

# Predictive models for home palliative care

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# National Tumor Assistance (ANT) Foundation

<https://ant.it/>

- ✓ One of the largest European Organization in the field of **home supportive and palliative care for cancer patients**.
- ✓ The mission is to offer the possibility of **spending the last period of life in one's living environment**.
- ✓ **Multidisciplinary teams** of physicians, nurses, psychologists, and volunteers assist patients and their caregivers at home during the **different stages of the cancer disease**.
- ✓ The home care model employs a **hospital-at-home approach**, a **free service for the patients** which is offered in agreement with the NHS in over **11 Italian regions (29 cities)**.



# The database

**vitaever**  
INNOVATION FOR HOME CARE



- ✓ The database included **data exported from the clinical electronic records (25 parameters) of 10.000 advanced cancer patients** assisted by ANT Foundation during **2020 and 2021**.
- ✓ The censored data from **7.150 patients assisted until death** were considered for the analysis.

# Aim

**Define predictive models (assistance duration, care intensity and pain therapy) for clinical practice to improve the organization of multidisciplinary teams, facilitate treatment planning, optimize resource allocation and maximize the impact of care for patients and their families.**

# Data collection

## At the admission

- Demographics (sex, age, city)
- Diagnosis
- Functional status (KPS)
- Oncological therapy
- Pain therapy
- Symptoms

## Each home visit

- Functional status (KPS)
- Symptoms
- Pain therapy

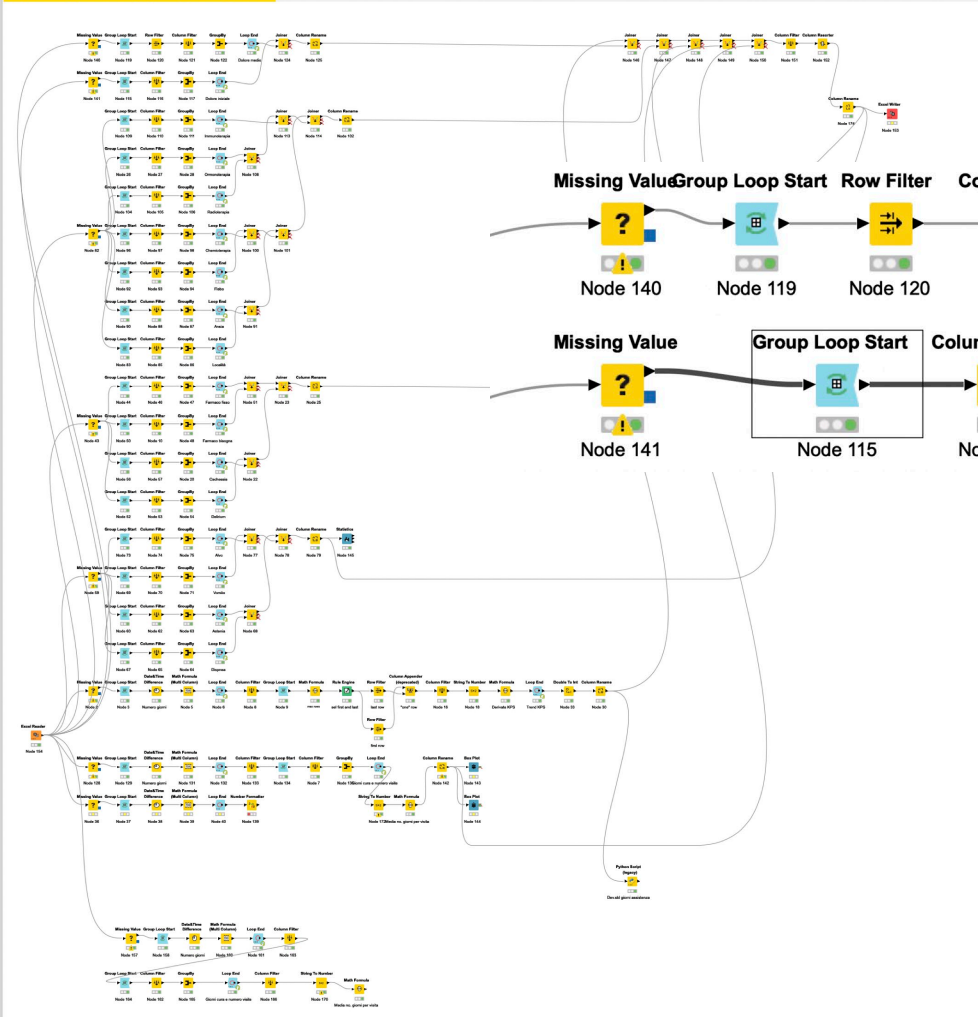
## Assistance

- Duration (days from the entry in home care to death);
- Number of physician home visits
- Pain therapy trend

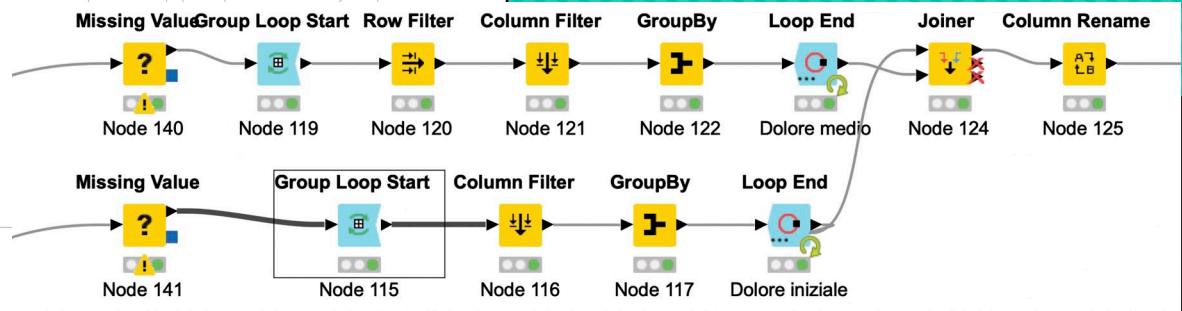
# The starting database: from Vitaever to Excel

	A	B	C	E	G	H	I	J	K	L	M	N	O	P
1	id	valore	data_inizio_assistenza	diagnosi	data_rilevazione	N. sintomo	astenia	dispnea	vomito	KPS	alvo	dolore_nrs	farmaco_fisso	farmaco_bisogna
2	226328	BARI	09/01/2020	tumori maligni di altre sedi specificate della pleura	09/01/2020	1	2	1	assente	20	stipsi	0	nessuna	nessuna
3	226328	BARI	09/01/2020	tumori maligni di altre sedi specificate della pleura		2								
4	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	17/01/2020	1	2	1	assente	50	regolare	0	nessuna	nessuna
5	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	23/01/2020	2	2	1	assente	50	regolare	0	nessuna	nessuna
6	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	05/02/2020	3	1	0	assente	50	regolare	0	nessuna	nessuna
7	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	10/02/2020	4	1	0	assente	50	regolare	0	nessuna	nessuna
8	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	14/02/2020	5	1	1	assente	50	regolare	0	nessuna	FANS/Paracetamolo
9	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	28/02/2020	6	1	0	assente	50	regolare	0	nessuna	FANS/Paracetamolo
10	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	30/03/2020	7	2	0	nausea	40	stipsi	5	oppiacei minori	FANS/Paracetamolo
11	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato	01/04/2020	8	2	1	nausea	30	stipsi	Non valutabile	oppiacei maggiori	morfina
12	226349	MARCHE SUD	17/01/2020	tumori maligni primitivi del fegato		9								
13	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	02/01/2020	1	2	0	nausea	40	regolare	0	nessuna	morfina
14	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	07/01/2020	2	2	0	assente	30	regolare	0	nessuna	nessuna
15	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	10/01/2020	3	2	0	assente	40	regolare	0	nessuna	nessuna
16	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	05/03/2020	4	1	0	assente	50	regolare	0	nessuna	nessuna
17	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	08/06/2020	5	2	0	assente	40	regolare	0	nessuna	FANS/Paracetamolo
18	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	13/07/2020	6	2	0	assente	30	regolare	0	nessuna	FANS/Paracetamolo
19	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	21/07/2020	7	2	0	assente	40	regolare	Non valutabile	nessuna	nessuna
20	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	06/08/2020	8	1	1	assente	30	regolare	Non valutabile	olo FANS/Paracetamol	FANS/Paracetamolo
21	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	11/08/2020	9	2	1	assente	30	regolare	0	olo FANS/Paracetamol	FANS/Paracetamolo
22	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	14/08/2020	10	2	1	assente	30	regolare	0	olo FANS/Paracetamol	FANS/Paracetamolo
23	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	18/08/2020	11	2	0	assente	30	regolare	0	olo FANS/Paracetamol	FANS/Paracetamolo
24	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	24/08/2020	12	2	0	assente	30	regolare	0	nessuna	FANS/Paracetamolo
25	226474	PESARO	02/01/2020	tumori maligni del colon,non specificato	27/08/2020	13	2	0	assente	30	regolare	0	nessuna	FANS/Paracetamolo

**A total of 110.000 rows**



# Data processing



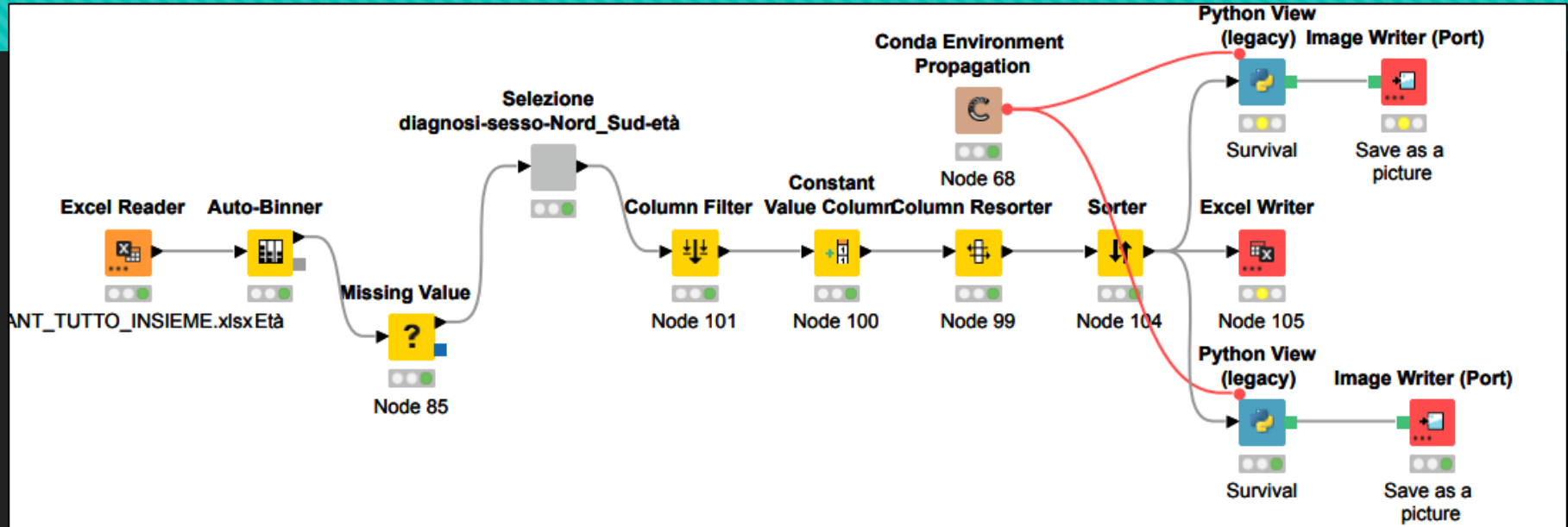
Each variable was differently processed to obtain a row for each patient.

# An ordered sheet with one row for each patient

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	ID	Città	data_inizio_assistenza	Età	sexso	Diagnosi_categoria	KPS Iniziale	KPS Finale	Giorni assistenza	Trend KPS /giorno	Intensità dolore	Dolore iniziale	Astenia frequenza	Dispnea frequenza	Vomi
2	226328	BARI	2020-01-09	67	M	Respiratory tract	70	40	30	1,0	0	0	2	1	
3	226349	MARCHE SUD	2020-01-17	80	M	Gastrointestinal	50	20	75	0,4	0	0	2	0	
4	226474	PESARO	2020-01-02	72	M	Gastrointestinal	60	40	261	0,1	0	0	2	0	
5	226477	BOLOGNA	2020-01-02	70	M	Gastrointestinal	80	40	30	1,3	0	7	1	0	
6	226480	BOLOGNA	2020-01-02	82	M	Respiratory tract	40	10	15	2,0	0	0	2	0	
7	226482	TOSCANA	2020-01-02	80	F	Head & Neck	60	50	172	0,1	2	7	1	0	
8	226483	BOLOGNA	2020-01-02	70	F	Respiratory tract	50	40	26	0,4	5	5	2	2	
9	226485	BOLOGNA	2020-01-02	74	M	Head & Neck	50	40	81	0,1	3	6	1	0	
10	226488	BOLOGNA	2020-01-02	93	F	Bone & Soft tissues	40	20	75	0,3	0	0	2	0	
11	226491	RIMINI	2020-01-02	85	F	Hematological	90	40	10	5,0	0	0	0	0	
12	226492	BOLOGNA	2020-01-02	75	F	Gastrointestinal	50	30	254	0,1	0	2	1	0	
13	226494	TOSCANA	2020-01-02	84	M	Gastrointestinal	50	40	52	0,2	0	4	2	0	
14	226496	BOLOGNA	2020-01-02	67	F	Respiratory tract	70	50	37	0,5	3	3	0	0	
15	226498	BARI	2020-01-02	80	M	Respiratory tract	50	10	115	0,3	0	1	2	0	
16	226499	TARANTO	2020-01-02	71	M	Urinary	40	30	20	0,5	2	2	2	1	
17	226500	BOLOGNA	2020-01-02	60	M	Head & Neck	60	40	26	0,8	Non valutabile	Non valutabile	2	0	
18	226501	BARI	2020-01-03	93	M	Genital tract	50	40	13	0,8	0	0	2	0	
19	226506	BRESCIA	2020-01-02	56	F	Breast	50	40	21	0,5	3	3	1	0	
20	226507	MARCHE SUD	2020-01-21	84	M	Respiratory tract	50	40	3	3,3	0	0	2	0	
21	226508	MARCHE SUD	2020-01-03	80	M	Hematological	40	40	10	0,0	0	1	2	0	

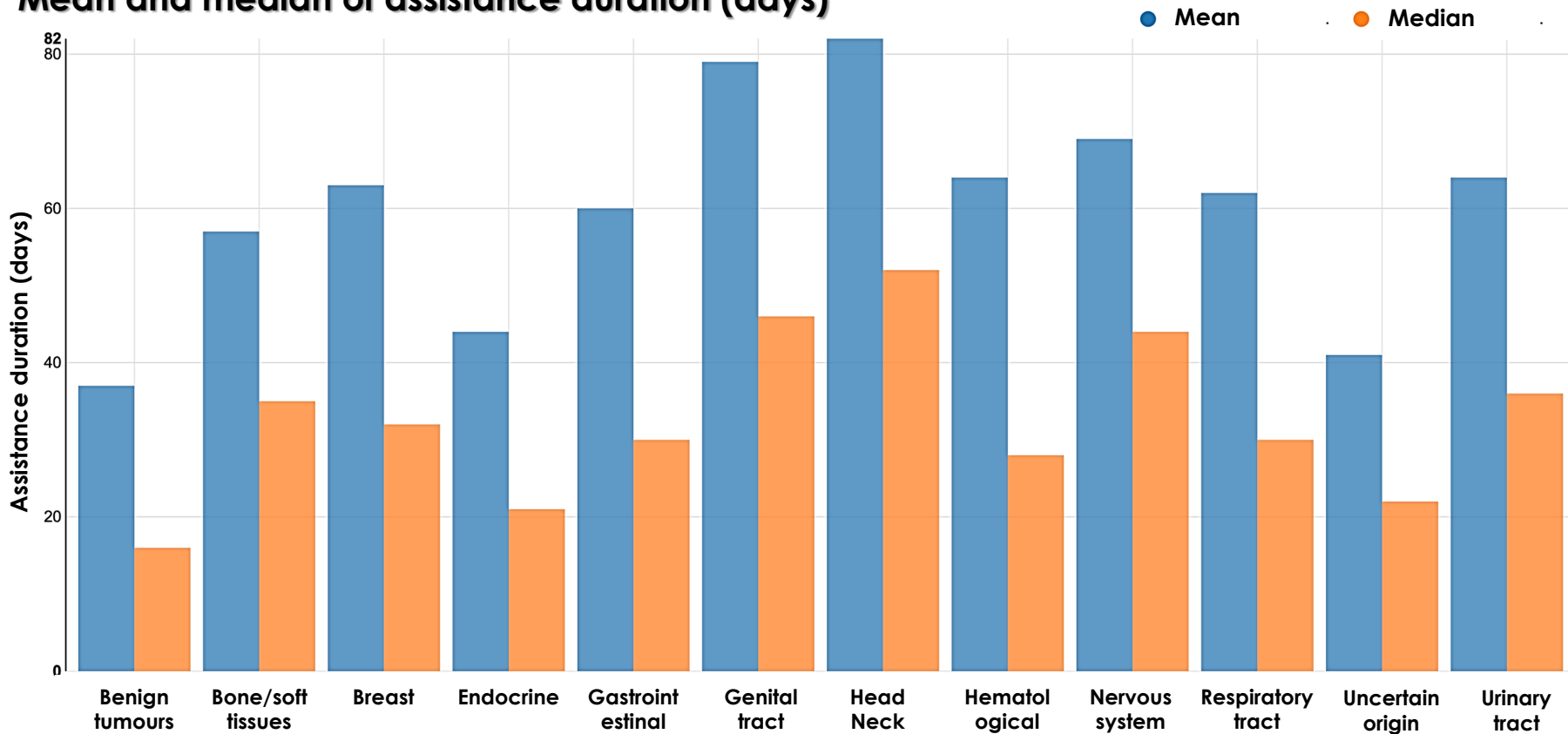


# Survival analysis

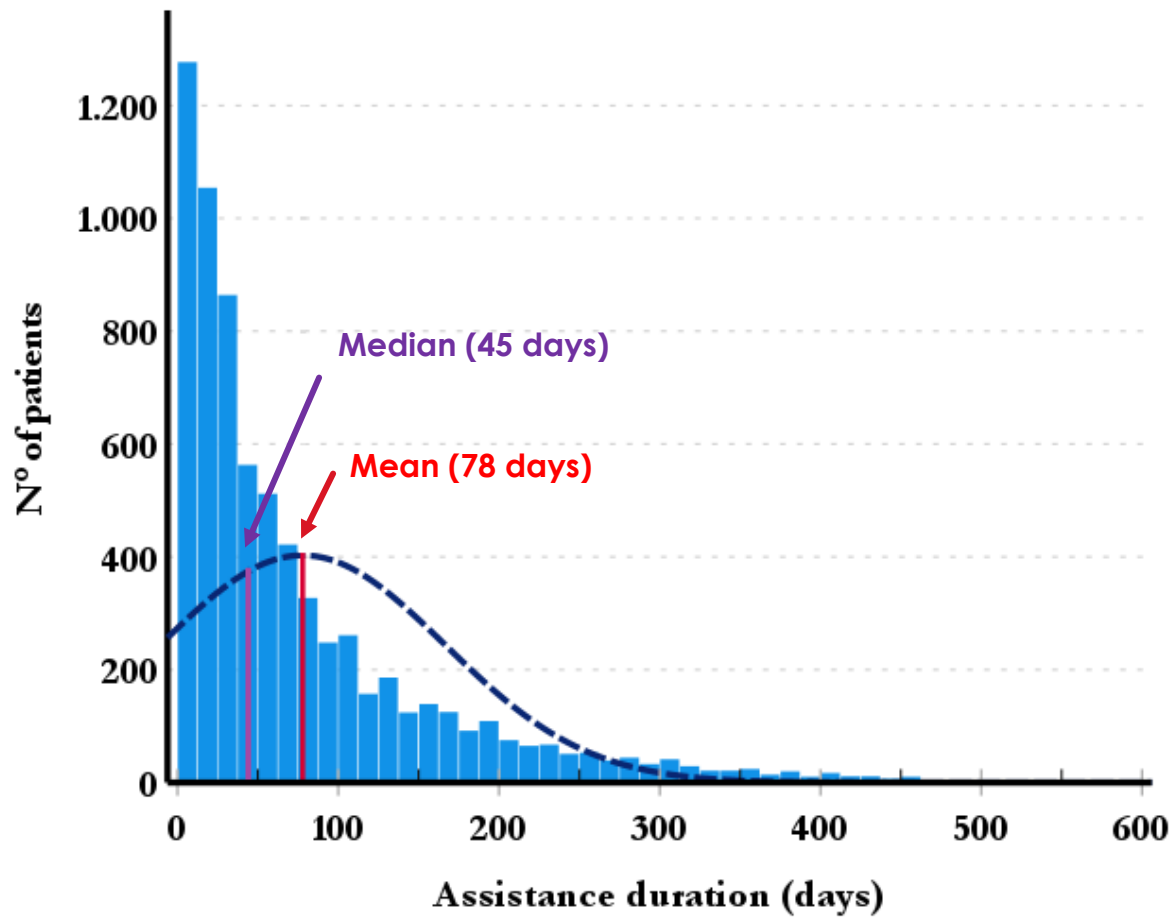


Exploratory data analysis: **Cox-regression** to evaluate the assistance duration based on diagnosis, age, sex, and geographical area.

## Mean and median of assistance duration (days)



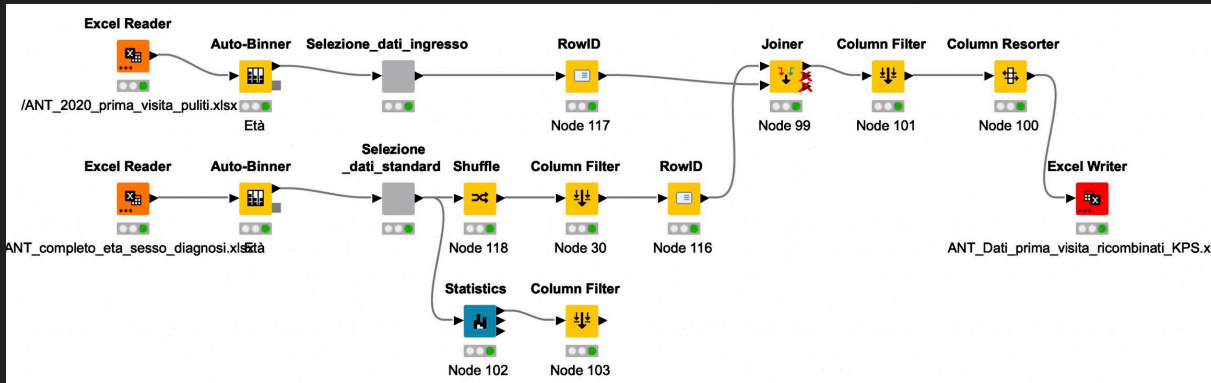
Diagnosis



# May we create predictive models for the care duration and intensity?

- We used all data from most of the patients to create the model.
- We verified the quality of the model using 12 patients considering only the data at the admission and integrating them with data from the assistance pathway of patients with similar clinical condition and sociodemographic characteristics.
- We used two algorithms: **XGBoost** and **AutoML**.

# Admission data integration



Select neighborhood group:

Sesso

M  F

Select neighborhood group:

Località\_nord\_sud

Sud  Nord

Select neighborhood group:

Diagnosi\_categoria

Respiratory tract  
 Gastrointestinal  
 Head & Neck  
 Hematological  
 Urinary  
 Genital tract  
 Breast  
 Nervous system  
 Endocrine  
 Bone & Soft tissues  
 Uncertain origin  
 Benign tumors

Select neighborhood group:

Età [Binned]

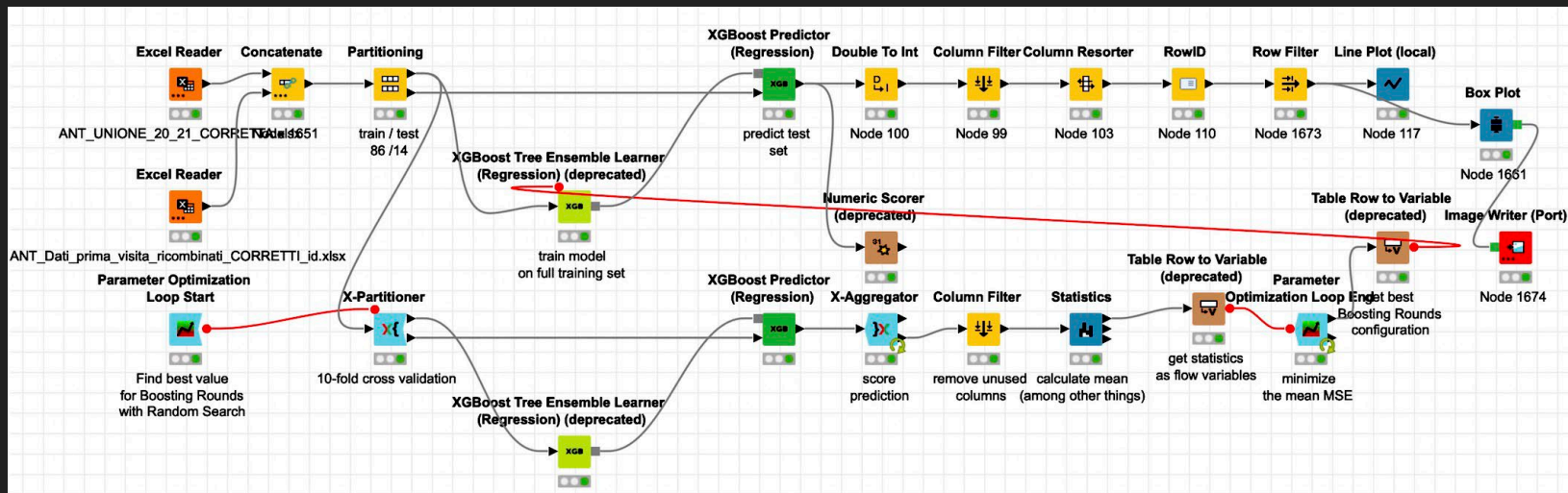
[0,12]  (12,23]  (23,34]  (34,45]  (45,57]  (57,68]  (68,79]  (79,90]  (90,101]

Select neighborhood group:

KPS Iniziale

20  
 50  
 40  
 80  
 60  
 100  
 30  
 70  
 10  
 90  
 0

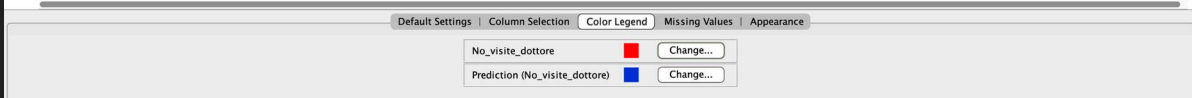
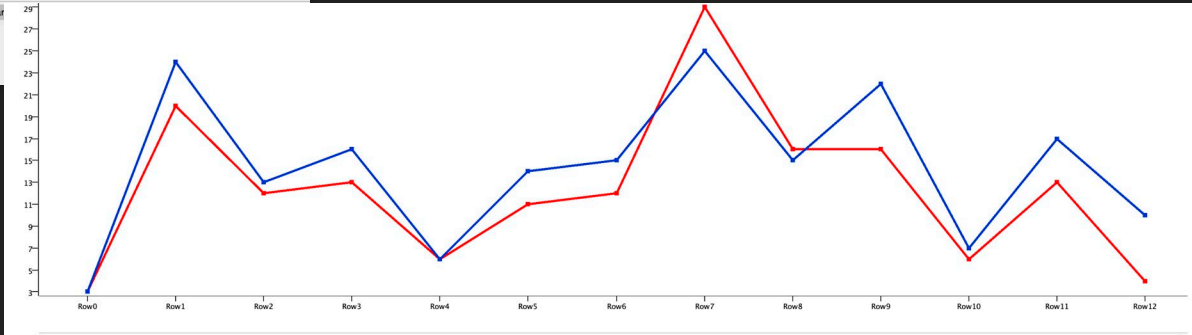
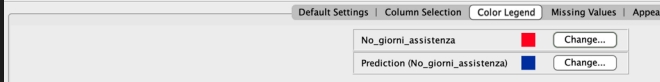
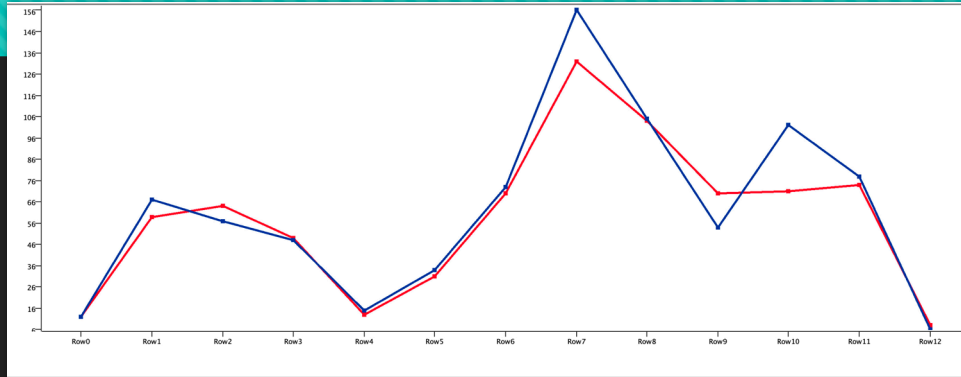
# Prediction of assistance duration



# Use of predictive models for the care duration and intensity

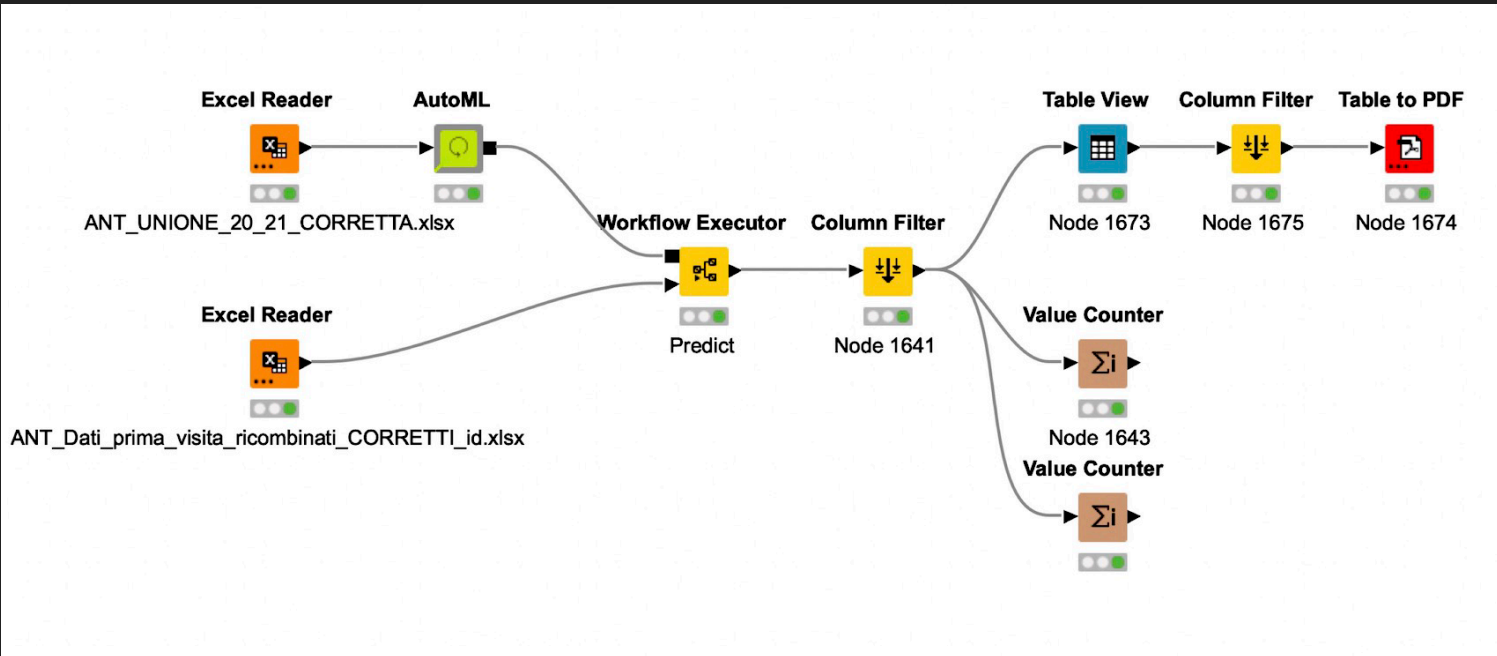
- We integrated the starting data of the patients with similar samples from the full database to create the model.
- We have two results from the workflow: the initial integrated data and the prediction from the algorithm.
- We use this prediction to prepare our resources forecast.

# Predictive model for assistance duration and for the number of physician visits





# Predictive model for the pain therapy



# Therapy for baseline pain

## KNIME Report

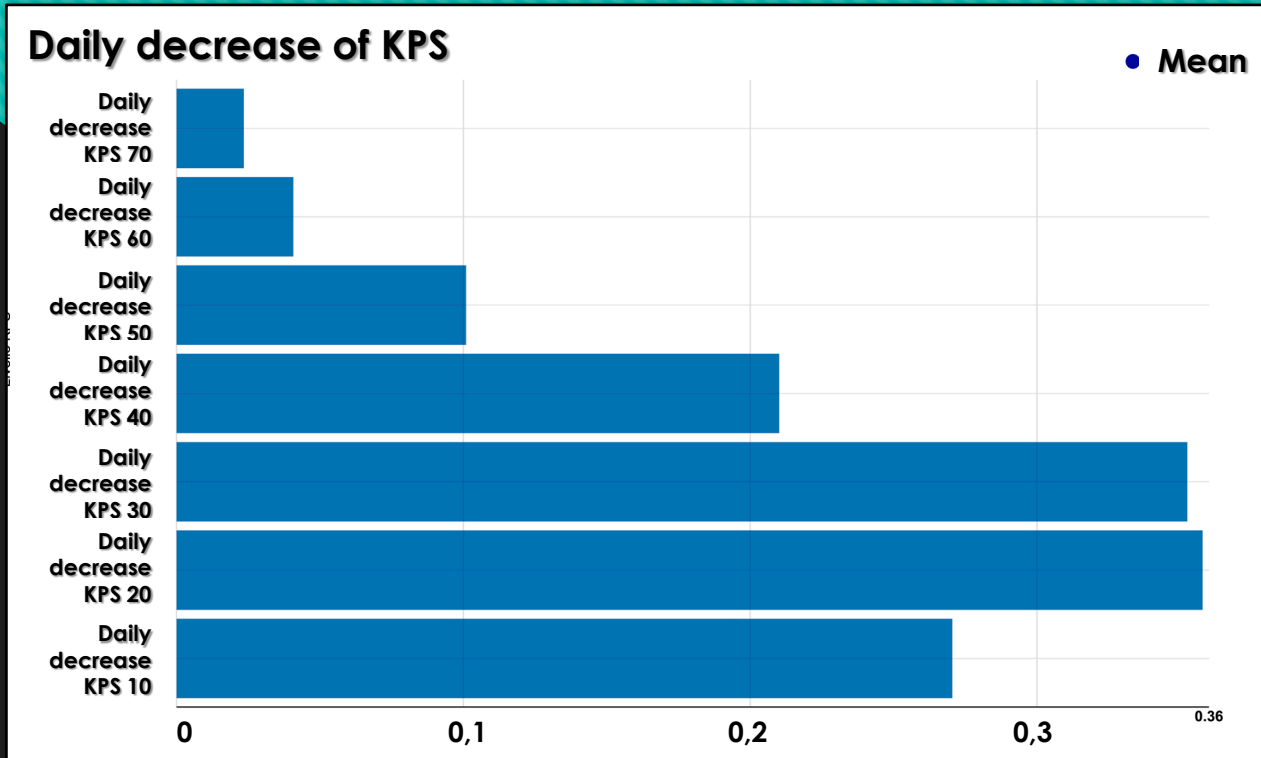
*Knime report powered by Birt*

"id"	"Pain therapy"	"Prediction (Pain therapy)"
453830	None	None
454208	None	None
454930	None	Strong opioids
455646	None	None
455844	Strong opioids	Strong opioids
456364	None	None
457098	Strong opioids	Strong opioids
457170	None	None
457204	Codein or tramadol	Strong opioids
457890	Paracetamol or NSAIDs	Strong opioids
459462	None	None
459528	Strong opioids	Strong opioids

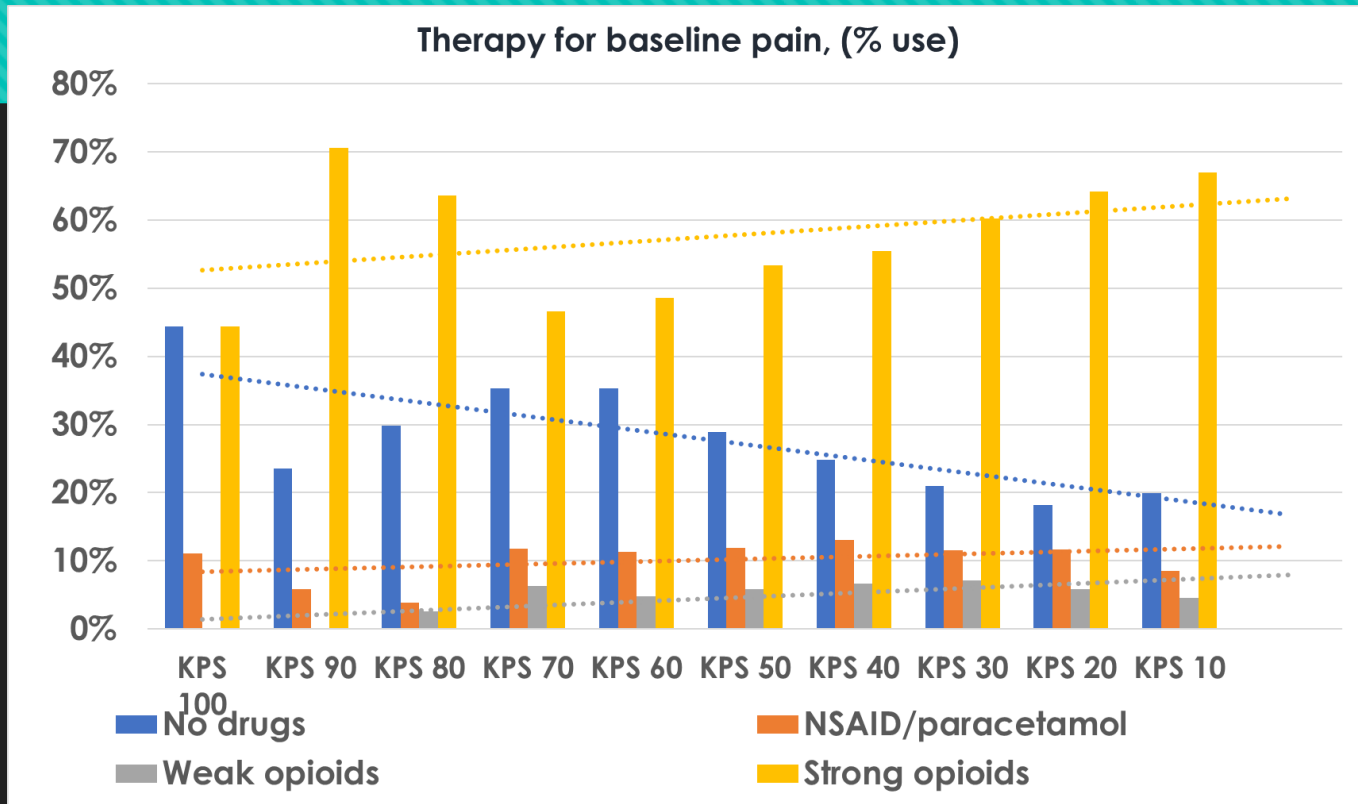
# Karnofsky Performance Status (KPS)

<b>100%</b>	Normal, no complaints, no evidence of disease.
<b>90%</b>	Able to carry on normal activity; minor signs or symptoms of disease.
<b>80%</b>	Normal activity with effort; some signs or symptoms of disease.
<b>70%</b>	Care for self; unable to carry on normal activity or to do active work.
<b>60%</b>	Requires occasional assistance, but is able to care for most of his/her personal needs.
<b>50%</b>	Requires considerable assistance and frequent medical care.
<b>40%</b>	Disable; requires special care and assistance.
<b>30%</b>	Severely disabled; hospital admission is indicated although death is not imminent.
<b>20%</b>	Very sick; hospital admission necessary; active supportive treatment necessary.
<b>10%</b>	Moribund; fatal processes progressing rapidly.
<b>0%</b>	Dead.

# Disease trajectory



# Functional status and pain therapy



# Future perspectives

- Refine these predictive models and supply them with the data of the new patients entering in care to obtain a tool always updated and integrated into clinical practice.
- Deepen the study of disease trajectories to offer a more and more appropriate and timely care tailored on the multidimensional needs of the patient during all phases of the disease.

# The feedback messages of the families assisted by the ANT Foundation

