

Metabolic surgery in the era of precision medicine



François Pattou

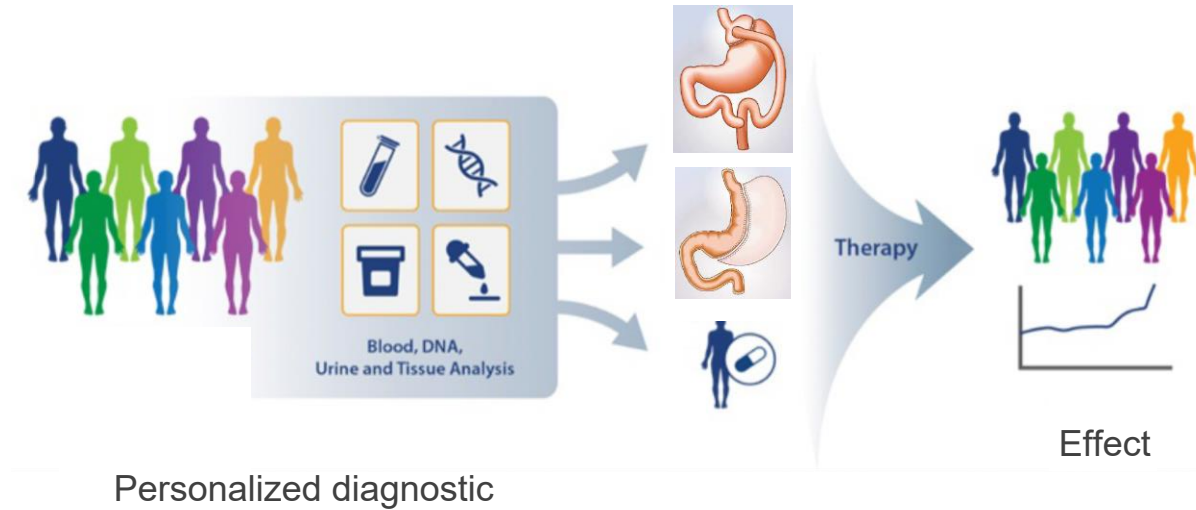
Endocrine and Metabolic Surgery, Lille University Hospital

European Genomic Institute for Diabetes, Inserm, Institut Pasteur Lille , France

This talk will be about

- ✓ **Precision** obesity medicine
- ✓ Personalized prediction of **weight trajectories**

Precision obesity treatment



Insights from bariatric surgery cohort



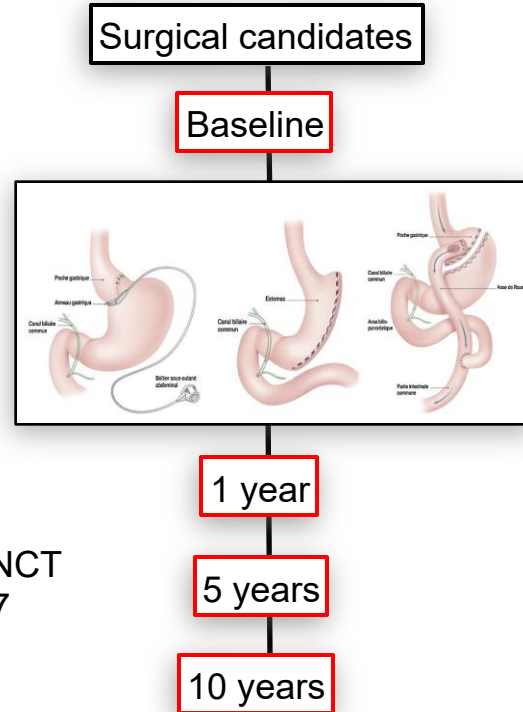
Deep phenotyping

Diabetes
Lipids
Inflammation
liver biopsy
Renal function
Hypertension

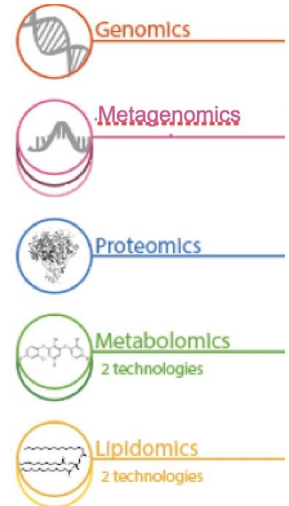
Tissue sampling

Liver
Muscle
Fat
Intestine

ClinGov NCT
01129297



Omics



ABOS a prospective bariatric cohort study since 2006 (>1800 patients enrolled)

Numeric transition of obesity research



Big data -> Advanced data science

Data driven clustering / MASLD Subtypes

nature medicine

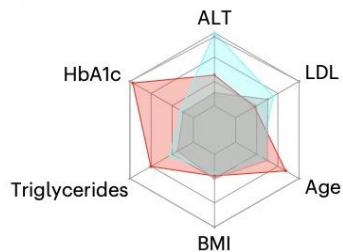


Article

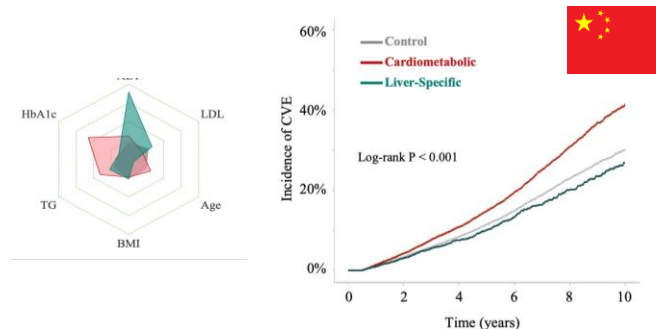
<https://doi.org/10.1038/s41591-024-03283-1>

Data-driven cluster analysis identifies distinct types of metabolic dysfunction-associated steatotic liver disease

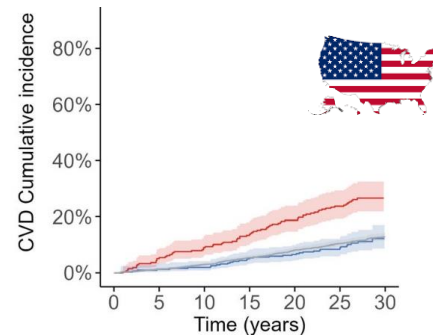
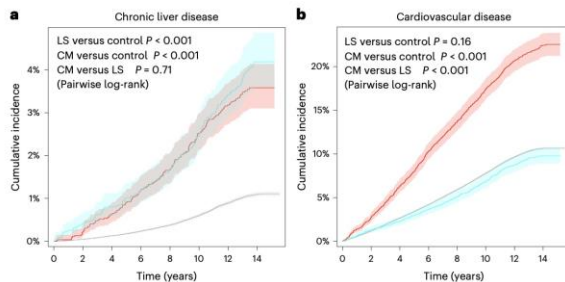
Violeta Raverdy^{1,2,3,4}, Federica Tavaglione^{5,6,7,8}, Estelle Chatelain^{5,6,7,8}, Guillaume Lassailly^{5,6,7,8}, Antonio De Vincentis^{1,2}, Umberto Vespasiani-Gentilucci^{1,4}, Sami F. Qadri^{9,10}, Robert Calazzo^{1,2}, Helene Verkint^{1,2}, Chiara Saponaro¹, Julie Kerr-Conte¹, Gregory Baud^{1,2}, Camille Marciniak^{1,2}, Mikael Chetboun^{1,2}, Naima Oukhouya-Daoud^{1,2}, Samuel Blanck¹¹, Jimmy Vandel¹², Lisa Olsson¹³, Rima Chakaroun¹⁴, Viviane Gnemmi^{12,14}, Emmanuelle Leteurre^{12,14}, Philippe Lefebvre¹⁵, Joel T. Haas¹⁶, Hannele Yki-Järvinen¹⁷, Sven Francke^{18,19}, Bart Staels²⁰, Carole W. Le Roux²¹, Valentina Tremaroli²², Philippe Mathurin¹, Guillemette Marot^{1,19}, Stefano Romeo^{12,19,23,24,25} & François Pattou^{1,2}✉



Raverdy et al. Nature Medicine 2024



Zhou et al. *JHEP Reports* 2025

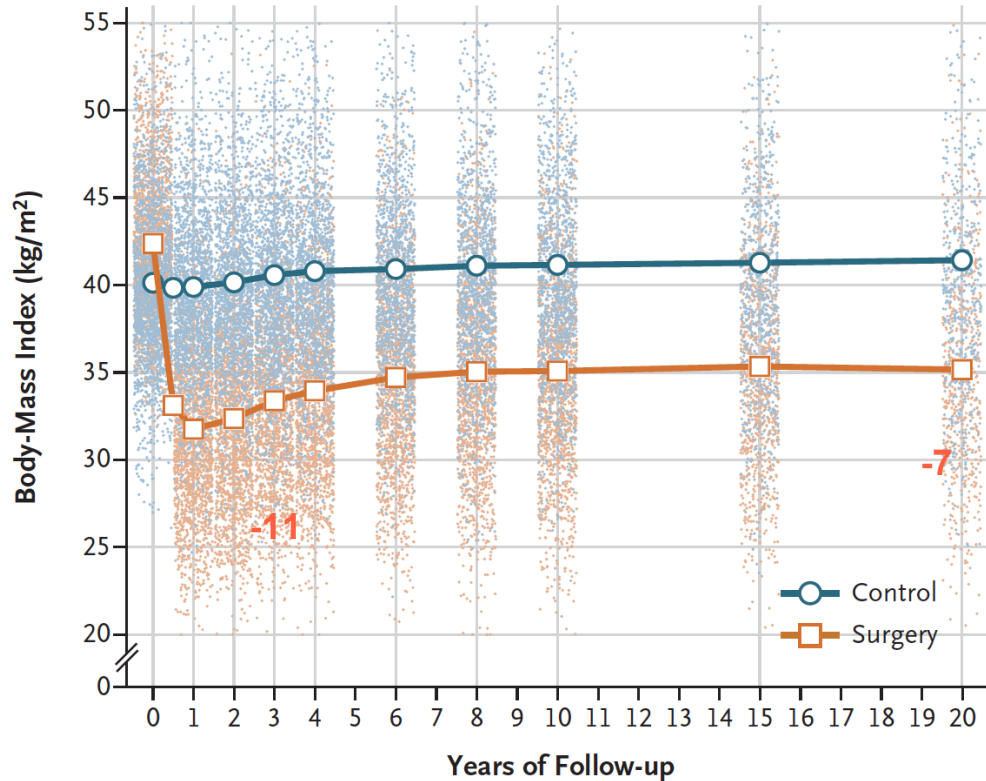


Wu et al. *Diabetes Obes Metab* 2026

How much will I weigh in five years ?



You will loose a lot of weight ...



2007 patients operated
vs 2040 controls
>20-y follow-up

Carlson et al.
N Engl J Med 2020



Insights from data driven science



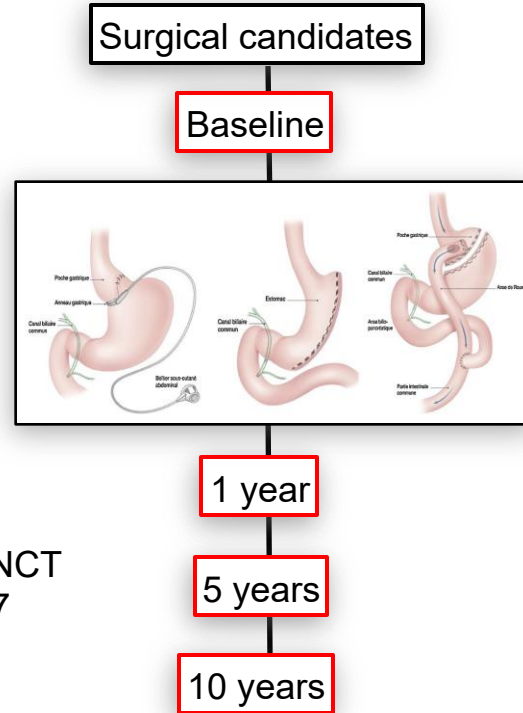
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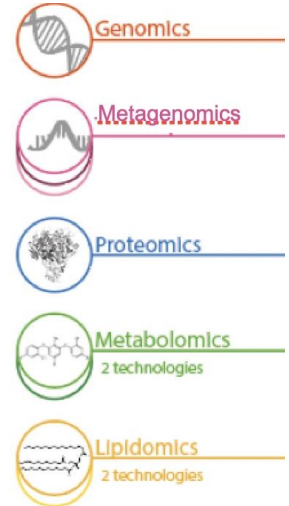
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Omics



ABOS a prospective bariatric cohort study since 2006 (>1800 patients enrolled)

Personalized weight loss prediction

Development and validation of an interpretable machine learning-based calculator for predicting 5-year weight trajectories after bariatric surgery: a multinational retrospective cohort SOPHIA study

Patrick Saux*, Pierre Bauvin*, Violeta Raverdy, Julien Teigny, Hélène Verkindt, Tomy Soumphonphakdy, Maxence Debert, Anne Jacobs, Daan Jacobs, Valerie Montpellier, Phong Ching Lee, Chin Hong Lim, Johanna C Andersson-Assarsson, Lena Carlsson, Per-Arne Svensson, Florence Galtier, Guelareh Dezfoulian, Mihaela Moldovanu, Severine Andrieux, Julien Couster, Marie Lepage, Erminia Lembo, Ornella Verrastro, Maud Robert, Paulina Salminen, Geltrude Mingrone, Ralph Peterli, Ricardo V Cohen, Carlos Zernweck, David Nocca, Carel W Le Roux, Robert Caiazzo, Philippe Preux, François Pattou

<https://bwtp.univ-lille.fr>



SOPHIA
Stratification of Obese Phenotypes to Optimize
Future Obesity Therapy

Preoperative data

Weight: 125 kg

Height: 170 cm

Age: 50 years

Non-smoker: ☐ Smoker: ☐

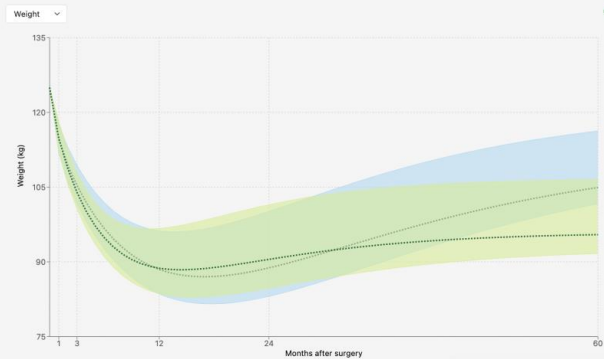
Type of intervention: Gastric Bypass

Type 2 diabetes: Diabetes

Number of years with Type 2 diabetes: 3 years

Predict trajectory

	Weight (kg)	Height (cm)	Age (years)	Smoker	Type of intervention	Type 2 diabetes	Number of years with Type 2 diabetes
Current prediction	125	170	50	No	Gastric Bypass	Diabetes	3
Stored prediction	125	170	50	No	Sleeve Gastrectomy	Diabetes	3



Saux et al. *Lancet Digital Health* 2023

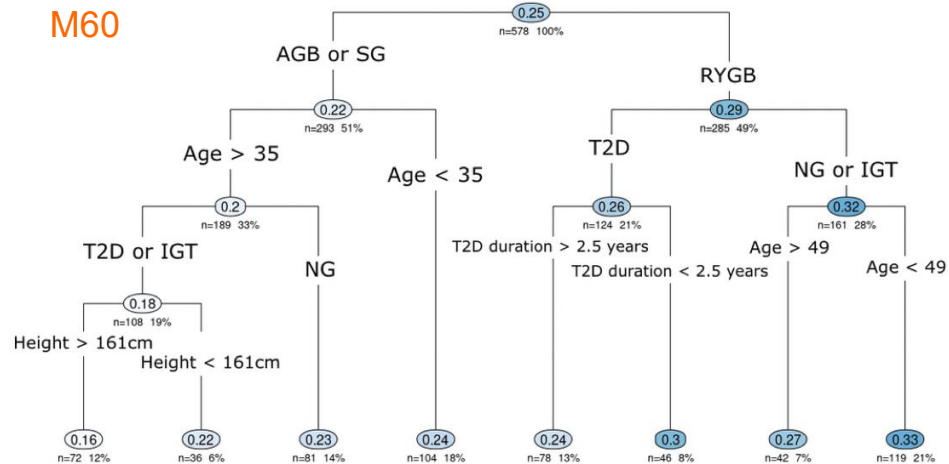
Interpretable machine learning

7 variables selected
(among >500)

Weight
Height
Procedure
Age
Diabetes
Diabetes duration
Smoking history

Decision trees

M60



-> simple non linear model / 5 year weight loss prediction / multiple procedures

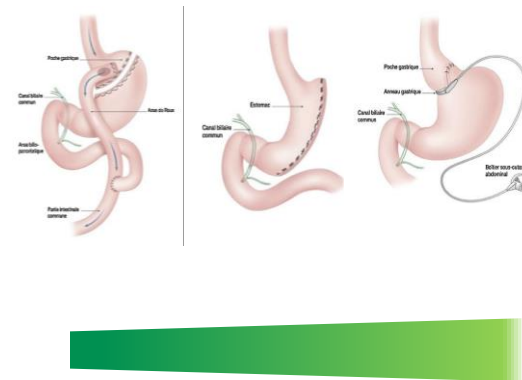
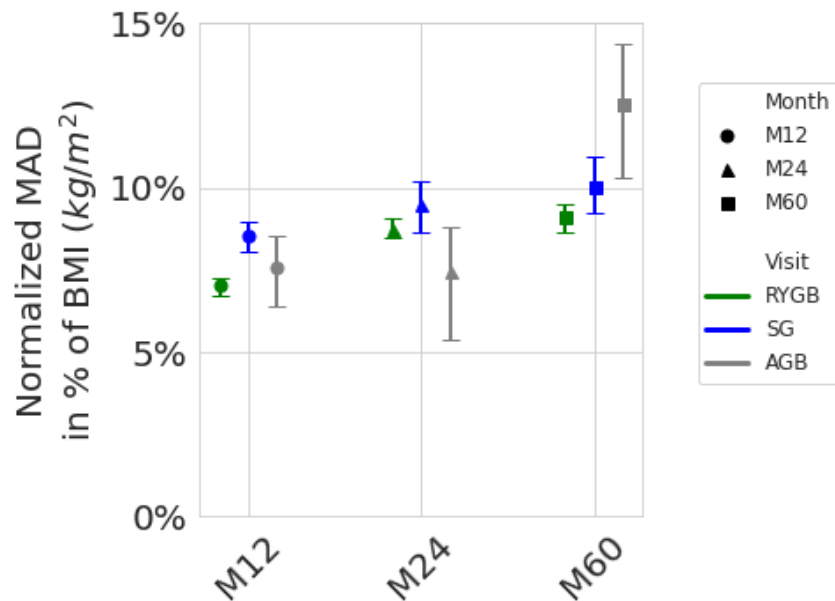
Global validation

>10,000 patients from 9 independent bariatric cohort studies in Europe, Asia, and America



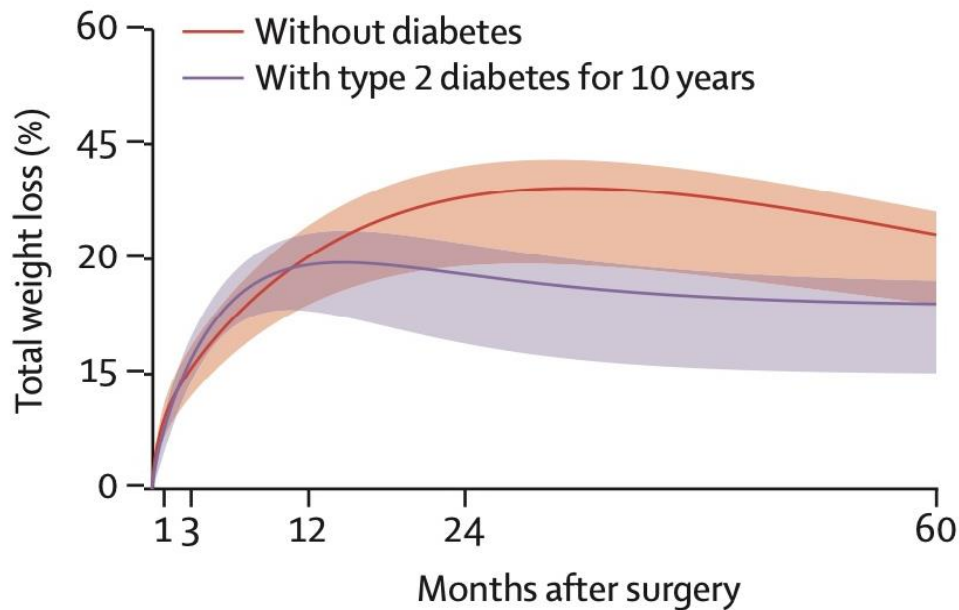
Saux et al. *Lancet Digital Health* 2023

Model accuracy / procedure & time



RYGB > Sleeve > Band

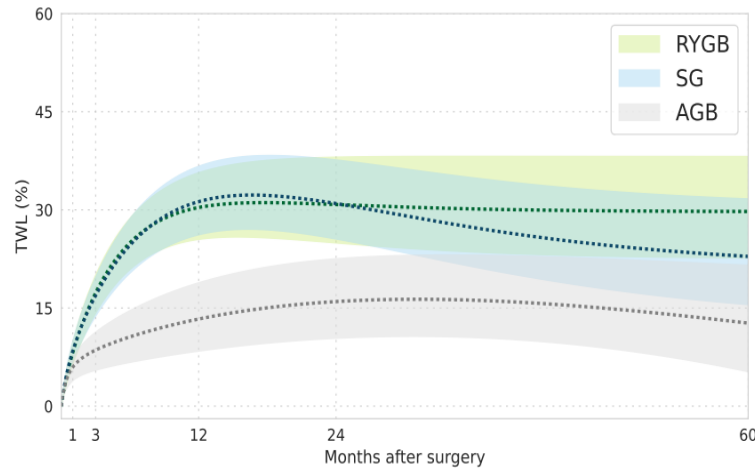
Model prediction / Diabetes status



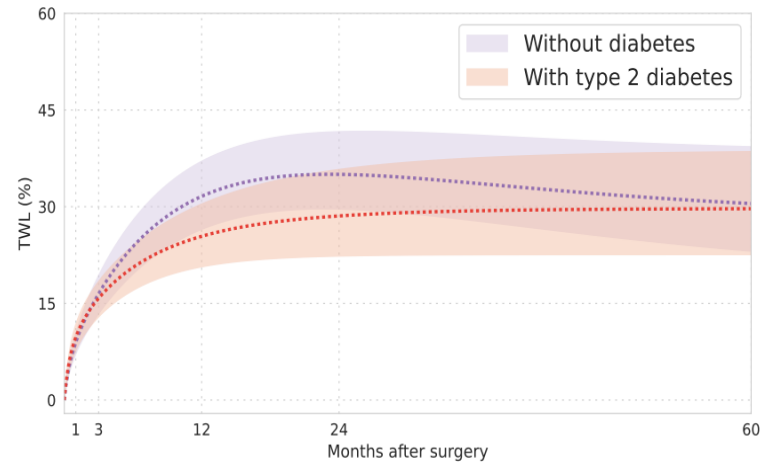
Saux et al. *Lancet Digital Health* 2023

Transportability in teenagers

2225 teenagers (12-19 y) followed in France and Sweden



Interventions



Type 2 diabetes

Marginal added value of Omics

Clinical model
+
GWAS / metabolomics / lipidomics / proteomics

Model	Prediction error (%)	Prediction error (kg)	Change from Lancet model (kg)
Lancet model ¹	8.22	10.81	-
Lancet model + All omics	7.95	10.46	0.35 kg improvement
Extended model ²	7.93	10.43	0.38 kg improvement

Adding omics does not result in any clinically meaningful improvement!



¹ Assume that 120 kcal/day is missing

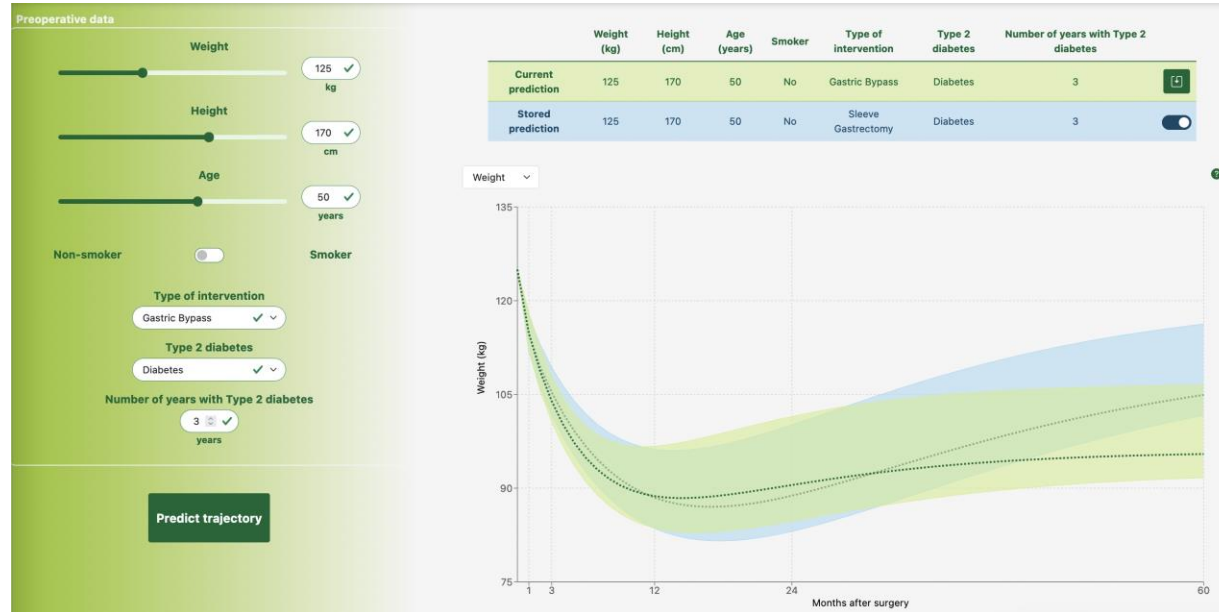
² Extended model includes Lancet model, additional clinical variables, and all omics

(Unpublished results)

The image shows a digital interface for the SOPHIA Bariatric Weight Trajectory Prediction tool. The interface is green and white. At the top, it says "SOPHIA Bariatric Weight Trajectory Prediction". Below this, there is a "Patient" section with sliders for Weight (120 kg), Height (170 cm), and Age (30 years). There are also checkboxes for "Non-smoker" and "Smoker", and a dropdown for "Type 2 diabetes" (set to "Diabetes"). Below this is a "Diabetes duration" section with a slider set to 5 years. The "Surgery" section has a dropdown for "Type of intervention" (set to "Gastric Bypass"). At the bottom is a green button labeled "Predict trajectory". A line from the table in the previous block points to the "Lancet model + All omics" row, which is highlighted in yellow.

Shared clinical decisions

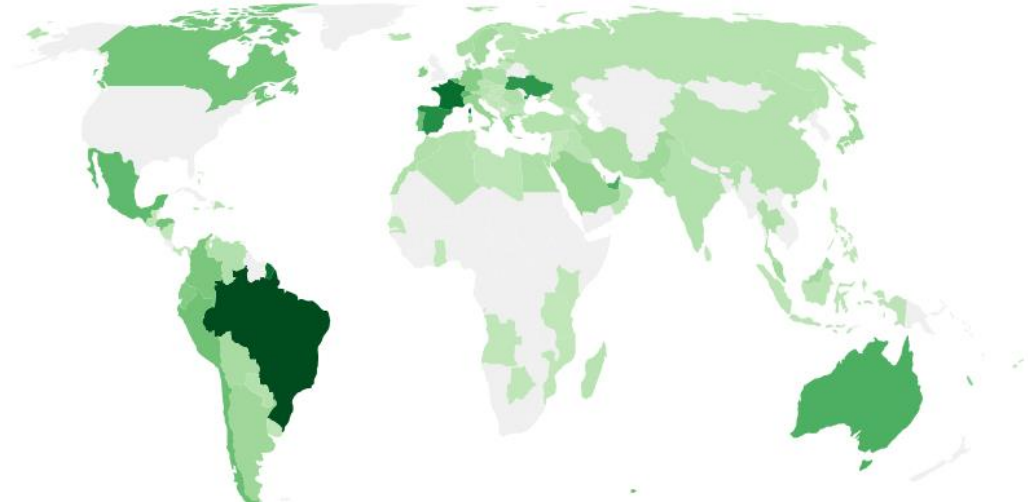
1.0 M
>1500 / day



Global diffusion

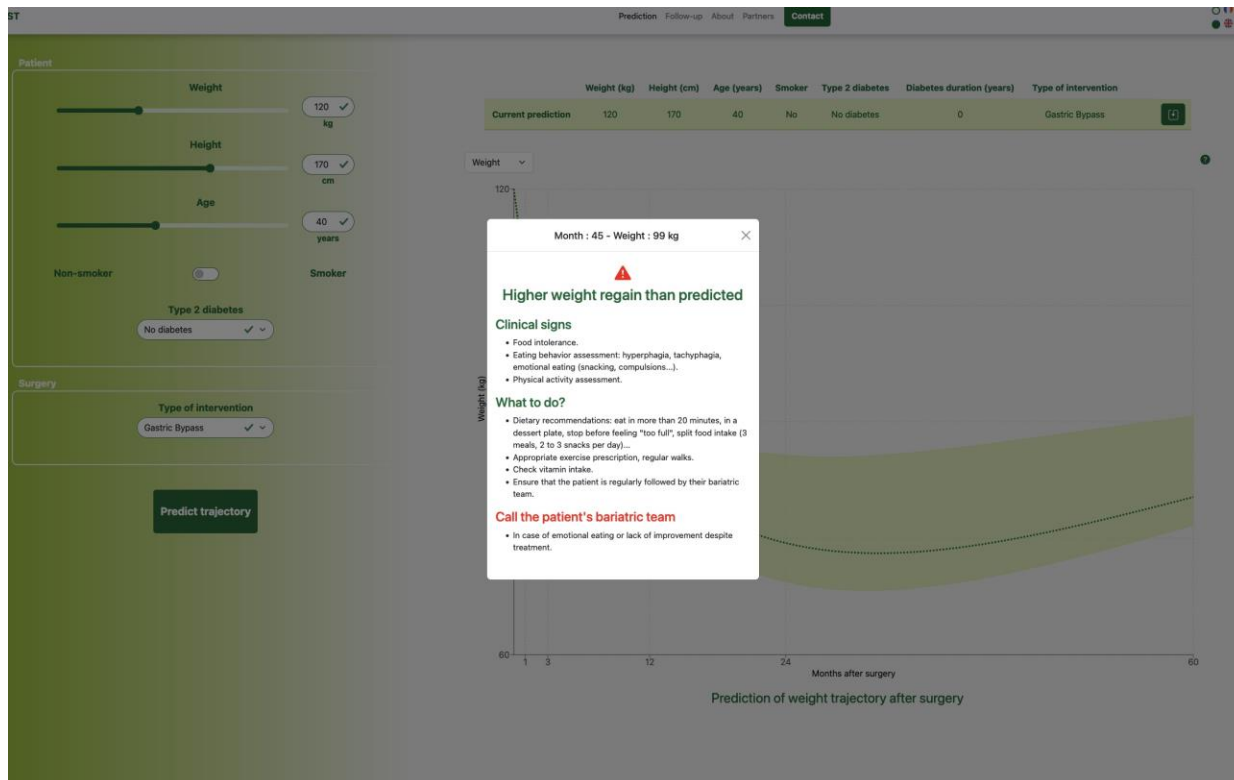


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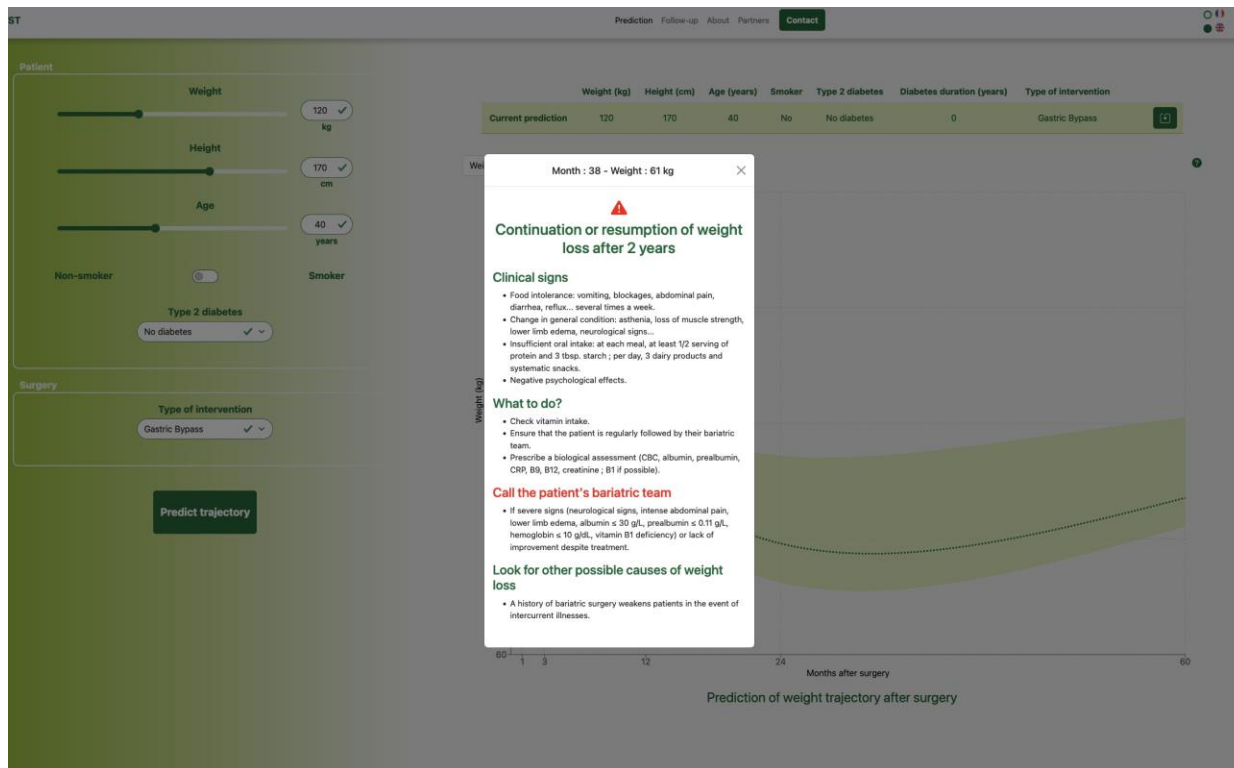


740 k connexions worldwide (>1000 / day)

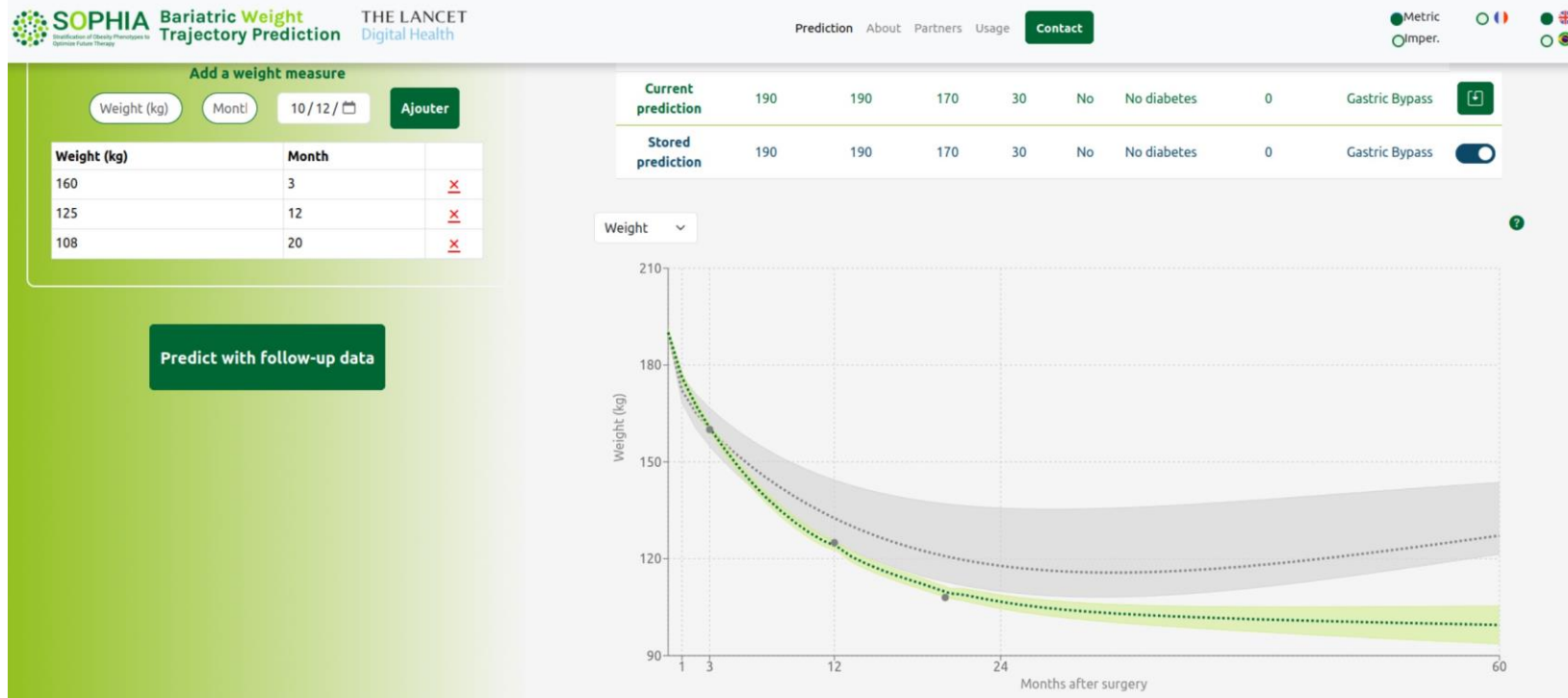
Post-op follow-up ...



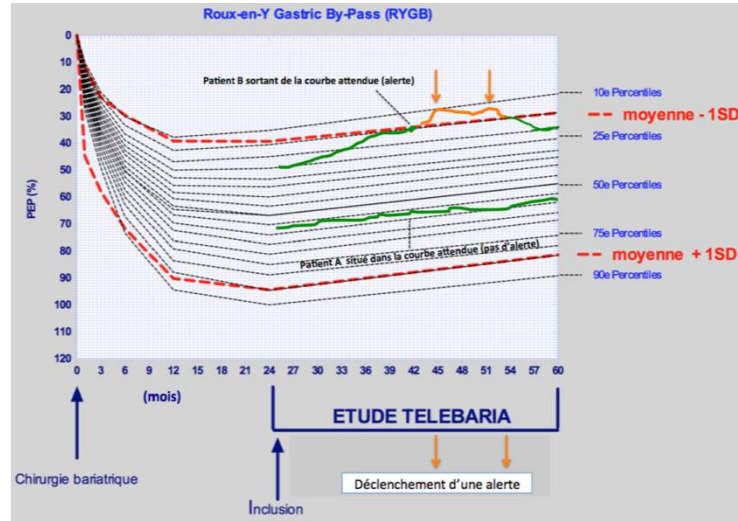
Post-op follow-up ...



Dynamic predictions ...



Clinical validation / RCT



Telebaria PRME) : multicenter randomized clinical trials in 300 patients

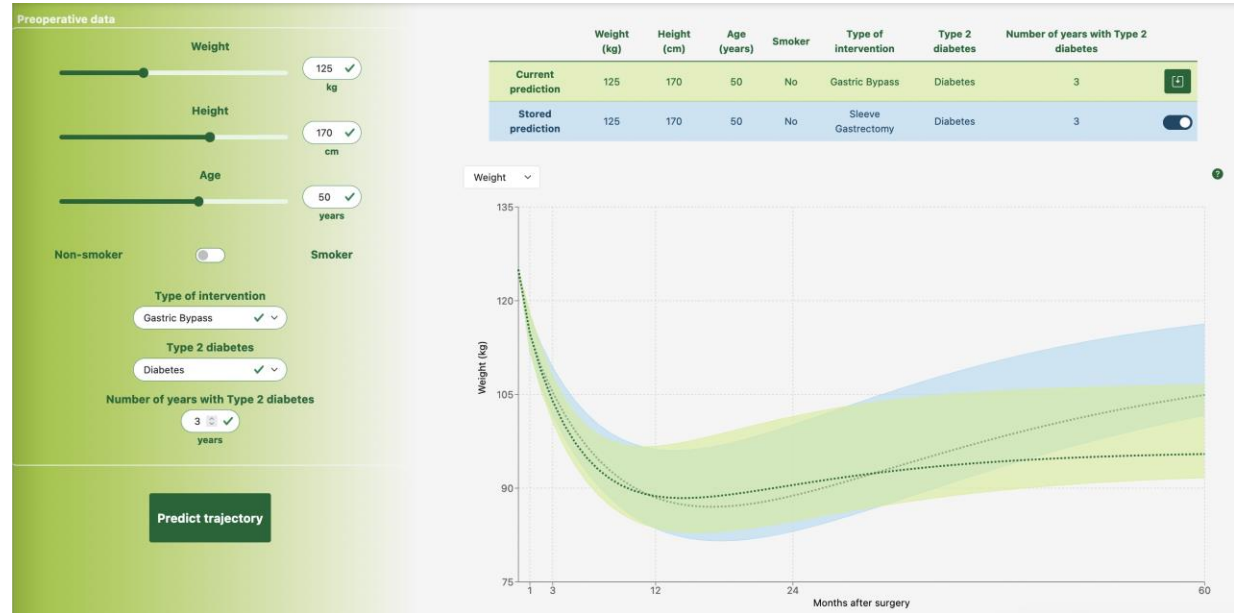
What's next ?

AI enabled predicting tools -> personalized predictions follow-up

- > interventions (new procedures, drugs, multimodal interventions)
- > populations (ethnic groups, data driven obesity endotypes)
- > exposures (omics, exposome)
- > outcomes (adverse effects, MASLD, major clinical events, survival)

Informed decision and treatment monitoring -> Precision obesity medicine

Free and available on line, just try it !



<https://bwtp.univ-lille.fr>