

# Hospitalisation of diabetic children in France based on data from the Entred-Enfant 2007 survey

## Main results

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## INTRODUCTION-CONTEXT

As in many other countries, the incidence of diabetes is increasing in France, where it has virtually doubled over the past twenty years, rising from 8 cases per 100,000 children in 1988 to an estimated 15 cases per 100,000 in 2007 [1]. In individuals under the age of 20 years, between 2006 and 2009, the mean annual increase in the prevalence of treated diabetes varied between 2.4% and 3.9% according to age group and gender [2].

The Entred-Enfant study was initiated following the conclusions of the expert assessment of epidemiological monitoring of paediatric diabetes, which InVS (Institut de veille sanitaire - French Institute for Public Health Surveillance) [1] entrusted to INSERM (Institut national de la santé et de la recherche médicale – French national health and medical research institute) in 2007.

The aim of Entred-Enfant was to gain knowledge concerning the terms and quality of medical care for diabetic children in France.

Entred-Enfant is the first study based on a representative sample of children treated for diabetes in France [3].

## AIMS

The study was in line with the aims of Entred-Enfant. The purpose was to describe:

- the characteristics of the post onset hospitalisation of diabetic children;
- the frequency of hospitalisation for acute complications of known diabetes, used as a disease control marker;
- the characteristics of hospitalised children.

## MATERIALS AND METHODS

### Study population

The Entred-Enfant population consisted of a sample of 924 children drawn randomly from child recipients of French National Health Insurance Fund for Employees (CnamTS), not including local mutualist sections, and of the Scheme for independent workers (RSI), under the age of 18 years as of 31st July 2007, living in Metropolitan France or in Overseas Departments and having received at least three reimbursements for oral anti-diabetic (OAD) medicines and/or insulin, between 1st August 2006 and 31st July 2007.

The two schemes cover approximately 75% of the French population.

Forty children were excluded from the study:

- 4 children suffering from diabetes associated with cystic fibrosis;

- 28 children treated with OADs alone (n=19) or receiving no treatment (n=9) over the study period;
- 8 children "lost to follow up" (no medical consumption or hospitalisations over the study period).

In total, 884 diabetic children were included in the study.

### Study period

Onset of diabetes may be associated with hospitalisation, particularly for ketoacidosis, a frequently inaugural acute complication of type 1 diabetes in children, or for the implementation of insulin treatment. The Entred-Enfant methodology did not allow inaugural hospitalisations to be identified in order to describe them. So to exclude inaugural hospitalisations, the study period was selected from 1st August 2007 to 31st July 2008, after establishment of the sample of diabetic children.

### Data sources

Medical claims from the National Health Insurance System database along with records from the French hospital discharge database (program of medicalization of the information system – PMSI), were extracted for all of the children included in the study, over the period of August 2007 to July 2008.

### Classification of hospitalisations

Diagnoses were encoded in accordance with the 10th revision of the International Classification of Diseases (ICD-10).

An algorithm taking into consideration the main, related and associated diagnoses enabled hospital stays to be grouped into 3 categories:

- stays for acute complications (ketoacidosis, hyperosmolarity, hypoglycaemia, diabetic coma);
- stays for diabetes monitoring;
- stays for other causes, whether related to diabetes or not.

The hospitalisation classification algorithm could not be validated by comparison to hospital records. Analysis of stay duration according to cause of hospitalisation, however, gave results consistent with practice, thus supporting the validity of the algorithm used.

## RESULTS

### Socio-demographic characteristics

Of the 884 children included in the study, 95.7% were covered by the CnamTS scheme and 97.2% lived in Metropolitan France. The mean age of the children was of  $12 \pm 4$  years, half were boys (50.3%). Only one child did not benefit from 100% medical fee coverage for chronic diseases for diabetes or another disease and 17% of children were recipients of a waiver of co-payment.

## Anti-diabetic treatments

All children were treated with insulin, suggesting that nearly the entire sample consisted of type 1 diabetic children. Only 2.3% of children received a treatment combining insulin with one or two OADs, mainly metformin (2%) and, to a lesser degree a glinide.

The frequency of insulin pump use was of 17.0%. As expected, the proportion of children using an insulin pump was higher among the youngest ones: 33.3% of under 5s, 18.4% of 5-9 year-olds, 16.6% of 10-14 year-olds and 14.0% of 15 year-olds and above ( $p < 0.02$ ).

## Prescribing physicians

For children covered by the CnamTS scheme, the physician principally in charge of the diabetes was determined from the number of reimbursed diabetes-specific prescriptions. The study confirms that diabetic children are followed mainly by hospital physicians (82%). Only 7% of children were followed only by a general practitioner, 8% were followed mainly by a private endocrinologist and 3% by a private paediatrician.

The proportion of children followed mainly at a hospital decreased with age: 95% of under 5s, 87% of 5-9 year-olds, 81% of 10-14 year-olds and 73% of 15 year-olds and above ( $p < 0.001$ ).

## Hospitalisation characteristics for diabetic children

One in 2 diabetic children was hospitalised at least once during the study period (52.0%; CI95%: [48.7% - 55.4%]) and 20.8% were hospitalised several times (table 1).

Approximately one third of children (35.5%) were hospitalised at least once during the year for diabetes follow-up and 26% were hospitalised twice or more for this cause. Though the

2009 guidelines of the International Society for Pediatric and Adolescent Diabetes (ISPAD), along with the French National Authority for Health (HAS) guidelines of April 2007, recommend an annual check-up by a multidisciplinary team [4; 5] and it is acknowledged that, in France, such check-ups are mainly performed at hospital.

The proportion of hospitalisation for diabetes follow-up varied significantly according to age. It was of 40.5% in children under the age of 5 and of 28.1% in those aged 15 years and over (table 1).

Moreover, 12.7% of children were hospitalised at least once for acute diabetes complications, 23% of these having been hospitalised twice or more for this cause.

For the few stays for which a diagnosis of diabetic coma was mentioned in the record, the nature of the acute complication having caused the coma (ketoacidosis, hypoglycaemia, hyperosmolarity) was not specified. Consequently, the hospitalisation frequencies for each acute complication could vary between 9.8% and 11.1% for ketoacidosis and between 2.3% and 3.5% for hypoglycaemia.

Micro-vascular complications were mentioned for 3.4% of children and adolescents ( $n=30$ ).

The declaration of a coma during hospitalisation, a stay in intensive care, in a continuous monitoring unit, or death during hospitalisation, were considered as markers of hospitalisation severity.

No deaths were reported; 1.5% of children were hospitalised in an intensive care or continuous monitoring unit and 2.5% of children suffered a diabetic coma.

TABLE 1

Characteristics of hospitalisation of diabetic children by age group (age as of 31/07/2007) over a 12-month period

	All	0-4 yrs	5-9 yrs	10-14 yrs	15-17 yrs	p <sup>a</sup>
<b>Number of children</b>	884	42	190	367	285	
At least one admission (%)						
any durations	52.0	59.5	51.0	54.8	48.1	ns
<24 hours	25.6	35.7	24.2	25.6	24.9	ns
≥24 hours	35.3	33.3	35.8	38.1	31.6	ns
Multiple admission (%)	20.8	21.4	19.5	22.9	18.9	ns
At least one admission for (%)						
controle and education	35.5	40.5	37.4	39.8	28.1	<0.02
acute diabetes complications	12.7	14.3	10.5	15.8	9.8	0.10
other causes	16.4	21.4	14.7	14.7	19.0	ns
<b>Number of hospitalised children</b>	460	25	97	201	137	
Number of admission per child						
median (Q1 -Q3)	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	ns
Total length of stay per child (days)						
median (Q1-Q3)	2 (0-5)	1 (0-3)	2 (0-4)	3 (0-6)	3 (0-6)	<0.01

ns indicates not significant

<sup>a</sup> test of the Chi2 (categorical variables) and test of the Kruskal-Wallis (quantitative variables)

For hospitalised children, the total number of stays did not vary according to age (table 1). The stay duration time per patient, however, was higher in children aged 10 years and over than in the under 10s (4.4 days on average versus 2.7 days ( $p<0.01$ )).

## Mention of a diabetes diagnosis during the hospital stay

For the 460 children hospitalised during the study period, there were 834 hospital stays.

Diabetes was mentioned in 91% of stays, identifying 94% of hospitalised children as diabetic. The existence of a diagnosis of diabetes during at least one stay was less frequent in the group of teenagers aged 15 years and over: 96% of under 5s, 98% of 5-9 year-olds, 97% of 10-14 year-olds and 88% of 15 year-olds and above.

## Characteristics of hospitalised children

On average, hospitalised children were younger and more frequently recipients of a waiver of co-payment. They were more frequently treated with insulin associated with OAD medicines, more frequently fitted with an insulin pump and more often followed mainly by a hospital practitioner (table 2).

TABLE 2 I

### Comparison of sociodemographic characteristics and healthcare between hospitalised and non-hospitalised diabetic children

	Non hospitalised children (n=424)	Hospitalised children (n=460)	p <sup>c</sup>
Mean age (yrs±stderr <sup>a</sup> )	12.2±0.19	11.7±0.18	0.06
Boys (%)	50.9	49.8	ns
Waiver of co-payment (%)	13.7	20.0	<0.02
Treatment (%)			
Insulin alone	99.3	96.3	<0.01
Insulin pump therapy	12.5	21.1	<0.001
Main diabetes health care provider (%) <sup>b</sup>			
Hospital practitioner	75.2	88.3	<0.0001

ns indicates not significant

<sup>a</sup> standard error of the mean

<sup>b</sup> data available for one of the two main National Health Insurance System only (n=846)

<sup>c</sup> Chi square test (categorical variables) and Student test (quantitative variables)

The effect specific to each of the factors was studied using multivariate logistic regression. In order to ensure good model quality, the type of treatment, with or without association with OADs, was not included in the analysis due to the high degree of correlation between treatment and age (all children under the age of 10 years were treated with insulin alone) and to the small population of children treated with insulin in combination with OADs. Once all other factors had been taken into consideration, the use of an insulin pump, a waiver of co-payment and monitoring by a hospital practitioner remained significantly linked to hospitalisation.

As shown in table 1, hospitalisation frequency varied according to age for monitoring causes ( $p<0.02$ ) and it was near significance for causes of acute complications ( $p=0.10$ ). Children aged between 15 and 17 years were followed less frequently than younger children. The 0-4 years and 10-14 years age groups displayed higher frequencies of acute complications, which could in part be related to the difficulty in stabilising treatment at these ages.

Children who were recipients of a waiver of co-payment were more frequently hospitalised for acute complications (22.0% vs. 10.8%,  $p<0.001$ ) and for other causes (23.3% vs. 15.0%,  $p<0.02$ ), suggesting poorer overall health.

Hospitalisation frequency did not vary according to treatment, neither for diabetes monitoring, nor for acute complications. Hospitalisation frequency for other causes, however, was significantly higher amongst children treated with insulin associated with OADs (45.0% vs. 15.7%,  $p<0.01$ ).

Only hospitalisation frequency for diabetes monitoring was significantly higher in children fitted with an insulin pump compared to non-fitted children (48.7% vs. 32.8%,  $p<0.001$ ). This difference can be explained by pump maintenance and adjustment.

As expected, only hospitalisation frequency for diabetes monitoring was significantly higher for children monitored mainly by a hospital practitioner (40.3% vs. 15.4%,  $p<0.0001$ ).

## CONCLUSION

The study contributed to assess the weight of hospital care for diabetic children in 2007-2008. Half of the diabetic children were hospitalised during the year. For 12.7% of children, hospitalisation was associated with an acute complication of diabetes, which could have been avoided in part by better diabetes monitoring. The HAS April 2007 guidelines, recommending an annual check-up by a multidisciplinary medical team, seems to be far from having been implemented as only a little more than one third of children were hospitalised annually to monitor their diabetes and that in France, such check-ups are mainly performed in the hospital.

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### Key figures

- Representative sample of 884 diabetic children with an average age of 12 years, half of whom were boys;
- 1 in 2 diabetic children hospitalised during a year;
- 21% of children with 2 or more stays during the year;
- 35.5% of children hospitalised for diabetes monitoring;
- 12.7% of children hospitalised for an acute complication of diabetes;
- 3.4% of children with at least one hospitalisation with mention of a micro-vascular complication;
- Severity: 2.5% of children hospitalised for an acute complication of diabetes with coma, and no deaths;
- Hospitalisation was independently linked to several factors: waiver of co-payment, use of an insulin pump, monitoring by a hospital practitioner;
- Mention of diabetes in the French hospital discharge database (PMSI): for 91% of stays and 94% of the study population children.

### For further information

For further information, see the "Diabetes" part on the InVS website at the following address: <http://www.invs.sante.fr/Dossiers-thematiques/Maladies-chroniques-et-traumatismes/Diabete>.  
A slideshow of the study results is available.

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