



**ICNIRP 7th International NIR Workshop**  
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# **Mobile Phones & Cancer – How does epidemiology investigate this?**

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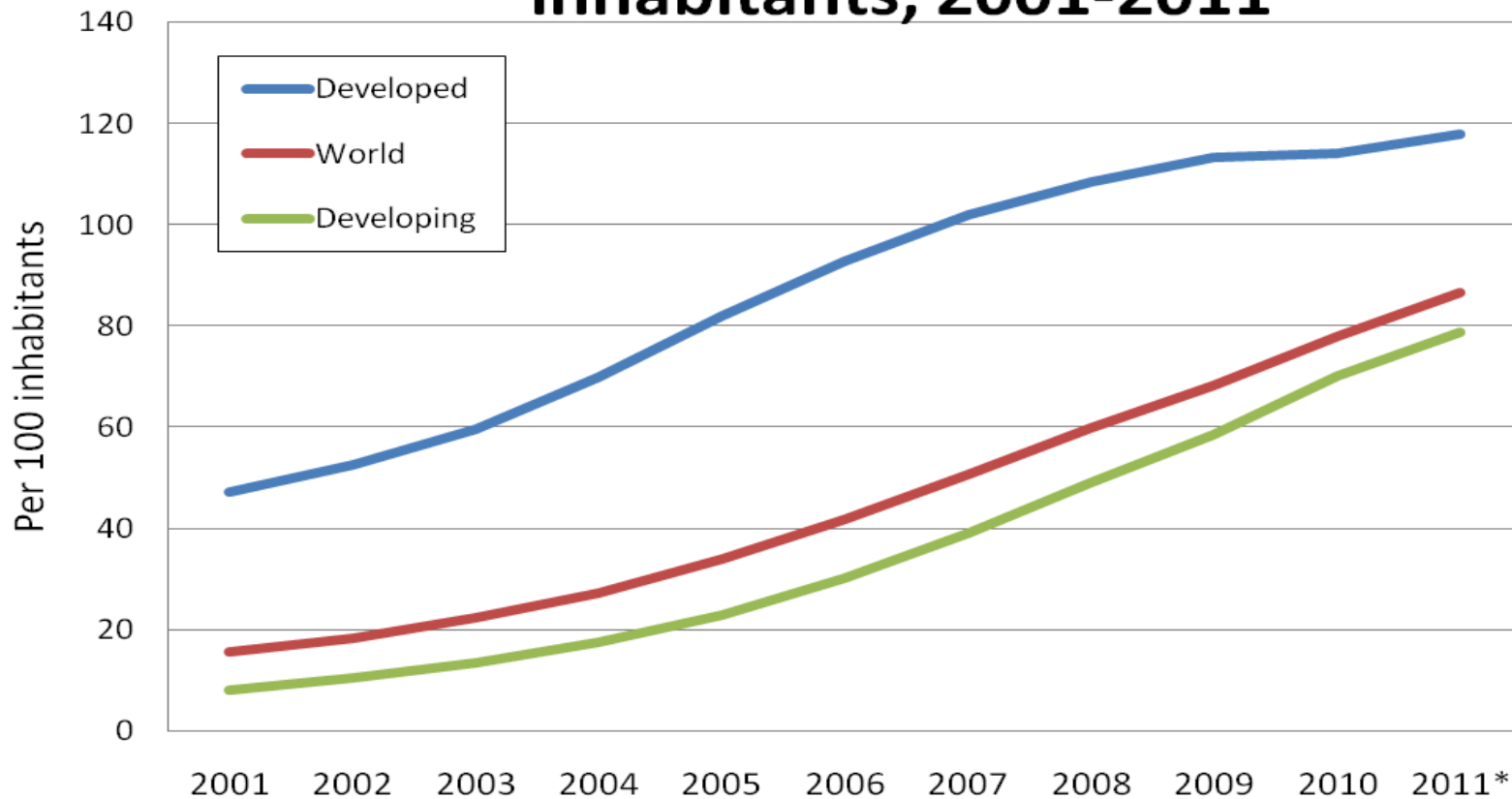
INSTITUTE OF CANCER RESEARCH



- There are now >5 billion cellular phone users in the world, five times as many as 10 years ago.



## Mobile-cellular subscriptions per 100 inhabitants, 2001-2011\*



Source: ITU World Telecommunications/ ICT Indicators database

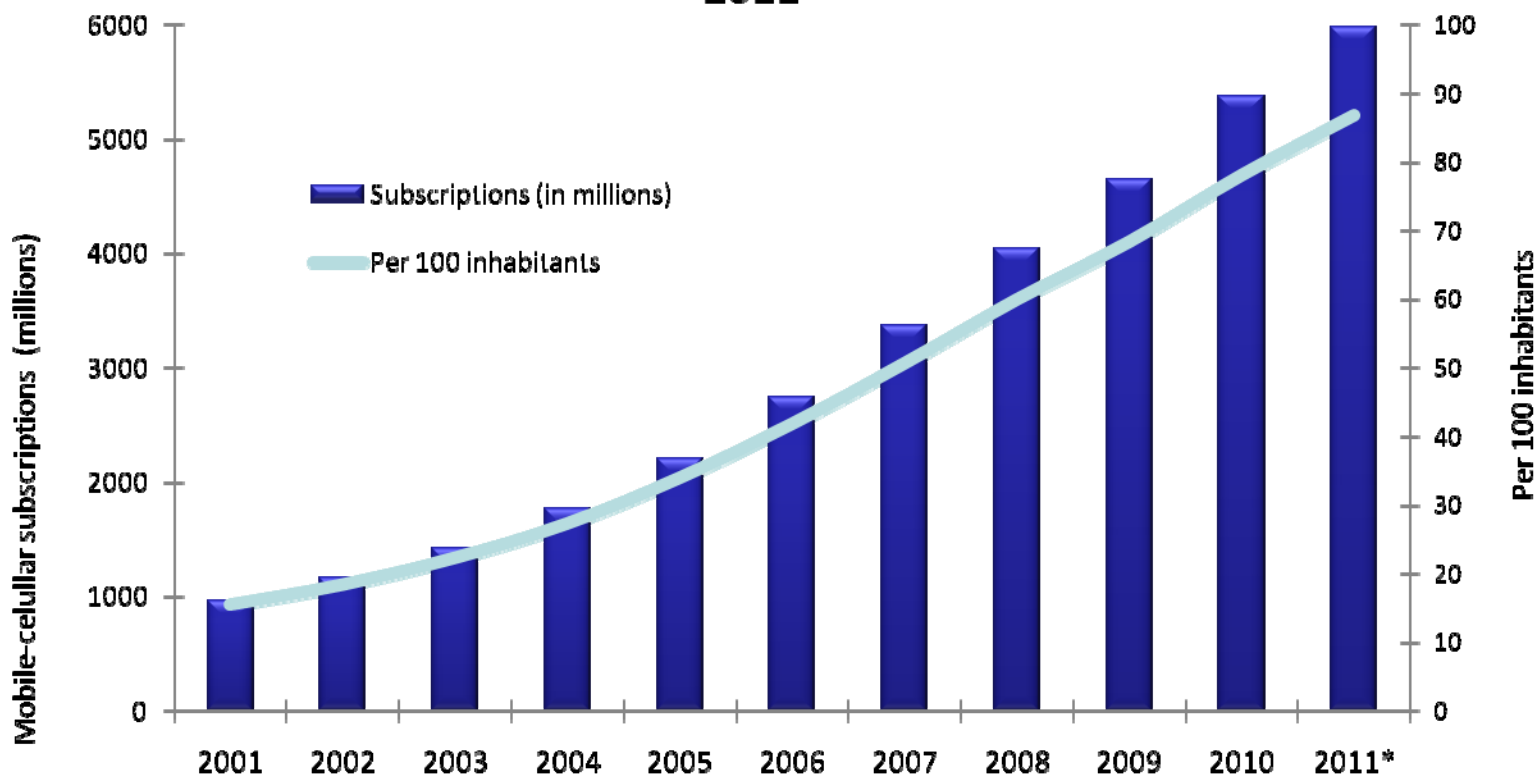


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### Global mobile-cellular subscriptions, total and per 100 inhabitants, 2001-2011\*



\*Estimate

Source: ITU World Telecommunication /ICT Indicators database



# Radiofrequency fields and cancer: physics

- RF fields have insufficient energy to disrupt molecular bonds directly.



# Radiofrequency fields and cancer: biology

- Balance of biological evidence suggests that RF field exposures below guideline levels do not cause mutation or initiate or promote tumour formation.
- No consistent laboratory evidence that RF can cause cancer in animals.



- Nevertheless, there is public concern and scientific questions have been raised about possible carcinogenicity, and several epidemiological studies have consequently been undertaken to investigate risks.



Epidemiology: study of the  
distribution and causes of disease in  
human populations.





# Epidemiology : strengths

- Assessment of risks in human beings, not in animals or cells.



## Epidemiology : limitations

- Can only investigate the types of exposure that have already been prevalent several years in the past.



How does epidemiology investigate this question, and what features of epidemiological studies should you look at carefully when assessing published epidemiological studies?



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# Epidemiological investigation of cancer risk in relation to RF exposure

Epidemiological studies have investigated risk of cancer in relation to occupational, recreational, residential and phone exposures.



# Types of epidemiological study

- (1) Analyses of routinely-collected mortality or cancer registration data from populations.

e.g. mortality or cancer risks over time in relation to extent of phone use over time.

e.g. cancer rates in relation to residential proximity to TV or phone masts (but beware the Texas Sharpshooter effect)



- Generally, such “ecological” data, on populations, give much weaker evidence than individual-level data.
- But, the secular trend data here have unusual strengths because mobile phone use has vastly increased, and become near-ubiquitous, over a short period of years.



- (2) Case-control studies, comparing extent of mobile phone exposure in persons with a particular disease (e.g. brain tumour) with that in control individuals without the disease.
- Phone use data usually obtained by interview of the subjects (or more rarely, of proxies).



- (3) Cohort studies, following disease risk over time in persons with a particular exposure (e.g. mobile phone subscribers).
- Phone use data can be from billing records.



# Cohort Studies

Can be:

1) Retrospective – exposure and diseases have occurred when study started.

*or*

2) Prospective – disease not yet occurred  $\pm$  exposure not yet occurred at start of study.



# Case-control studies : Strengths

- Relatively quick and cheap  
(compared with cohorts)





# Case-control studies : limitations

- Mobile phone use over a period of years is remembered very inaccurately, which will make any real effects appear weaker than they truly are.
- Mobile phone use is only a crude proxy of RF exposure, so if there are real effects of RF, they will appear weaker in studies based on phone use data.



# Case-control studies : limitations

- Exposure is assessed retrospectively, and therefore if assessed by interview there is scope for recall bias (i.e. cases may remember phone use differently as a consequence of knowing they have cancer and believing it is caused by phone use).

This applies especially to recall of side of phone use.



# Case-control studies : limitations

- Some potential subjects may not take part (e.g. because they have died or are unwilling), and this non-participation may be biased

e.g. phone users may preferentially take part as controls, raising apparent use by controls.

Therefore greater non-participation → more scope for bias (especially a problem for population-based studies).



# Case-control studies : limitations

- The presence of a brain tumour may biologically affect memory and cognition, and hence reporting of phone use, and before diagnosis may affect actual phone use.
- For acoustic neuroma, the tumour may affect hearing and hence phone use before diagnosis, or lead to earlier diagnosis in phone users.



# Case-control studies : limitations

- Controls may be biased if they do not accurately represent the source population of the cases – especially a problem for hospital-based studies.
- If interviewers are not blinded to case/control status of the subject they interview, they may ask questions and record answers differently between cases and controls, because of their own views on whether phones cause cancer.



# Cohort studies : strengths

- Phone use assessment not biased by presence of disease.
- All occurrences of outcomes (e.g. of cancers) included, unconstrained by fatality, availability for interview, etc.



# Cohort Studies : limitations

- Need very large numbers of subjects and long follow-up, so can be slow and expensive.



## Cohort Studies : limitations

- If phone use is assessed from billing records:-
  - Cannot be sure who is the user (as opposed to the bill-payer),
  - There may be no information on incoming calls
  - Cannot assess behavioural factors (e.g. side of use, hands-free use).
  - These could be confounding by carcinogenic factors that are associated with phone use, and information may not be available on these.





# Interpretation of Epidemiological Results

- One should consider whether epidemiological results are due to bias, confounding, methodological inadequacies, or chance.
- It is valuable to assess the results against the 'Bradford Hill' criteria:-

Strength of association, dose-response, consistency, biological plausibility, etc.

*Hill AB. Proc R Soc Med 1965;58:295-300*



- Consistency: it is important, as in other biological science, to discover whether results from one investigator are confirmed by others, before giving them much weight.
- Weight should be given to results that fulfil the other criteria above and are confirmed by different investigators and by different methods.



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Thank you