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# *Determinants of the cost of asthma in Ile-de-France*

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## INTRODUCTION

Various studies of asthma show the influence of medical practices on the global cost of this disease, but in fact, little try to identify precisely the determinants of costs. Most of them are randomised prospective studies which try to measure the impact of educational programs. The other thing is that most studies are on specific population, for example US studies on Medicaid population or on children. The specificity of our survey is a design which insists on the gradation of severity.

## *Objectives*

### **Questions:**

1. Is it possible to identify medical and behavioral profiles of asthma patients?
2. If so, are they related with care consumption?
3. Is there a link between hospital and ambulatory care?
4. Which variables explain the cost of asthma treatment?

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**The objective** of the work reported here is to test, on a mixed population, the role of medical and behavioural variables on costs :

**We will address four questions.**

1. Is it possible to identify medical and behavioural profiles of asthma patients ?
2. If so, are they related with care consumption ?
3. Is there a link between hospital and ambulatory cares ?
4. Which variables explain the cost of asthma treatment ?

## Method (1)

### *Data and method*

- A medical side
  - All patients, ages 10 to 44, with an asthma prescription during 5 days in September 99,
  - Three questionnaires and a medical examination
  
- An economic side
  - Retrospective observation of consumption in public health insurance files
  - Identification of asthma-related consumptions
  - Direct costs estimated with official tariffs

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**Data** : This work is based on the matching of data from two sources :

1. The first one is a medical survey performed for URCAM-IDF in late 1999
  2. The second one is the database of the national health insurance system
- The initial sample consists of patients aged between 10 and 44 years, with an asthma prescription recorded in the insurance file during 5 days in September 99. For each patient, we had three questionnaires and a medical examination.
  - For the economic study, we extracted from the insurance files all medical services covering a 12-month observation period.
  - The main methodological problems were :
    - 1 - first to identify the asthma-related services
    - 2 - second the missing data about hospitalisation.
  - As a consequence, we had to make assumptions which we will tell a word about in a second.
  - Last methodological choice, but not least: we valorise all direct expenditure for medical care, including hospitalisation, with public tariffs. This enables us to standardize the measure.

## Method (2)

## *Sample*

- 3020 patients with an asthma-related prescription recorded in the insurance files
- 1793 of which
  - have exploitable medical consumption records
  - can be assessed according to the international asthma severity classification
- Focus of presentation: persistent patients

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## **Sample**

We wouldn't insist on this slide but we haven't work with the initial sample. We keep only patients with a known stage of severity of asthma and for which we've got exploitable medical consumption records.

We have to add that our sample isn't representative of the French population of asthma patients in terms of severity. More specifically, intermittent asthma patients are underrepresented. They represent 18 % of our sample and 50 % of the French asthmatic population. It's a consequence of the method of the medical study : by picking patients with asthma prescriptions over a small period, you won't have the patients who consume little asthma medications.

So in this presentation, we focus on the persistent asthma population.

**Method (3)**

***Asthma-related ambulatory care***

**Ambulatory visits:**

- *physicians visits* with asthma prescriptions
- *physiotherapist treatment* prescribed by certain types of physicians

**Pharmaceutical products:**

- all medications indicated for asthma if the prescription also includes an anti-asthmatic or a corticosteroid

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**Care due to asthma**

The insurance files do not say for which disease a unit of care is consumed. So, we need to make assumptions to allocate care between asthma and other conditions. I just illustrate our choices with some examples.

- ✓ For physician visits, we keep all visits associated with an asthma prescription.
- ✓ For non medical practitioners, we keep only physiotherapists' cares prescribed by a physician whose speciality is in linked to asthma.
- ✓ For pharmaceutical products, we keep all medications indicated for asthma if the prescription also includes an anti-asthmatic or corticosteroid.

**Method (4)**

***Asthma-related hospital care***

Two sources available

**1. Insurance files:**

- 580 hospitalisations over a year
- 137 (24%) for asthma, identified based on the type of ward

**2. Patients questionnaires:**

- 118 hospitalisations for asthma declared
- ...only 54 of which are recorded in the insurance file

**We chose to combine both sources**

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✓ Hospital : we have two sources for hospital data :

1. the insurance file, but we know it's incomplete for public hospitalisation,
2. and the patients declarations with classical bias.

➤ We used both sources but we're not going to get into the details of how. If anything, this probably overstates the number of hospitalisations for asthma.

**Method (5)*****Analysis*****1. Descriptive analysis**

- Main medical variables
- Classification of patients

**2. Models**

- Relationship between hospital and ambulatory care
- Determinants of the cost of asthma (analysis of variance)

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**Results of allocation of resource**

We can show you the descriptive results during the discussion if you're interested.

**Statistical Methods**

Here, We'll insist on the assessment of multivariate associations between candidate predictors and outcomes of interest. This assessment was conducted as follow:

- 1 - on one hand, qualitative classification methods to define the patient profiles;
- 2 - on the other hand, we conducted a logistic regression and analyse of variance to assess the determinants of asthma-related costs.

**Description (1)**

***The patient and his health***

- Socio-economic variables: age, sex, profession, exemption of public co-payments
- Characterisation of asthma: severity and history of the asthma
- The patient and his asthma: knowledge, compliance, etc.
- The patient and his health: other chronic conditions, accidents, BMI, self-assessed health, tobacco consumption
- Medical care: treatment appropriateness, etc.

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We have no time to describe all the variables, but you can read we have information about socio-economical status, about the characterisation of asthma, the behaviour of patients with asthma, the general health of patients and obviously medical care, like appropriateness of the treatment.

## Description (2)

# *Patients profiles*

## **Population : patients with persistent asthma**

- Class A (42.5%): stable, mild to moderate severity, controlled by appropriate treatment
- Class B (29%): moderate to severe, asthma not stabilized in spite of an appropriate treatment
- Class C (18.5%) : mild to moderate, inadequate treatment
- Class D (10%): recent asthma, limited knowledge and bad self-management

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## **Results of data analyses**

So, We begin with the descriptive analysis. We built a classification on a population of more than 1600 persistent asthma patients. 4 profiles clearly appeared.

1. The first one is the biggest group. Rather young, they have often been asthmatic since childhood. They have a good knowledge of their illness and a positive perception of their global health.  
The level of severity of illness is a mild-to-moderate persistent asthma and during the medical examination the pharmacologic therapy was judged by the physician to be adapted for 80 % of them.
2. The second one has the most severe asthma. Moreover, asthma is instable in spite of a well adjusted treatment. They are older than the first group, and have a bad perception of their global health. 50% have weight problems and 25 % have another chronic conditions.
3. The third group is very interesting. They are more often suffering of moderate to severe symptoms at the moment of the medical examination and are also characterized by a bad management of their asthma. Indeed, they all have an insufficient pharmacologic therapy with regard to their symptoms. In addition, 40% smoke and 35% do not know how to use inhalers.
4. The last group concentrates patients whose asthma has been diagnosed for less than one year. Treatment variables aren't significant in that group. Most important problems with these patients are their behaviour and knowledge.

**Description (3)*****Cost of care by profile*****POPULATION: persistent asthma patients**

	<b>Class A</b>	<b>Class B</b>	<b>Class C</b>	<b>Class D</b>
Ambulatory care prompted by asthma (Official tariffs)	102 € [94 ; 110]	134 € [119 ; 150]	83 € [74 ; 93]	101 € [69 ; 134]
Asthma medications (Official tariffs)	336 € [313 ; 359]	608 € [556 ; 660]	189 € [163 ; 214]	197 € [160 ; 234]
Hospitalization (% patients)	3.3 %	21.6 %	2.5 %	7 %
Hospitalization (Days per year)	6.9 days [1 ; 12.9]	7.3 days [4.1 ; 10.4]	4.6 days [0 ; 10.5]	4.2 days [1.4 ; 6.9]

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The following slide describes the consumption profiles of these categories.

1. Severe patients (those of class C) are the heaviest consumers. You can see the burden of severity by comparing with the first profile (class A). There is no difference in terms of adaptation of the treatment of asthma, which is good. The first group is younger, but above all they are less severe.
  2. In contrast, the third group is the one which consumes the least: less visits, less medication and less hospitalisation. These patients are low-cost because their asthma is badly managed. At the end of the period, the result is an uncontrolled asthma for 35 % of them and moderate to severe symptoms for 65% of them.
  3. We wouldn't discuss the fourth group because the diagnosis is recent and the distribution of cost is not available for the whole year. So we can't compare them with the others. Nevertheless, the proportion of hospitalised patients is higher than in the other classes (except for C).
  4. By identifying medical and behavioural profiles of asthma patients with differentiated levels of health care use, we can postulate that some profiles are more appropriate targets for effective public health interventions.
- In fact this analysis shows that the most expensive patients are so because of the severity of asthma : the management of the disease is good and there is probably little margin of action.
  - On the contrary, the third and the fourth groups are obvious targets for educational programs, these patients represent 30% of persistent asthma patients.

## Models (1)

# *The cost of persistent asthma*

- **Four econometric models**

- Probability of hospitalization
- Ambulatory cost
- Pharmacological treatment cost
- Total asthma-related cost

- **Main significant variables**

- Severity
- Exemption of public co-payments
- Appropriateness of treatment
- Type of physician which usually follows the patient for asthma
- Duration of asthma combined with patient age
- Others (compliance, quality of life, weight...)

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## Results of models

So, We will now present some results of four econometric models.

We model the probability :

1. to have been hospitalised during the year before the survey,
2. the ambulatory cost,
3. the medication cost and lastly,
4. the total direct asthma-related cost, including the cost of hospitalisation..

We tested the impact of the variables we presented on a previous slide.

1. We'll focus on the effects of severity, of the appropriateness of treatment, and of the patients' age and duration of asthma.
2. The other main significant variables are : the exemption of public co-payments and the fact that the usual source of care for asthma is a specialist. Both increase costs.

## *Main effects of interest*

- **When asthma severity increases from mild to moderate and moderate to severe**

- Probability of hospitalization
- Ambulatory cost
- Pharmacological treatment cost
- Total asthma-related cost



**Increase**

/...

First, we observe the well-known impact of illness severity : which implies higher medical costs.

**Models (3)**

*Main relevant effects*

<b>Impact of asthma age and patient age</b>	<b>Total cost</b>	<b>Hospital (logit)</b>	<b>Ambulatory</b>	<b>Medication</b>
<i>Child since childhood (reference)</i>				
Young adult since childhood	ns	-	ns	+
Young adult since adolescence	+	ns	ns	ns
Adult since childhood	++	--	+	+++
Adult since adolescence	+	-	ns	++
Adult since adult	++	ns	ns	+
<ul style="list-style-type: none"> <li>• Child : 10 to 15</li> <li>• Young adult : 16 to 29</li> <li>• Adult : 30 to 44</li> </ul>			/...	13

In the second table, we observe two effects :

- 1 – Total costs increase with age.
- 2 - The risk of hospitalisation decreases when patients have been suffering from asthma for many years and the more they have medication, the less they have hospitalisation.

**Models (4)***Main relevant effects*

<b>Impact of treatment appropriateness</b>	<b>Total cost</b>	<b>Hospital (logit)</b>	<b>Ambulatory</b>	<b>Medication</b>
<i>Treatment judged adequate (reference)</i>				
Inadequate treatment	ns	+	ns	-
<i>Step of care = level symptoms (reference)</i>				
• Step of care >> level symptoms	--	--	-	-
• Step of care > level symptoms	-	-	ns	ns
• Level symptoms > step of care	--	ns	ns	--
• Level symptoms >> step of care	---	--	--	---

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Here, we observe that inadequate treatment increases the risk of being hospitalized the year before and at the same time, it decreases the medication costs.

We constructed another variable which characterizes the appropriateness of treatment by comparing the step of medication and the degree of symptoms : we identify two factors which lower cost.

1. Some patients have low costs during the study year because of absence of good pharmacology and ambulatory therapy but we observe a demeaned asthma status at the end of the period.
2. Some patients on the contrary have a heavy treatment because of severe asthma. Yet, when the therapy results in a well controlled asthma (lower symptoms), all costs and the risk of hospitalization are lower.

## *Conclusion*

- Main result of data analysis
  - Identification of target groups of patients for public health actions
- Main result of models
  - The impact of severity
  - The impact of the appropriateness of treatment
- The results must be confirmed by a **prospective survey**

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### **Conclusion**

We summarize the main results :

- 1 - The data analysis allows the identification of target groups of patients for public health actions
- 2 - Medical and behavioral variables that explain the cost of asthma management can be identified, especially the well-known impact of severity and more interestingly the positive impact of the appropriateness of treatment,
- 3 - but the retrospective nature of the data collection in our survey makes it difficult to identify causal relationships. Prospective surveys should yield more specific conclusions.

**Annexes (1)*****Asthma-related care (volumes)***

	Total	Asthma	% Asthma
Physicians <i>Number of visits</i>	17 601	5 363	30 %
Physiotherapists <i>Number of visits</i>	4 422	2 128	48 %
Cost of drugs/person <i>official tariffs</i>	618 €	322 €	52 %
Hospitalisation <i>Number of patients</i>	1 793	136	7.6 %

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## Annexes (2)

*To be hospitalised*

PROBABILITY REDUCTION		REFERENCE	PROBABILITY INCREASE	
<i>Severity</i>				
		Mild persistent patients	Moderate persistent Severe persistent	2.096 2.569
<i>Asthma history</i>				
		More than 1 year asthma	Recent asthma	2.198
Teenager begin child	0.439	Child begin child		
Adult begin child	0.337			
Adult begin teenager	0.432			
<i>Treatment</i>				
Medication>symptom	0.589	Medication = symptom		
Medication>>symptom	0.447			
Medication<<symptom	0.435			
		pharmacy	Increase of 1000 F	1.148
		Adequate treatment	Inadequate treatment	1.608
<i>Medical follow-up</i>				
No follow-up	0.179	General practitioner	GP + specialist Specialist	2.223 2.362
<i>Insurance</i>				
		No total exoneration	Total exoneration	2.259
<i>Quality of life</i>				
		[9-10]	[0-4]	2.753

**Annexe (3) *Ambulatory cares (without pharmacy)***

COST REDUCTION		REFERENCE (636 F)	COST INCREASE	
<i>Severity</i>				
		Mild persistent patients	Moderate persistent	+118
			Severe persistent	+136
<i>Patient</i>				
[10-14]	- 118	[30-44]		
[15-29]	- 102			
Man	-114	Woman		
Other chronic illness	-286	No chronic illness		
Accident	-240	No accident		
		No obesity	Obesity	+150
<i>Treatment</i>				
Medication>>symptom	-138	Medication = symptom		
Medication<<symptom	-220			
		No hospitalization	Hospitalization	+161
<i>Insurance</i>				
		No exoneration CNAM	Exoneration CNAM	+262
		No exoneration AMG	Exoneration AMG	+170
<i>Quality of life</i>				
		[9-10]	[0-4]	+325
			5	+246
			6	+187
			[7-8]	+111

Tous les montants sont en francs 2001

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## Annexes (4)

*Cost of medications*

COST REDUCTION	REFERENCE (481 F)	COST INCREASE	
	<i>Severity</i>		
	Mild persistent patients	Moderate persistent	+632
		Severe persistent	+1730
	<i>History of asthma</i>		
Recent asthma	-966	Sup 1 year asthma	
		Teenager begin child	+402
		Adult begin child	+1214
		Adult begin teenager	+815
		Adult begin adult	+693
	<i>Treatment</i>		
Medication>>symptom	-380		
Medication<symptom;	-659	Medication = symptom	
Medication<<symptom	-1233		
		No hospitalization	Hospitalization
			+717
Bad compliance	-302	Compliance	
Inadequate treatment	-317	Adequate treatment	
	<i>Medical follow-up</i>		
		General practitioner	GP + specialist
			Specialist
			+658
			+279
	<i>Insurance</i>		
		No exoneration CNAM	Exoneration CNAM
			+1969
	<i>Quality of life</i>		
		[0-4]	+794
		5	+515
		6	+583
		[7-8]	+320

Tous les montants sont en francs 2001

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**Annexes (5)***Costs by severity degree*

	Intermittent	Mild persistent	Moderate persistent	Severe persistent
Number of patients	318	424	739	312
Ambulatory costs	481 [394-568]	572 [506-638]	727 [662-794]	839 [734-943]
Medication costs	532 [466-597]	1451 [1300-1600]	2326 [2170-2482]	4105 [3683-4527]
Hospitalization				
<i>Number of patients</i>	6	17	66	47
<i>Costs</i>	15225	22052	21909	34045
Total costs	1300 [960-1640]	2908 [2297-3520]	5011 [3784-6267]	10072 [6616-13529]

**Tous les montants sont en francs 2001**