

# AI and Health

## Trauma Matrix

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8 mars 2019

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# Research activities

- Dimensionality reduction methods to visualize complex data (PCA based) : multi-sources, textual, arrays, questionnaire
- Low rank estimation, selection of regularization parameters
- Missing values - matrix completion
- Causal inference
- Fields of application : bio-sciences (agronomy, sensory analysis), health data (hospital data)
- R community : book R for Stat, R foundation, taskforce, packages :  
[FactoMineR](#) explore continuous, categorical, multiple contingency tables (correspondence analysis), combine clustering and PC, ..  
[MissMDA](#) for single and multiple imputation, PCA with missing  
[denoiseR](#) to denoise data with low-rank estimation  
[R-miss-tastic](#) missing values platform

# Collaborators

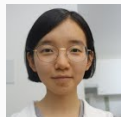
PhD students : G. Robin, W. Jiang, I. Mayer, N. Prost, polytechnique

Colleagues : J-P Nadal (EHESS), E. Scornet (X), G. Varoquaux (INRIA), S.

Wager (Stanford), B. Naras (Stanford)

Traumabase (APHP) : T. Gauss, S. Hamada, J-D Moyer

Support : PEPS (AMIES) - DataIA - Capgemini



**Major trauma** : any injury that endangers the life or the functional integrity of a person. Road traffic accidents, interpersonal violence, self-harm, falls, etc → hemorrhage and traumatic brain injury.

**Major source of mortality and handicap in France and worldwide**  
(3rd cause of death, 1st cause for 16-45 - 2-3th cause of disability)

⇒ A public health challenge

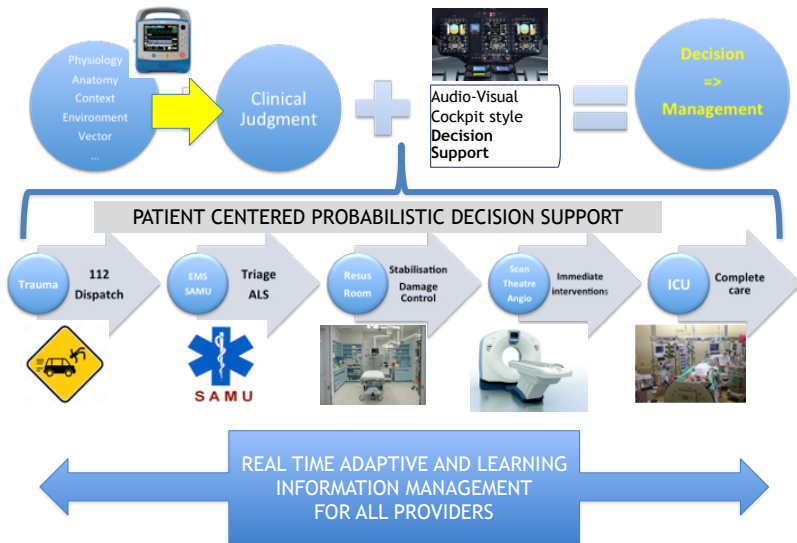
Patient prognosis can be improved : **standardized and reproducible procedures** but **personalized** for the patient and the trauma system.

Trauma decision making : rapid and **complex decisions** under **time pressure** in a dynamic and multi-player environment (fragmentation : loss or distortion of information) with high levels of uncertainty and **stress**.

Issues : patient management exceeds time frames, diagnostic errors, decisions not reproducible, etc

⇒ Can Machine Learning, AI help ?

# Decision support tool for the management of severe trauma : Traumamatrix



# Decision support tool for the management of severe trauma : Traumamatrix

TraumaMatrix : an integrative decision support and information management solution to clinicians for the first 24 hours of major trauma management to improve patient care and survival in major trauma.

- Analysis of the Traumabase
- Develop mathematical tools and machine learning models to predict trauma specific outcomes and decisions  
⇒ Scientific and methodological challenges
- Develop a user friendly and ergonomic interface for clinicians
- Test in real-time its impact on clinician decision making and patient outcome

⇒ Trans-disciplinary research and collaboration (medical, cognitive, mathematical, technological)

# Traumabase

15000 patients (4000 new/ year)/250 variables/11 hospitals, from 2011

	Center	Accident	Age	Sex	Weight	Height	BMI	BP	SBP
1	Beaujon	Fall	54	m	85	NR	NR	180	110
2	Lille	Other	33	m	80	1.8	24.69	130	62
3	Pitie Salpetriere	Gun	26	m	NR	NR	NR	131	62
4	Beaujon	AVP moto	63	m	80	1.8	24.69	145	89
6	Pitie Salpetriere	AVP bicycle	33	m	75	NR	NR	104	86
7	Toulon	AVP pedestrian	30	w	NR	NR	NR	107	66
9	HEGP	White weapon	16	m	98	1.92	26.58	118	54

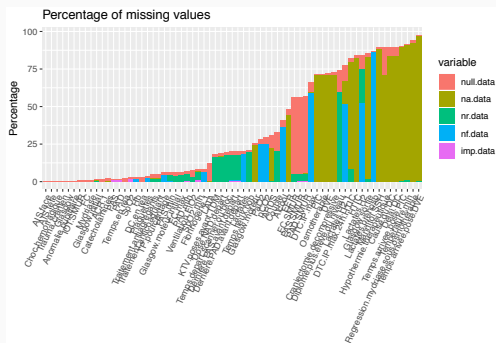
.....

	SpO2	Temperature	Lactates	Hb	Glasgow	Transfusion	.....
1	97	35.6	<NA>	12.7	12	yes	
2	100	36.5	4.8	11.1	15	no	
3	100	36	3.9	11.4	3	no	
4	100	36.7	1.66	13	15	yes	
6	100	36	NM	14.4	15	no	
7	100	36.6	NM	14.3	15	yes	
9	100	37.5	13	15.9	15	yes	

⇒ **Predict** the Glasgow score, whether to start a blood transfusion, to administer fresh frozen plasma, etc...

⇒ **Estimate causal effect** : administration of the treatment "tranexamic acid" (within the first 3 hours after the accident) on mortality for traumatic brain

⇒ Many missing values with different coding



⇒ Heterogeneous data (data integration, from different sources. Hospital effect : lack of standardization) - Evolutive data

⇒ High barriers to aggregation of medical data (privacy concerns, proprietary attitude towards data, complexity/size of aggregated data, updates problems). Data stay on each site : distribute computation



- Logistic regression with missing values. Prediction of hemorrhagic shock. W. Jiang (PhD, X), M. Lavielle (INRIA XPOP), TraumaBase
- On the consistency of supervised learning with missing values. G. Varoquaux (INRIA), E. Scornet (X)
- Causal inference (double robust) methods with missing values. S. Wager (Stanford), I Mayer (PhD, X-EHESS)
- Distributed multilevel matrix completion for medical databases. G. Robin (PhD, X), B. Narasimhan (Stanford), F. Husson (Agrocampus)
- Effect of fibrinogen on mortality in traumatic haemorrhagic shock : a propensity score analysis. TraumaBase, Polytechnique students
- Effect of tranexamic acid on mortality for head trauma patient. I. Mayer (PhD, X-EHESS), J-P Nadal (EHESS), TraumaBase