



agence de la  
Biomédecine

# Operational maps for dialysis centers access time in France

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# 1 - Context

## The REIN registry

**The French Renal Epidemiology and Information Network (REIN) registry started in 2002 :**

- to provide a tool for public health decision support
- For evaluation and research related to renal replacement therapies for end-stage renal disease (ESRD).

**Main objectives :**

- To describe the incidence and prevalence of dialysis treatments
- To characterize the treated population
- To describe mortality
- To describe treatment modality

**Institutional Support : Agence de la biomédecine (health public body)**

**→ 22 local organizations corresponding to the 22 French regions**

# 1 - Context

## Base figures

### In 2008 in France :

- ESRD prevalence : 68 000 patients (12/31/2008) : 37 000 in dialysis, 31 000 transplants.
- ESRD incidence : 9 300 new cases by year (146 pmp, 361 for US)

The transport time between home and dialysis center is a medical indicator and an economic indicator :

- Dialysis budget : 4 billions € in 2007 (national health insurance)
- The travel cost represents 13% of dialysis budget

It's also an indicator for public health decision :

- In 2003, 7.5% of patients were over 45 minutes to get to their dialysis center (Source : CNAM)

Quality of life (Health public law)

# 1 - Context

REIN's need

- To find a simple, reliable and generally applicable indicator of health care offer adequacy

Objective

- Offer operational documents for public health planification

Public

- Nephrologists and decision makers

# 1 - Context

## Method

- ➔ Pilot study in Bourgogne (Burgundy), because journey time is manually informed in the registry for this region, with internet trip planner for each patient

### 1/ Area description

- Population
- Prevalent localization in 2007

### 2/ Dialysis centers access

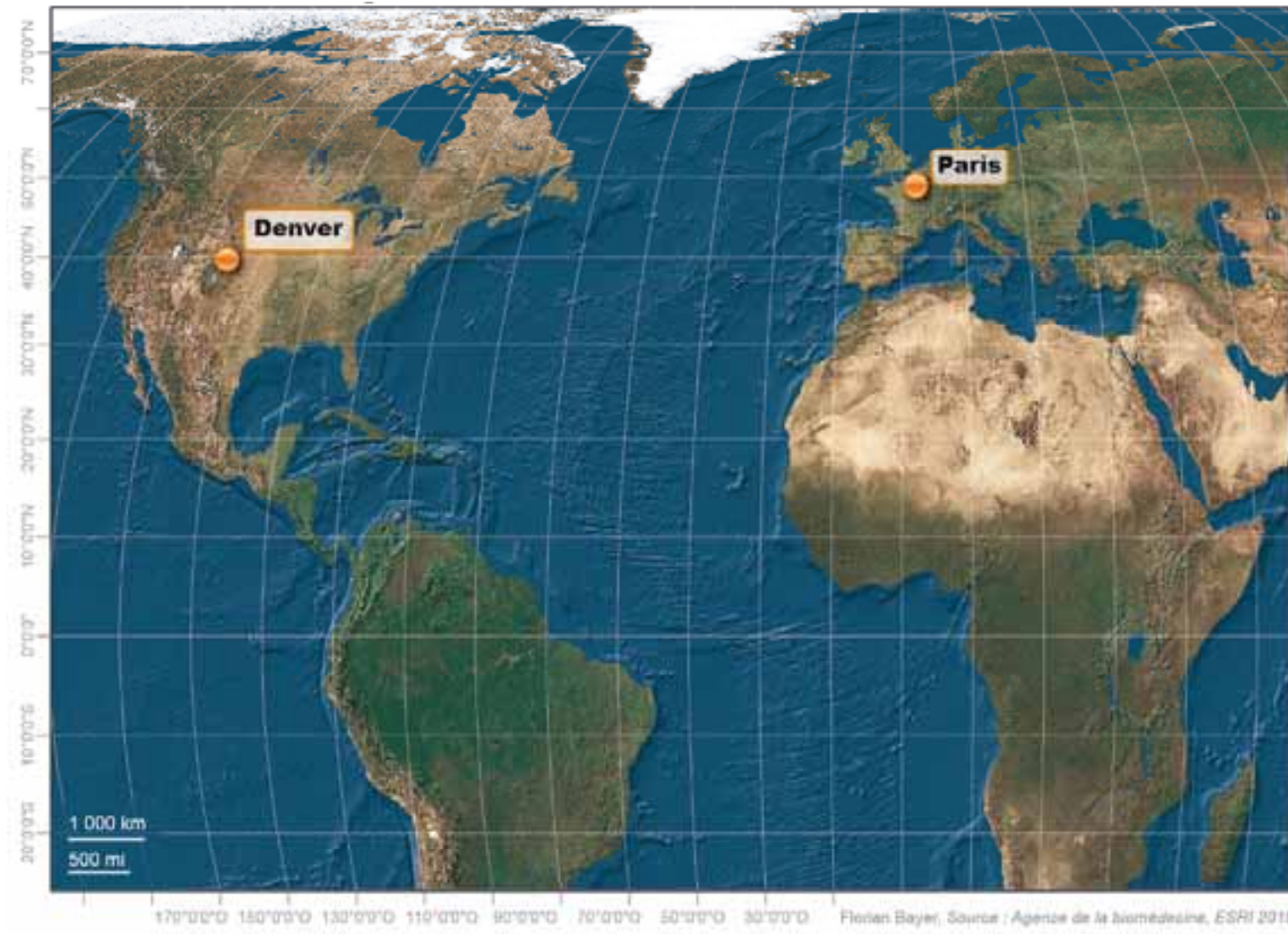
- « real » access time (registry report)
- theoretical access time calculation to the nearest dialysis center (model)

An aerial photograph of a study area, showing a mix of green fields and grey urban areas. A red dot is placed on a small orange building in the center of the image. The map is overlaid on a light grey background with a white grid.

# A- Study area description

## 1/ Territory and population

# A-1 Situation



# A-1 Situation

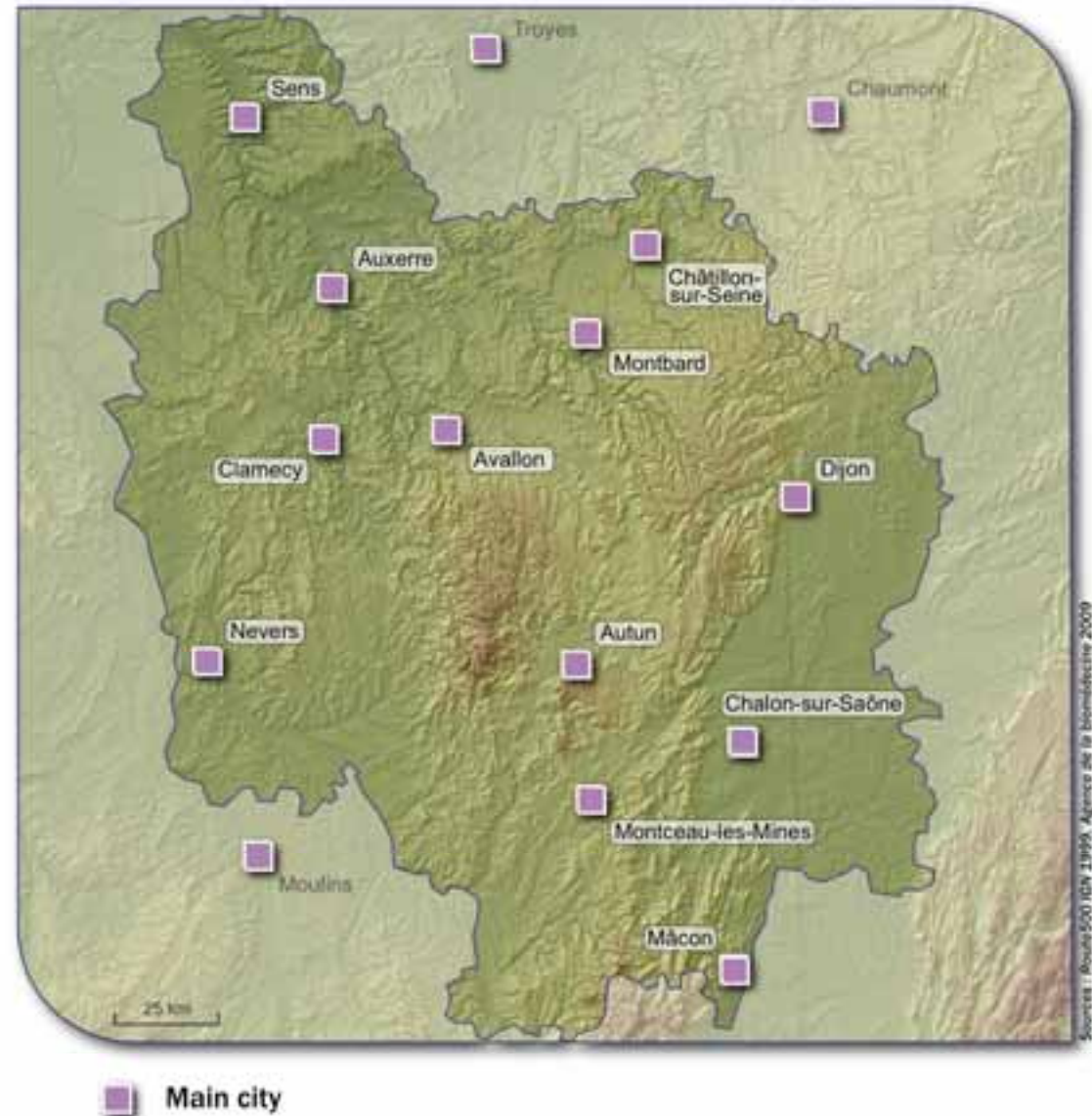


Source : Agence de la biomédecine 2010

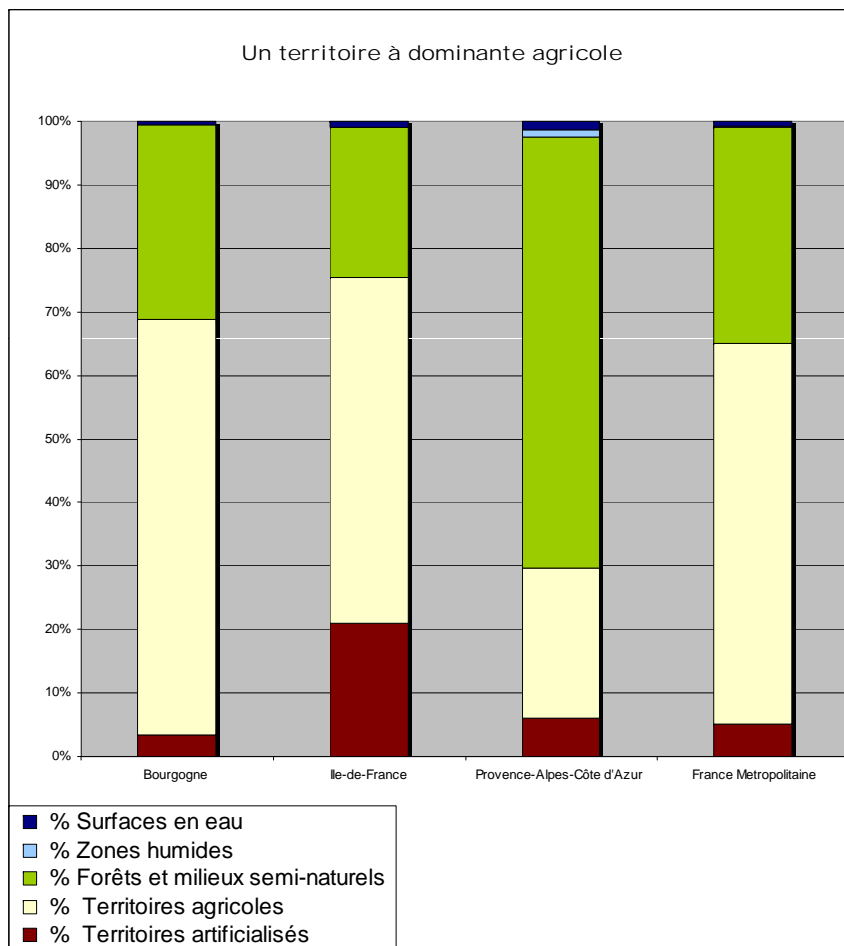


# A-1 Situation

## Some major cities in Bourgogne

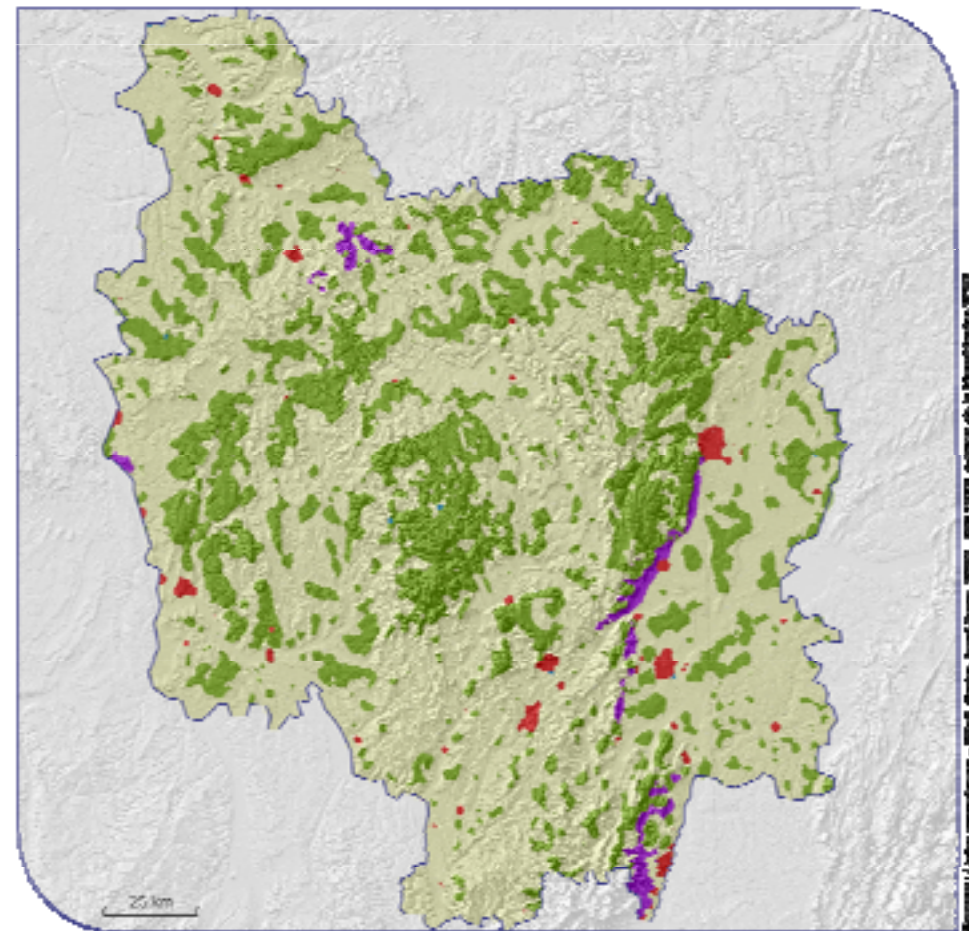


# A-1 Land occupation



Source : Union européenne – SOeS, CORINE Land Cover, 2006

## Une région à dominante agricole



### Typologie de l'occupation du sol : majorité dans un rayon de 200m



# A-1 Population

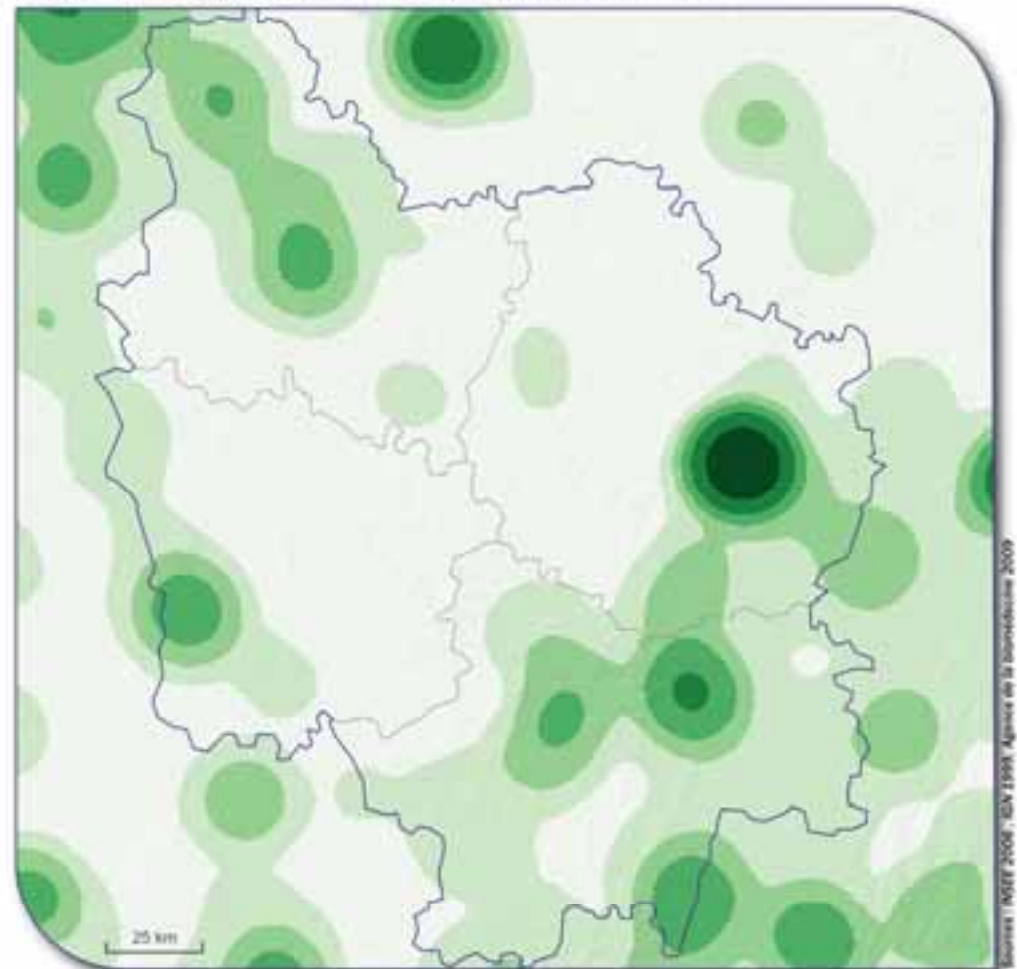
In 2006 (source INSEE) :

- 1 628 000 inhabitants
- 52% women, 48% men
- 25% of inhabitants are older than 60 years old
- 10% of inhabitants are older than 75 years old

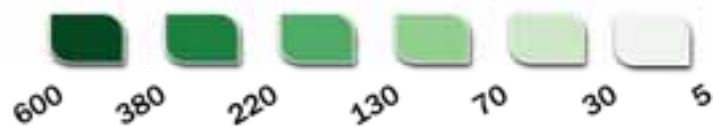
Main cities (inhabitants) :

- Dijon (150 000)
- Chalon-sur-Saône (50 000)
- Nevers (40 000)
- Auxerre (38 000)
- Mâcon (35 000)
- Sens (27 000)

The main population areas in 2006



Population density\* (inhabitants by km<sup>2</sup>)



\*Interpolation by quadratic neighbourhood, radius of 20 km at the town residence



# A-1 Population

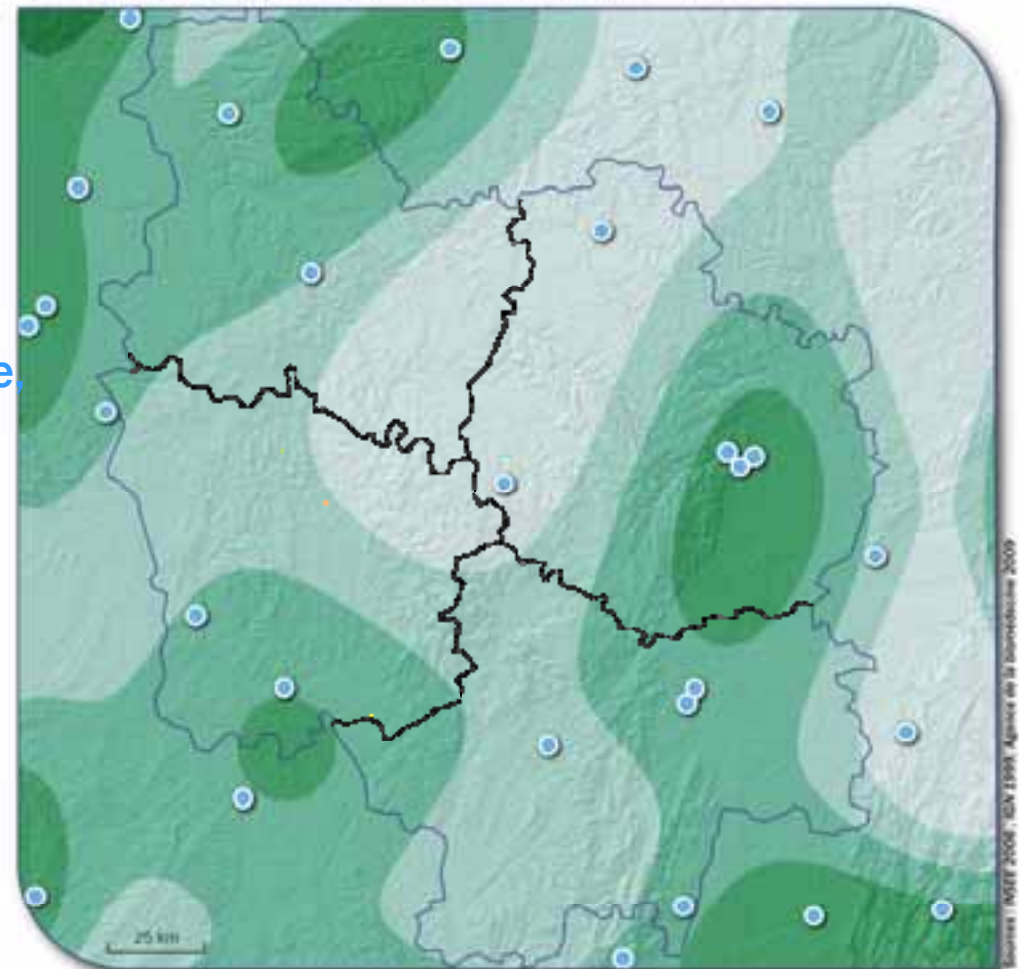
Population organized in 3 areas :

- North west : IDF, Troyes
- East : Vallée de la Saône
- South west : Nevers, Decize, Moulins

« Empty » areas :

- Morvan
- Auxois
- Vallée du Châtillonnais

Global population organization in 2006



Population concentration by extrapolation\*



\*Trend surface, order 12, 80% of the variance

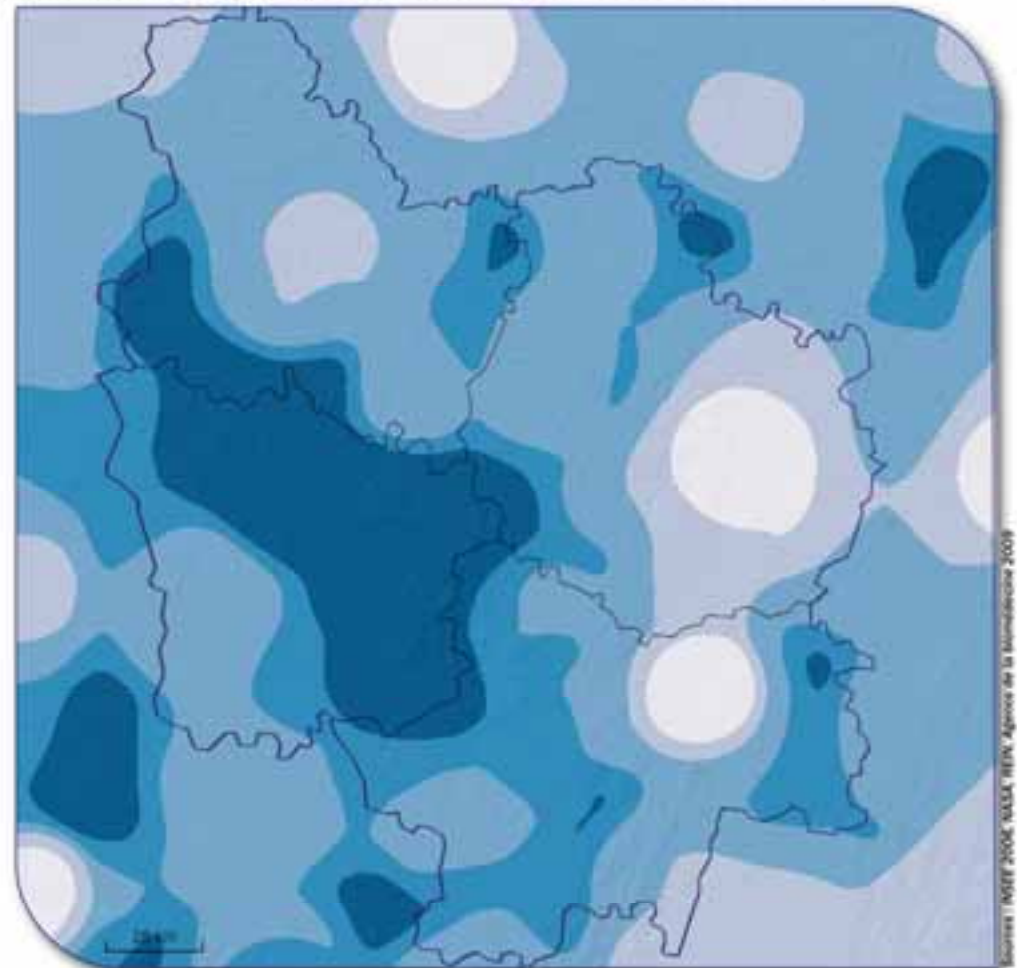
# A-1 Population (relative)

Relative trend :

- North and east Nièvre.
- Rural area

Bourgogne : settlement of retired people from Paris area

Part of the 60 years old and more in 2006



Percentage of the 60 years old and more compared to the global population at the place of residence\*



\*Quadratic smoothing, 20 km

# A- Study area description

2/ Cohort



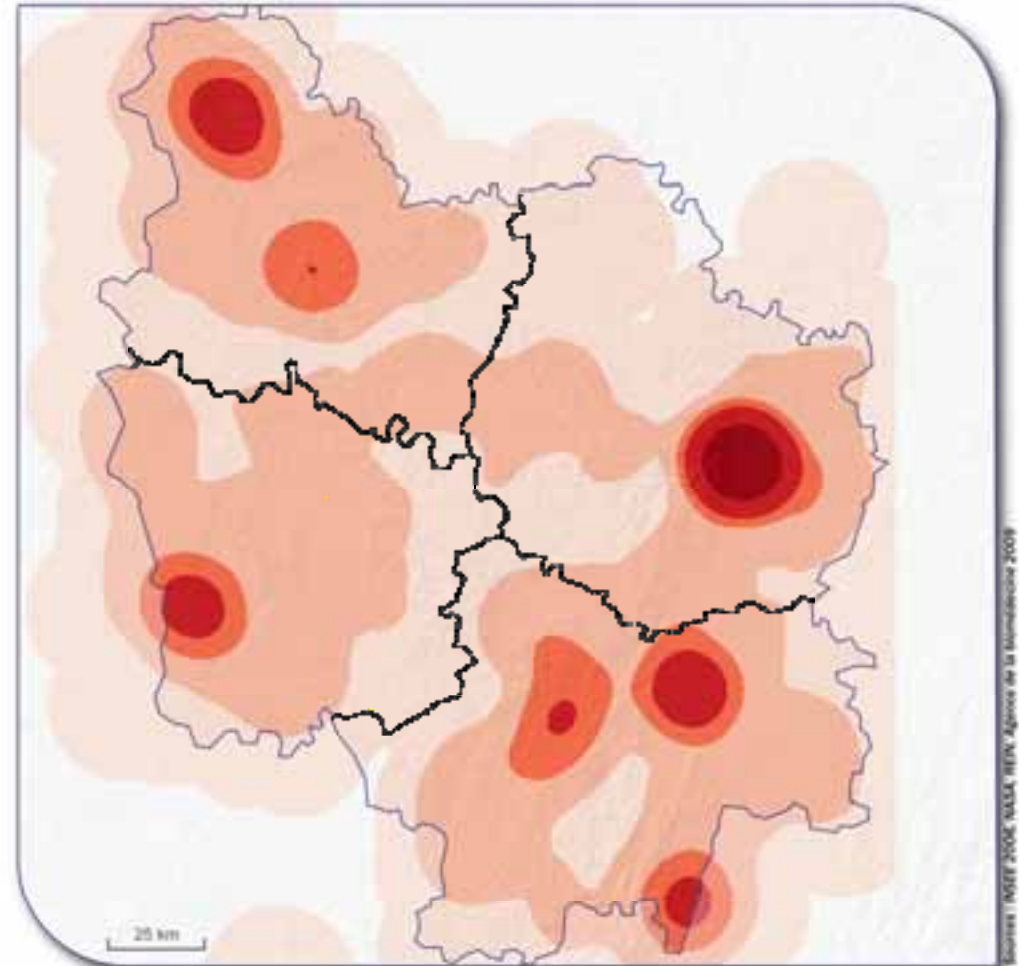
# A-2 Cohort

825 ESRD patients (12/31/07)

- 800 from all regions and treated in Bourgogne.
- 24 living in Bourgogne but treated in an another region
- 1 missing data

A cohort study of 824 patients all treatment modalities combined

**Spatial concentration of the patients in 2007**



**Number of patients treated in a dialysis center by 100 km<sup>2</sup> localized at the place of residence\***



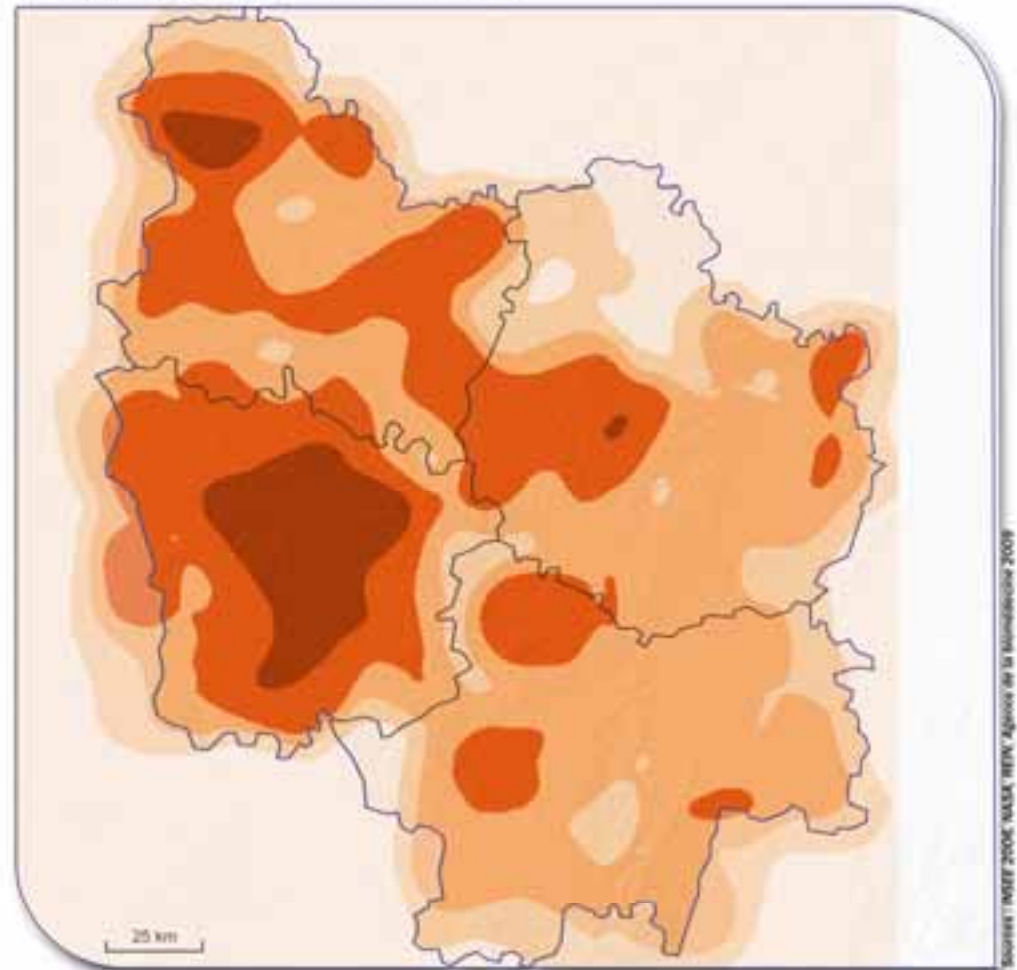
\*Quadratic smoothing, 20 km

# A-2 Cohort

507 pmp in dialysis (national : 577)

- Nièvre center
- Sens
- Autun
- Gueugnon

Global prevalence in 2007



Number of patients treated in a dialysis center for 10 000 inhabitants, localized at the place of residence\*



\*Quadratic smoothing, 20 km



# A- Study area description

## 3/ Dialysis in Bourgogne



# A-3 Situation

- 2007 : 20 dialysis centers in Bourgogne
- Nearby the main urban areas

Distribution of the dialysis centers in 2007

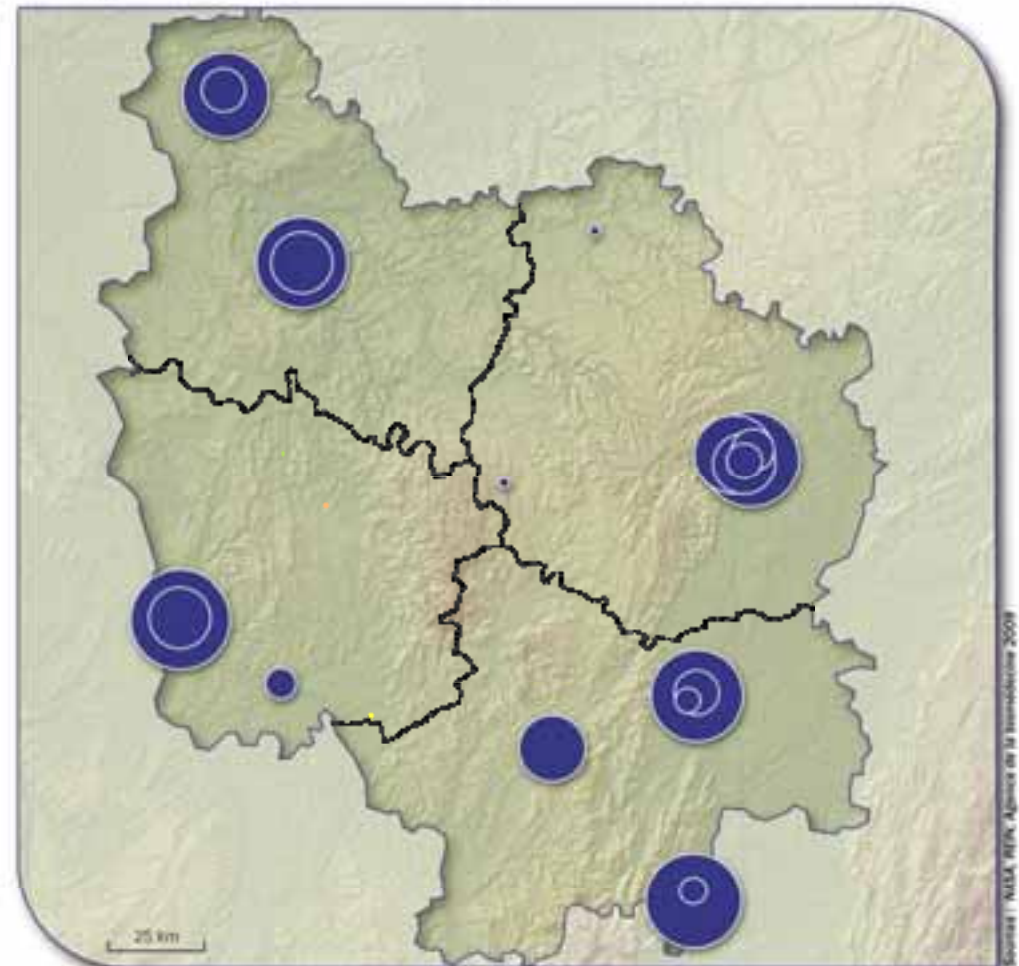


● City with at least one dialysis center

# A-3 Centers activity

- Logical and reassuring
- The main activities are in the main cities

Dialysis centers activity the 31th december 2007



Number of treated patients



# A-3 Dialysis

There are several types of dialysis : Hemodialysis and peritoneal dialysis.

**Hemodialysis** : purification of the blood through an artificial membrane.

Three structures in France :

- Hemodialysis in specialized centers (permanent presence of a nephrologist) : located in an hospital
- Medical dialysis unit (permanent presence of a nurse): located theoretically at a medium distance from an hospital
- Autodialysis unit (the patient is autonomous) : located everywhere



Source image : [www.renaloo.com](http://www.renaloo.com)

# A-3 dialysis

Peritoneal dialysis, blood purification through the peritoneal membrane



Source image : [www.renaloo.com](http://www.renaloo.com)



## B- acces to dialysis centers

1/ The « real » access time



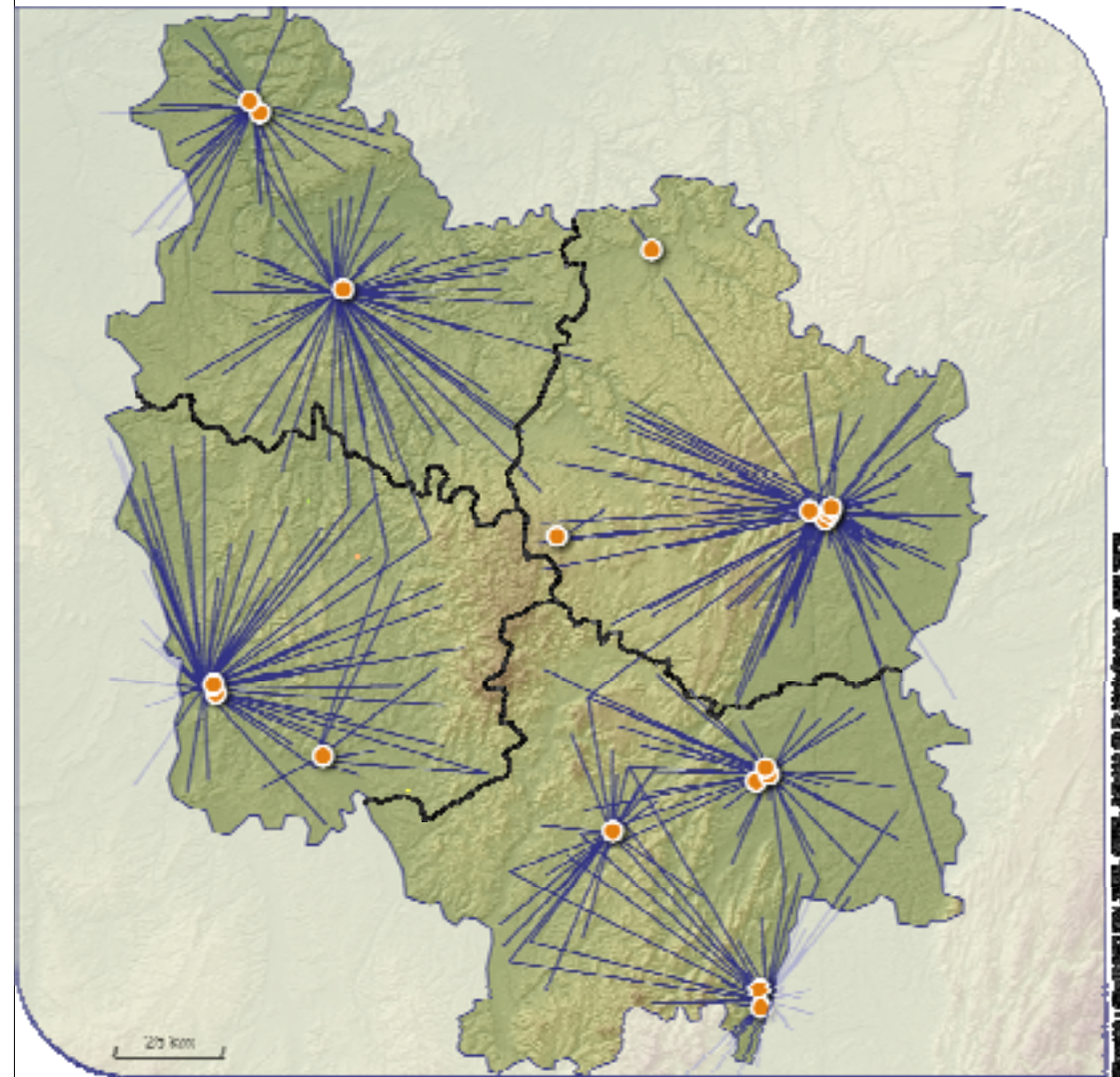
# B-1 acces to dialysis centers

Patients treated at home are not analyzed.

824 incident cases to 664 (12/31/2007)

→ Answer the question : where are my patients ?

Journey between home and dialysis center



— Simplified journey between place of residence and dialysis center

● Dialysis center

# B-1 acces to dialysis centers

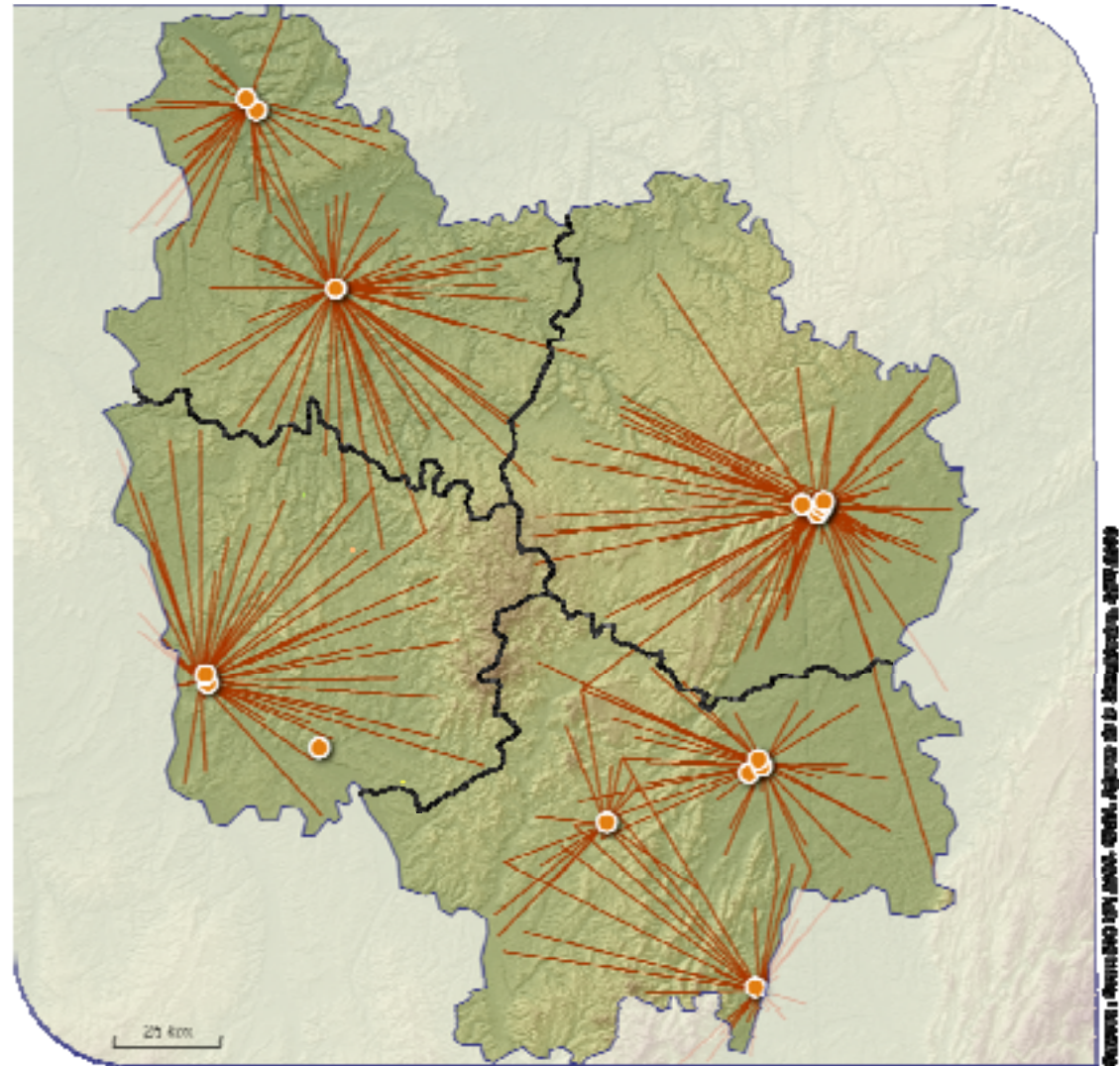
Home dialysis in Bourgogne is not enough developed : a lot of travel can be expected

560 patients in specialized centers or medical dialysis unit

- mean 30 minutes
- median 25 minutes

Cartography can be use as a quality control tool

Journey between home and specialized center or MDU



— Simplified journey between place of residence and dialysis center

● Specialized center or MDU



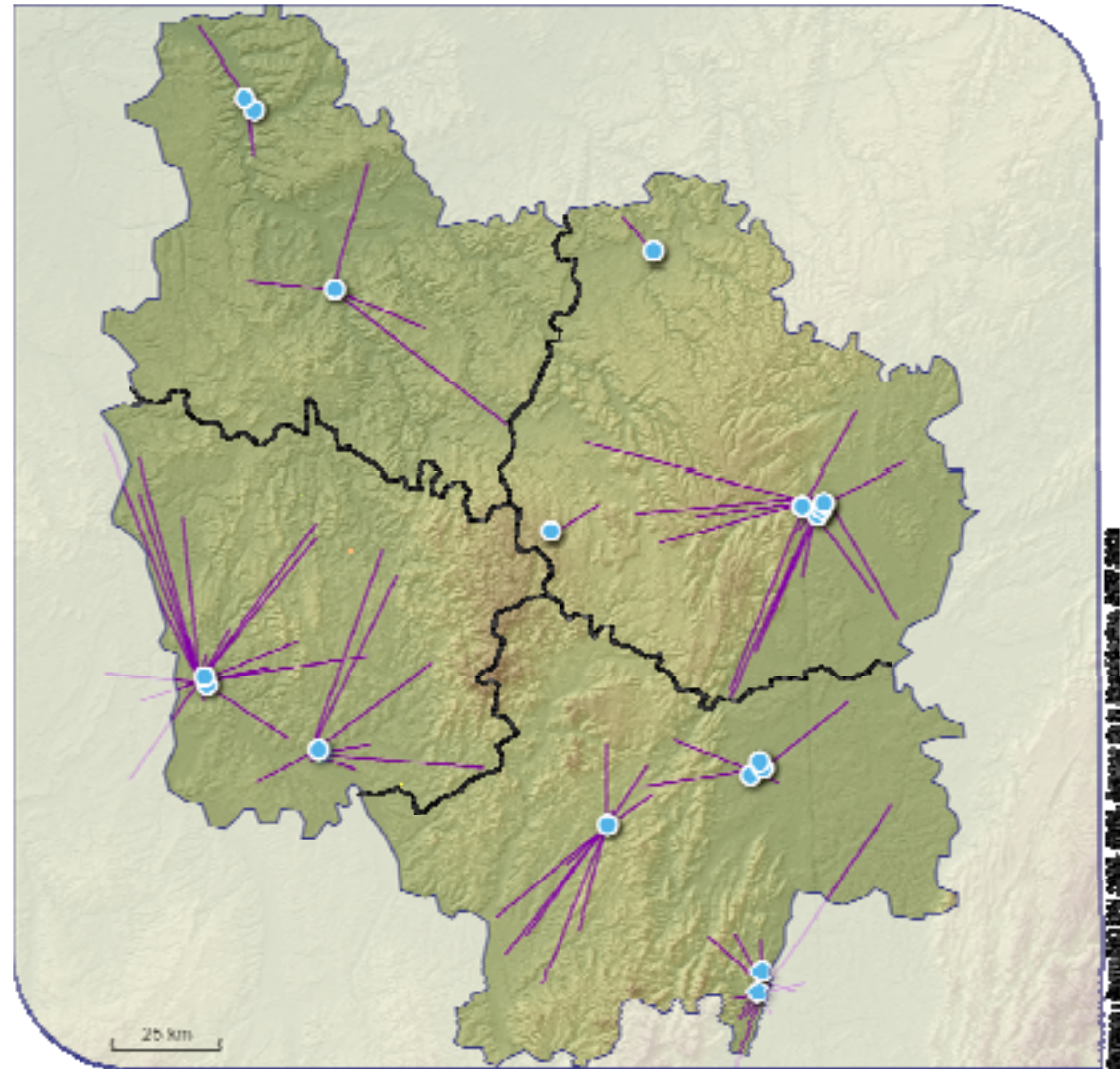
# B-1 acces to dialysis centers

104 patients in autodialysis

- Mean 26 minutes
- Median 20 minutes

An area appears to be in difficulty : Morvan

Journey between home and autodialysis center



— Simplified journey between place of residence and dialysis center

● Autodialysis

## B- acces to dialysis centers

2/ Theoretical access time calculation to the nearest dialysis center

## **B**-2 Calculated journey time

Is it possible to calculate the access time to a dialysis center for each patient ?

Study cohort : 664 patients in 2007 (12/31/07)

- Patients treated at home excluded
- Calculations are made with Network Analyst, without taking into account the toll highways (no health care reimbursement)
- Limit : our network database is old (1999) and without minor roads (poor estimation for urban areas)

## B-2 Calculated journey time

Two-third of the calculated times are matching the declared times in the registry for this region.

But 21% of the residuals are between +/- 5 to 10 minutes

- Network database is not enough detailed
- Acceptable for a study at this scale

<b>Résidus déclarés-calculés en 2007 (Obs_Theo5_ 2007)</b>				Quantile	Estimate
N	664	Sum Weights	664	100%	50
Mean	0.05572289	Sum Observations	37	99%	20
Std Deviation	10.3050705	Variance	106.194477	95%	10
Skewness	-0.7832124	Kurtosis	5.83553294	90%	10
Coeff Variation	18493.4237	Std Error Mean	0.39991429	<b>75%</b>	<b>5</b>
				<b>50%</b>	<b>0</b>
				<b>25%</b>	<b>-5</b>
				10%	-10
				5%	-20
				1%	-35
				0%	-70

C- Centers' access

Indicator of health care offer adequacy

## C - Indicator of health care offer adequacy

**Objective :** Offer operational documents for public health planification

**Postulate :**

- 1- The previous model is acceptable for a regional study (scale).
- 2- Depending on the treatment modalities, patients are going to the nearest dialysis center.

**Methods :**

- Calculating the theoretical journey time to the nearest dialysis center, by treatment modality.
- Cross with demographic data (INSEE 2006) → theoretical influence of each dialysis center.
- Cross with REIN registry data → What would be the theoretical impact for the patients in case of an opening/closing of a center.
- Only for the patients living in the region (626 without home dialysis)

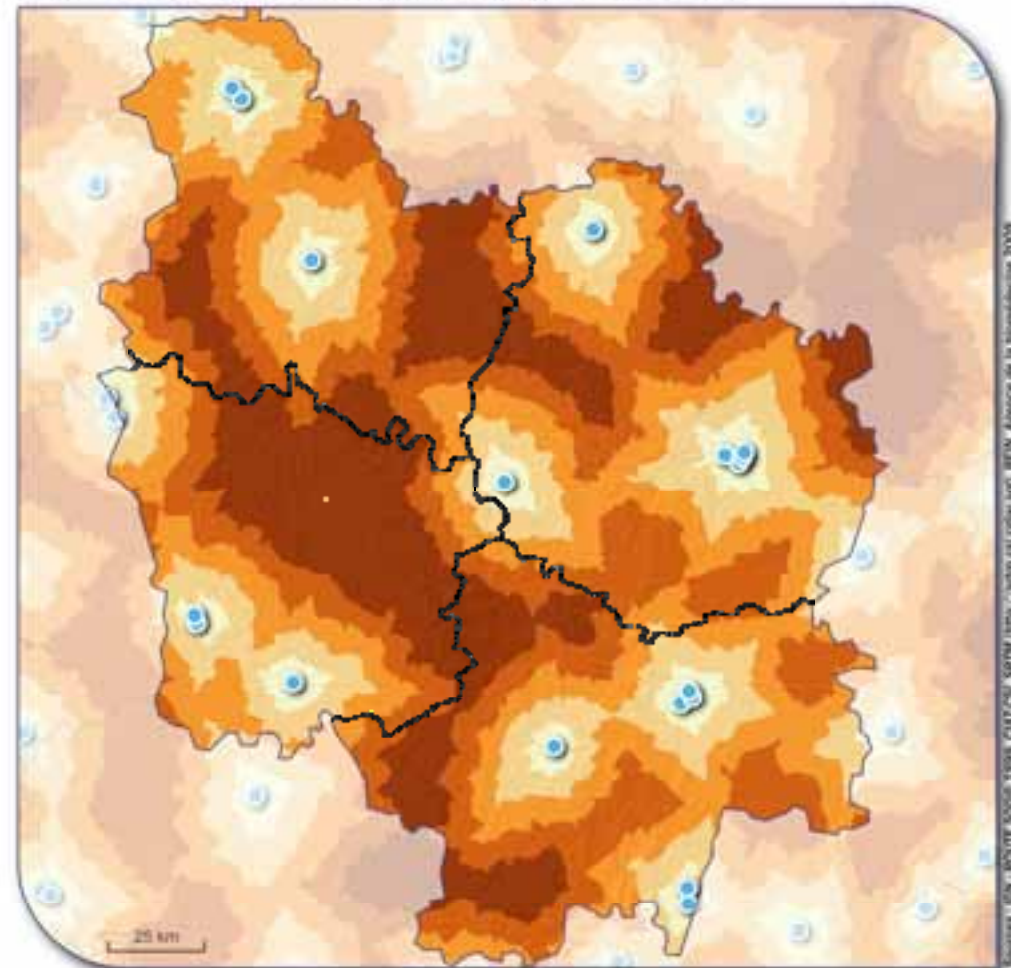
# C-Theoretical approach

Total centers 2007	> 40 minutes	% > 40 minutes
Global population	132 568	8,1
75 years old and more	17 839	10,6
All residents patients*	73	11,6

\*except home dialysis

8.1 % of the global population have an access time to the nearest dialysis center greater than 40 minutes

## Theoretical access to dialysis centers



Theoretical access time by car to the nearest dialysis center with at least one patient\*, except for toll highways (minute)



\* 12/31/2007

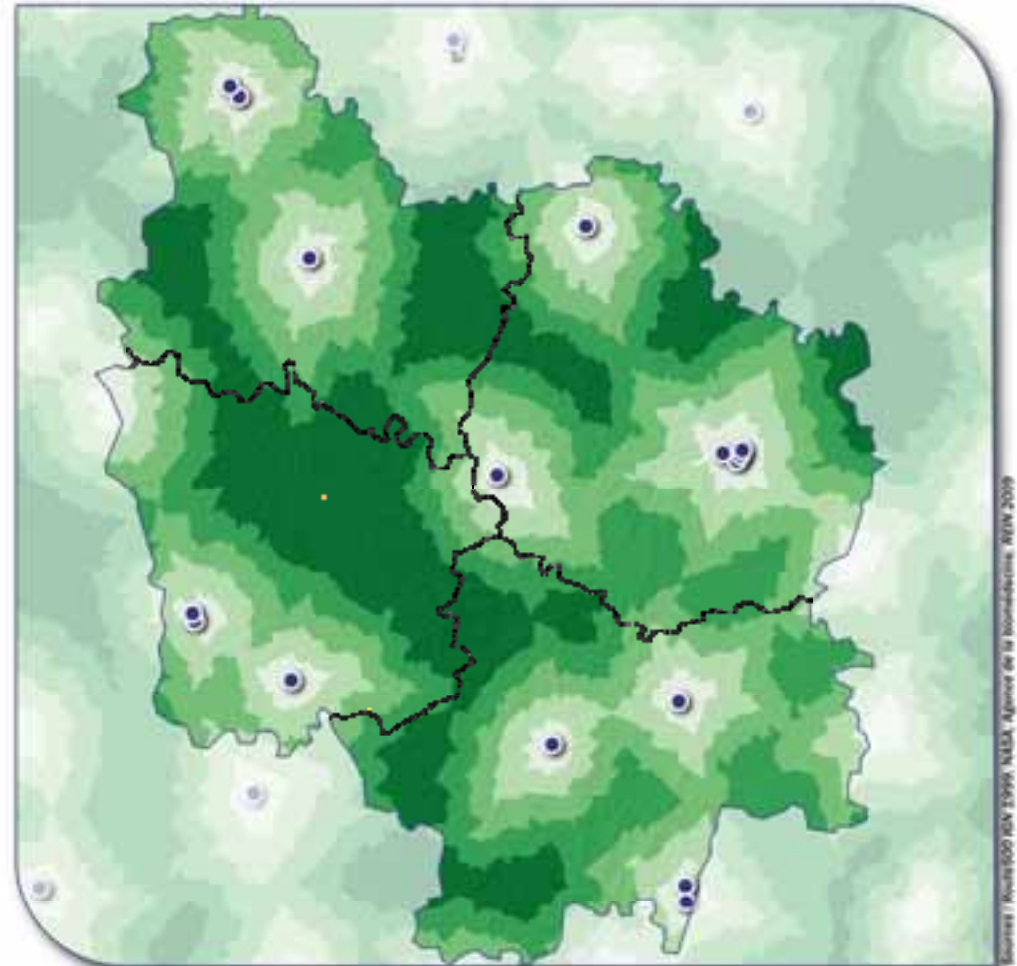


# C-Theoretical approach

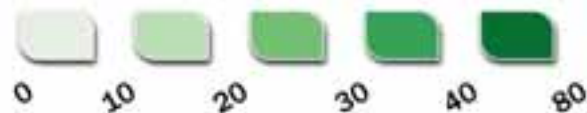
Why taking into account centers with only one patient ?

- Limit : at least 4 patients
- ~~Saulieu et Chatillon sur Seine~~

## Theoretical access to autodialysis centers



Theoretical access time by car to the nearest autodialysis center with at least 1 patient\*, except for toll highways (minute)



\* 31/12/2007



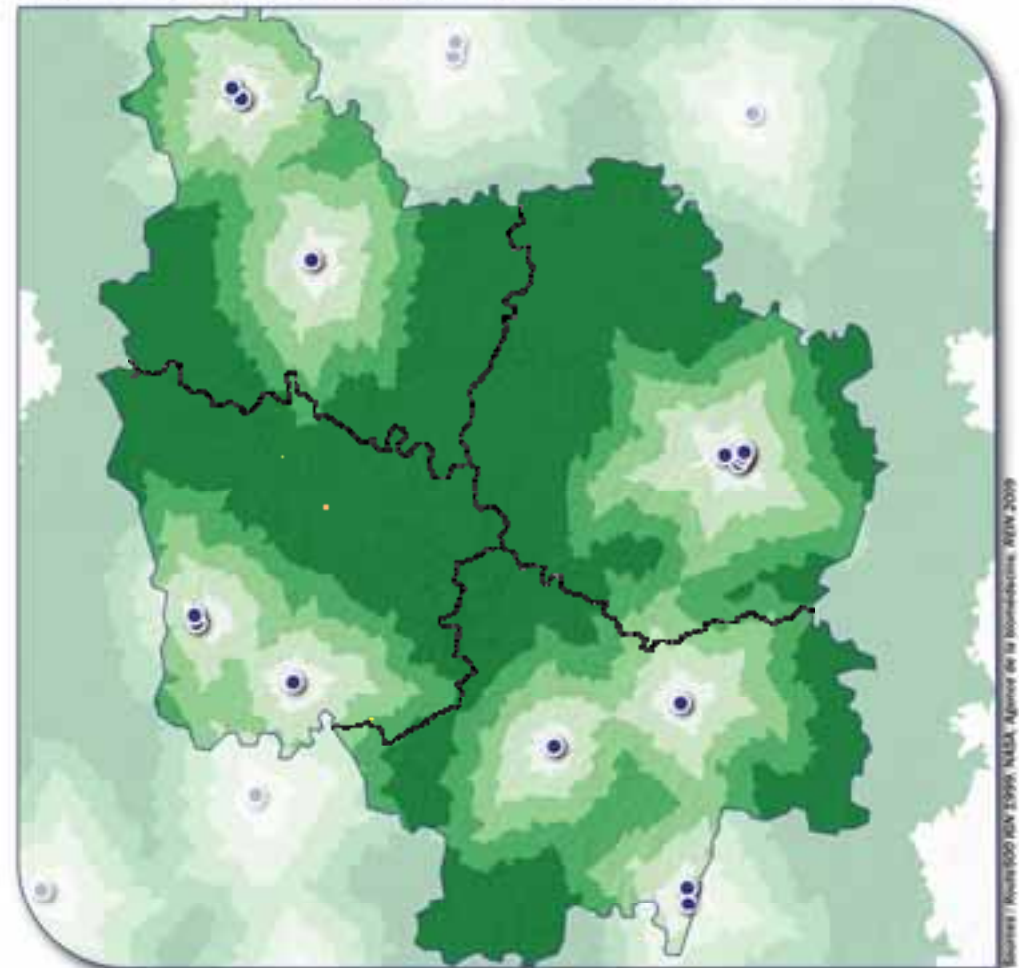
# C-Theoretical approach

Autodialysis (>3) 2007	> 40 minutes	% > 40 minutes
Global population	290 976	17,8
75 years old and more	37608	22,4
All residents patients*	114	18,2
Resident patients in autodialysis	15	15,6

\*except home dialysis

17.8 % of the global population have an access time to the nearest autodialysis center greater than 40 minutes

## Theoretical access to main autodialysis centers



Theoretical access time by car to the nearest autodialysis center with at least 4 patients\*, except for toll highways (minute)



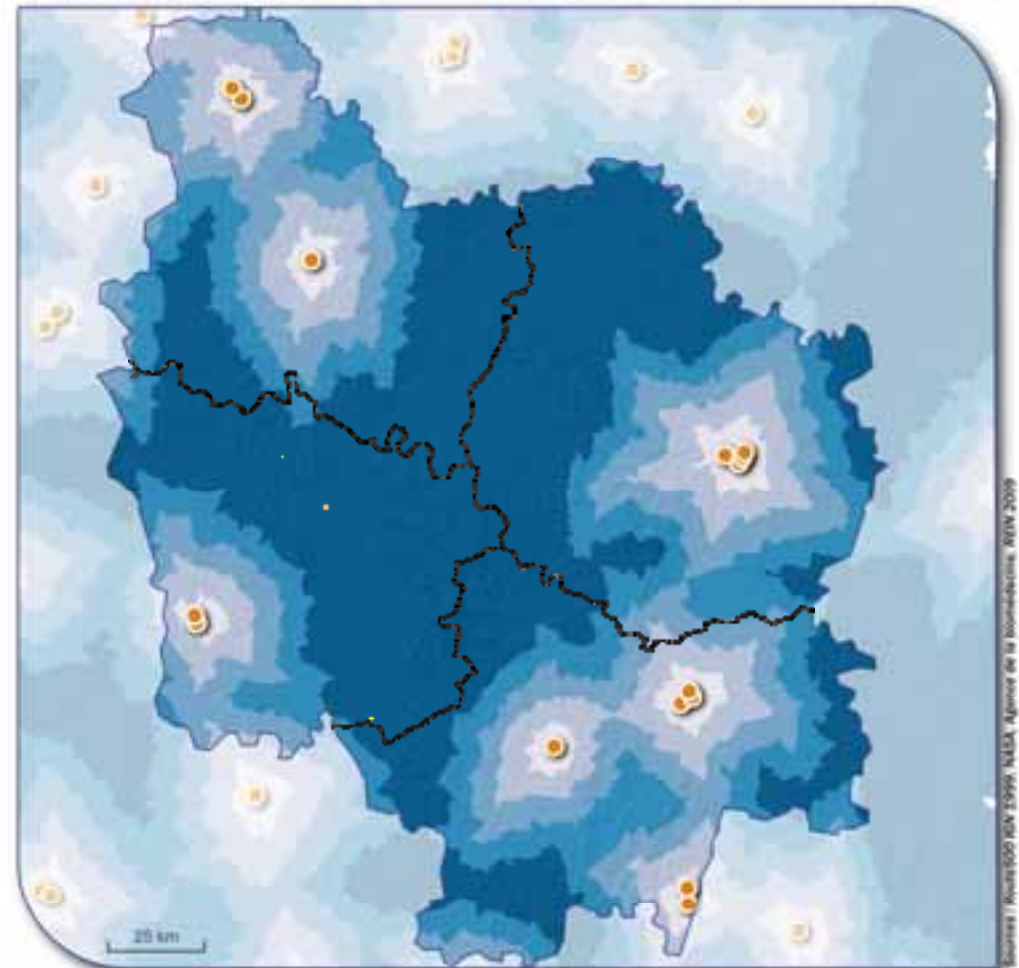
\* 12/31/2007

# C-Theoretical approach

Specialized centers and MDU 2007	> 40 minutes	% > 40 minutes
Global population	298 850	18,3
75 years old and more	39 224	23,3
All residents patients*	121	19,3
Resident patients in specialized centers / MDU	102	19,2

\*except home dialysis

## Theoretical access to specialized centers and MDU



Theoretical access time by car to the nearest specialized center or MDU with at least 4 patients\*, except for toll highways (minute)



Specialized centers or MDU

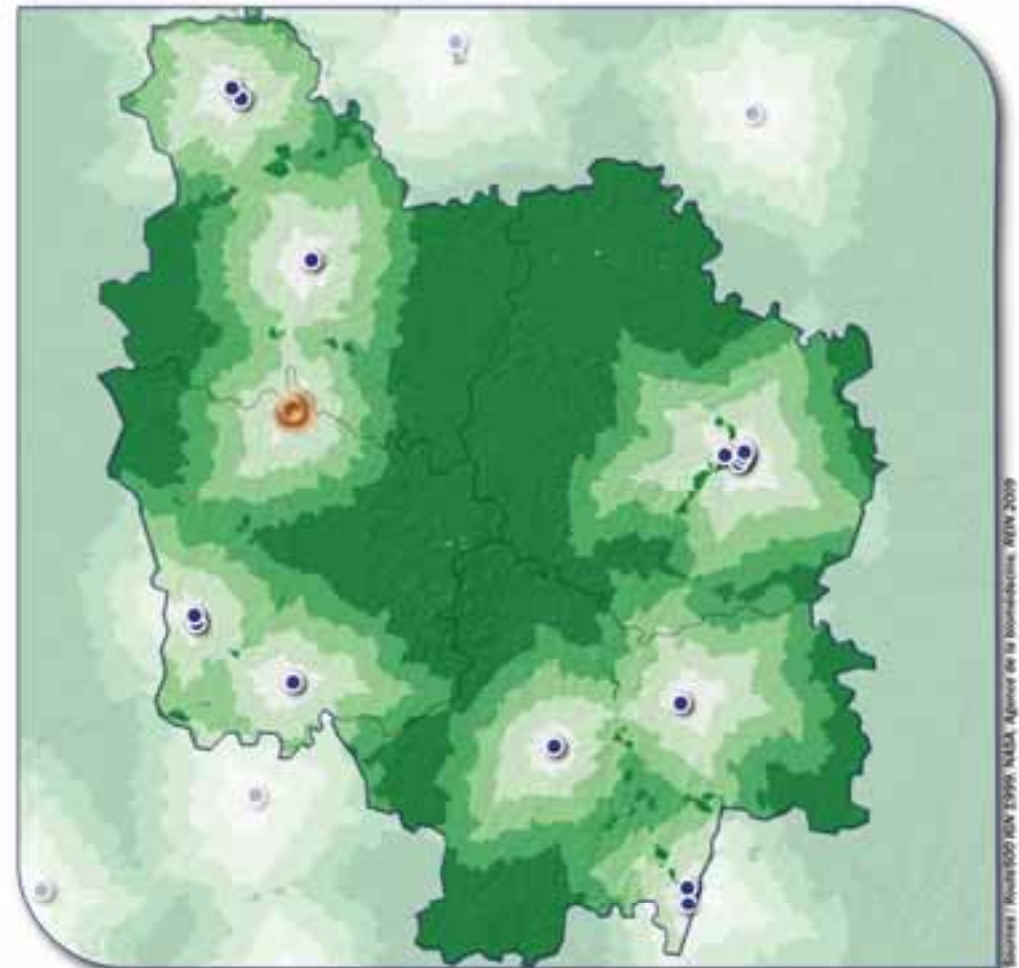
\* 12/31/2007

# C-Simulation tool

Theoretical acces		
Autodialysis (>3) 2007	> 40 minutes	% > 40 minutes
Global population	290 976	17,8
75 years old and more	37608	22,4
All residents patients*	114	18,2
Resident patients in autodialysis	15	15,6

Example : 2 closing, 1 opening		
Autodialysis (>3) 2007	> 40 minutes	% > 40 minutes
Global population	264 880	16,2
75 years old and more	33 734	20,1
All residents patients	96	15,3
Resident patients in autodialysis	12	12,5

## Simulation : Clamecy



Theoretical access time by car to the nearest autodialysis center with at least 4 patients, except for toll highways (minute)



# Conclusion



## - Conclusion

1. The results calculated by the model are similar to the actual data in the registry. But the results in urban area have to be improved → a new network database in november 2010
2. Acces to dialysis centers in Bourgogne is pretty good
  - Only 11,6 % of the patients (8% of the region population) have an access time to the nearest dialysis center greater than 40 minutes
  - This is a major information for nephrologists and decision makers
3. This study highlights some hot-spots in Morvan
  - Small number of patients but several statistical methods show this area as significant



## - Conclusion

### Assesment

The REIN registry will be able to provide an indicator of health care offer adequacy for access time :

- The number of patients located at x minutes of the nearest dialysis center

With hindsight : classical study in health geography, but :

- In France they are scarce but the needs from the professionals are real
- Stakes for the patients quality of life and for economical reasons

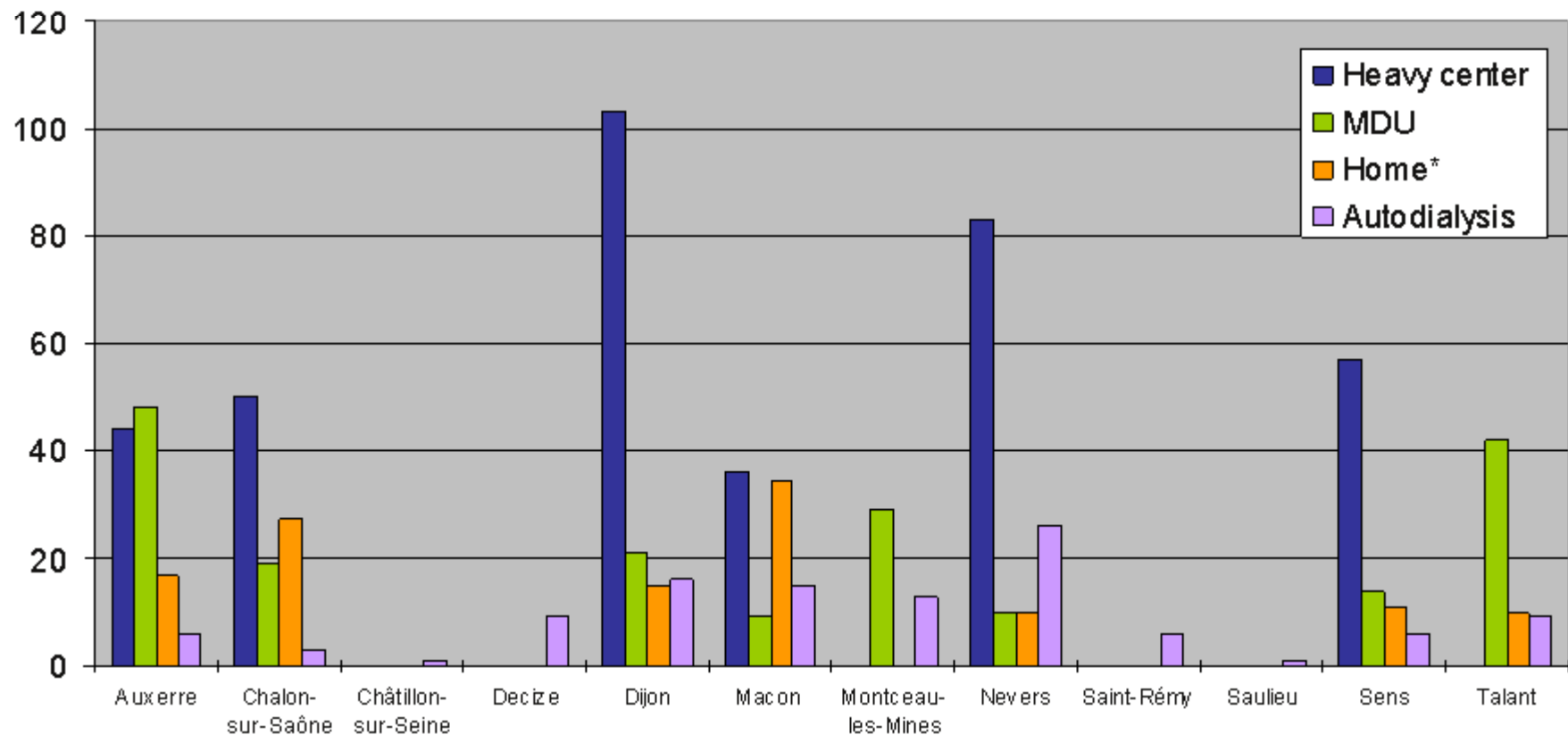


# Thank you for your attention

Many thanks to Dr. Cécile Couchoud, Dr Jean-François Cabanne, Dr. Christian Jacquelinet, ESRI Health and ESRI France

# A-3 Centers activities

Dialysis centers activities by modalities (12/31/07)



\*Location of the monitoring establishment



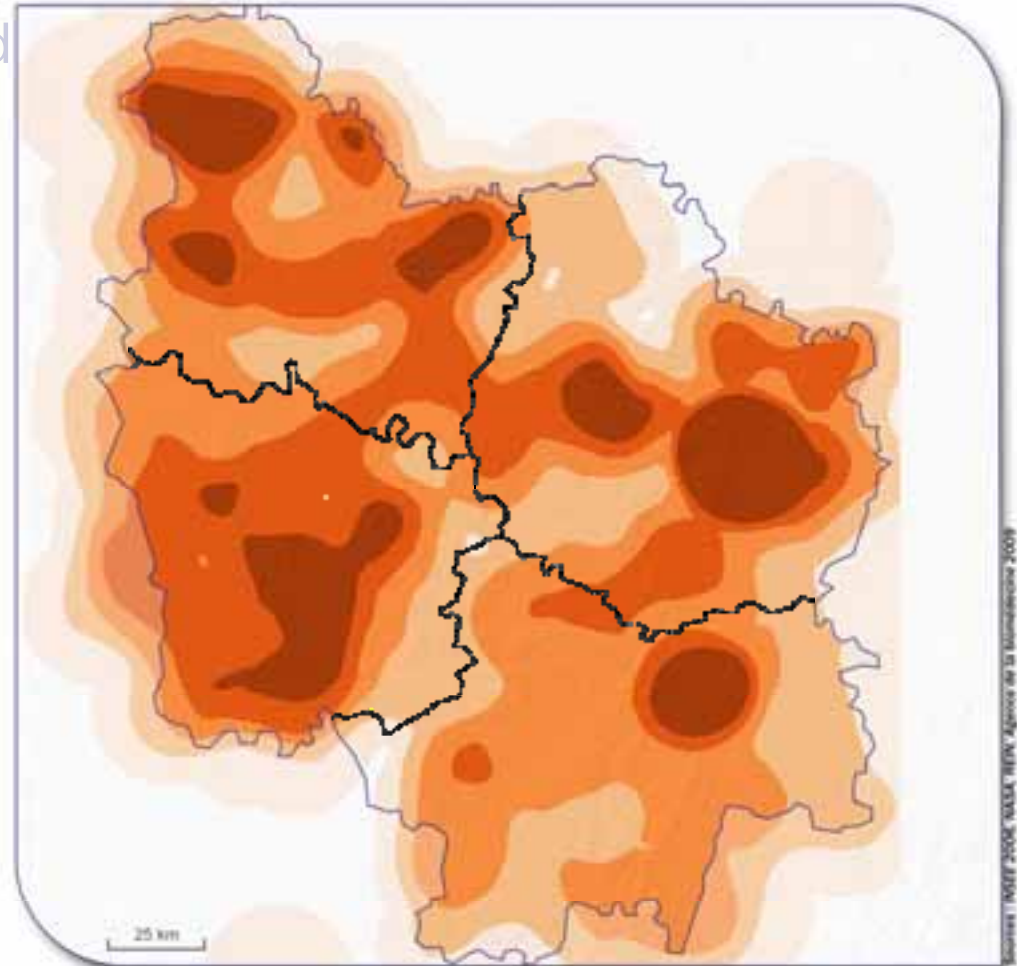
# A -2 Cohort : 60 years old and more

- Nièvre center
- Sens
- Dijon
- Chalon-sur-Saône
- Gueugnon
- ➔ West of Dijon

Complex interpretation

- ➔ Rurality and age
- ➔ Urbanity and health care access

Prevalence for the 60 years old and more in 2007



Number of patients treated in a dialysis center for 10 000 inhabitants of 60 and more, localized at the place of residence\*



\*Quadratic smoothing, 20 km