



# mobi-kids

Study on Communication Technology,  
Environment and Brain Tumours in Young People



Elisabeth Cardis for the MobiKids consortium

# Mobile phones, RF and health

- History of mobile phone use
  - 1st generation – analogue phones
    - ✓ started in early 1980's
      - “bag telephones” with antenna on the bag
      - car phones
      - mainly 450 MHz range
      - costs were high and phones unwieldy
    - ✓ late 1980's – early 1990s ...
      - “Smaller” hand held phones with antennas
      - 800-900 MHz
      - still expensive ... “businessmen”



# Mobile phones, RF and health

- 2nd generation - digital phones

- started around 1992
- 800-900 MHz
- then 1500, 1800-1900 MHz
- prices decreased
- subscription prevalence increased
- „, but use still low ...
  - ✓ 100 hours lifetime,
  - ✓ 2-2.5 hours monthly in Interphone controls (interviewed 2000-2004)

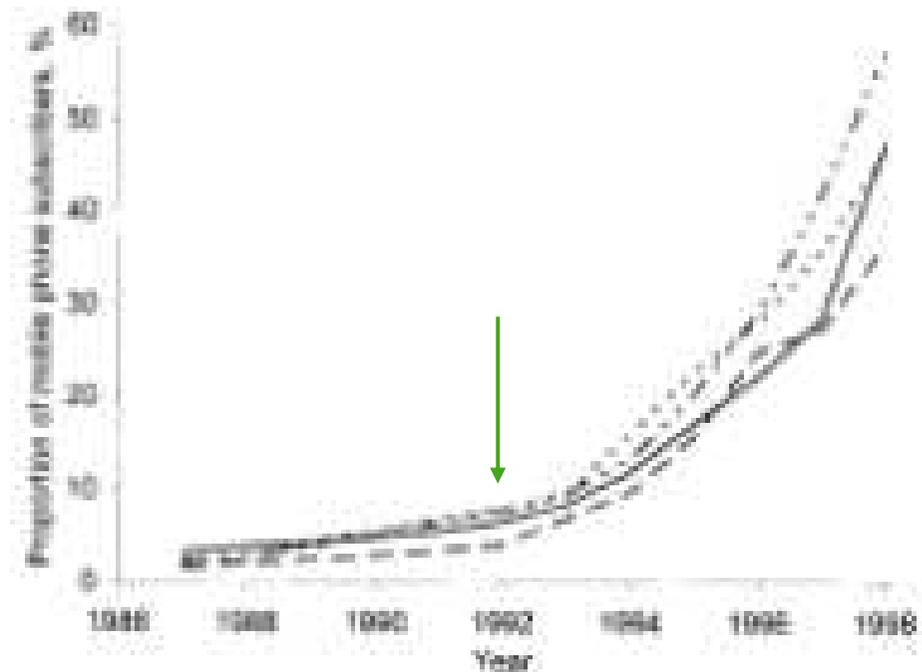


FIGURE 1. Annual proportion of mobile phone subscriptions in four Nordic populations during 1987-98. Denmark is indicated as —, Finland as - - -, Norway as — and Sweden as - - -.

Lönn et al, 2004

# Mobile phones, RF and health

- Today ...
  - 4.6 billion users in the world
  - Increasingly 3G, 3.5G, 4G
  - Higher frequencies ... 2.2 GHz  
though now re-using lower frequencies
  - Prevalence of use still increasing, particularly in young people
  - So is amount of use ...  
... not unusual to see young people using phones  
1 or more hour a day

# Mobile phones and brain tumours in young people

- Public and public health interest
  - International recommendations
    - ✓ WHO International EMF Project
    - ✓ EU supported EMF-Net
  - National recommendations



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Tecnologías de la comunicación,  
medioambiente y tumores cerebrales en la gente joven

# Use of mobile phones during childhood and adolescence



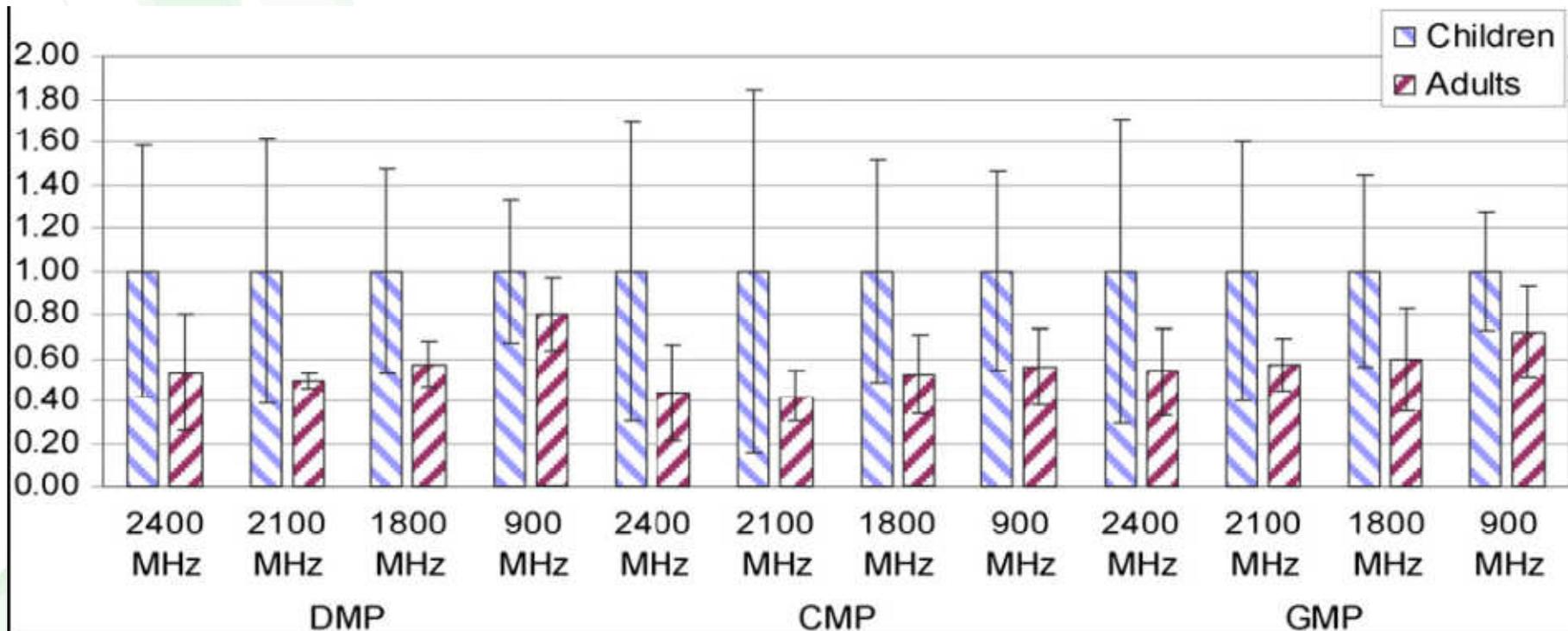
- Benefits – non-negligible
  - Emergencies
  - Communication with family
  - Communication with friends
- What are the potential risks ?
  - Cognitive effects
  - Brain and CNS tumours
- Health effects of RF not demonstrated at this point  
*... but if there is a risk, it is likely to be greater for exposures in childhood and adolescence ...*

## Why would the risk be larger?

- Children who start using phones will have much more exposure
  - Many more years of use
  - Greater quantity of use as much cheaper than before
- Children may be more vulnerable

# Exposure is greater ...

The relative mean MSAR1g tends to be higher in children than in adult brain tissues  
*(results normalized to children)*



Wiert et al, 2008

# What do we know about health effects of RF ?

- Have been reviewed over the years by a number of national and international committees
  - Most reviews have been inconclusive – some suggesting lack of effects at athermal levels
- WHO-IARC Monographs evaluation 31 May 2011
  - based on a critical review of all available peer-reviewed studies, classified RF as *“possibly carcinogenic to humans – 2B”* \*

\* *Baan et al, The Lancet Oncology – epub 22 June 2011*

# The INTERPHONE study

- *Objectives*

- To determine whether mobile phone use increases the risk of cancer, and
- To examine the association with other known / suspected risk factors

- *Design*

- Population based case-control studies:
  - ✓ Glioma
  - ✓ Meningioma
  - ✓ Acoustic neurinoma
  - ✓ Parotid gland tumours
- All persons aged 30-59 years who reside in the study regions (metropolitan areas in most countries)
- Case diagnoses: 2000 until late 2004



## INTERPHONE - study results

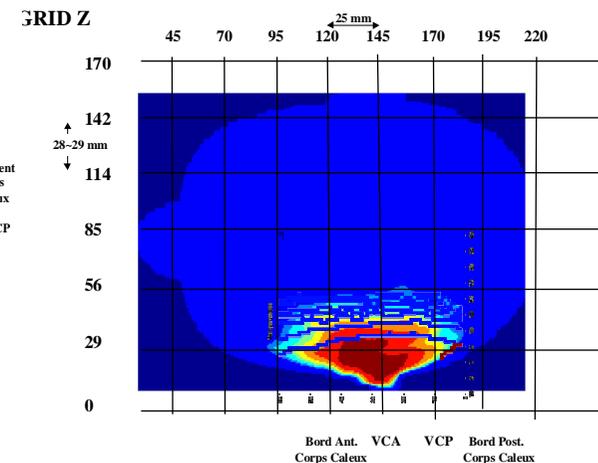
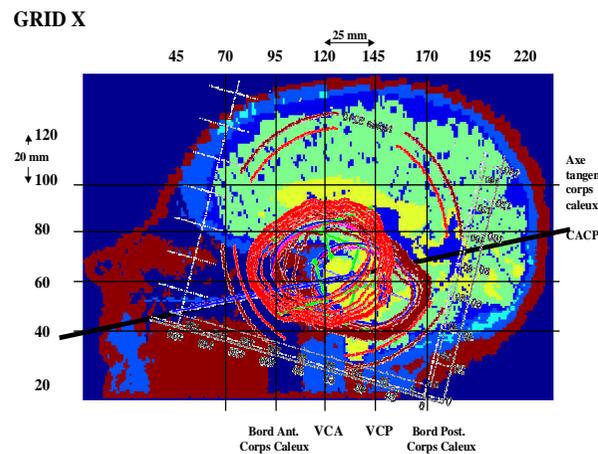
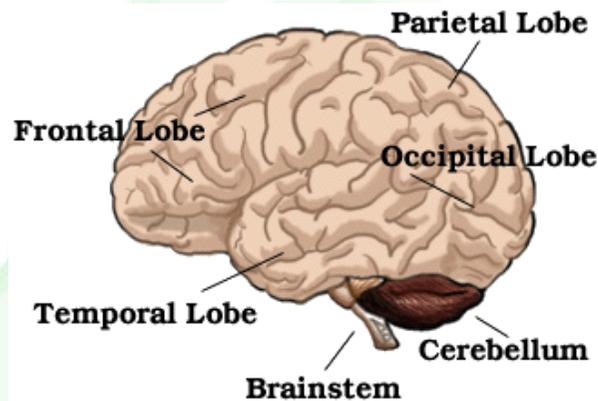
- Meningioma: 2409 cases and 2662 controls
- Glioma: 2708 cases and 2972 controls
- Acoustic neuroma (AN): 1105 cases and 2145 controls
- Reduced OR among ever regular users
  - Meningioma: 0.79 (95% CI 0.68-0.91)
  - Glioma: 0.81 (95% CI 0.70-0.94)
  - AN: 0.85 (95% CI 0.69-1.04)
- No increased risk for use 10+ years
  - Meningioma: 0.83 (95% CI 0.61-1.14)
  - Glioma: 0.98 (95% CI 0.76-1.26)
  - AN: 0.76 (95% CI 0.52-1.11)
- **Overwhelming majority of ORs below 1 ... risks underestimated ?**

*The INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. IJE 2010*

*The INTERPHONE Study Group. Acoustic neuroma risk in relation to mobile telephone use: Results of the INTERPHONE international case-control study . Cancer Epidemiol, 2011*

# INTERPHONE - study results

- No evidence of exposure response relationship but ...
- Increased OR in highest users ( $\geq 1640\text{h}$ )
  - Glioma: 1.40 (95% CI 1.03-1.89)
  - Risk highest
    - ✓ On side of head where phone is used **1.96 (1.2-3.2)**
    - ✓ For tumours in the temporal lobe **1.87 (1.1-3.2)**



## INTERPHONE study results

- Recent 5-country analyses with estimated RF dose at the location of the tumour (*Cardis et al, OEM, 2011*)
  - a dose-response relationship for glioma 7+ years before dx
  - no association in short-term users

... Results suggestive, but biases and error prevent a causal

- *Caution needed until more definitive conclusions can be drawn*

## CHANGES IN PATTERN OF USE

- Interphone study subjects
  - Light users compared to today
    - ✓ Few used the phone more than 10 years
    - ✓ Median cumulative call time over life: 100 hours
    - ✓ Highest group  $\geq 1640$  hours: *about 30 min/day over 10 years*
  - Not unusual today for people to speak one hour or more, particularly young people
- Need more research, particularly among young people
  - ... CEFALO study just published
  - ... Mobi-Kids starting with funding from the EU 7th framework programme

## Brain tumours in young people - CEFALO

- **Aydin et al 2011, JNCI**
  - 352 cases, 646 controls
  - 7-19 years old, 2004-2008
  - Participation rates - 83% cases, 71% controls
  - Results
    - ✓ Ever regular use (194 cases) OR 1.36 (95% CI 0.92-2.02)
    - ✓ No evidence of increase with duration or amount of use  
*...only 52 cases with subscriptions for 4 years or more*
  - **Interpretation difficult**
    - ✓ Relatively small number of subjects
    - ✓ Subjects young – median 13 years
    - ✓ Very few long term or heavy users
      - *median years of use 2.7*
      - *median cumulative hours of use lifetime: 35*
    - ✓ Most ORs above 1 ...

- Overall objective
  - To assess the risk of brain tumours in young people in relation to:
    - ✓ childhood and adolescent exposure to EMF from communication technologies
    - ✓ other potential environmental and host factors
- Case-control study
  - Cases
    - ✓ Benign and malignant brain tumours
    - ✓ Aged 10-24, 2010-2013
    - ✓ Rapid ascertainment from diagnosing and treatment hospitals
  - Controls
    - ✓ 2 per case
    - ✓ **Appendicitis controls**, to minimise selection bias related to non-participation.
    - ✓ Individually matched on age, sex and region



## MobiKids countries – about 2400 cases expected

- EU funding

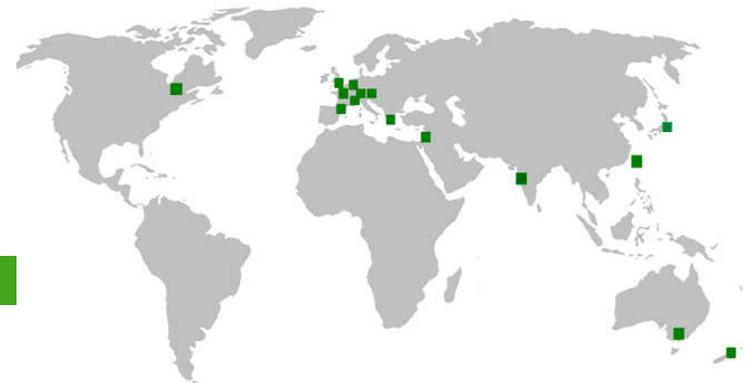
- Austria
- France
- Germany
- Greece
- Israel
- Italy
- The Netherlands
- Spain\*



- Separate funding

- Australia
- *New Zealand*
- Canada
- India
- Korea
- Japan
- *Taiwan*
- *US ?*

\**CREAL coordinator*



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medioambiente y tumores cerebrales en la gente joven

## Collection of information on patients

- MRI and CT scans review for tumour localisation
- Histological slides, case notes for a sample of cases
- Saliva in some countries
  - to contribute to future international consortia on genetic aspects and gene-environment interactions in the aetiology of this rare disease
- Detailed study questionnaire

# Detailed study questionnaire

MobiKids - [B. Uso de Teléfono Móvil]

MobiKids Archivo Edición Vista Ayuda

 **mobi-kids**  
State of Communication Technology,  
 Measurement and Health Evidence in Young People

**Interview Status Summary**

**FPrimary 11-01-15-01-0001** **Exit**

Was the Informed Consent signed?  0 : No  1 : Si

Link	Status *	Section
---	On-going	Follow-Up Registry
---	Completed	Appendix A

Index Name:

Link	Status *	Section
---	Pending	Appendix B

<b>Main Questionnaire Status:</b> <input type="text" value="2 :"/> <input type="button" value="To Continue..."/>	<b>Parental Questionnaire Status:</b> <input type="text"/> <input type="button" value="To Continue..."/>
<b>Last Section:</b> <input type="text" value="B_MobilePhone_Use 2"/>	<b>Last Section:</b> <input type="text"/>
<b>Last Field:</b> <input type="text" value="B1_MPU"/>	<b>Last Field:</b> <input type="text"/>

Status *	Main Questionnaire Section
---	Completed A. General Information
---	On-going B. Mobile Phone Use
---	Pending C. Other wireless communication devices usage
---	Pending D. Exposure to other (not communication) sources of ELF and RF
---	Pending E. Occupational
---	Pending F. Medical Radiation
---	Pending G. Medical History
---	Pending Index Questions On Water And Disinfection By-Products (country specific)
---	Pending H. Interview responsiveness & status

Status *	Parental Questionnaire Section
---	Pending I. Maternal Questionnaire
---	Pending Mother Questions On Water And Disinfection By-Products (country specific)
---	Pending J. Family History of Cancer
---	Pending K. Paternal Questionnaire
---	Pending L. Interview responsiveness (Parental)

Link	Status *	Section
---	Pending	M. Clinical Questionnaire

# Validation of self-reported mobile phone use

- **Historical traffic/billing records from providers for cases and controls**
    - Frequency and duration of voice and data use
    - Identification of phones (in some countries through IMEI)
  - **Laterality**
    - Interview hands a phone to the subject
    - Photograph if not in person
  - **Software-modified-smartphones (SMSP) study among volunteers**
    - Frequency and duration of voice and data use
    - Laterality
    - Hands free
    - Estimated power
- ... Validation and information on use patterns*

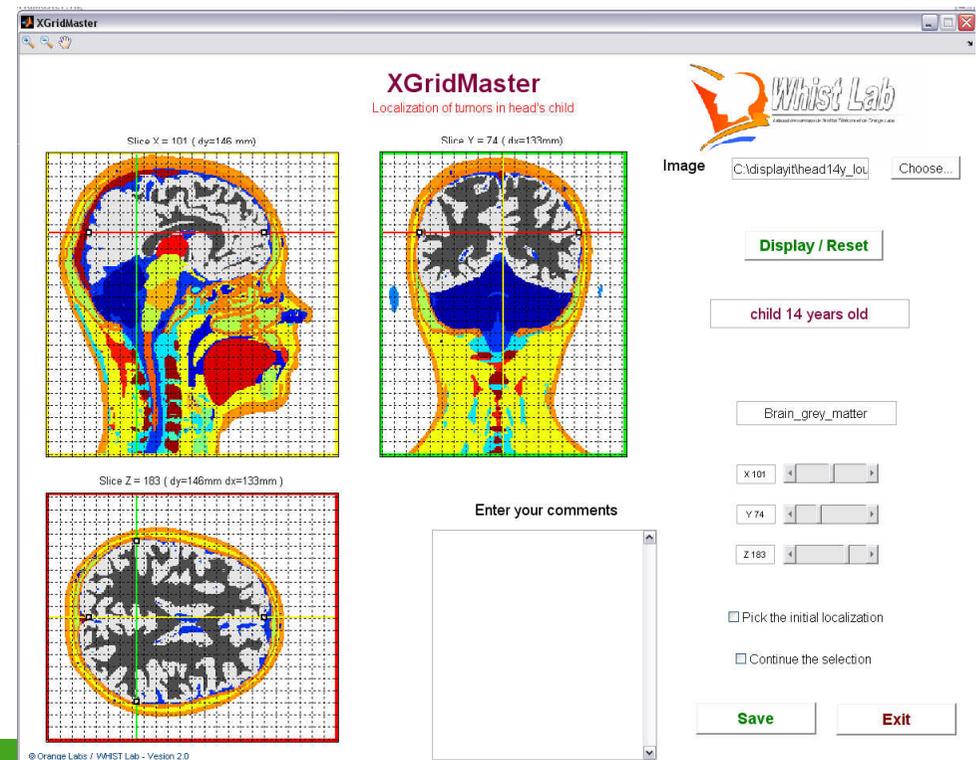


ZonWN



# Tumour diagnosis and localisation

- Tumour diagnosis:  
central review of sample of histological slides  
by international panel of neuropathologists to verify diagnosis
- Tumour localisation:  
review of MRI/CT scans - mark  
precise location of tumour on  
specially developed grids



# Exposure assessment

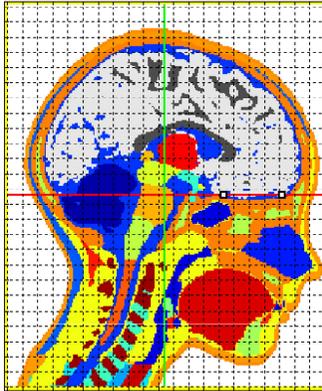
- Exposure assessment subcommittee:  
*Myron Maslany, Joe Wiart, Hans Kromhout, Malcolm Sim, Ae-Kyoung Lee, Masao Taki, Elisabeth Cardis*
- Exposure assessment - EMF
  - Estimation of RF and ELF exposure at different locations of the brain from mobile and DECT phones and other communications technologies
  - Estimation of EMF exposure from other residential and occupational sources





# Objective: characterise the exposure

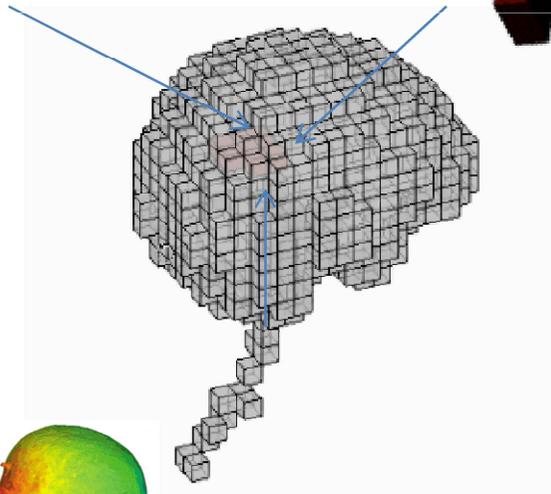
## Tumor localisation



## SAR

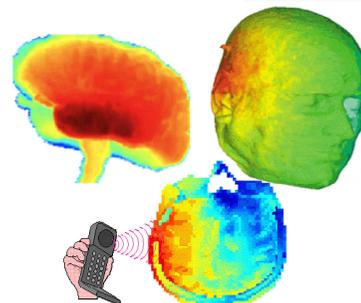


## EXPOSURE



SAR distribution in brain :

highly localized



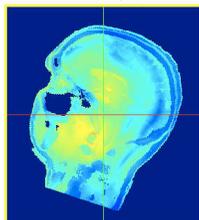


# Phone Models designed and used

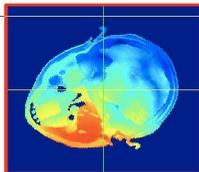
Closed Slide phone



Slice X = 122 (122)



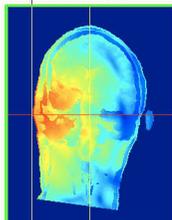
Slice Z = 157 (157)



Bar phone



Slice Y = 142 (142)



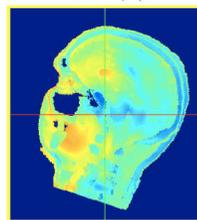
PDA



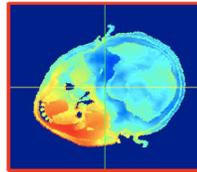
Flip phone



Slice X = 122 (122)



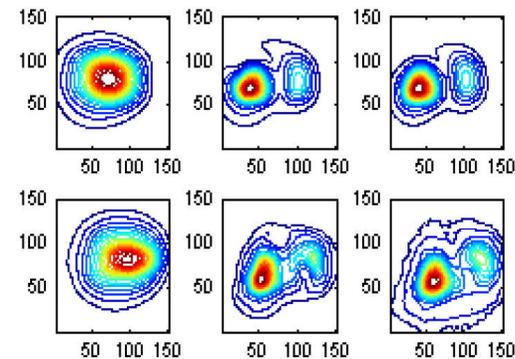
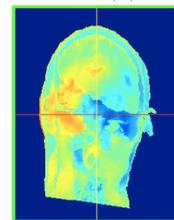
Slice Z = 157 (157)



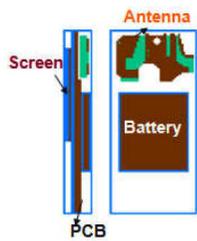
Opened Slide phone



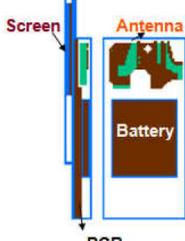
Slice Y = 142 (142)



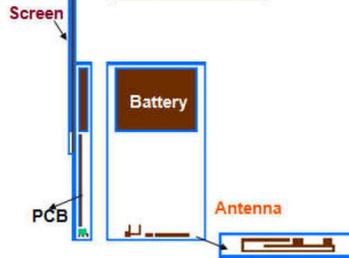
Top antenna



Center antenna



Bottom antenna



Plastic  $\epsilon_r = 5$

Metal

Antenna support  $\epsilon_r = 3$

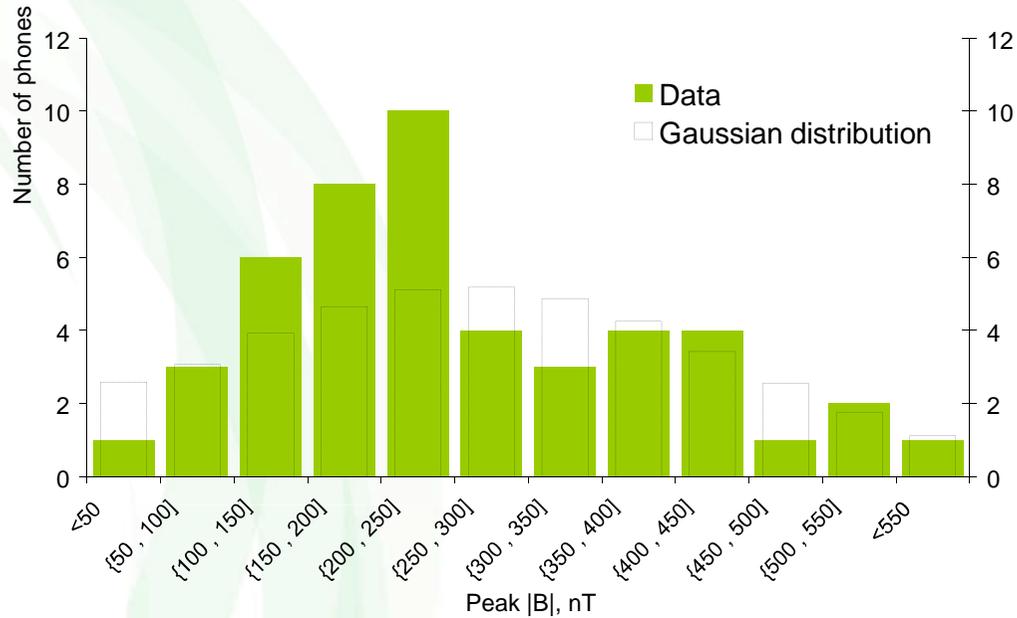


# RF Exposure assessment

- Study of factors modifying spatial distribution
  - phone position
  - frequency band
  - Hand
  - Ear
  - Distance of the phone from head



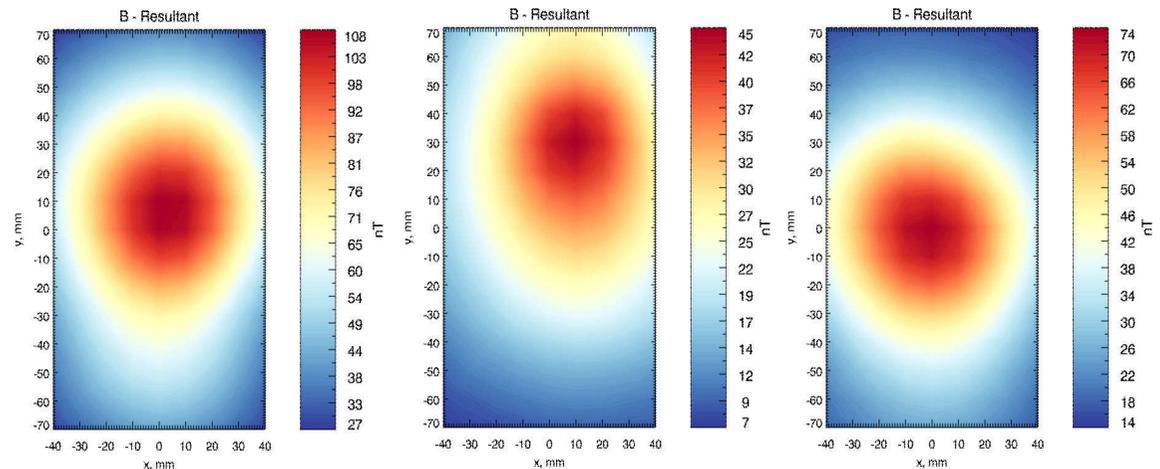
# ELF exposure assessment



peak resultant magnetic flux density of all 47 phone models measured



Resultant magnetic flux density patterns for phones with different battery positions



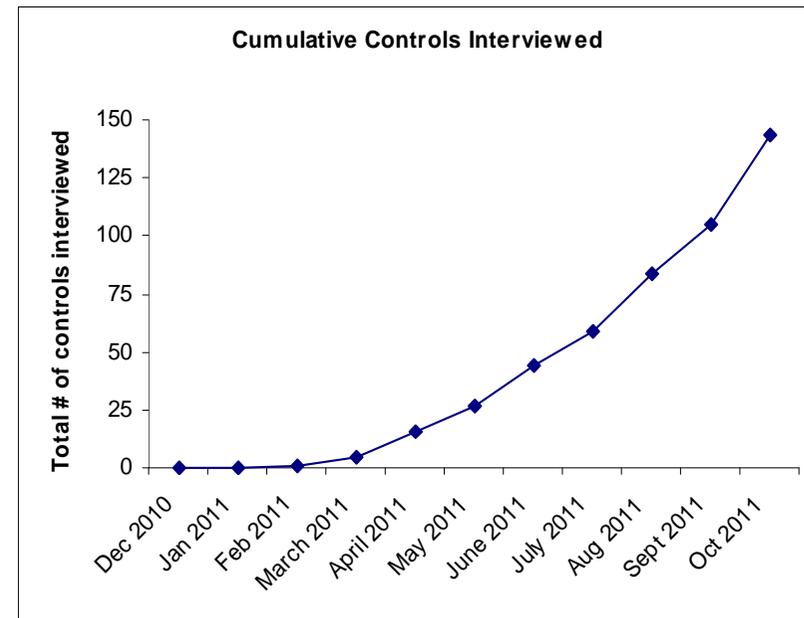
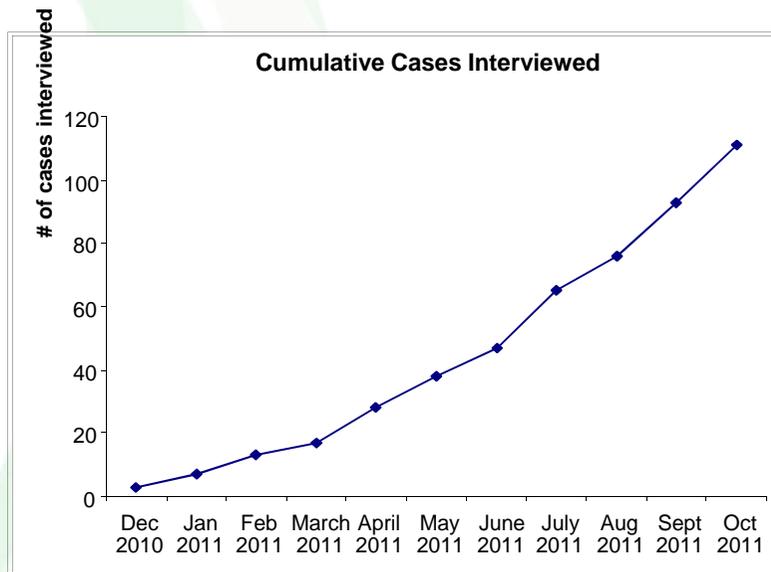
## Exposure assessment – others

- Questions – pets, living on farm, etc.
- Evaluation of availability of geocoded data on other exposures for linkage with *residential and school history of subjects*
  - ✓ land use
  - ✓ water companies
  - ✓ pesticide use
  - ✓ ,,,



## Current status

- Ethics approvals:
  - Obtained or ongoing in most countries (hundreds of hospitals !)
- First interviews started early 2011



Data collection duration: 2.5-3 years



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