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INSTITUT
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PAEDIATRIC COMPUTED TOMOGRAPHY EXPOSURE AND RADIATION-INDUCED CANCER THE FRENCH ONGOING COHORT OF CHILDHOOD CT SCAN

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▌ Medical exposure to Ionizing Radiation (IR) has dramatically increased over time and represents the main artificial IR exposure

- Increased use of CT scan both for adult and paediatric patients
  - In 2007, 70 and 7 million of CT scans were respectively performed In the USA and in France
- High dose associated with this type of exposure
  - CT scan : 5-10% of all imaging procedures but 40-70% of the collective dose

▌ cancer risk after medical X ray diagnosis

- Assessed for repeated exposure with relatively high doses **(Boice 1991; Howe 1995; Doody 2000;Bithell, 1975)**
- Still debated for more recent exposure associated with lower doses **(Bartley, 2010; Rajaraman, 2011; Hammer, 2009)**

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Children : at risk group

- From epidemiological studies (Follow-up of atomic bomb survivors and patients submitted to radiotherapy and/or radiodiagnosis exposure) **(Ron, 2003; Unscear 2006; Preston, 2007)**

A very strong association between age at exposure and risk has been observed, with a decreased risk with increasing age at exposure

- Long life expectancy

- Technical rqdiological protocols not always optimized

International interest on this topic

➤ **European Epi-CT project**

➤ 15 partners

➤ 9 national cohorts (Belgium, Denmark, **France**, Germany, Netherlands, Norway, Spain, Sweden and the United Kingdom)

➤ 1 million children expected

➤ Pooled analysis results in 2015

EU FP7 Euratom grant agreement n°269912

Cohorte Enfant Scanner -

Cohort « Enfant Scanner »
## A French cohort of children submitted to CT scan in early infancy

Aim of the study :

➢Estimation of the incidence of leukaemia or cancer following CT scan exposure in the cohort as compared to the national French paediatric rates

➢Quantification of the dose response relationship

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Participating hospitals

20 of the 30 most important French radiology departments

75% of the French paediatric population
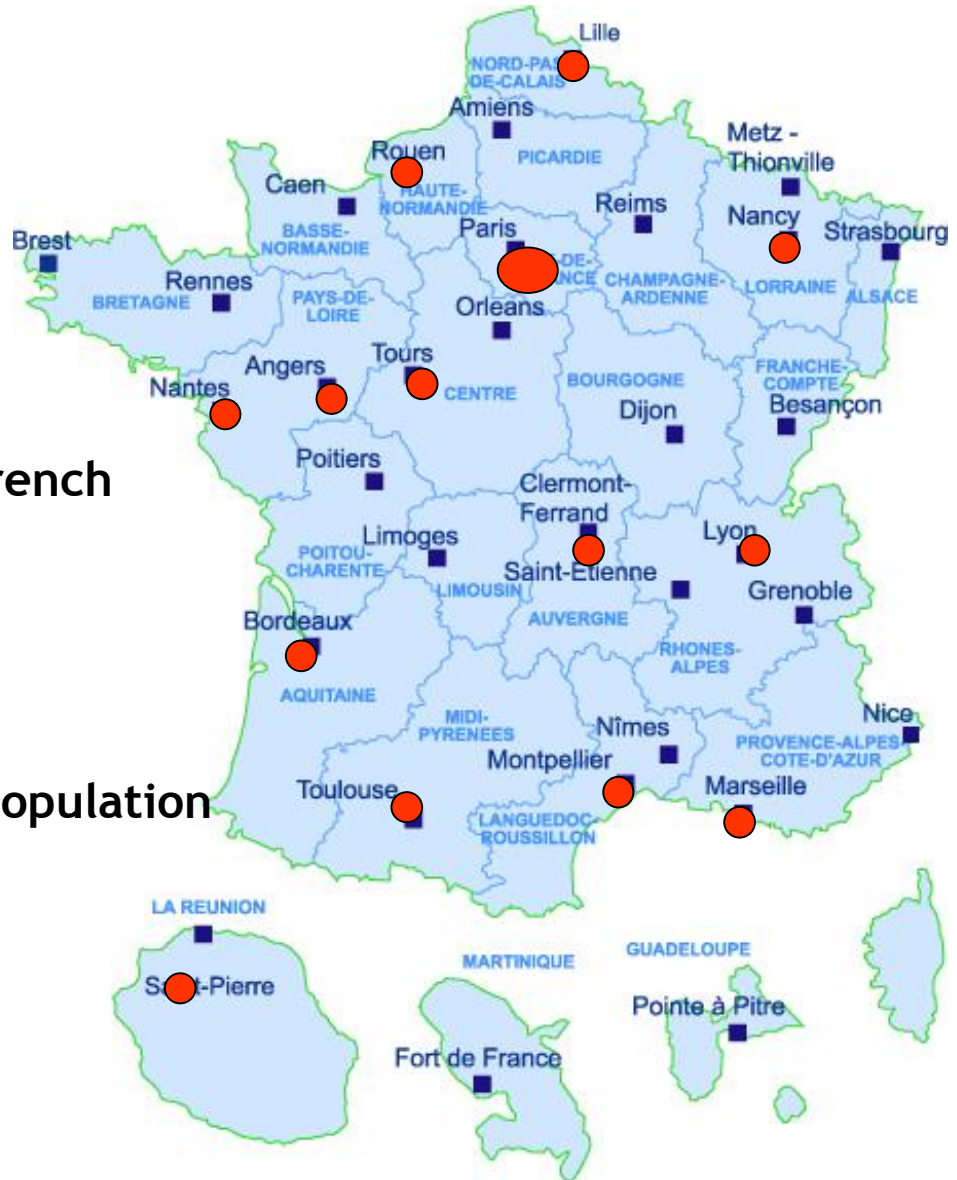
First period 2000-2006: 14 hospitals included **(Brit Journal of Radiology 2012)**

➢ 27 362 children (**0 to 5 years old at the first CT scan**) recruited retrospectively

➢ 44 417 CT scans, mean 1.5 exam per child (min1-max 30)
  ➢ 75% with only one 1 examination

➢ *Second period 2007-2012*: within the EPI-CT project : 6 supplementary hospitals

➢ 47 106 children (0-10 years old at the first CT scan) recruited

➢ 62 901 CT scans, mean 1.3 exam per child (min 1-max 30)
  ➢ 83% with only one 1 examination

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## Protocol :

Collected variables

- Demographic data

- Medical information : medical diagnosis associated with the hospitalization of the child

- Exposure assessment: number of CT scans performed, anatomical part irradiated, technical parameters associated with the exam
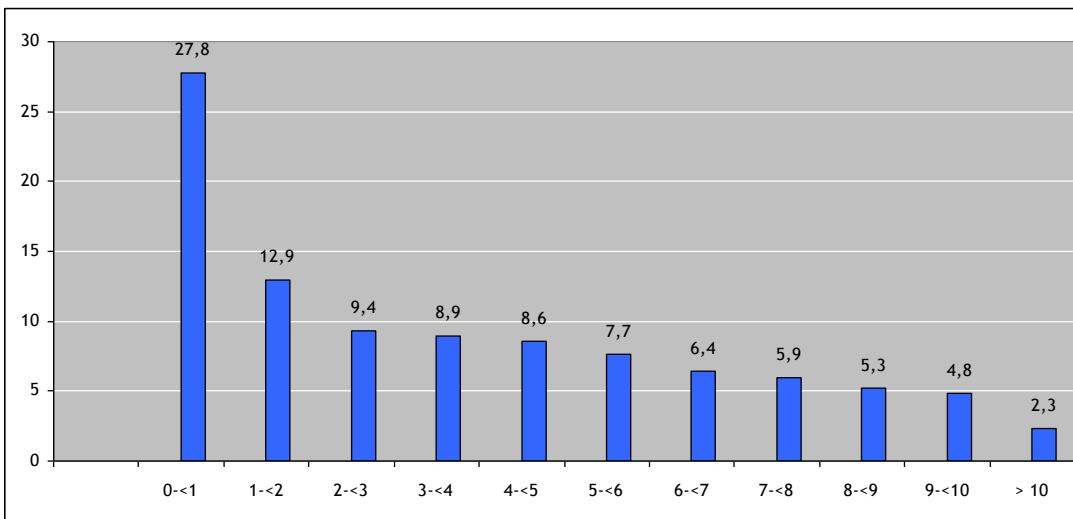
Assessment of cancer cases through
- National Paediatric Registries of Cancer and Leukaemia in the follow-up of the cohort until the age of 18
- For adults, the cancer status will be assessed through death certificates

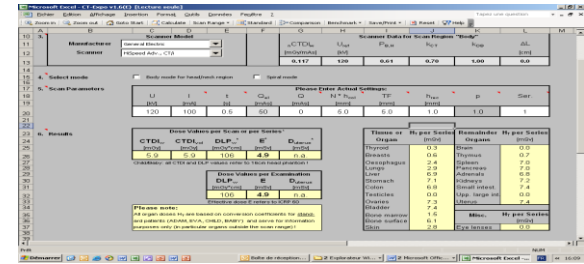➤ Percentage of exams by anatomical explored region
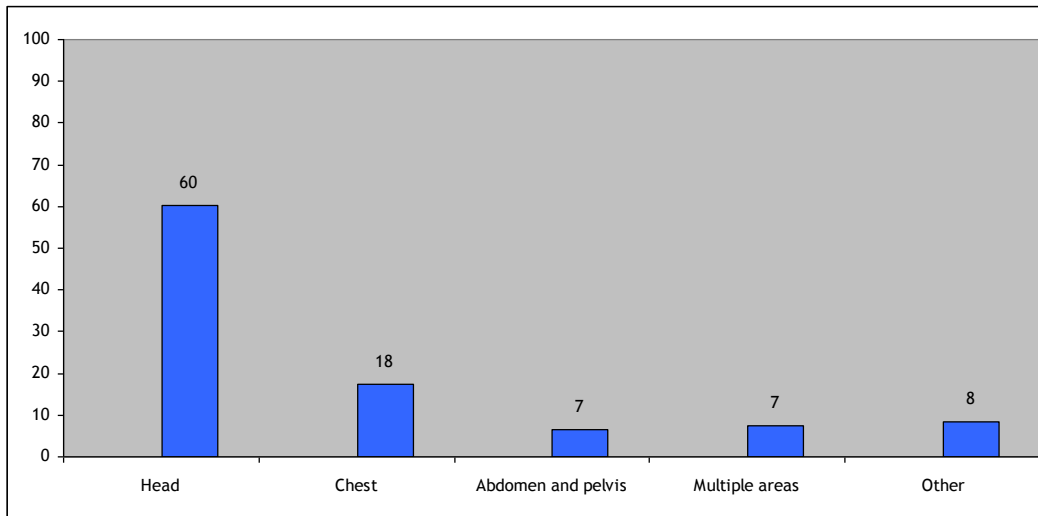
•Most frequent examination : Head CT scan

➤ Percentage of exams by category of age at exposure

•About 30% of examinations in the first year of life

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Organ dose estimation

➢ *First period 2000-2006*

➢ - No retrospective individual electronic data files before 2005-2006

➢ - Technical parameters for data acquisition from protocols of the radiology department

➢ - Organ doses estimation with the software CT expo for each procedure according to the age of the child

➢ Second period 2007-2012

➢ Storage of the examination on PACS system : individual technical parameters available

➢ Use of a software developed by NCI with phantoms for several categories of age

Organ dose estimation (Bernier, Brit J Radiology, 2012)

➢ *Head examination*

  ➢ Median dose to the brain 14-26 mGy
  ➢ Median dose to the eyes 21-37 (max 55 mGy in case of middle ear exam)
  ➢ Median dose to the bone marrow : 2-6 mGy

➢ Chest examination

  ➢ Median dose to the thyroid, lung, breast : 5-10 mGy

➢ Abdomen and pelvis

  ➢ Median dose to the testicles: 7-12 mGy
  ➢ Median dose to the ovaries: 8-16 mGy

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➢ **finalisation of the database**

➢**Exposure reconstruction for the second period**

  ➢Collection of electronic files from the PACS system

➢**Vital status and cancer status assessment for the whole cohort**

  ➢Linkage with paediatric cancer registries

➢**Statistical analysis**

  ➢first analysis in 2012

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➢ **This cohort permits to better characterize organ doses associated with CT scan exposure in childhood**

    ➢ a large numbers of centers involved

    ➢ Quite elevated doses have been observed for radiosensitive organs (lenses, ovaries, breast, etc…) with a large variability according to the protocol used

    ➡️   Optimization of the protocols should be perform

➢ **Follow-up of the cohort will assess cancer risk linked to CT scan exposure in this high risk group**

➢*EPI-CT***, a planned collaborative project with other European countries will increase the statistical power of the analyses**

➢**Other populations should be studied : children subjected to interventional cardiology procedures**

Associated teams

Financial support

▌**Unit of Epidemiology of the French Institute of Radiological Protection and Nuclear Safety (IRSN)**
  - ▪ **MO Bernier, M mezzarobba, S Caër-Lorho, D Laurier:** Setting of the study

▌*Medical Radiation Protection Expertise Unit* **(IRSN)**
  - ▪ **B Aubert, JL Réhel:** Dosimetric estimation

▌**French Society of Paediatric Radiology (SFIPP)**
  - ▪ **H Brisse, C Adamsbaum:** contacts with the departments of radiology

▌**Departments of Paediatric Radiology (20 centers)**
  - ▪ Data and protocols used

▌**Registries of Paediatric Cancer (RTSE) and Leukemia (RNHE)**
  - ▪ **B Lacour (RTSE), J Clavel, A Goubin U Inserm754:** Follow-up of the cohort

▌**Institut National du Cancer**

▌**Ligue contre le cancer**

▌**EU, FP7**