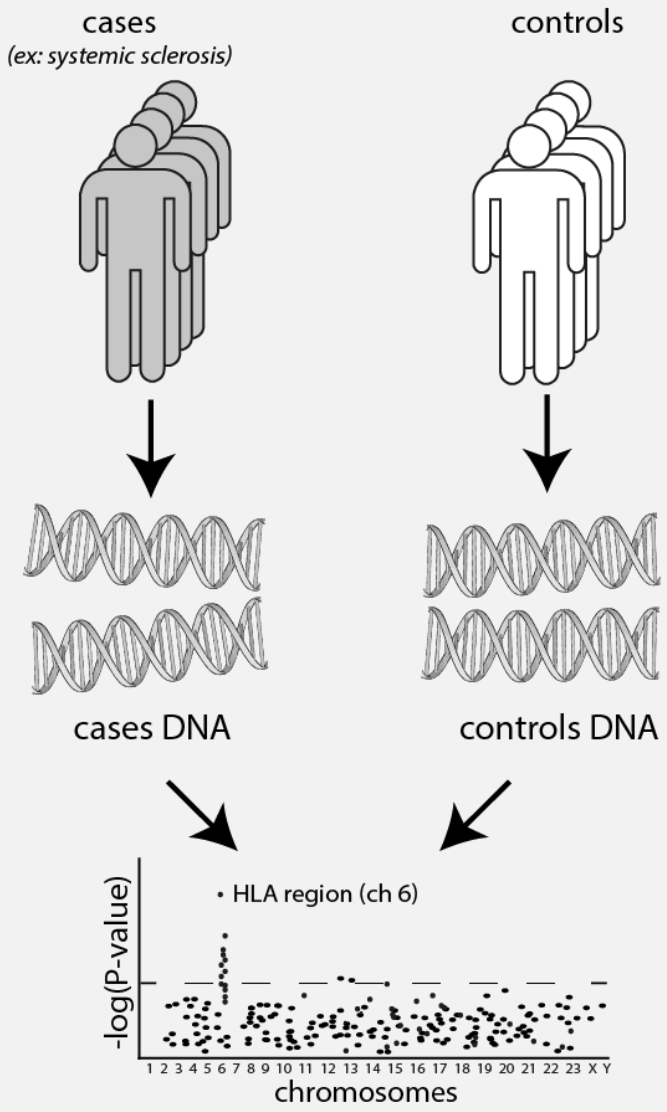
BRISK, caTRIP, cBio Cancer Portal,
G-DOC, iCOD, iDASH, tranSMART

Integrating Heterogeneous Bio-medical Data for Cancer Research: the CARPEM infrastructure

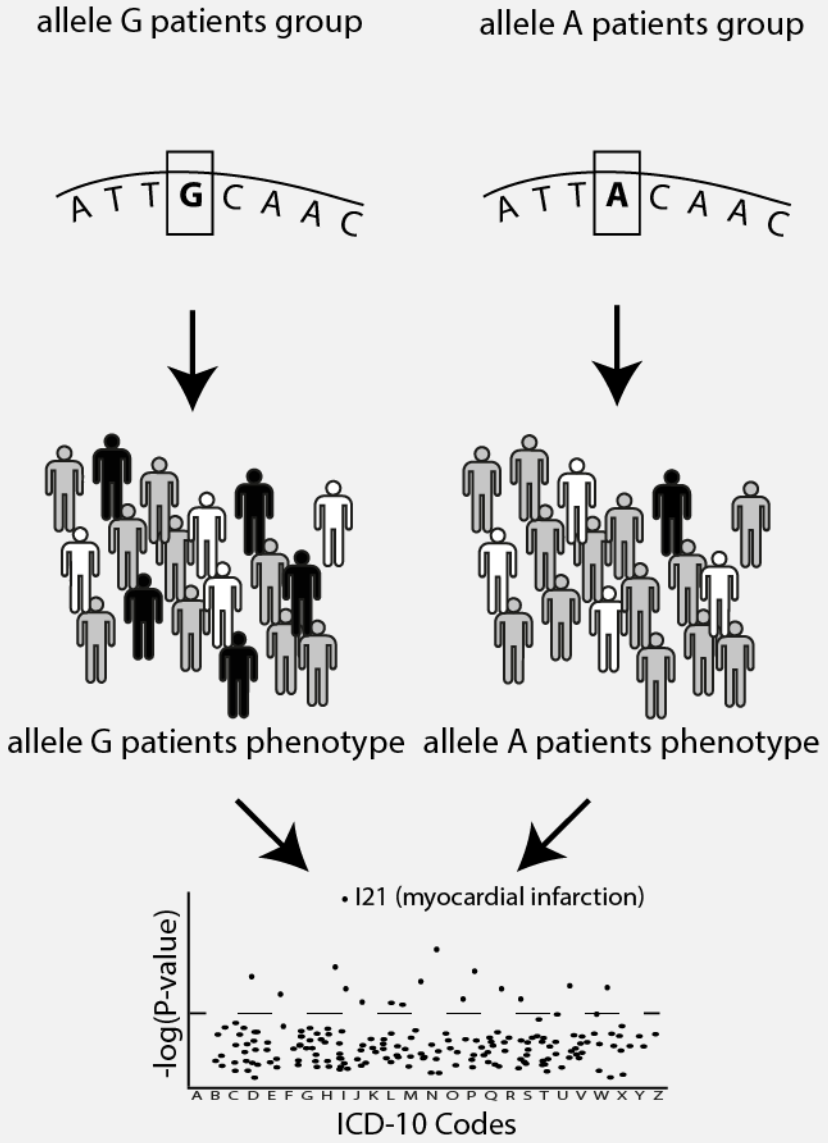
Bastien Rance[1,2]; Vincent Canuel[1]; Hector Countouris[1,2]; Pierre Laurent-Puig[1,3]; Anita Burgun[1,2]



Genome Wide Association Study (GWAS)



Phenome Wide Association Study (PheWAS)

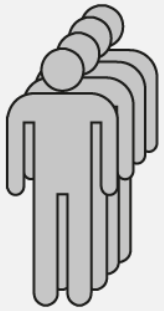


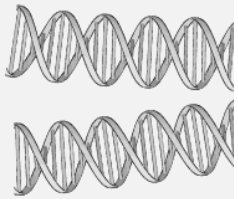
McCarthy et al, Nature Reviews Genetics, 2008 / Denny et al, Bioinformatics 2010

Genome Wide Association Study (GWAS)

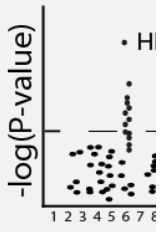
Phenome Wide Association Study (PheWAS)

cases
(ex: systemic sclerosis)

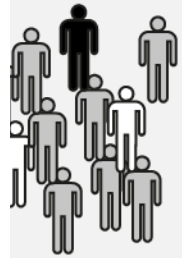




cases DNA



patients group



nts phenotype

ion)

ICD-10 Codes

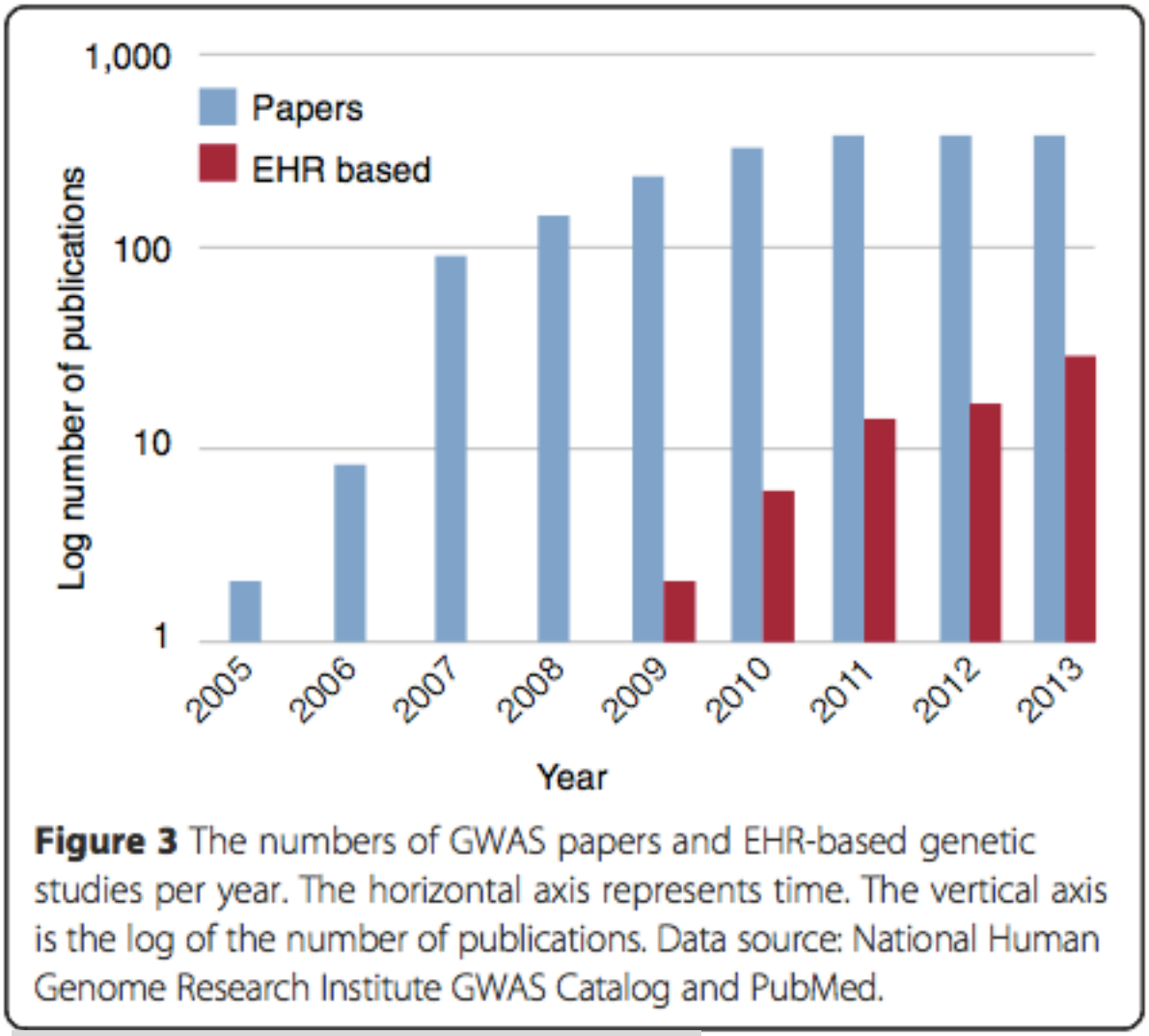


Figure 3 The numbers of GWAS papers and EHR-based genetic studies per year. The horizontal axis represents time. The vertical axis is the log of the number of publications. Data source: National Human Genome Research Institute GWAS Catalog and PubMed.

Wei WQ et al Genome Medicine, 2015

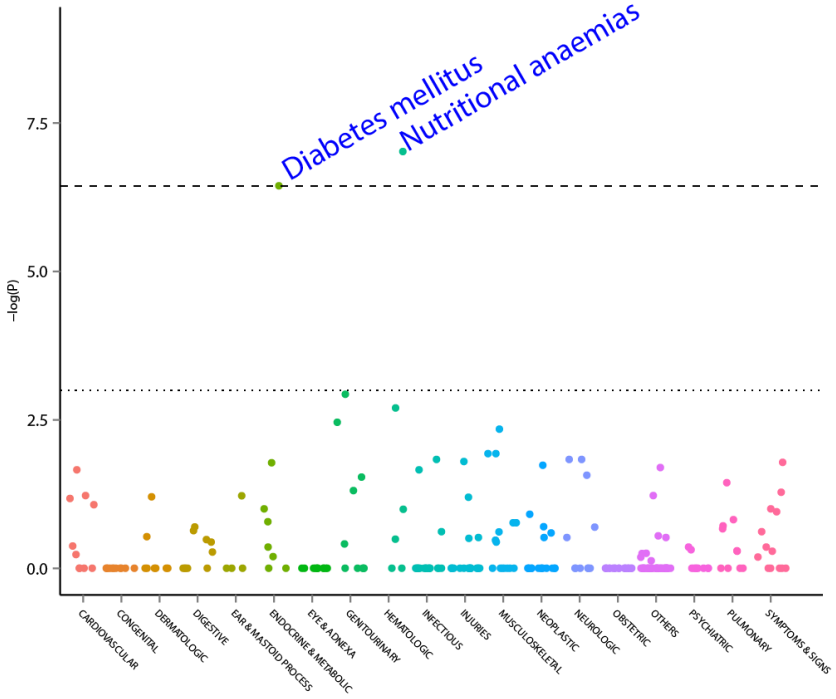
McCarthy et al, Nature Reviews Genetics, 2008 / Denny et al, Bioinformatics 2010

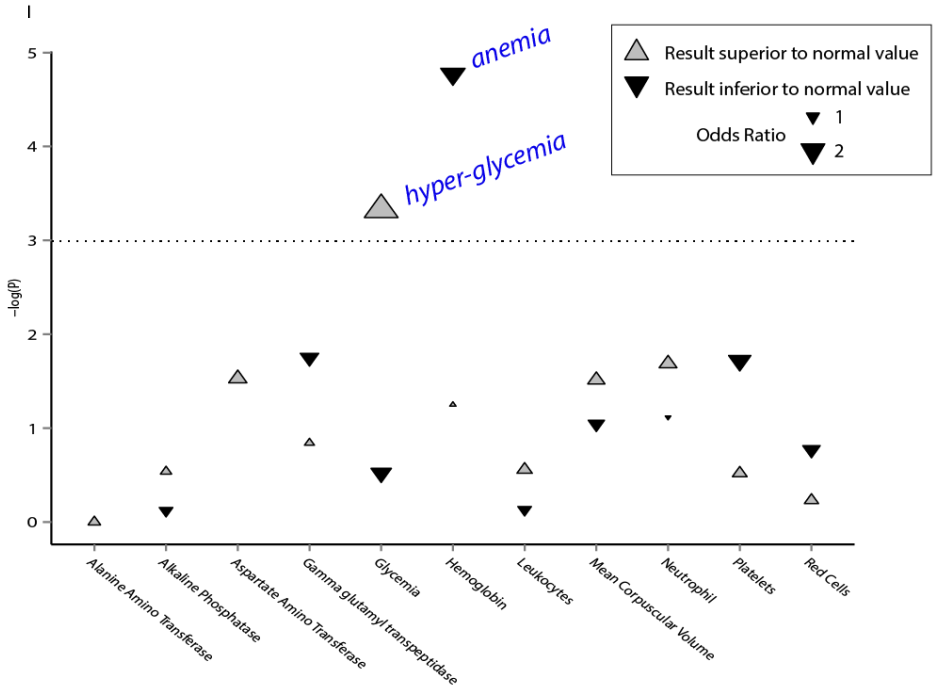
OPEN ACCESS Freely available online

PLOS | COMPUTATIONAL BIOLOGY

Phenome-Wide Association Studies on a Quantitative Trait: Application to TPMT Enzyme Activity and Thiopurine Therapy in Pharmacogenomics

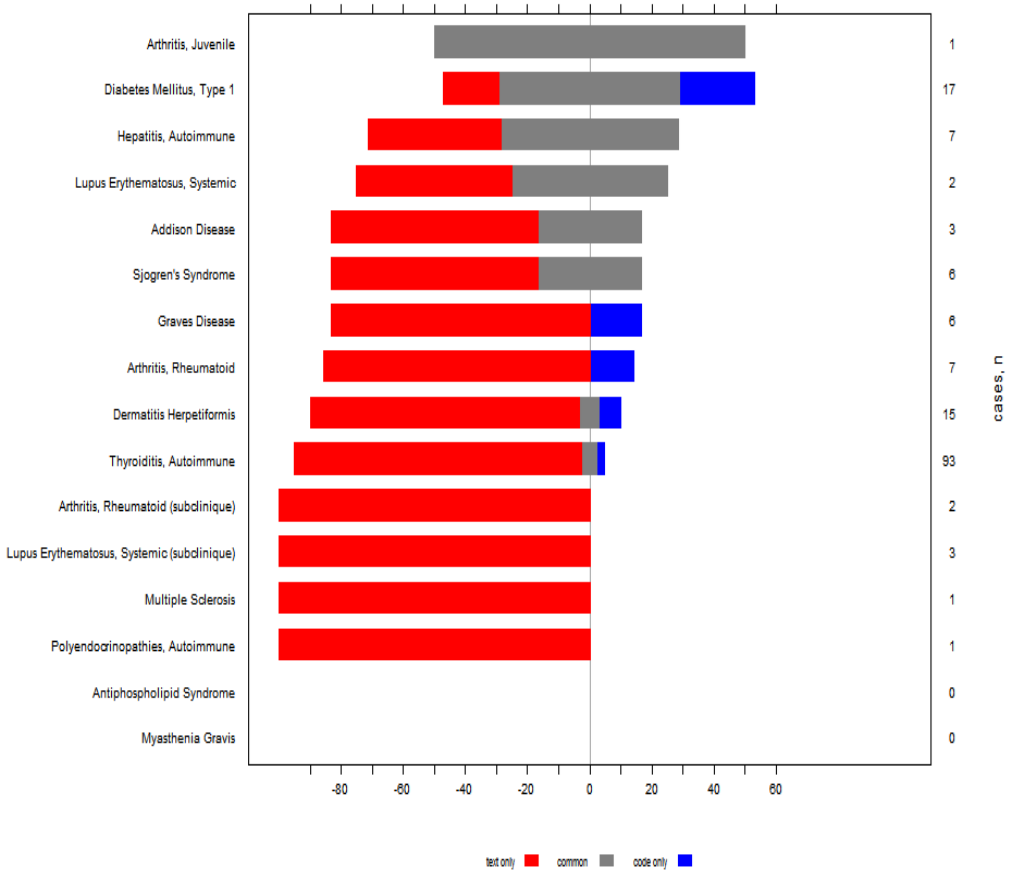
Antoine Neuraz[1,2], Laurent Chouchana[3], Georgia Malamut[4], Christine Le Beller[5], Denis Roche[6], Philippe Beaune[3,6], Patrice Degoulet[1,2], Anita Burgun[1,2], Marie-Anne Loriot[3,6], Paul Avillach[1,2]*





Phenotype	Low activity	Intermediate activity	Normal activity	Very High activity
Thiopurine	10 % dose	30 – 70 % dose	100 % dose	> 100 % Dose ?

Case study: Autoimmune comorbidities of the Celiac Disease



81%

de l'information présente dans les textes uniquement (et absente des données structurées)

Escudié JB, Rance B, Malamut G, Khater S, Burgun A, Cellier C, Jannot AS. A novel data-driven workflow combining literature and electronic health records to estimate comorbidities burden for a specific disease: a case study on autoimmune comorbidities in patients with celiac disease. BMC Med Inform Decis Mak. 2017 Sep 29;17(1):140.

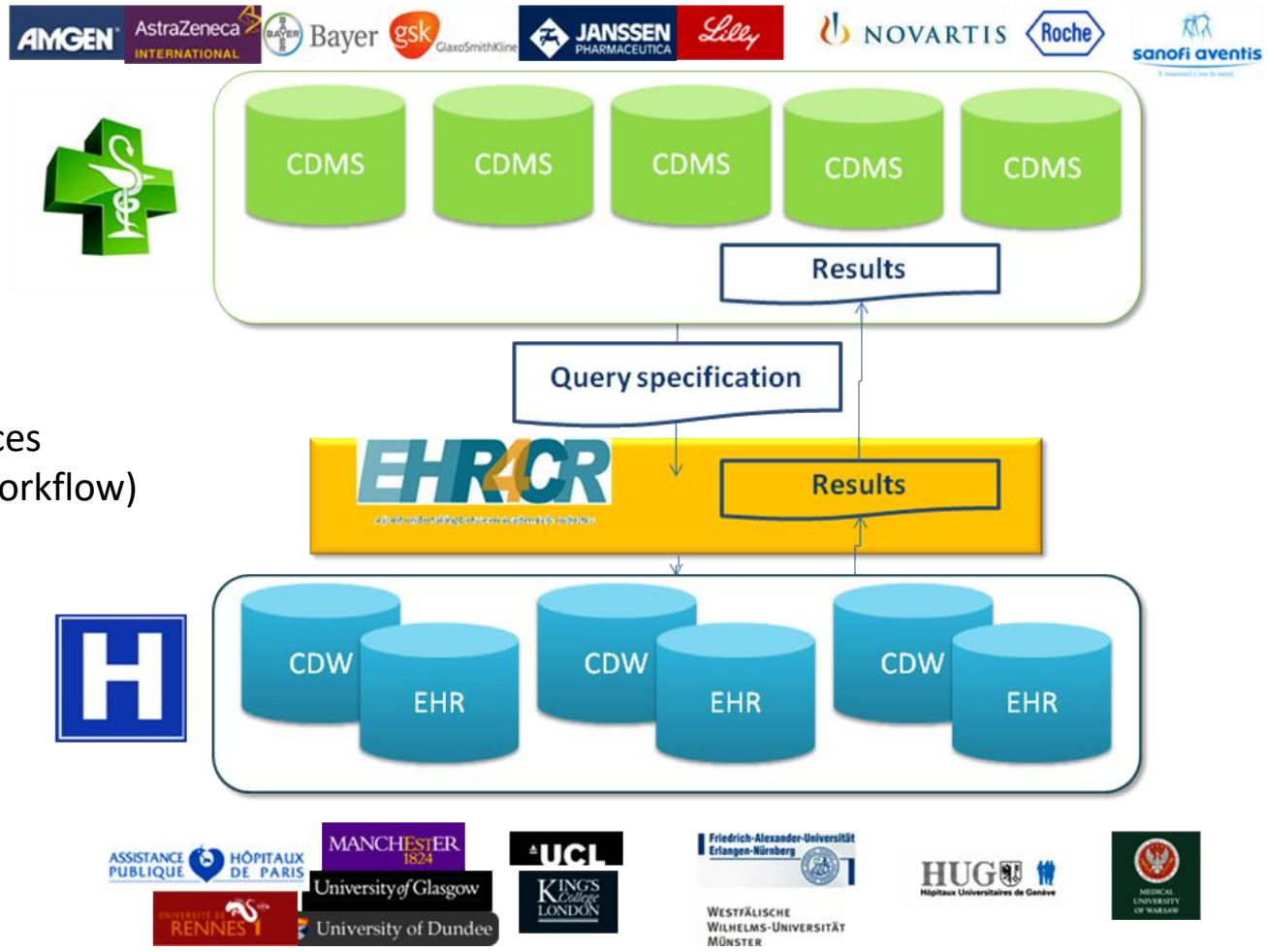
Escudié JB, Jannot AS, Zapletal E, Cohen S, Malamut G, Burgun A, Rance B. Reviewing 741 patients records in two hours with FASTVISU. AMIA Annu Symp Proc.2015 Nov 5;2015:553-9.

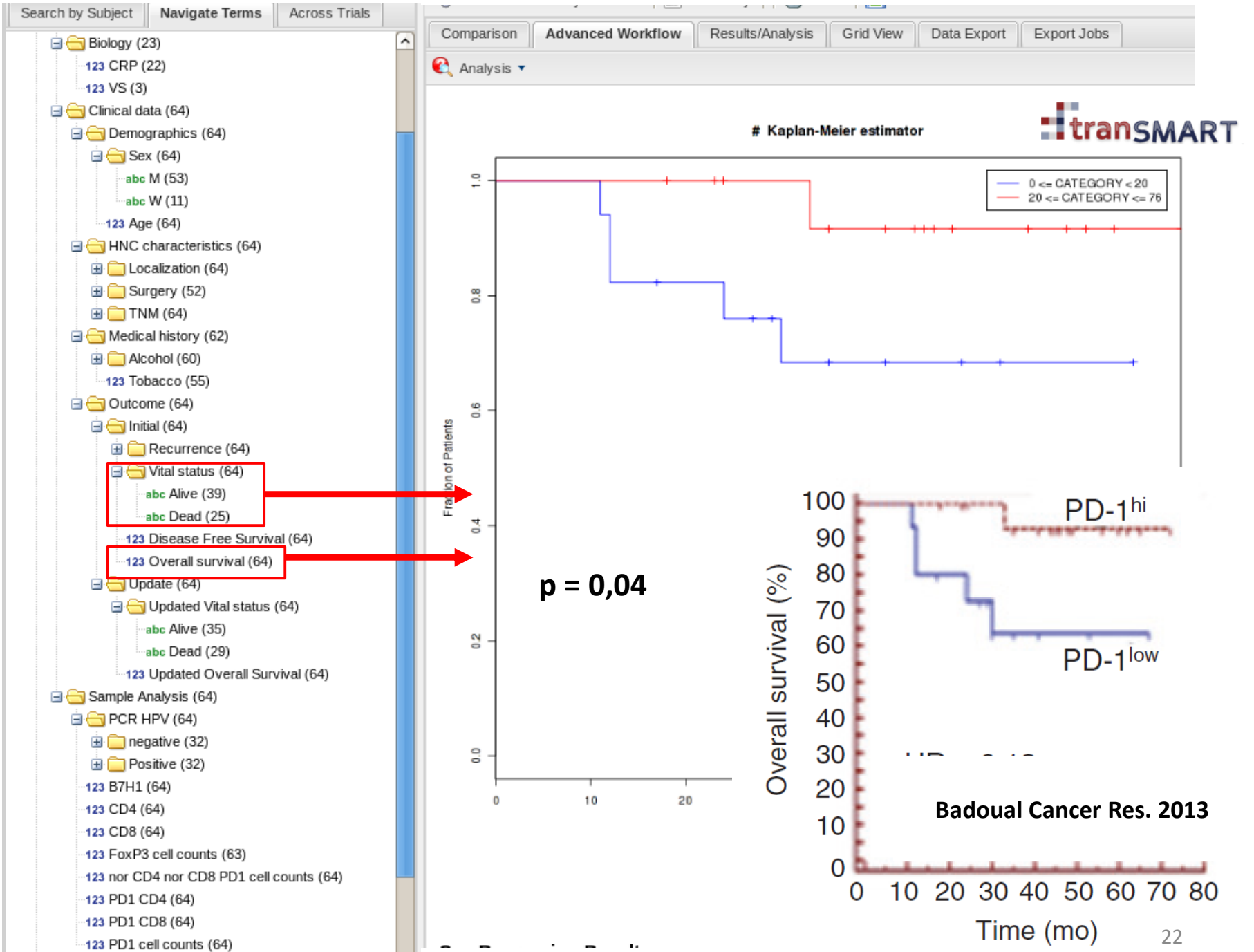
Phenotyping with Dr Warehouse (Garcelon et al. JBI 3017)

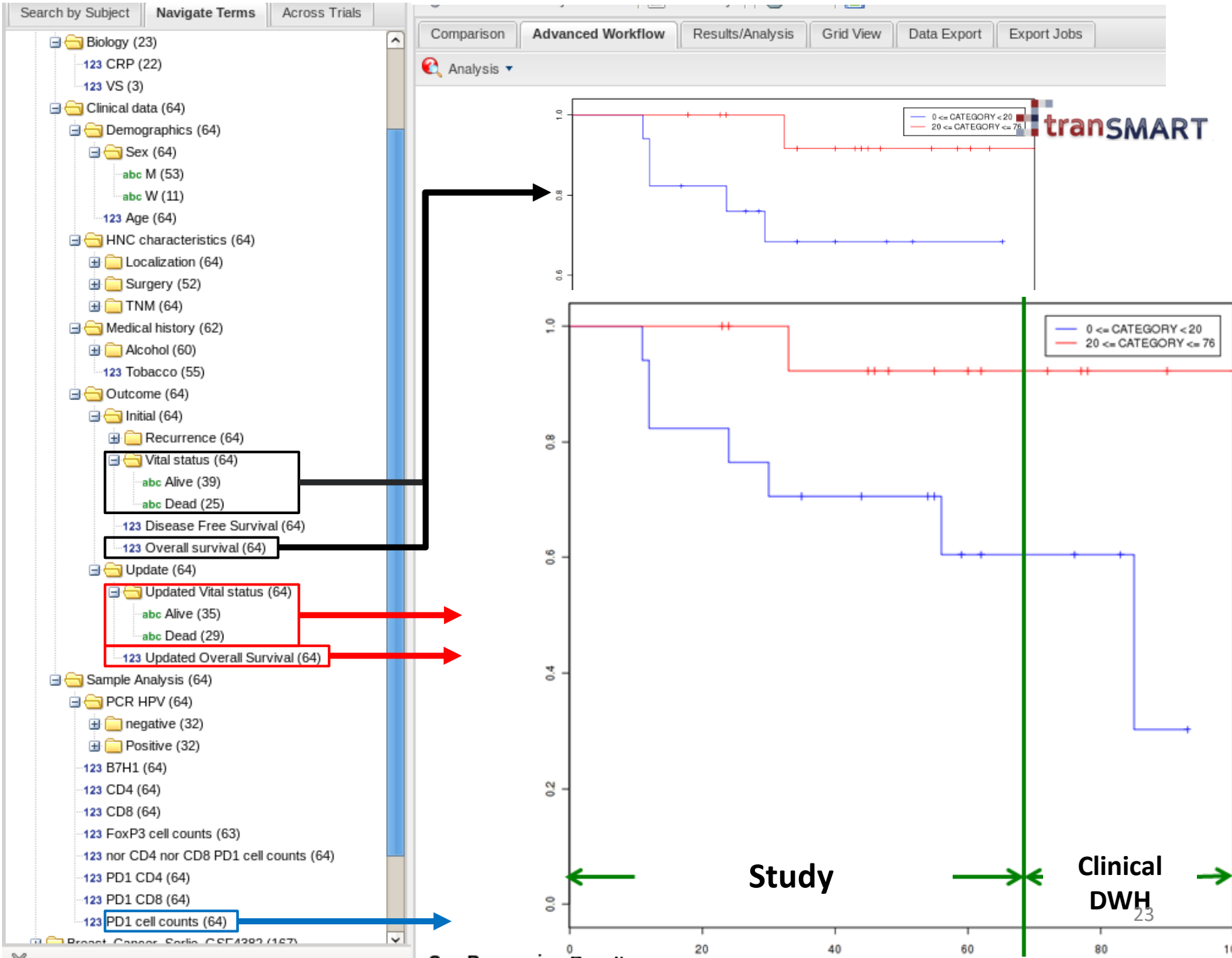
Support / complément à la recherche clinique

EHR4CR
A joint undertaking between Academia & Industry

Protocol feasability
Patient recruitment services
Cliinical trial execution (workflow)
Pharmacovigilance




Search by Subject
Navigate Terms
Across Trials
Biology (23)
CRP (22)
VS (3)
Clinical data (64)
Demographics (64)
Sex (64)
M (53)
W (11)
Age (64)
HNC characteristics (64)
Localization (64)
Surgery (52)
TNM (64)
Medical history (62)
Alcohol (60)
Tobacco (55)
Outcome (64)
Initial (64)
Recurrence (64)
Vital status (64)
Alive (39)
Dead (25)
Disease Free Survival (64)
Overall survival (64)
Update (64)
Updated Vital status (64)
Alive (35)
Dead (29)
Updated Overall Survival (64)
Sample Analysis (64)
PCR HPV (64)
negative (32)
Positive (32)
B7H1 (64)
CD4 (64)
CD8 (64)
FoxP3 cell counts (63)
nor CD4 nor CD8 PD1 cell counts (64)
PD1 CD4 (64)
PD1 CD8 (64)
PD1 cell counts (64)
Comparison
Advanced Workflow
Results/Analysis
Grid View
Data Export
Export Jobs
Analysis
Kaplan-Meier estimator
tranSMART
0 <= CATEGORY < 20
20 <= CATEGORY <= 76
Fraction of Patients
p = 0,04
Overall survival (%)
PD-1hi
PD-1low
Badoual Cancer Res. 2013
Time (mo)


Search by Subject
Navigate Terms
Across Trials
Biology (23)
CRP (22)
VS (3)
Clinical data (64)
Demographics (64)
Sex (64)
M (53)
W (11)
Age (64)
HNC characteristics (64)
Localization (64)
Surgery (52)
TNM (64)
Medical history (62)
Alcohol (60)
Tobacco (55)
Outcome (64)
Initial (64)
Recurrence (64)
Vital status (64)
Alive (39)
Dead (25)
Disease Free Survival (64)
Overall survival (64)
Update (64)
Updated Vital status (64)
Alive (35)
Dead (29)
Updated Overall Survival (64)
Sample Analysis (64)
PCR HPV (64)
negative (32)
Positive (32)
B7H1 (64)
CD4 (64)
CD8 (64)
FoxP3 cell counts (63)
nor CD4 nor CD8 PD1 cell counts (64)
PD1 CD4 (64)
PD1 CD8 (64)
PD1 cell counts (64)
Comparison
Advanced Workflow
Results/Analysis
Grid View
Data Export
Export Jobs
Analysis
tranSMART
0 <= CATEGORY < 20
20 <= CATEGORY <= 76
Study
Clinical DWH

PHARMACOGENOMICS

Biobanks and Electronic Medical Records: Enabling Cost-Effective Research

Erica Bowton,[1*] Julie R. Field,[1] Sunny Wang,[1] Jonathan S. Schildcrout,[2] Sara L. Van Driest,[3] Jessica T. Delaney,[4] James Cowan,[1] Peter Weeke,[4] Jonathan D. Mosley,[4] Quinn S. Wells,[4] Jason H. Karnes,[4] Christian Shaffer,[4] Josh F. Peterson,[4,5] Joshua C. Denny,[4,5] Dan M. Roden,[4,6] Jill M. Pulley[7]

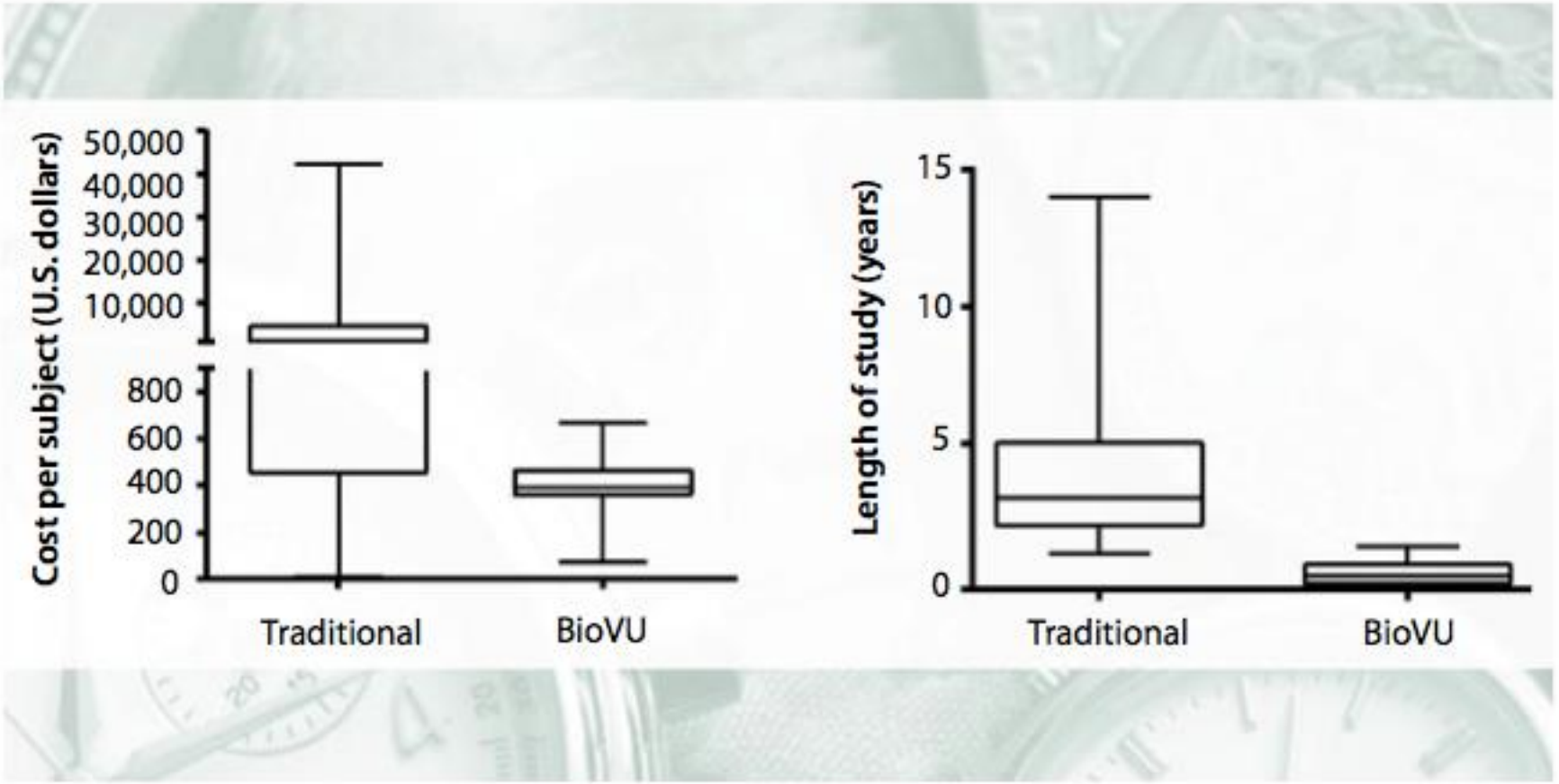


Fig. 1. Time is money. Comparison of traditional NIH-funded pharmacogenomic studies versus EMR/biobank studies (BioVU). (**Left**) Median cost of study per subject. (**Right**) Median length of study in years.

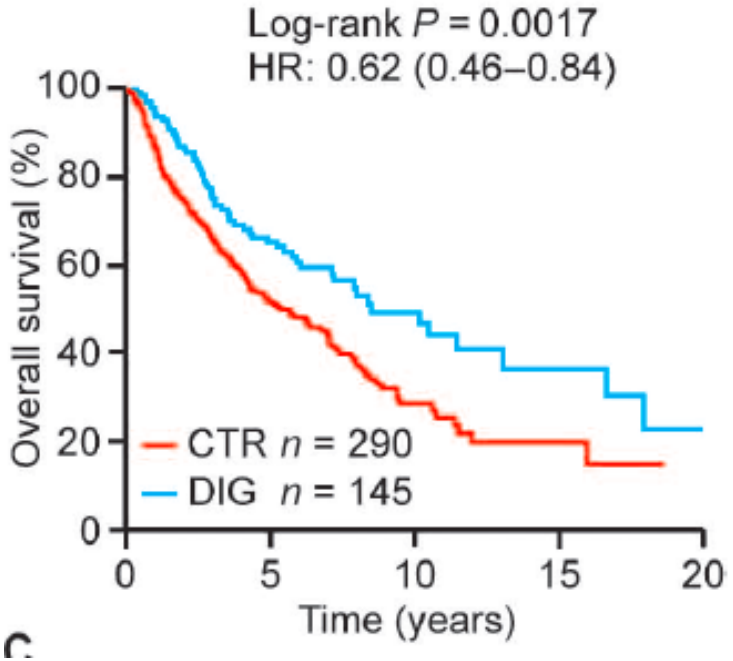
RESEARCH ARTICLE

CANCER

Cardiac Glycosides Exert Anticancer Effects by Inducing Immunogenic Cell Death

Laurie Menger,[1,2,3] Erika Vacchelli,[1,2,3] Sandy Adjemian,[1,2,3] Isabelle Martins,[1,2,3] Yuting Ma,[1,2,3] Shensi Shen,[1,2,3] Takahiro Yamazaki,[2,3,4] Abdul Qader Sukkurwala,[1,2,3] Mickaël Michaud,[1,2,3] Grégoire Mignot,[5,6] Frederic Schlemmer,[1,2,3] Eric Sulpice,[7] Clara Locher,[2,3,4] Xavier Gidrol,[7] François Ghiringhelli,[5,6] Nazanine Modjtahedi,[1,2,3] Lorenzo Galluzzi,[2,8] Fabrice André,[2,9] Laurence Zitvogel,[2,3,4] Oliver Kepp,[1,2,3]*† Guido Kroemer[1,8,10,11,12]*†

- Cell -> mice -> retrospective data
- text-based research algorithm to identify all carcinoma patients who, between 1981 and 2009, received digitalin during conventional carcinoma therapies
- compared the overall survival of 145 patients treated with CGs with that of 290 patients who did not receive CGs.



Martin K, et al. . Differences between clinical trials and postmarketing use. Br J Clin Pharmacol.

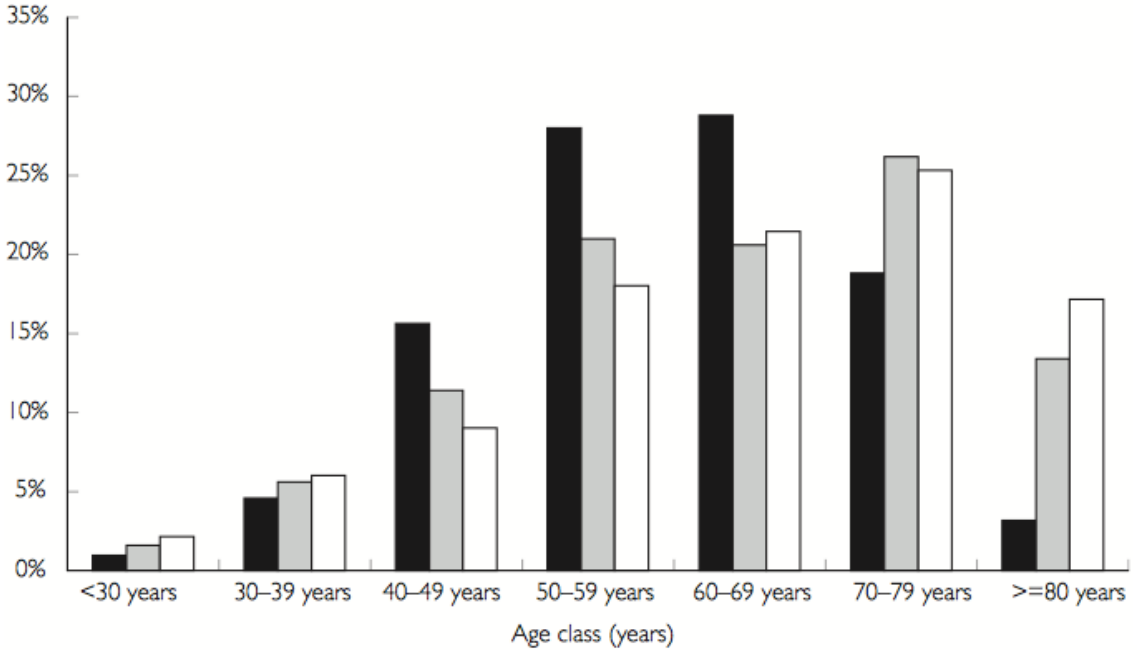
- Essais cliniques : populations sélectionnées et conditions standardisées
- Vie réelle : comorbidités et comportements des patients
- 3 populations 3 molécules : tacrine, simvastatin et celecoxib
  - Cible : critères d'inclusion/exclusion
  - Effets adverses
  - Toute la population

Table 2
Comparison of male : female ratios between the three populations

	Population		
	Target	Joint	Injured
Tacrine	0.9	0.6	0.5
Simvastatin	4.6	1	1.5
Celecoxib	0.4	0.5	0.5

Figure 1

Age distribution for the three populations for celecoxib. Target population (■), joint population (▒) and injured population (□)



Martin K, et al. . Differences between clinical trials and postmarketing use. *Br J Clin Pharmacol* tacrine, simvastatin et celecoxib

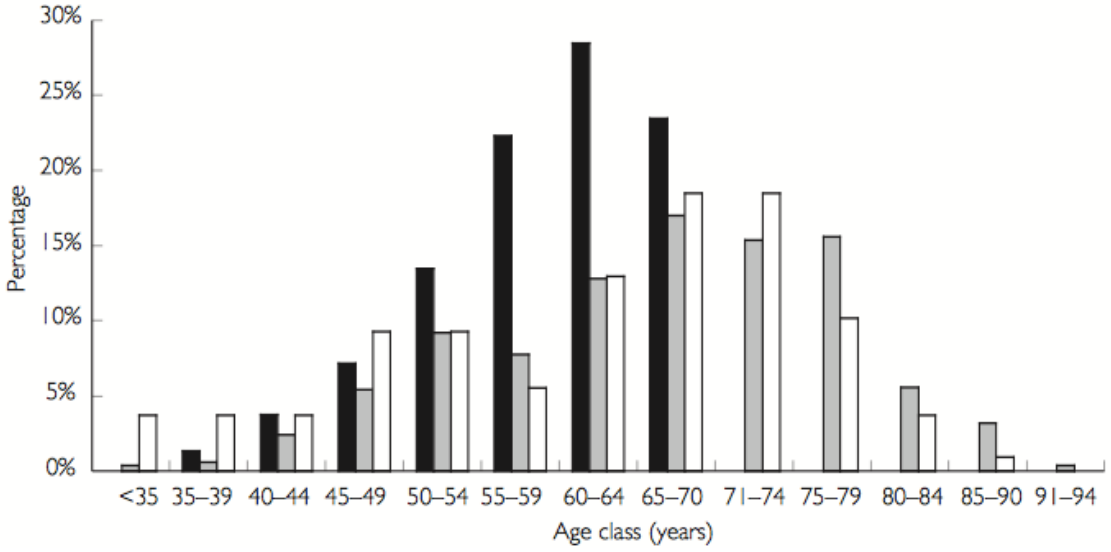


Figure 2

Age distribution for the three populations for simvastatin. Target population (■), joint population (▒) and injured population (□)

Aide à la décision dans le cadre du soin

Evidence-Based Medicine in the EMR Era

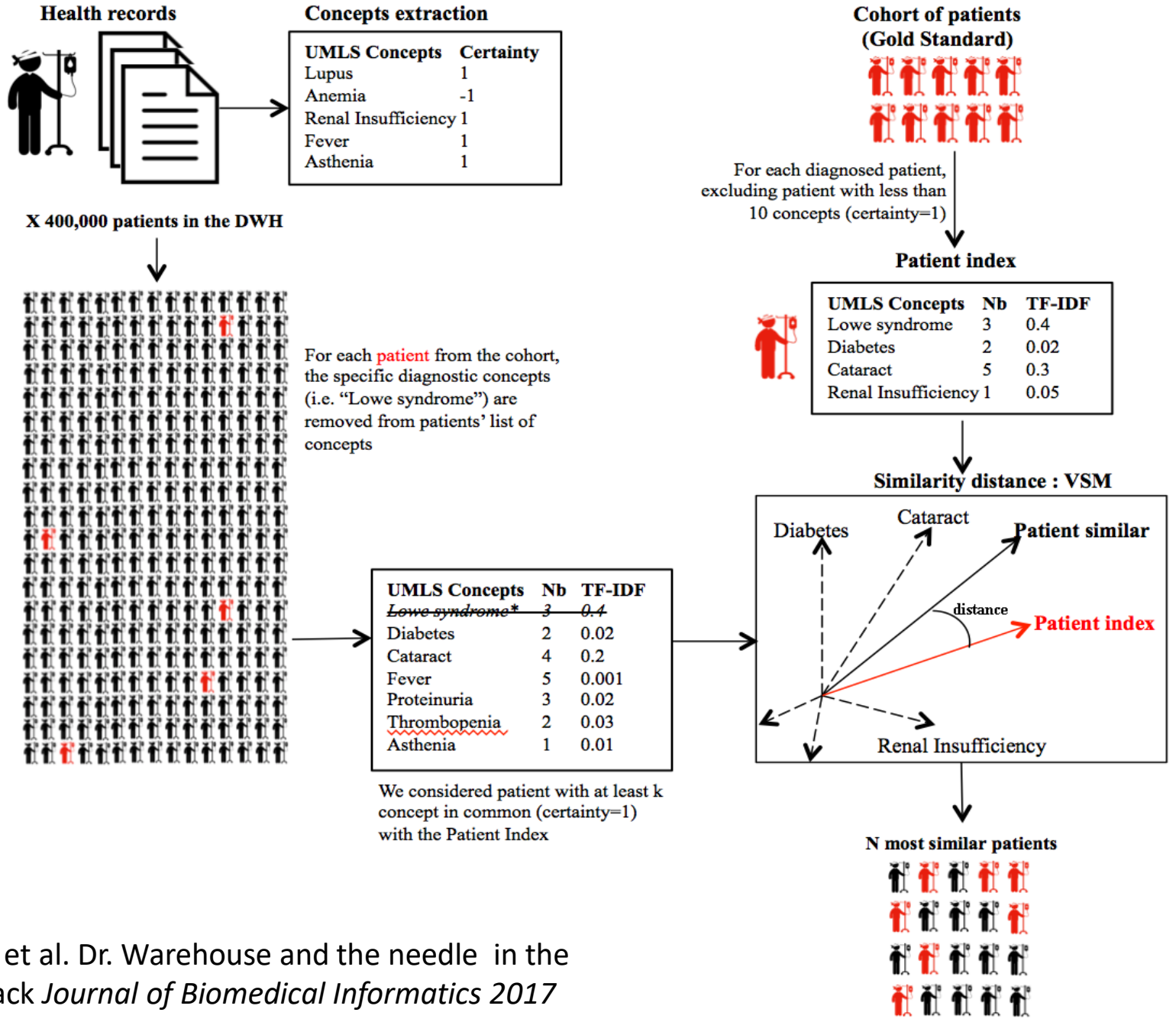
J.Frankovich, C.A. Longhurst, S M. Sutherland.

Stanford, publication NEJM 9 Nov 2011

Results of Electronic Search of Patient Medical Records (for a Cohort of 98 Pediatric Patients with Lupus) Focused on Risk Factors for Thrombosis Relevant to Our 13-Year-Old Patient with Systemic Lupus Erythematosus.*

Outcome or Risk Factor	Keywords Used to Conduct Expedited Electronic Search	Prevalence of Thrombosis	Relative Risk (95% CI)
		no./total no (%)	
Outcome — thrombosis	"Thrombus," "Thrombosis," "Blood clot"	10/98 (10)	Not applicable
Thrombosis risk factor			
Heavy proteinuria (>2.5 g per deciliter)			
Present at any time	"Nephrosis," "Nephrotic," "Proteinuria"	8/36 (22)	7.8 (1.7–50)
Present >60 days	"Urine protein"	7/23 (30)	14.7 (3.3–96)
Pancreatitis	"Pancreatitis," "Lipase"	5/8 (63)	11.8 (3.8–27)
Antiphospholipid antibodies	"Aspirin"	6/51 (12)	1.0 (0.3–3.7)

« we made the decision on the basis of the best data available »
« in the light of experience as guided by intelligence. »



Garcelon et al. Dr. Warehouse and the needle in the needlestack *Journal of Biomedical Informatics 2017*

Search:

Patient	Similarité	Concepts communs	Concepts patient
Patient 1 (statut cohorte Syndrome de lowe : 1) Afficher le comparateur	54	Acidose, Albuminurie, CATARACTE CONGENITALE, Crise, Deshydratation, Retard de croissance, Syndrome de Fanconi, Hemolyse, saignement, Hypercalciurie, nephropathie, Cyphose, Lithiase, HYPOTONIE, Nephrocalcinose, Proteinurie, Rachitisme, Scoliose, renal, Agitation, CRISTALLURIE, Tolerance, Selles liquides, Crises convulsives, Tension, Petite taille, Retard psychomoteur, Microalbuminurie, anomalies du transport des acides amines, agitation, Demineralisation, CATARACTE, Insuffisance renale	Glaucome, gastroenterite, Handicap, EPILEPSIE, rougeur oculaire, Acidose metabolique, Diarrhee, Diarrhee chronique, temps, Lithiases renales, ocrl1, Paleur, Pale, **Syndrome de Lowe**, RETARD DE DEVELOPPEMENT, maladies metaboliques, Masse musculaire, Fievre, Hypothermie, Sursauts, Gammaglobulinemie, Glycosurie, ANEMIE MICROCYTAIRE, Hypertonie oculaire, glaucome, Epilepsie occipitale, Malaise, Hematurie, Polypnee, Hematurie macroscopique, Prise de poids, Bronchiolite, Photophobie, diarrhees, t3 normale, Syndrome nephrotique, alimentation, Selles molles, rhinite, Anorexie, vomissement, Troubles du transit, Eruption, Urgences, Fatigue, Constipation, Cetonurie, Sedation, Keratite, opacite corneenne, Hypoglycemie, lithiase renale, Crises generalisees, HYPOKINESIE, hypertonie, Gaz
Patient 2 (statut cohorte Syndrome de lowe : 1) Afficher le comparateur	51	Acidose, CATARACTE CONGENITALE, Kyste, Deshydratation, Retard de croissance, saignement, Hypercalciurie, allergie, nephropathie, Cyphose, Lithiase, HYPOTONIE, Nephrocalcinose, Proteinurie, renal, CRISTALLURIE, Tolerance, Tension, Amino-acidurie, Malformation, Petite taille, Masse, Microalbuminurie, anomalies du transport des acides amines, Demineralisation, CATARACTE	Prise de poids, Eruption, Retard staturo-ponderal, hypovolemie, Amblyopie, Gastrostomie, Peau seche, urate, Genu valgum, vomissement, ulceration, Diarrhee, **Syndrome de Lowe**, Infections, Perte de poids, Cytolyse hepatique, Syndrome nephrotique, lithiase renale, Constipation, ocrl1, Urgences, Dysmorphie, Fente palatine, Masse musculaire, temps, retrognathisme, malnutrition, Nerveux, Stress, cryptorchidie bilaterale, reflexe nauseeux, Anorexie, Gastro-enterite aigue, luxation congenitale de hanche, Glaucome, hypotonie neonatale, alimentation, Bouton, hypertrophie, Acidose metabolique, glaucome congenital
Patient 3 (statut cohorte Syndrome de lowe : 1) Afficher le comparateur	51	vesicule, Crise, Deshydratation, Retard de croissance, pieds plats, saignement, hepatite b, Hypercalciurie, allergie, Lithiase, HYPOTONIE, Nephrocalcinose, osteomalacie, Proteinurie, Scoliose, thrombopenie, renal, Agitation, CRISTALLURIE, Tension, Dysmorphie faciale, Malformation, Retard psychomoteur, troubles de l'hemostase, anomalies du transport des acides amines, agitation, Demineralisation, CATARACTE	Gaz, marche ataxique, Douleurs abdominales, incontinence fecale, Sursauts, Chute, Inquietude, Tumefaction, Fecalome, Protides totaux, azotemie, Gastrite, RETARD DE DEVELOPPEMENT, Colique, depots calciques, Tartre, ocrl1, Acidose metabolique, Alopecie, alimentation, Lordose, Puberte, **Syndrome de Lowe**, Gynecomastie, parodontopathies, Intervention chirurgicale, lithiase renale, Constipation chronique, EPILEPSIE, Carie, perte de sommeil, cataracte, Plaquettes normales, Cecite, distension, Hepatite C, Constipation, Douleur, Glaucome, crises d'epilepsie, retention d'urine, Varicelle, Gingivite, Stress, perte de connaissance, Observation, cecite des deux yeux, Constipation opiniatre, Douleurs abdominales, Anorexie, temps, glaucome

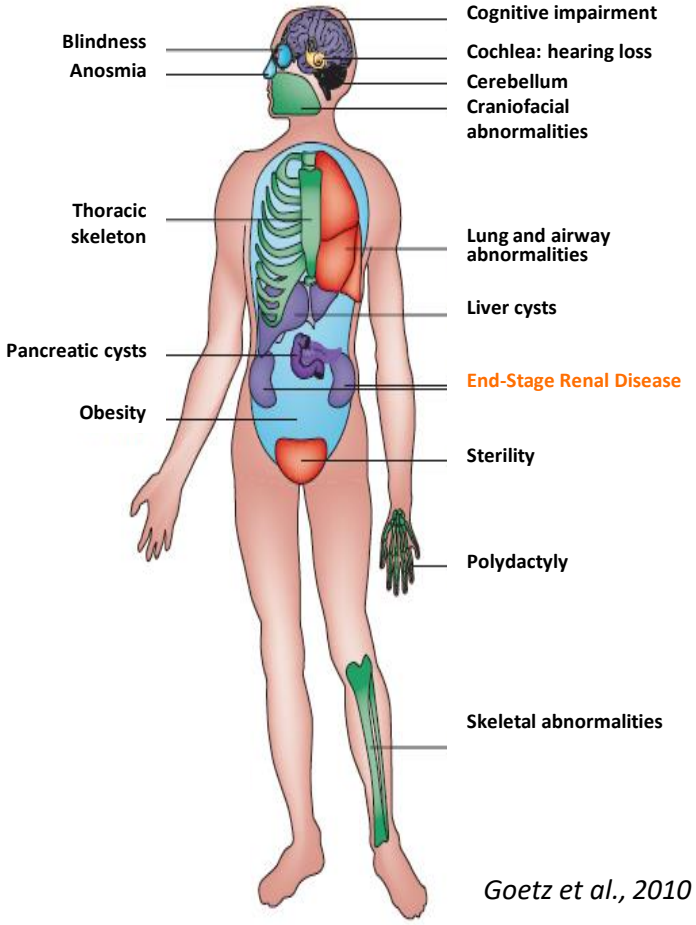
Une redéfinition des maladies: l'exemple des ciliopathies

Source : **C'IL-LICO Consortium**

The C'IL-LICO Project: Next-Generation Medicine For Renal Ciliopathies

C'IL-LICO is based on similarities between ciliopathy signaling pathways, offering an opportunity to identify common therapeutic option(s).

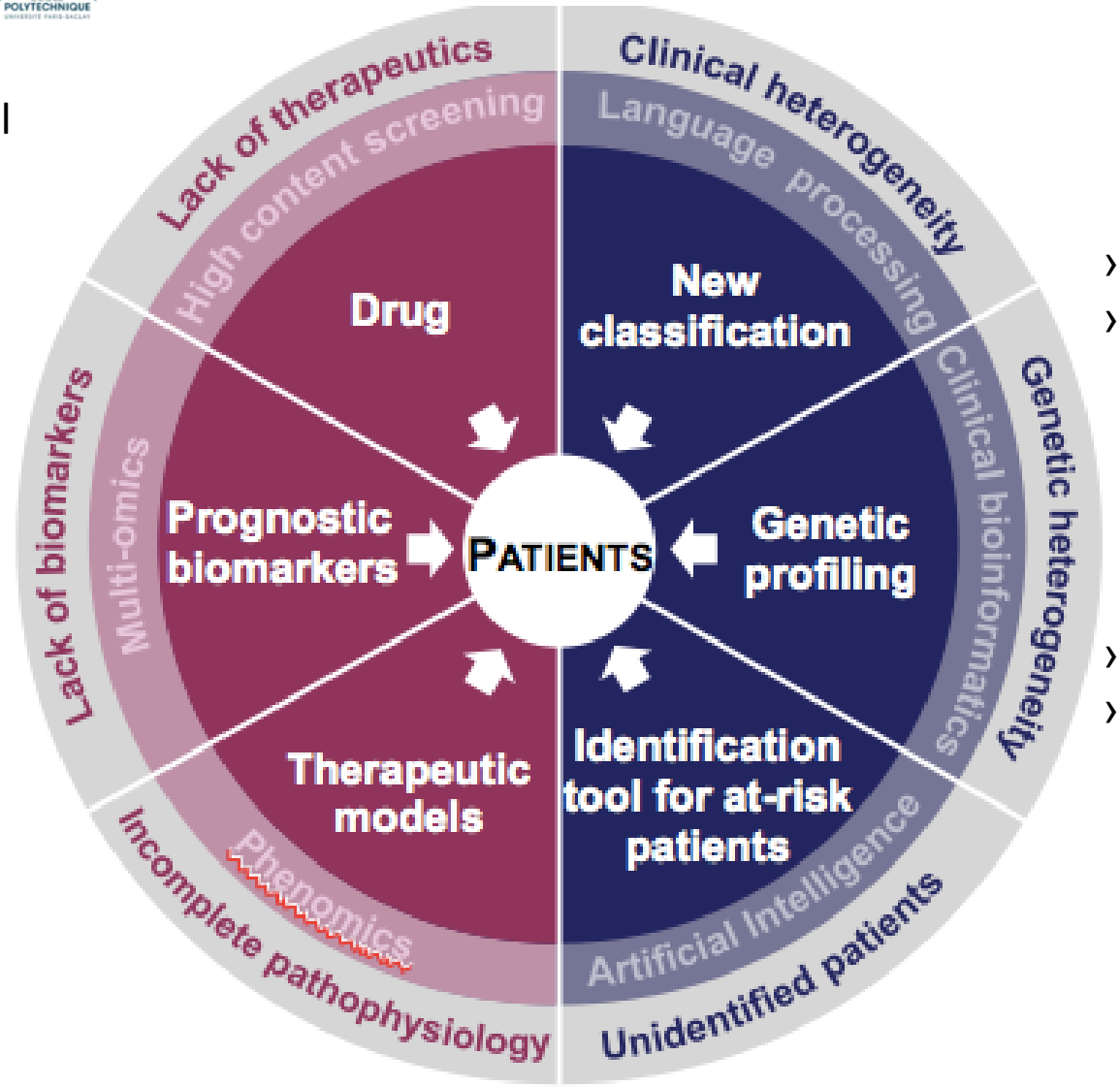
- **Rare and severe genetic diseases** caused by **ciliary dysfunction**
- **Individually rare, collectively frequent : 1/2000 birth**
- **End-stage renal disease (ESRD)**: main cause of morbidity and mortality
- **25% ESRD patients are undiagnosed**: part of them could have a ciliopathy
- **Common pathways in ciliopathies**: opportunity for **common treatment of different patients**



Goetz et al., 2010

Source : **C'IL-LICO Consortium**

› ***DRUG*** ready to enter clinical trial (active file of 25 patients to be recruited)



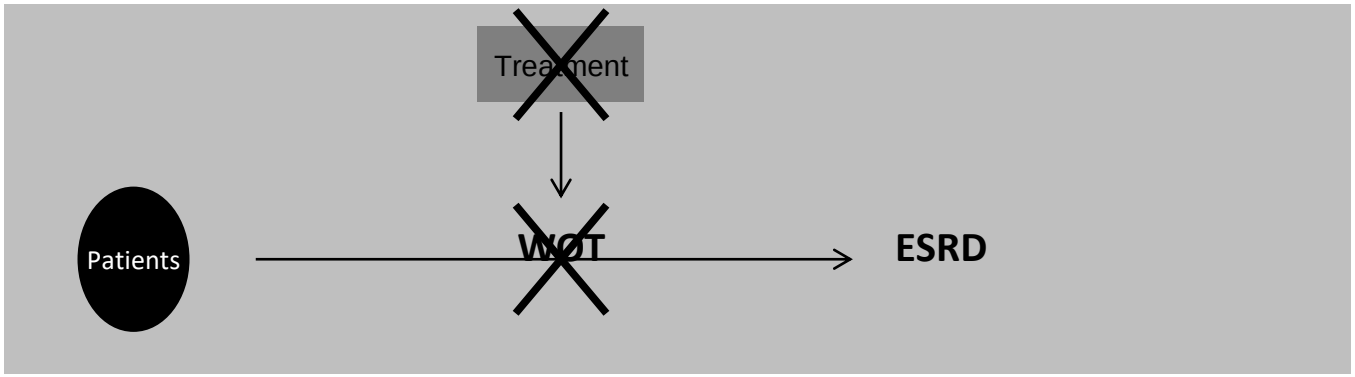
› ***CIL-DIAG2***:
› Genetic diagnostic validation tool in clinical settings

› ***CIL-SMART***:
› ***AI***-based diagnostic decision-support tool

› ***CIL-BIOM***: Prognostic biomarker-based kit to predict patients at-risk for renal impairment and eligible for treatments

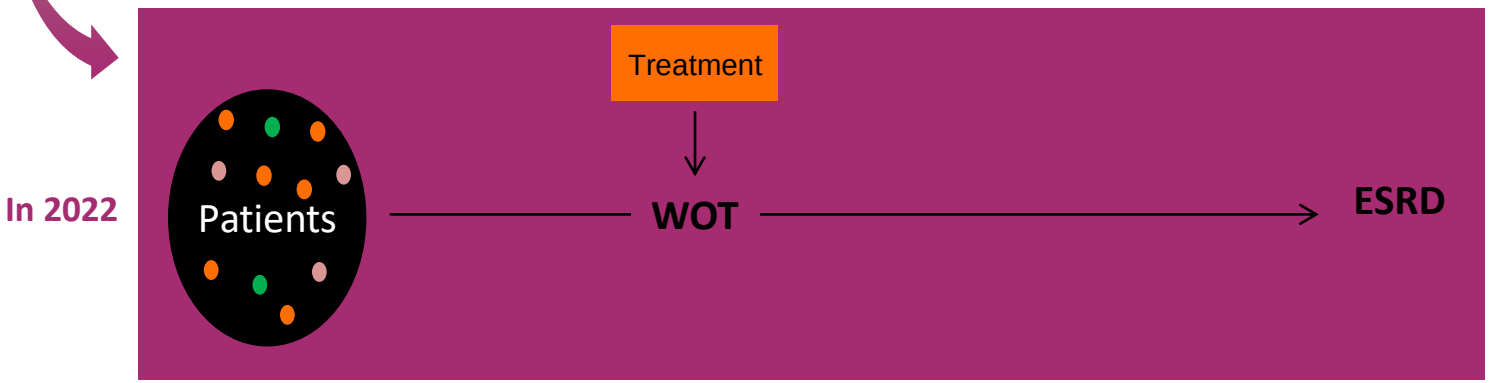
Source : **C'IL-LICO Consortium**

Providing the right treatment, to the right patient, at the right time: C'IL-LICO outstanding opportunity for ciliopathy patients.



C'IL-LICO

- **Detect undiagnosed patients**
- Prognosticate the occurrence of comorbidities to **define the Window Of Therapeutics**
- Develop **first-in-class** pathway-specific treatment and identify **patients eligible** for it



Source : **C'IL-LICO Consortium**

Stéphanie Allassonnière
David Baudoin
Philippe Beaune
Jean-Emmanuel Bibault
Vincent Canuel
C'IL-LICO Consortium
Hector Contournis
Patrice Degoulet
William Digan

Elise Dugas
Jean-Baptiste Escudié
Nicolas Garcelon
Yannick Girardeau
Anne-Sophie Jannot
Sandrine Katsahian
Vincent Looten
Stanislas Lyonnet
Marie-Anne Loriot

Marie France Mamzer
Antoine Neuraz
Pierre Laurent-Puig
Bastien Rance
Grégoire Rey
Eric Zapletal
Sarah Zohar

anita.burgun@aphp.fr