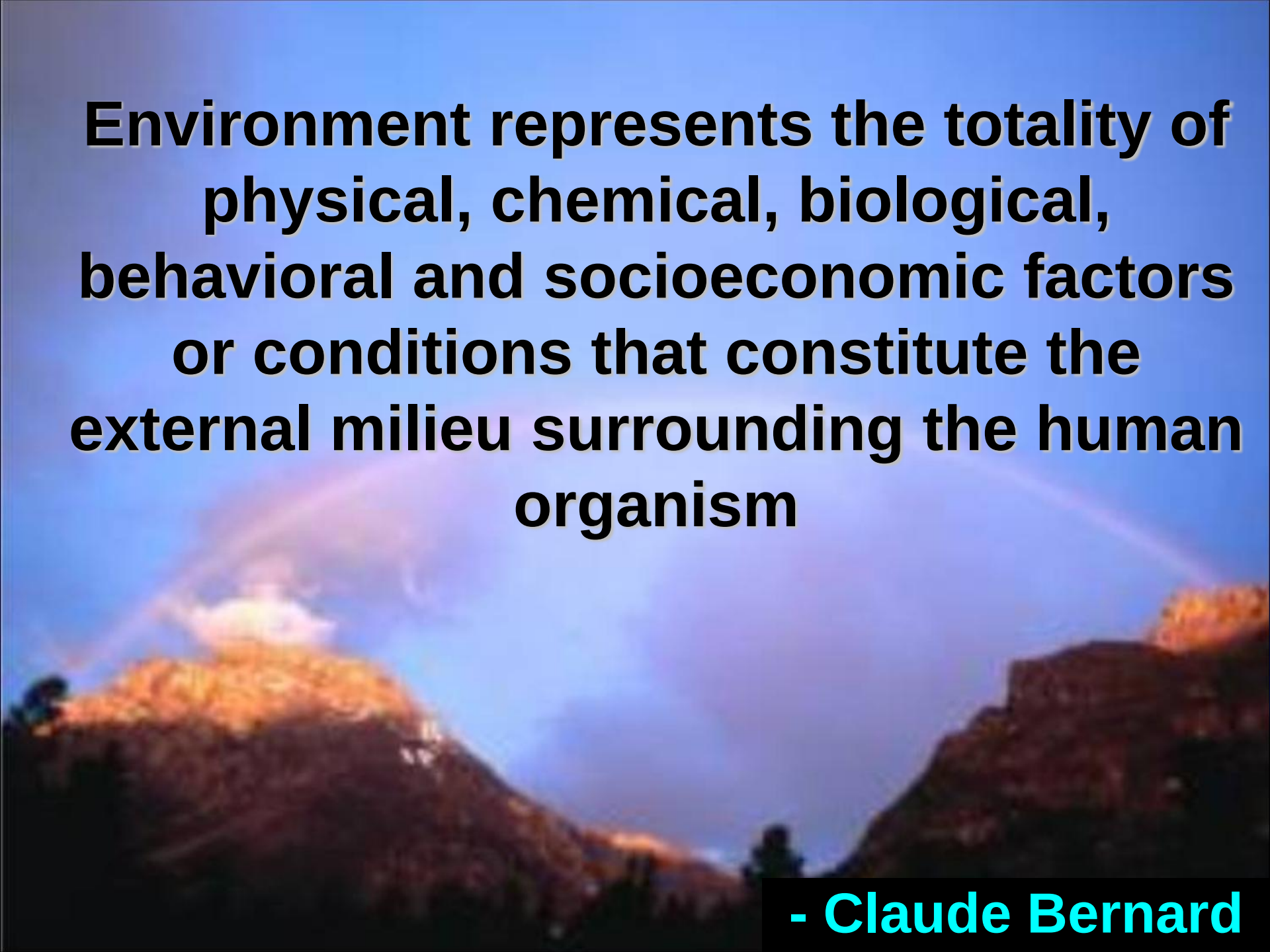
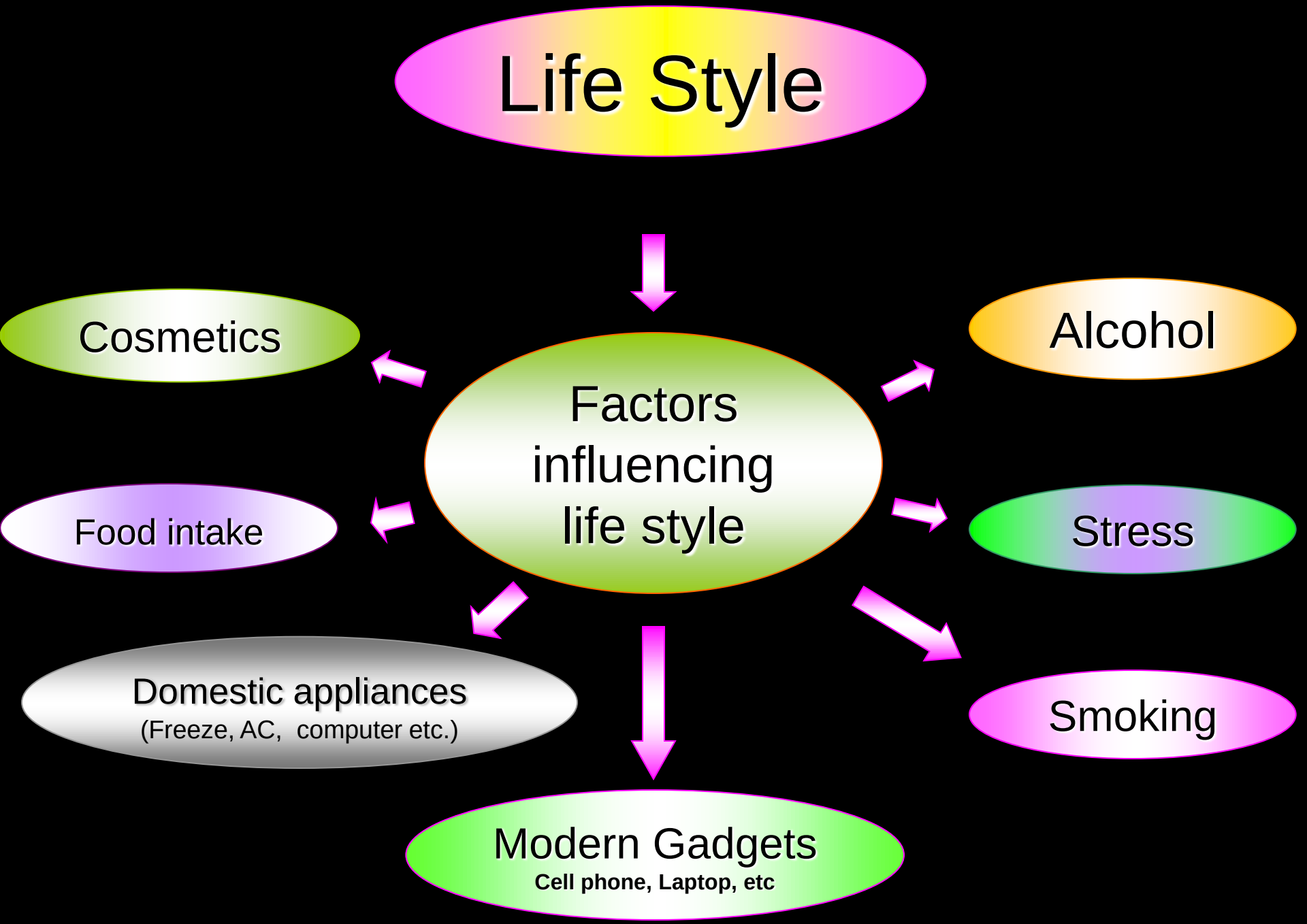
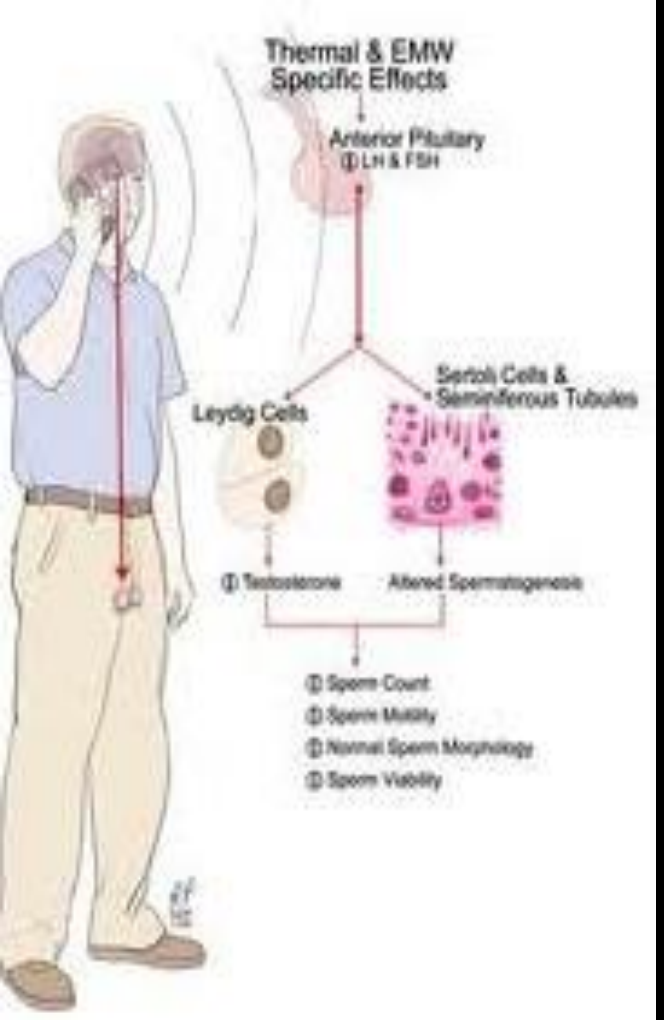

Environment represents the totality of physical, chemical, biological, behavioral and socioeconomic factors or conditions that constitute the external milieu surrounding the human organism
- Claude Bernard


Life Style
Factors influencing life style
Cosmetics
Alcohol
Food intake
Stress
Domestic appliances
(Freeze, AC, computer etc.)
Smoking
Modern Gadgets
Cell phone, Laptop, etc





# Effect of Electro-Magnetic Field (EMF) on Human Health

**Dr. R. S. Sharma**
**Sr. Deputy Director General & Scientist-G**
**Division of RCH**
**Indian Council of Medical Research**
**New Delhi –110 029**

# Typical sources of electromagnetic fields

| Frequency range | Frequencies | Field source | Examples of maximal intensities |
|---|---|---|---|
| Static frequency (SF) | 0 Hz | Natural<br>VDU (video displays)<br>MRI and other diagnostic/scientific instrumentation<br>Industrial electrolysis | 70 μ T<br>1 T in the tunnel; 200 mT at the gate:<br>< 0.5 mT outside the device room<br>10-30 mT at the level of the feet |
| Extremely low frequency (ELF) | 0-300 Hz<br>50 Hz | Power lines<br>Domestic distribution<br>Electric engines in cars, train and tramway | 10-20 μ T under the line or 10 Kv/m<br><0.i-0.2 μ T (microteslas) in room<br>50 μ T and 300 V/m |
| Intermediate frequencies (IF) | 300 Hz – 100 kHz | Typical examples are: VDU, anti theft devices in shops, hands free access control systems, card readers and metal detectors | 30 to max 700 nT<br>10 V/m |
| Radio frequencies (RF) | 100 kHz – 300 GHz | Broadcasting and TV; mobile telephony microwave oven<br>Radar, portable and stationary radio transceivers, personal mobile radio. | 0.1 $W/m^2$<br>0.5 $W/m^2$<br>0.2 $W/m^2$ |

# Historical Prospective

- The invention of cell phone came about mostly as a Corporate Strategy to keep one firm monopolizing a set of radio channels that looked as if they might one day be valuable.
- 1947 – 1972 : AT&T, Bell Lab, Motorola
- 4th Dec. 1972 Mr. Cooper announced that shortly he is going to develop a device that could send and receive voice massages without wire.
- 3rd April, 1973 He called to Joel S Engel

- Once  produced, the first cell phone took off like one of those successful rockets than being  lunched by NASA

- It all occurred in a culture that had little understanding of what radio-frequency signal were or how they worked.

- Govt. Agency in USA were well aware about the technology and about its health effects.
- Mays Swicord – who shaped FDA, in his thesis submitted to University of Maryland reported that  " RFR at precisely the same frequency range being proposed for cell phone could disturb the DNA deep within the center of the Brain Cell.
- 1994 he left FDA and in the same year the FDA approved the cell phone for general use without any safety testing at all.

- He joined Motorola as Senior researcher and Editor of the Bioelectromegnetics  Society News Letter.
-

- 1997 – Jerry Phillips submitted a paper in this new letter reporting that “ Genes of rodents exposed to cell phone like radiation looked significantly worse than those unexposed animals.
- But when this paper was published, in the end it was mentioned that “the changes in genes expression following cell phone radiation is probably of no physiological consequences.
- By the time his paper was published , he lost his job and lost his all funding.

- 1993 - FDA through Microwaves News reported several studies showing that microwave radiation increases cancer risk.

- But in May1997 FDA reported that “ little is know about the possible health effects of repeated or long term exposure to low level of RFR.

- 2000, Feb. FDA announced that “ there is currently insufficient scientific basis for concluding either that wireless communication technology are safe or they pose risk to users”. – advised  a well planned animal study.

- Meanwhile  technology  changed from  Analog cell phone.

- Gro Harlem Brundtland : former WHO DG in 2002 reported that
- Nearby operating cell phone could make her ill.

- Mike Repacholi was asked to examine her statement. And he said that “ she must have been crazy”
- He then Chaired number of WHO studies
- He helped formed ICNIRP and even currently also Emeritus Director of ICNIRP.
-

- ICNIRP : is not directly funded by the industry but its half of the members are associated with a project funded by

- Royal Adelaide Hospital, Australia

- Science is limited by the measurement techniques but

- its even more limited by political and economic circumstances that determine ;

- what questions are asked
- who gets to answer them
- who funds research
- where and when that work become public

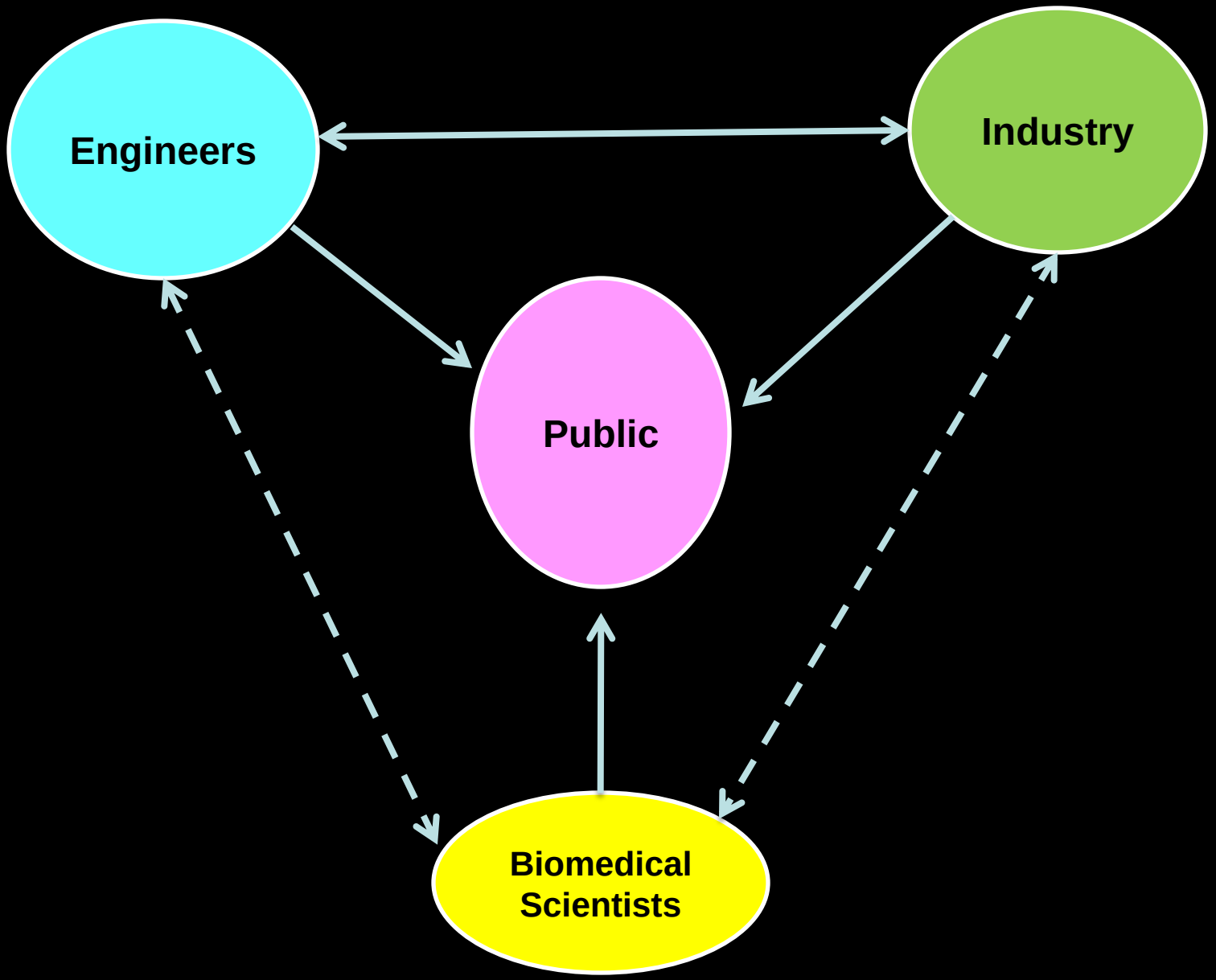
-

# Cell Phone Biological Studies

| | Effect | No Effect | Total |
|---|---|---|---|
| Industry Funded | 27 (29%) | 66 (71%) | 93 (30%) |
| Non-Industry Funded | 147 (69%) | 67 (31%) | 214 (70%) |
| Total | 174 (57%) | 133 (43%) | 307 |

Chris Busby and Roger Coghill (2006)

# Disconnect

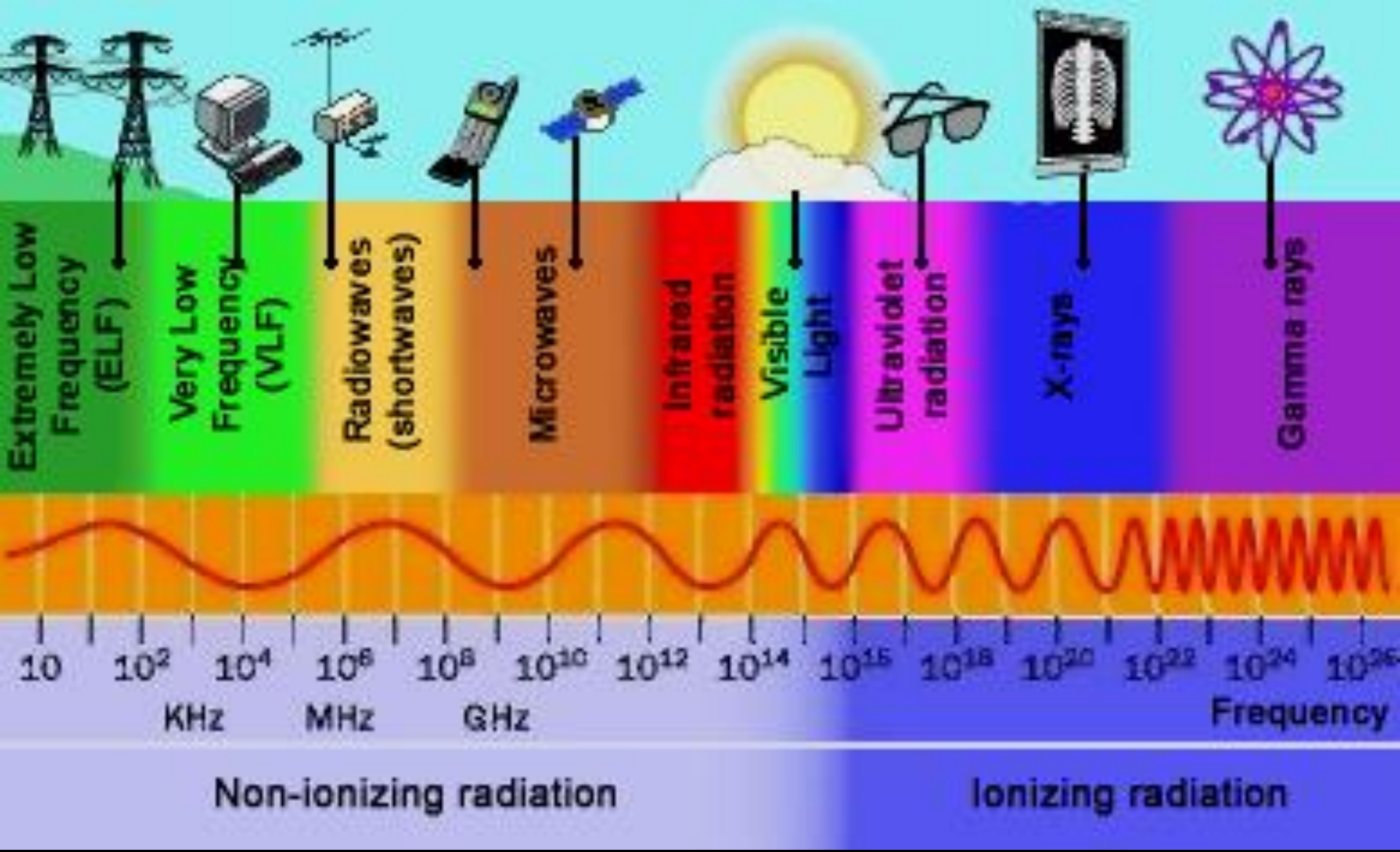


# Science of cell phone

- Cell  phone signals are weak, invisible and fast.
- Radiating in all direction at low power radio frequency.
- It can not heat human tissue
- If RFR can not induce heat  than it can not cause any other problem

- But it violates the basic law of Physics
- All energy is conserved,  then question arises that if RFR energy is not  transformed in to heat then it must have transfoemed in to

- Potential energy
- Kinetic energy
- Chemical energy



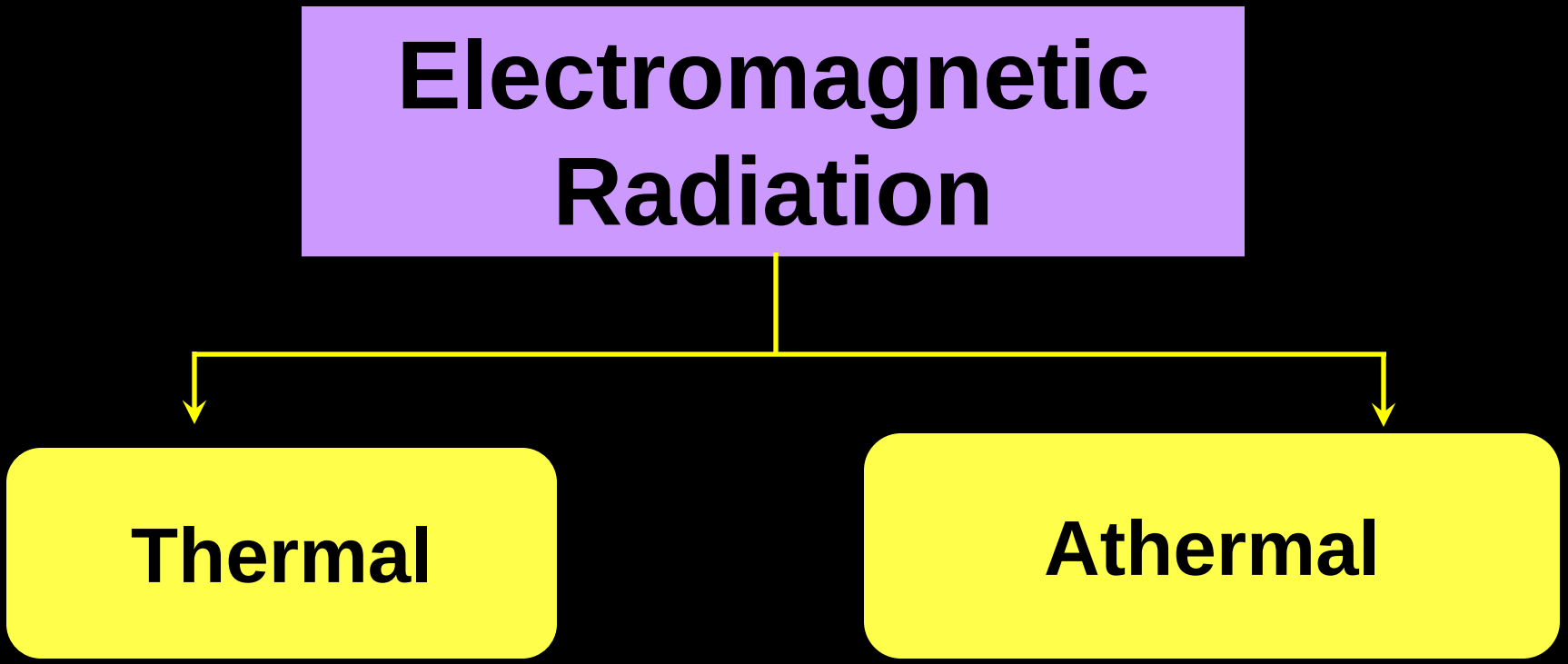

**Type of Mobile Radiation:**

- **Between 900 to 1800 MHz**
- **Falls in the range of microwave radiation**

**http://www.astrosurf.com/luxorion/Radio/spectrum-radiation.png**

1. **Biological effects** – Effects are measurable responses to a stimulus or to a change in the environment and are not necessarily harmful to our health

2. **Health Hazard** - Changes that are irreversible and stress the systems for long period of time.

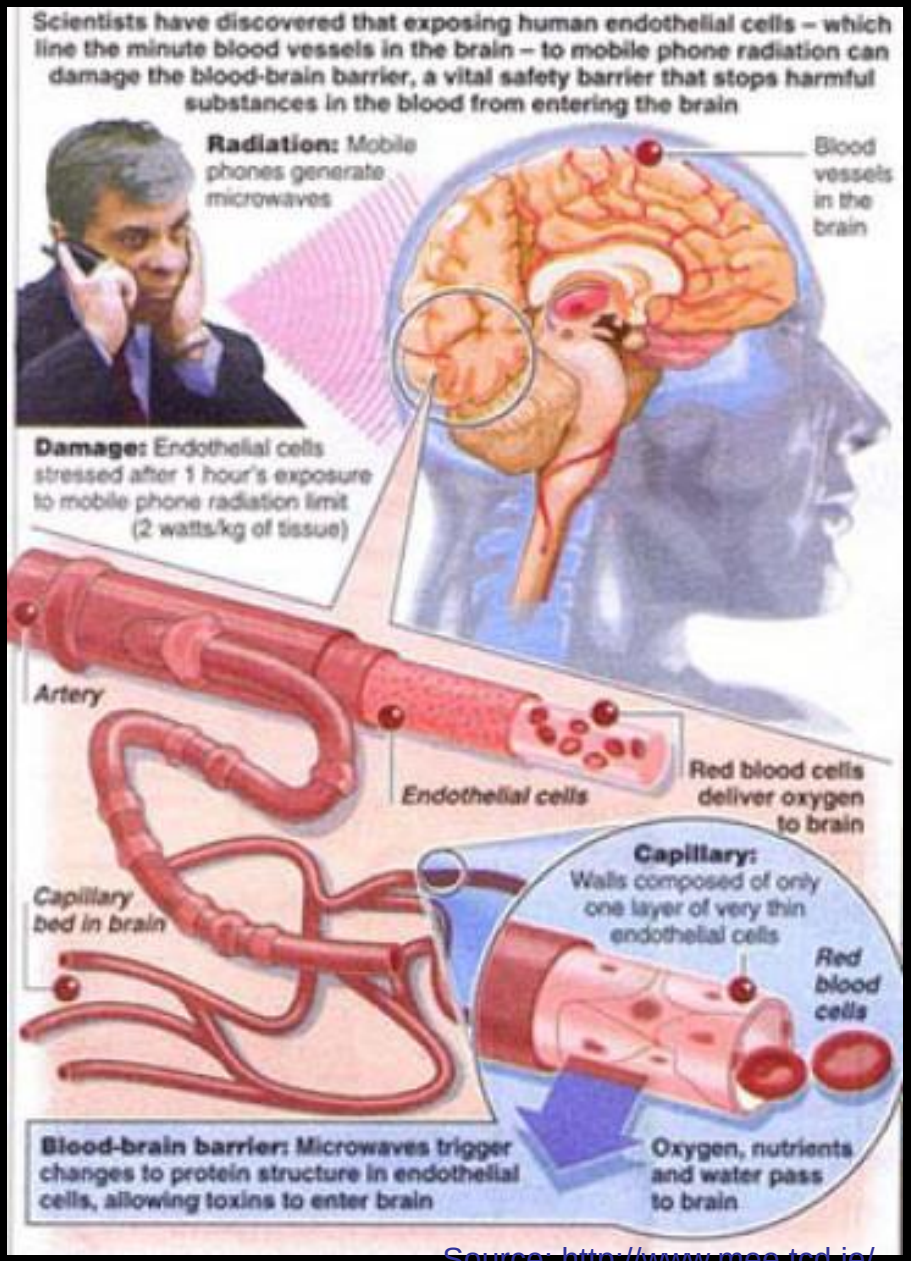

Electromagnetic Radiation
Thermal
Athermal

# Thermal Effects of Mobile Radiation

- The specific energy absorption rate (SAR) is measured in W/Kg
- The measurement is important when assessing possible health effects
- Microwaves absorbed by the body are converted to heat
- The amount of heat produced is related to the amount of energy deposited

# THERMAL EFFECT – Mechanism

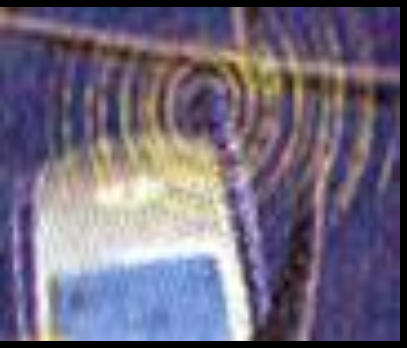
- An effect of microwave radiation is dielectric heating, in which any dielectric material (e.g., living tissue) is heated by rotations of polar molecules induced by the electromagnetic field
- In the case of a person using a cell phone, most of the heating effect will occur at the surface of the head, causing its temperature to increase by a fraction of a degree
- In this case, the level of temperature increase is an order of magnitude less than that obtained during the exposure of the head to direct sunlight
- The brain's blood circulation is capable of disposing of excess heat by increasing local blood flow.



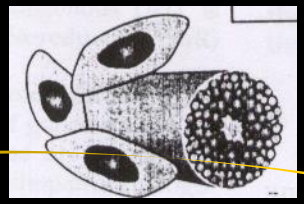

Source: http://www.mee.tcd.ie/

# Thermal Effect - Possible mechanism

**Radio Frequency Radiations (RFR)**



**Tissue**



**activate**

**Normal defense response**

**Thermo receptor molecules in a cell**

**may activate**

**Cascade of II & III messenger system, gene expression**

**and**

**Up regulation of Heat Shock Proteins (HSPs)**

**Chronic expression of HSPs**

**may promote**

**Oncogenesis/Metastasis**

# Athermal Effects of Mobile Radiation

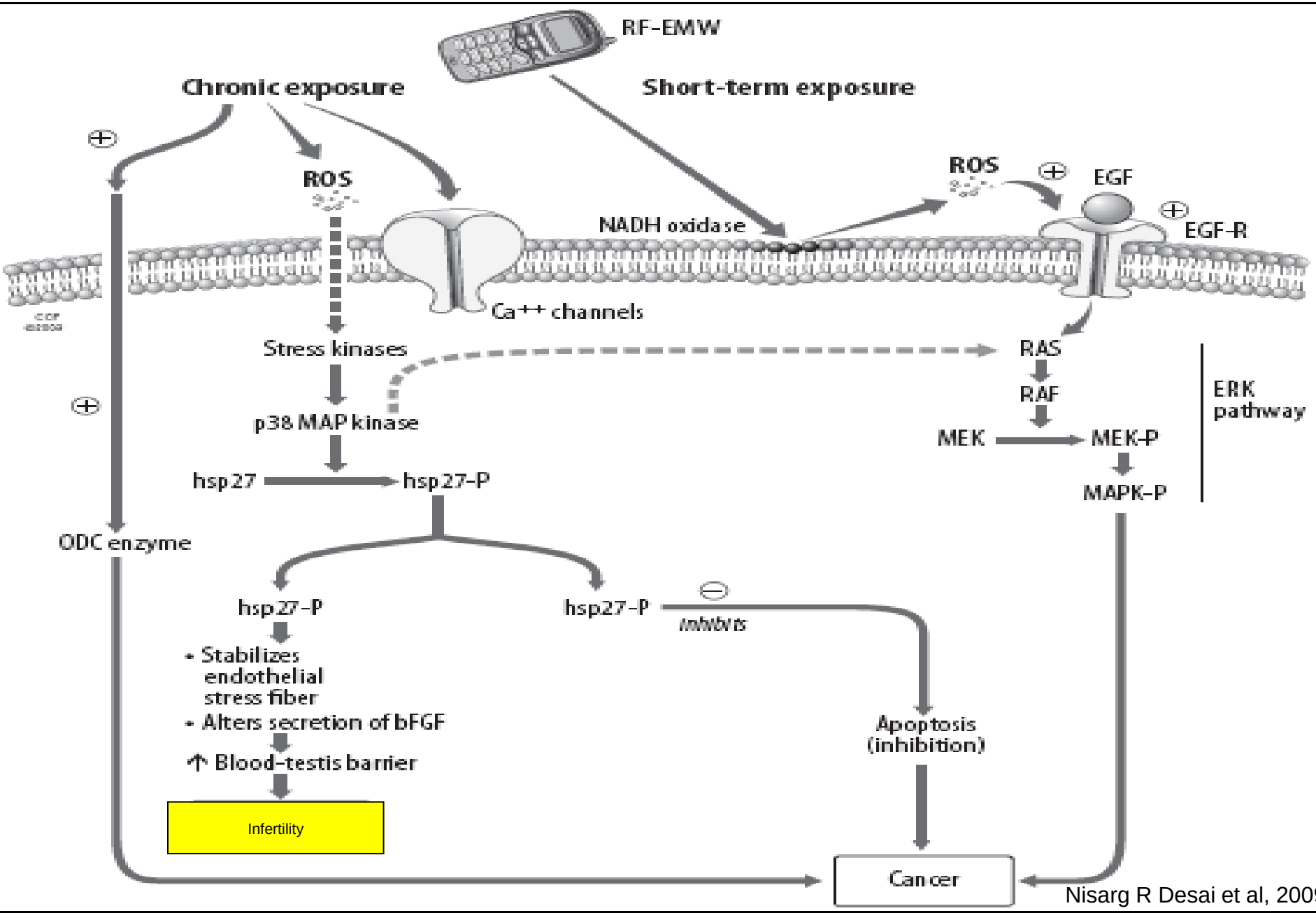
- Absorbed at molecular level and manifests changes in vibrational energy of the molecules producing various molecular transformations and alterations { Microwaves irradiating the community, *Hidden hazards,* Bantan Books Publisher, Australia, 1991}

- It has been argued that athermal effects could be reinterpreted as a normal cellular response to an increase in temperature

- It also has been hypothesized that –
  - Hormonal control of bodily functions may be effected
  - In laboratory, low SARs effect the bio-energetic of living systems
  - Chromosomal defects have arisen in a small number of mobile phone network engineers

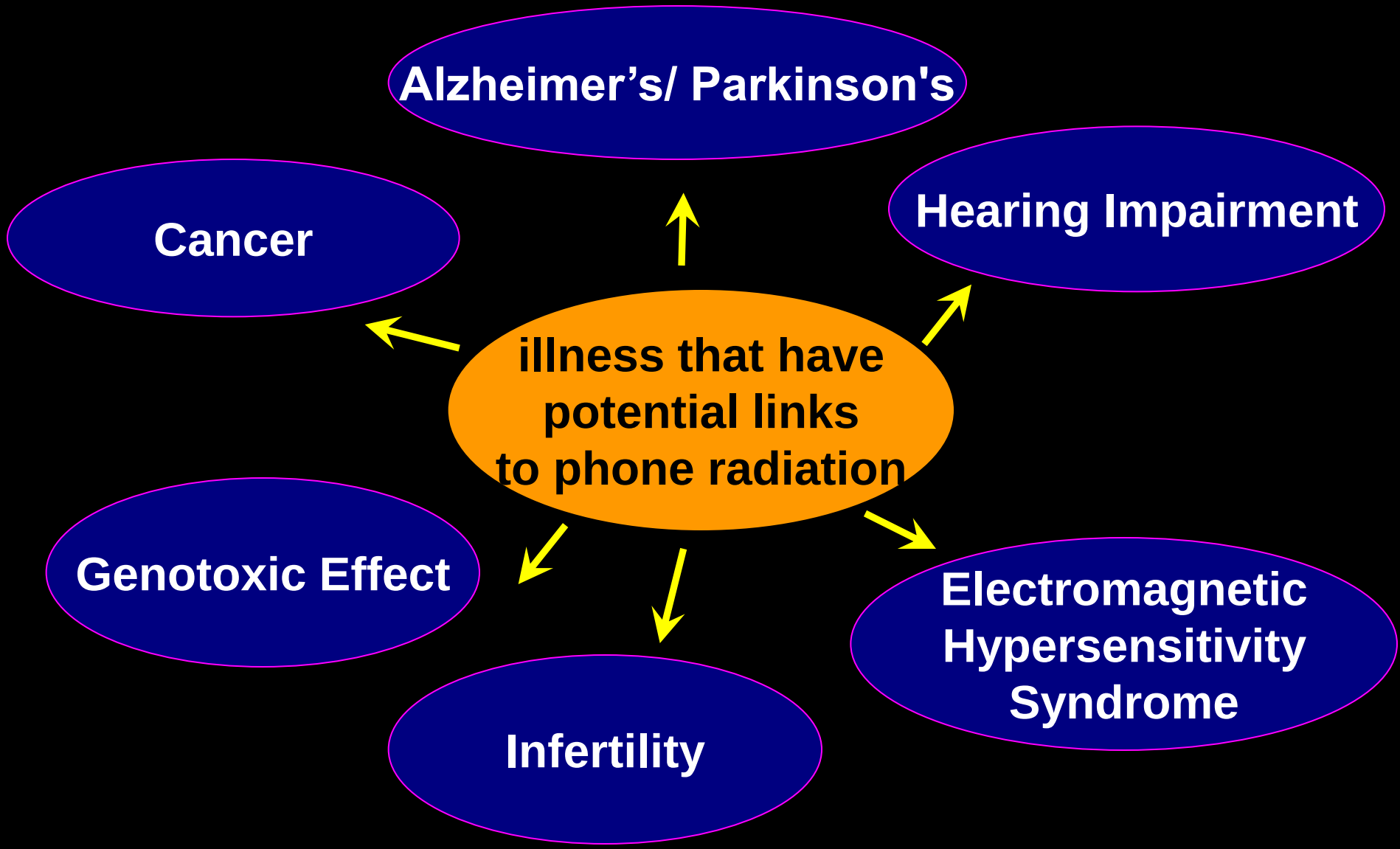
***Source: http://www.ksu.edu.sa/***

# Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on male reproductive system




Nisarg R Desai et al, 2009

# ILLNESS THAT HAVE POTENTIAL LINKS TO MOBILE PHONE RADIATION

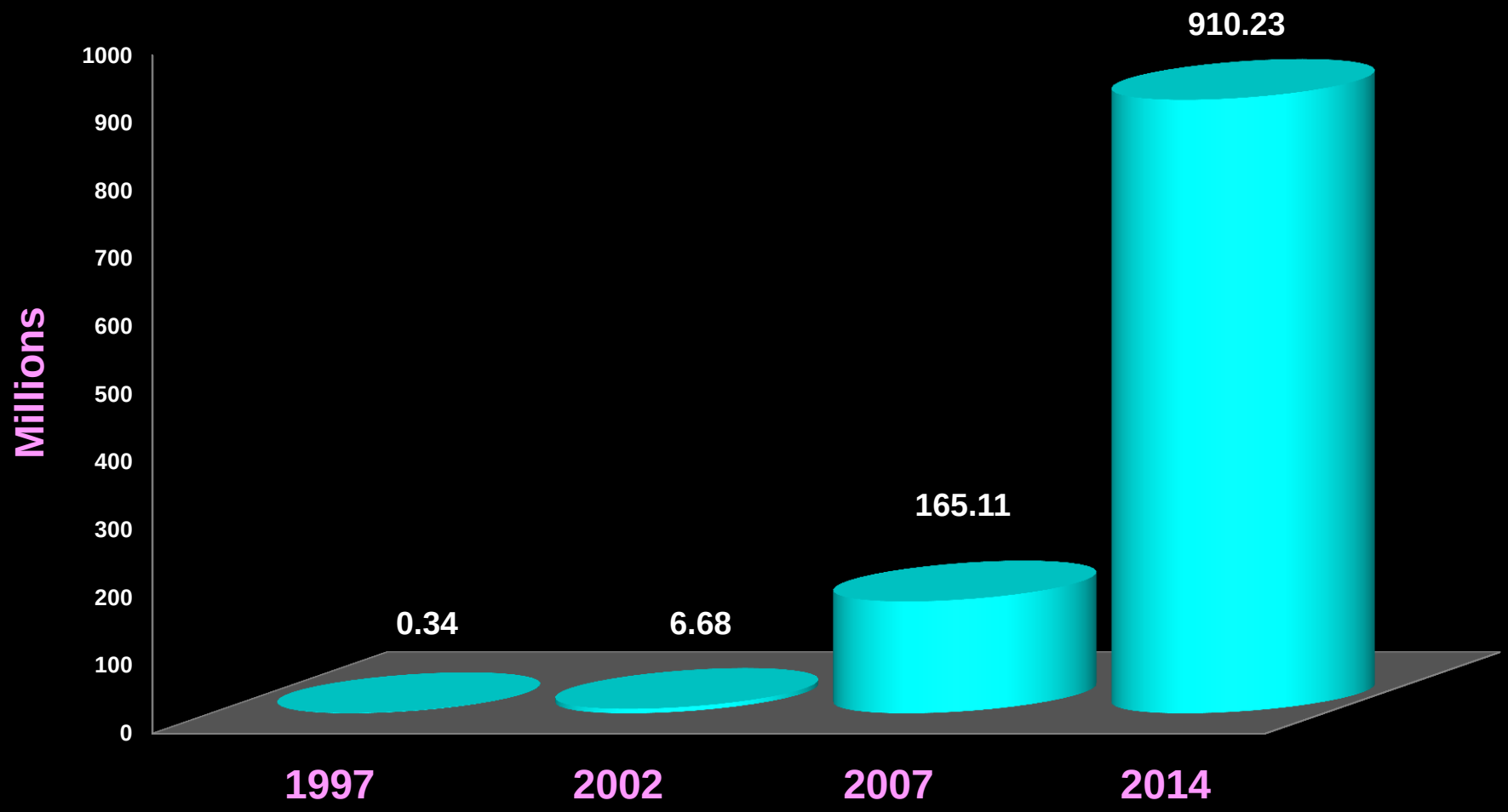



*Source: http://www.ksu.edu.sa/*

# Indian Scenario

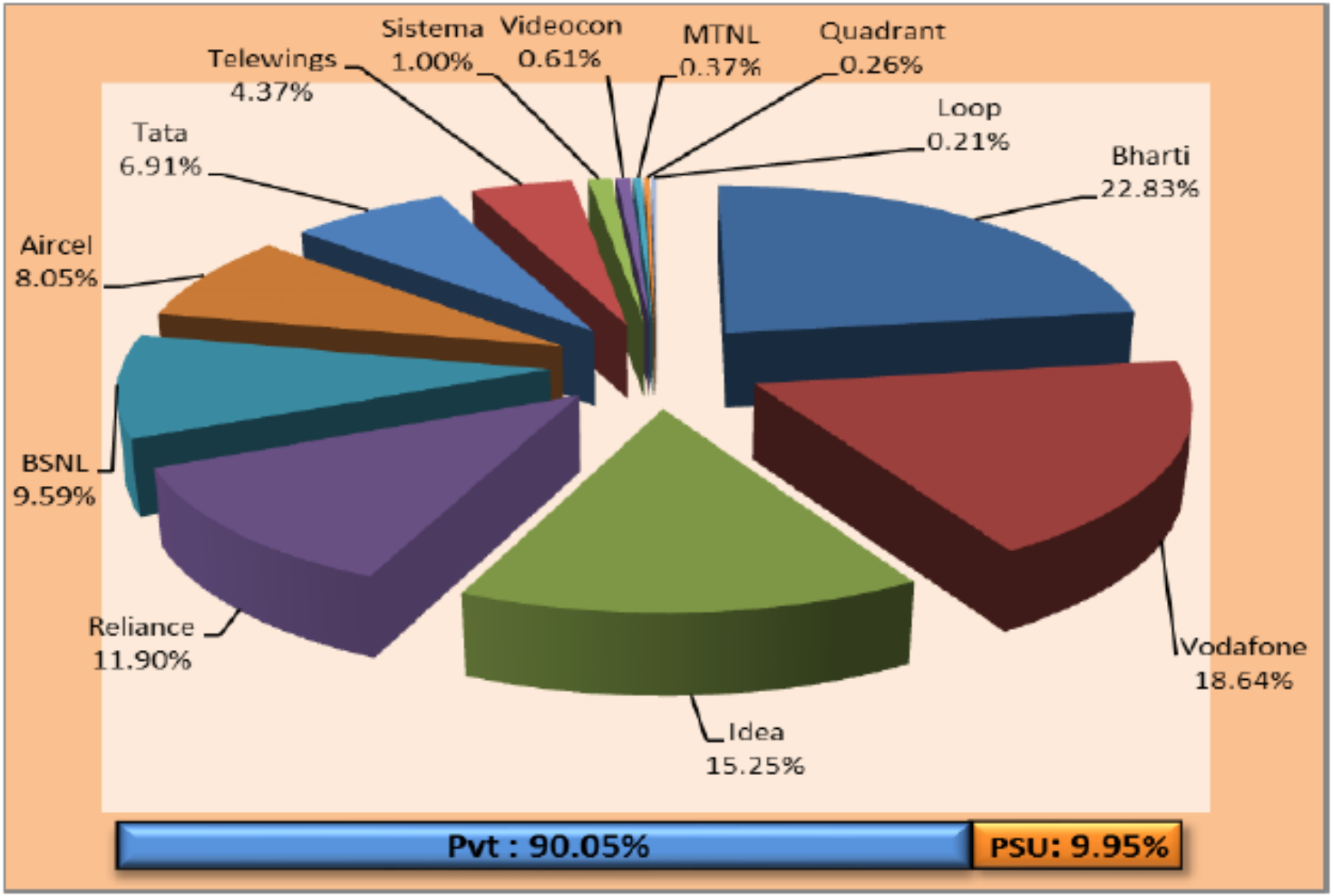
# The radio frequency sources in India

| S. No. | R. F Source | Operating Frequency | Transmission Power | Numbers |
|---|---|---|---|---|
| 1 | AM/FM Tower | 540 KHz – 108 MHz | 1 KW – 30 KW | 503 |
| 2 | TV Tower | 48 MHz – 814 MHz | 10 – 500 Watt | 1201 |
| 3 | Wi-Fi | 2.4 – 2.5 GHz | 10 – 100 mW | -- |
| 4 | Cell Towers | 800, 900, 1800, 2200, 2300 MHz | 20 W | 5.4 Lacs |
| 5 | Mobile Phones | GSM-1800/CDMA<br>GSM-900 | 1 W<br>2 W | 919+ Million |

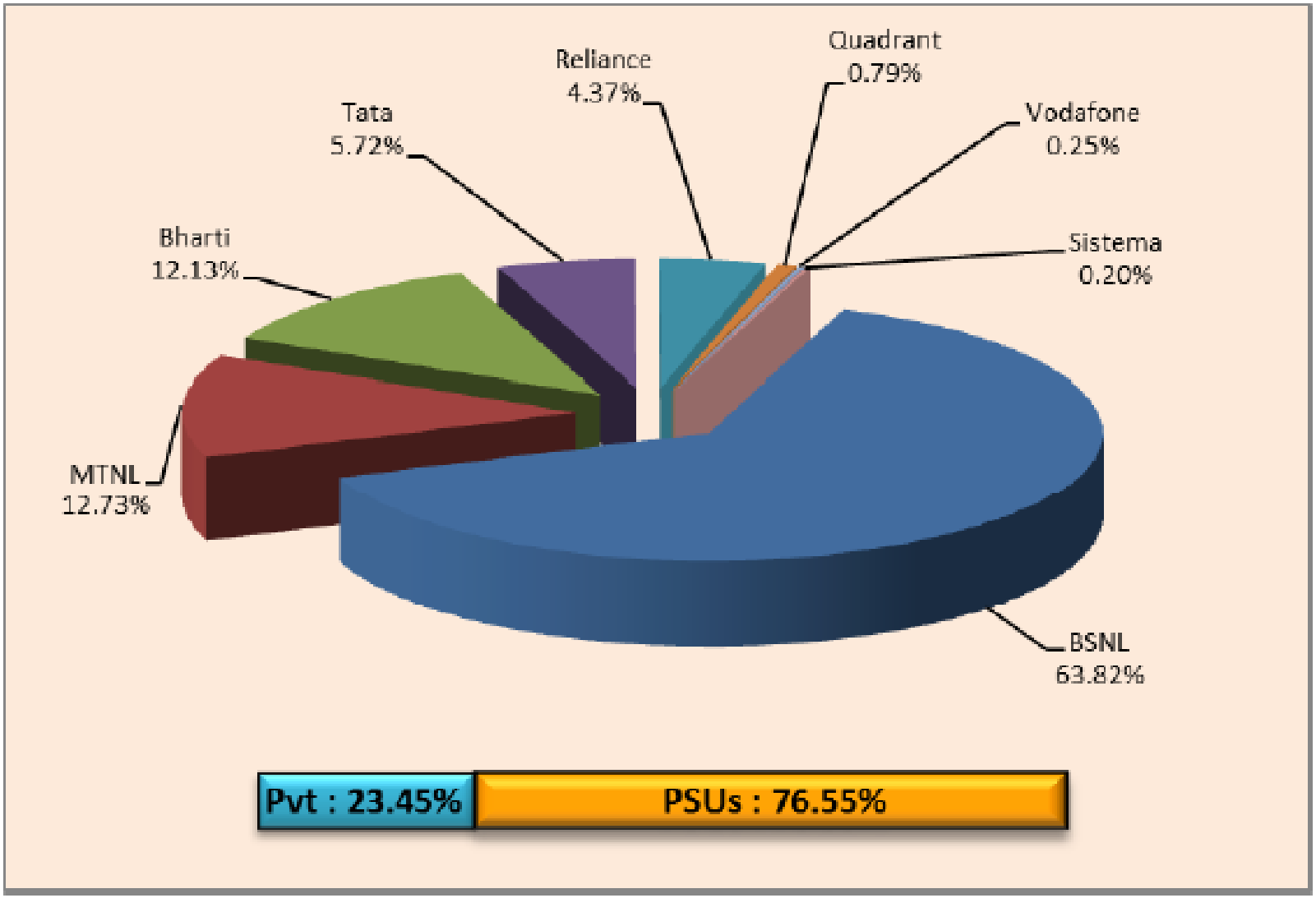



Source – Telecom Regulatory Authority of India, 1997-2007 and 2014

# A. Service Provider wise Market Share as on 31st July, 2014.



# Service Provider wise Market Share of wireline subscribers as on 31st July, 2014



# Factors Influencing effect of EMF on Human Health

1. Mass, shape and size of the body,
2. The orientation of the body with the field vectors
3. The electrical properties of both the body and the environment.

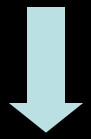
i. ambient temperature,
ii. air velocity,
iii. humidity
iv. body insulation.

4. Characteristics of the individual i.e. age, gender, activity level, muscles content,
5. Fat contents,
6. Bone Mineral Density,
7. Debilitation and/or other diseases would also contribute.
8. As all these factors have not been studied in a comprehensive manner and hence no conclusions are possible.

# Potential Health Impacts of RFR

# Effects on biological membrane permeability

RFR alter the transport of Cations through ion-channels located in biological membrane



Change

Can affect the membrane potential and nervous signal transduction.

# Effects on Cell Growth and Proliferation

- **RFR exposure *in vitro***

  ↓ **leads to**

  **Change in transcription and cell proliferation**

  ↓ **assessed by**

  **in-corporation of an RNA-precursor and DNA-precursor respectively.**

- **RFR exposure → linked to changes in cell cycle**

# Tumors

| | | |
|---|---|---|
| **Glioma** | : | **Type of tumor starts in the glial cells of the brain** |
| **Acoustic neuroma** | : | **Type of tumor of myelin forming cells (schwann cells) of $8^{th}$ cranial nerve** |
| **Meningioma** | : | **Type of tumor arising from meninges, the membranous layers surrounding the CNS** |

# Cancer

- Most laboratory studies were unable to find a direct link between exposure to RFR and the incidence of mutation or cancer.

- Most *in vitro* studies → DNA or chromosomal damage due to RFR

- Several *in vivo* studies in rodents → Direct effect of RFR on DNA

# Acoustic neuromas

- **Particular interest** → 
  - **Location**
  - **Short induction period**
- **Doubling of the relative risk estimate after 10 years of regular mobile phone use compared to subjects who never used mobile phone in Denmark and Sweden**

  **(Christe nsen et al 2004, Lonn et al 2004)**
- **Six of thirteen components of Interphone study were pooled for joint analysis** →

**No over all association was seen in all long term users**

↓ **Data suggested** **(Schremaker 2005)**

**There may be increased risk when the preferred side of the head used is considered in analysis.**

**Limitation → in exposure assessment**

# Cancer ……

## Childhood leukemia

- Meta analysis of 12 studies using a time-weighted average of exposure greater than 3 mg

↓ 68% increased risk of childhood leukemia

- International Agency for Cancer Research (IARC)

↓

EMF (> 1.4 mG) → Possible human carcinogen or group 2b carcinogen

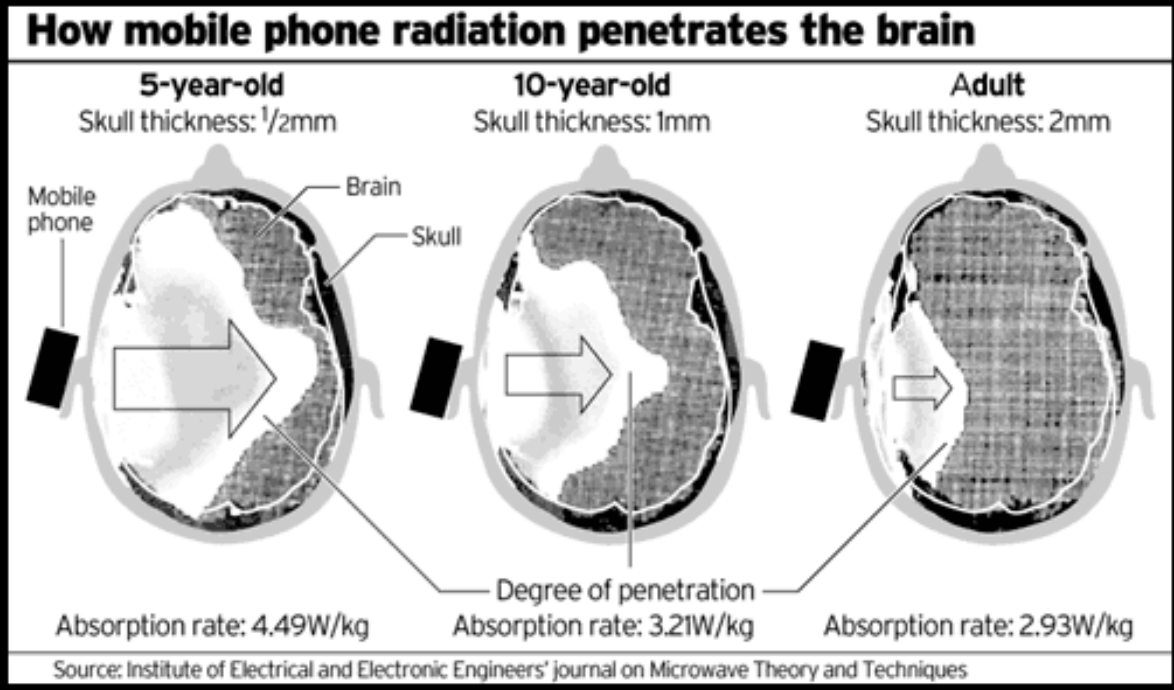
(Greenland; 2000)

# Cancer ……

**Swiss agency for Environment, Forest and Landscape (1999)**

↓ **EMF/RFR fields**

**“Possible carcinogen”**




## Childhood Brain Tumors

**Meta analysis ⟹ reported increased risk for childhood brain tumors in EMF/RFR exposed children.**

**(Wartenberg et al; 1998)**

# Lennart Hardell Group – Studies

- **Investigation confirmed an association between mobile phone use and malignant brain tumors (2010).**
- **Use of mobile phones and cordless phones is associated with increased risk for glioma and acorestic neuroma (2012-13).**
- **No conclusive evidence of an association between use of mobile and cordless phones and menignioma was found. An indication of increased risk was seen in the group with highest cumulative use (2013).**

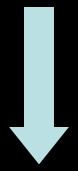
- **The percentage of tumor volume increased per year of latency period and per 100 hrs of cumulative use, statistically significant. This study confirmed the previous study findings (2013).**

## Point of worry

- **Highest risk for glioma and acoustic neuroma in subjects who started use of cell phone before the age of 20 years.**
- **The prognosis of glioma is worse, the longest time one has used the cell phone – shortens the survival.**

# Cell phone use and behavioral problems in young children

- Danish National Birth Cohort (DNBC)
- Prenatal and postnatal exposure to cell phone use and behavioral at age 7 yrs in 13,000 children were studied.



Exposure to cell phones prenatally, and to a lesser degree postnatally, was associated with more behavioral difficulties

JECH, Dec. 2010

# Effects on the Nervous system

**Possible changes due to RFE exposure**

- **Blood – brain barrier permeability**
- **Brain electrical activity**
- **In the release of neurotransmitters**
- **In melatonin secretion**
- **In retina, iris and corneal endothelium**
- **In behavioral, cognitive, neurochemical and neurological effects in human and animals**

**(OPHA, 2003; Dcosta et al, 2003; Sienkiewicz et al, 2005; Besset et al, 2005)**

# Effects on the Nervous system…

**Concern**

- Acoustic neuroma
- Brain tumors
- Tumors of the salivary gland
- Impairment to short terms memory
- Headaches
- Sleep disturbance
- Depression & tiredness
- Increase agitation in combination with nervous exhaustion

(Ozturan et al, 2002; A rai et al, 2003; Parrzzini et al, 2005)

# Effects on the Nervous system…

**Concern**

- **Fatigue**
- **Muscle weakness**
- **Reduced intellectual activities**
- **Absent mindedness**
- **Inability to concentrate**
- **Increase sensitivity to external factors such as noise, bright light etc.**
- **Attacks of giddiness/dizziness**
- **Unstable gait**
- **Cold hands and legs**
- **Heart problems such as palpitation, fast & slow heart beat**
- **Breathing problems**
- **Overactive thyroids**
- **Irregular menstrual cycle**

**(Back et al, 2003; Uloziene et al, 2005)**

# Effects on immune system

- **Some evidence of immune system response similar to those resulting from thermal stress are triggered by non-thermal exposure to RF-fields.**

- **Adverse effects on the immune system can indirectly predispose to infection and caner.**

- **Individual variation in response to RFR.**

# Cardiovascular functions

- ⇓ in blood pressure after cell phone exposure

(Braune et al 1998)

⇓

Not replicated by Braune et al 2002

- ⇑ in blood flow in the external ear have been replicated

(Paredi et al, 2001; Curcio et al 2004)

⇓ because of

**Vasodilatation caused by heating of mobile phone electronics and battery**

# Effect of RFR on Reproduction

- Reduction in male fertility in rates 30 min exposure — (Kowalczuk, 1983)
- Did not observe same effect — (Beechey et al, 1986; Dasdasi et al, 1999)
- Reduction in seminiferous tubal diameter and ⇑ in rectal temperature — (Dasdog et al, 1999)
- Lower sperm count in military personal associated with potential RFR exposure — (Danulescu et al, 1996; weyandt et al, 1996 Schrader et al, 1998)
- A cluster of six cases of testicular cancer among traffic policemen using microwave generators — (Davies & Mastofic, 1993)
- Excess risk of testicular cancer in Military personal exposed to Microwaves & radio wave — (Hayes et al, 1990)
- 30% ⇓ in sperm count in heavy users of cell phone — (Fejes et al, 2004)

# Hungarian Study

## 221 men for 13 months

**Heavy use of mobile** **Vs** **Non users**

↓ **Sperm Count**

**30% drop in sperm count in mobile users**

↓

**Suggested further studies to confirm**

# Criticisms

It did not take into account various factors e.g.

a) Stress level of user
b) Age of user
c) Coital frequency
d) Amount of radiations the man had been exposed to
e) Criteria's of heavy user

# American Society for Reproductive Medicines (Annual Meeting)

**Dr. Ashok Agarwal – Cleveland Clinic Foundation US**

## Cleveland – Mumbai (Sept. 04 – Oct. 05)

| | | | |
|---|---|---|---|
| - | 1 Normal men | - | 86 million/ml |
| - | Cell phone (< 2 hrs./day) | - | 76 million/ml |
| - | 2 to 4 hrs./day | - | 71/ million/ml |
| - | > 4 hrs./day | - | 66/million/ml |

# Apoptosis, cell count and antioxidant changes at 900MHz mobile phone radiation in male wistar rats

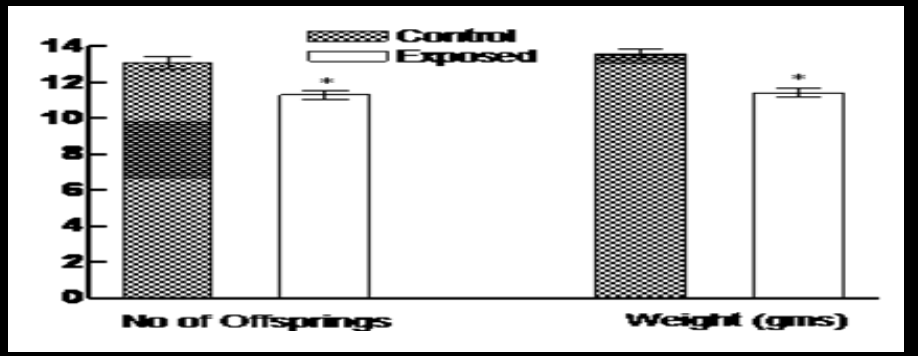

## Prof. J. Behari

School of Environmental Sciences, JNU, New Delhi

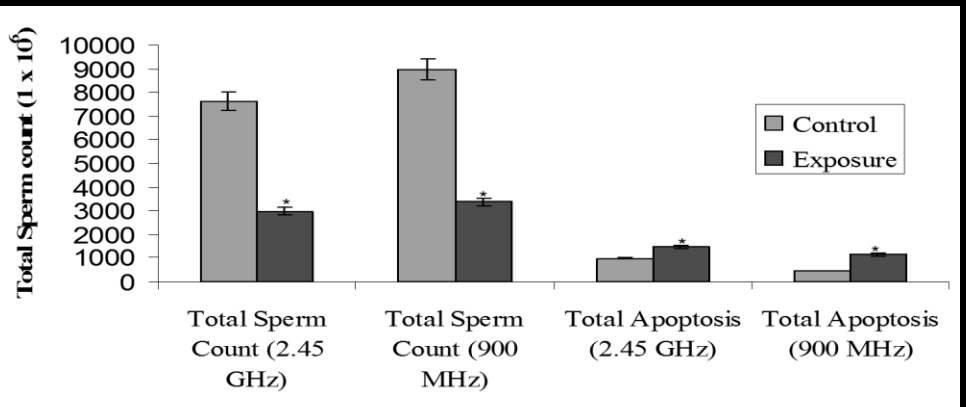

### Antioxidant enzyme activity in sperm cells.

| Antioxidant Enzyme | Control | Exposed | P<0 .001 |
|---|---|---|---|
| SOD | 198.78 ± 7.53 | 150.19 ± 6.49 | * |
| GPx | 4.13 ± 0.19 | 2.38 ± 0.09 | * |
| CAT | 6.86 ± 0.76 | 9.81 ± 1.60 | * |

Difference between body weight of offspring and their number, where p< 0.05 as indicated significant shown as *




Comparative analysis of sperm between 900MHz & 2.45GHz

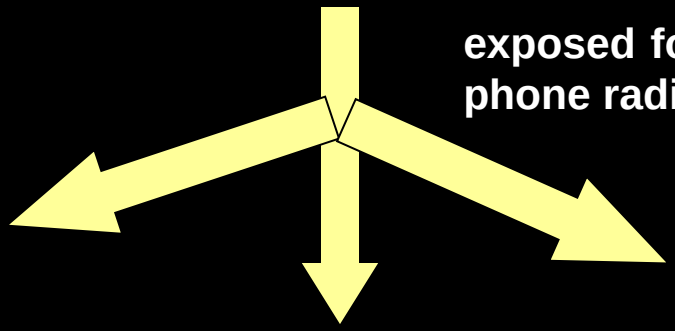



A photomicrograph showing the DNA double strand break of exposed (figure 2a) as compared to control (figure 2b) rat sperms observed in fluorescent microscope (100X). Dye ethedium bromide

## *In Vitro* Human Study

**The effect of pulsed 900-MHz GSM mobile phone radiation on the acrosome reaction, head morphometry and zona binding of human spermatozoa .**

**Highly motile human spermatozoa**



**exposed for 1 h to 900-MHz, mobile phone radiation. SAR 2.0 W/kg.**

**Sperm-zona binding was assessed,using the hemizona assay**

**acrosome reaction was evaluated using flow cytometry**

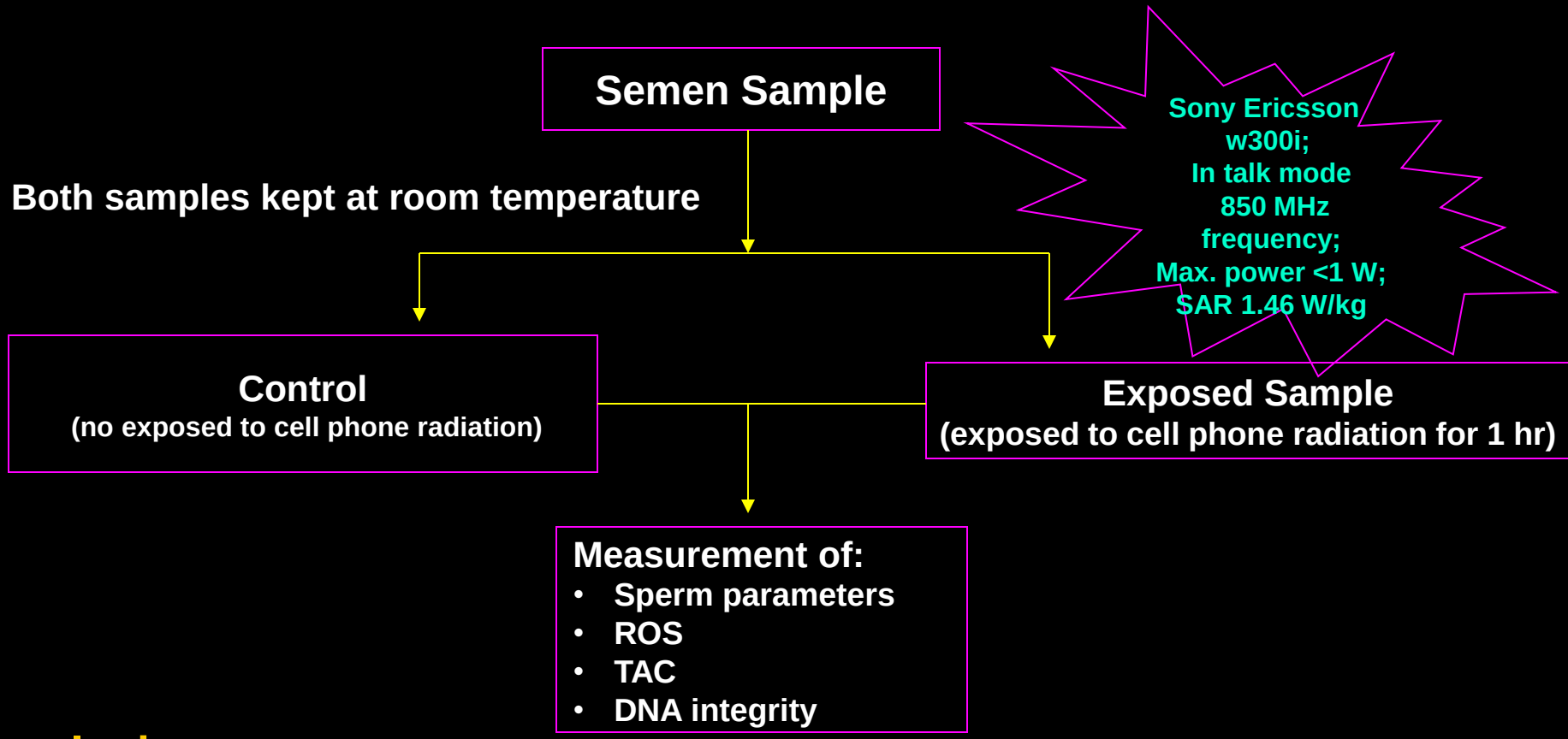
**Morphometric parameters were assessed using computer-assisted sperm analysis**

**Conclusion:-**

- **This study concludes that although RF-EMF exposure did not adversely affect the acrosome reaction,**
- **It had a significant effect on sperm morphometry.**
- **Significant decrease in sperm binding to the hemizona was observed.**
- **These results could indicate a significant effect of RF-EMF on sperm fertilization potential**

**Falzone et al. (2010)**

# Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an *in vitro* pilot study




## Conclusions:

- Cell phone radiation causes oxidative stress in neat semen and leads to decreases in spermatozoa motility and viability.
- It can be speculated that carrying a cell phone in a pocket may cause deterioration of sperm quality through oxidative stress.

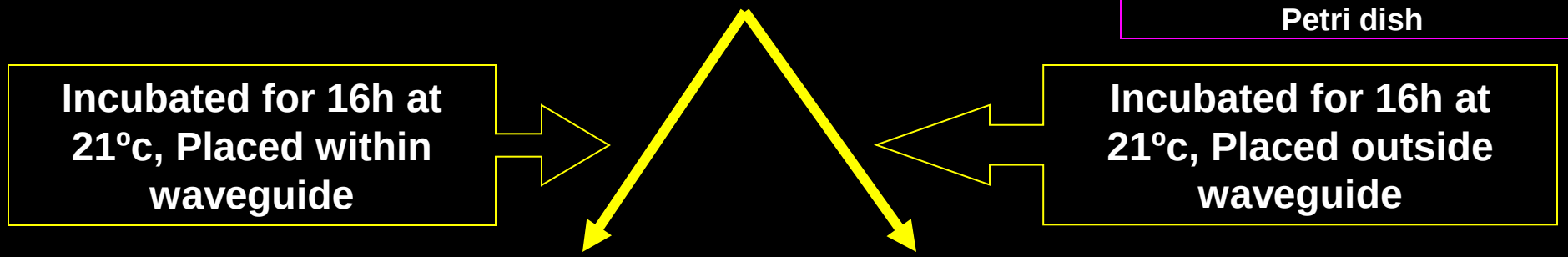
Ashok Agarwal, 2009.

# Mobile Phone Radiation Induces Reactive Oxygen Species Production and DNA Damage in Human Spermatozoa *In Vitro* study

22 normozoospermic donors, age - 24.1±1.1 y

High quality spermatozoa collected

Percoll gradient–purified Spermatozoa (15x106 Cell) were suspended in 1ml HEPES-buffered BWW in a 35mm Petri dish




**Assays**

Light Microscopy, Dihydroethidium Assay, MitoSOX Red (MSR) Assay, Assay for 8-hydroxy-29-deoxyguanosine (8-OH-dG), TUNEL Assay, Analysis by Flow Cytometry

## Conclusions:

- RF-EMR exposure enhances mitochondrial reactive oxygen species generation by human spermatozoa.
- Decreasing the motility and vitality of these cells.
- These findings have clear implications for the safety of extensive mobile phone use by males of reproductive age.
- Potentially affecting both their fertility and the health and wellbeing of their offspring.

De Iuliis GN, et al. (2009)

# Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study

## Three hundred sixty-one men

divided into four groups

Group A: no use  Group B: <2 h/day  Group C: 2–4 h/day  Group D: >4 h/day

Sperm parameters

(volume, liquefaction time, pH, viscosity, sperm count, motility, viability and morphology).

## Result

Mean sperm motility, viability, and normal morphology were significantly different in cell phone user groups within two sperm count groups. The laboratory values of the above four sperm parameters decreased in all four cell phone user groups as the duration of daily exposure to cell phones increased.

## Conclusion

Use of cell phones decrease the semen quality in men by decreasing the sperm count, motility, viability, and normal morphology. The decrease in sperm parameters was dependent on the duration of daily exposure to cell phones and independent of the initial semen quality.

Agarwal, Deepinder and Kartikeya (2007)

# Effect of early pregnancy electromagnetic field exposure on embryo growth ceasing.

**Analysis was conduced based on the interview of 138 embryo growth ceasing cases and the matched control using multi factor conditional logistic regression analysis.**

- Proportion of watching TV
- Using mobile phone, Microwave Oven, electromagnetic equipments, near residence and work place
- High voltage lines: < or = 100 m
- Cell phone towers: < or = 500 m

## Observations

- Embryo growth ceasing was significantly higher in the cases than the control in single factor analysis.
- By multi factor analysis on ly watching TV and using mobile telephone during the first term of pregnancy were associated with risk of embryo growth ceasing.

**Watching TV and using mobile telephone during the first term of pregnancy may increase the risk of embryo growth ceasing significantly**

**Suggestion: Pregnant women should not use the appliances for a long time or do the safety protection when using the appliances e.g. distance protection.**

Han J et al. 2010

- **Significant increase in peak heart rate, serum total cholesterol, LDL, triglycerides levels in acute RFR exposed male students in comparison to control students (Parkar et. al 2010)**
- **Long term and intensive mobile phone use may cause inner ear damage (Panda et al, 2008)**
- **Review – regular and long term use of mobile phone can have negative impact up on biological system especially on Brain.**
- **Increased reactive oxygen species (ROS) play in important role by enhancing the effect of these radiations which may caused neuro-degemerative diseases (Kesari et al. 2013)**

# ICMR Study

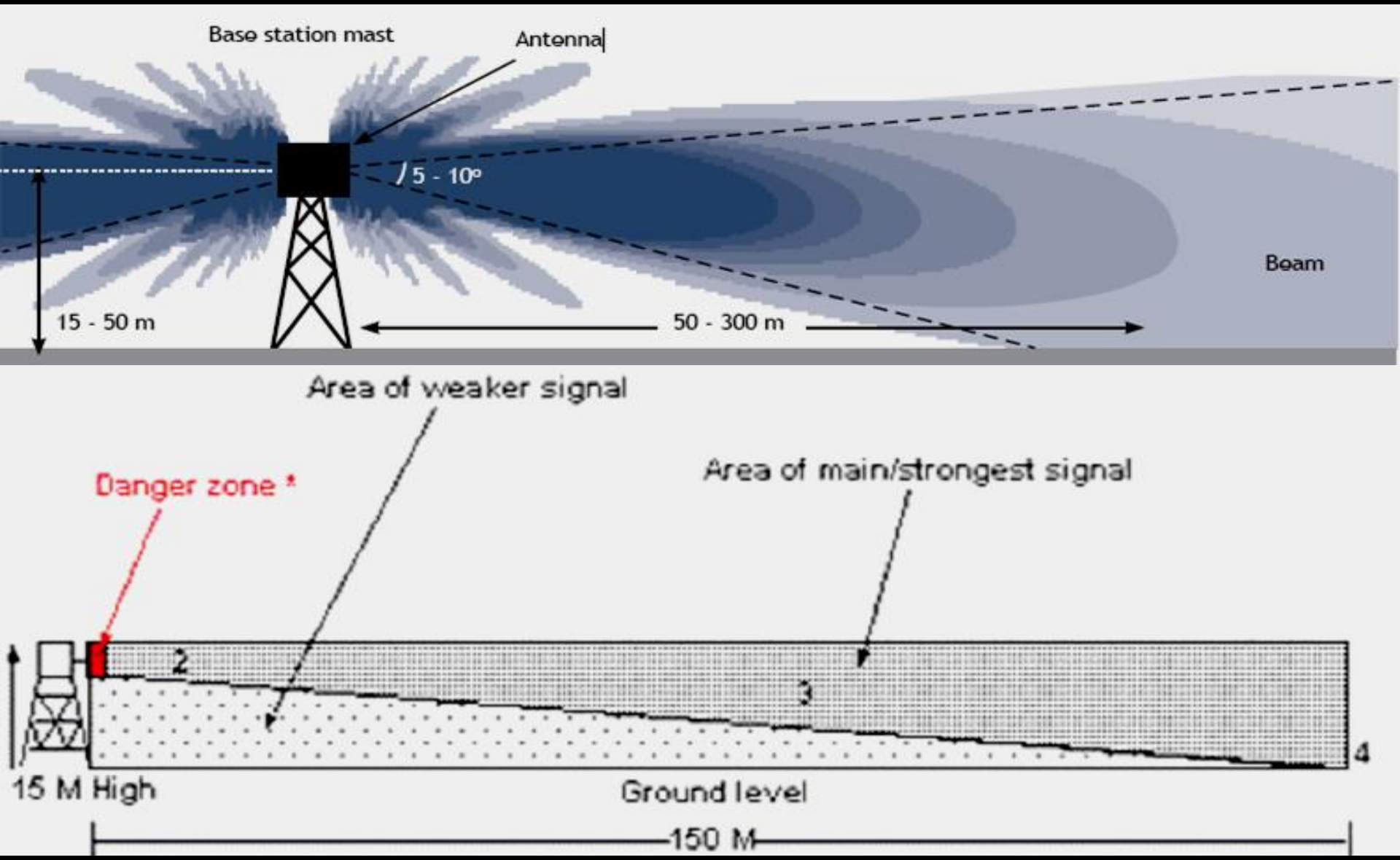
- **ICMR has initiated a multi-disciplinary cohort study in Delhi & NCR to find out adverse effects of RFR, if any, emitted from cell phone on adult Indian population.**
- **Under this study efforts are going on to examine whether use of cell phone is associated with**
  - **reproductive dysfunctions,**
  - **infertility,**
  - **neurological disorders (cognitive behavior, sleep related disorders, depression etc.),**
  - **cardiovascular disorders,**
  - **Otorhinolaryngology (ENT) disorders and promote cancer if any, in Human Volunteers.**

- **Under this study efforts are also going on to survey the health status of the people residing near the cell phone tower in Delhi.**

- **The provision has also been made under this study to measure specific absorption rate, power density, wave length and frequency of RFR emitted from various types of cell phones used by the enrolled subjects as well as from cell phone towers installed at various places in Delhi.**

- **The physical characteristics of RFR emitted from various cell phones will be correlated with the clinical & laboratory findings. The study is ongoing.**

# Impact of Cell Phone Tower on Human Health



# Cell phone tower transmit RFR in the following frequency range

1. 869-890 MHz (CDMA)
2. 935-960 MHz (GSM 900)
3. 1805-1880 MHz (GSM 1800)
4. 2110-2170 MHz (3G)
5. 2190-2310 MHz (4G)

# Health Effects from Mobile Base Station

1. ***Study of the health of people living in the vicinity of mobile phone base stations. (Paris)***

   **(Santini et al., 2002)**

**Found significant health effects on people living within 300 metres of mobile phone base stations.**

**Conclusions include the recommendation:**

***"… it is advisable that mobile phone base stations not be sited closer than 300 meters to populations"***

# Health Effects from Mobile Base Station

2. ***"Effects of Global Communications System Radio-Frequency Fields On Well Being and Cognitive Function of Human Subjects With and Without Subjective Complaints" (Netherlands)***

**(Netherlands Organization for Applied Scientific Research (TNO), 2003)**

- **Found significant effects on wellbeing i.e, headaches, muscle fatigue/pain, dizziness etc from 3G mast emissions**

- **Those who had previously been noted as *'electrosensitive'* under a scheme in that country were shown to have more pronounced ill-effects, though others were also shown to experience significant effects.**

# Health Effects from Mobile Base Station

3. ***The Microwave Syndrome - Further Aspects of a Spanish Study***

**(Oberfeld Gerd et. al. 2004)**

**This study found significant ill-health effects in those living in the vicinity of two GSM mobile phone base stations. *The strongest five associations were found***

- **depressive tendency,**
- **fatigue,**
- **sleeping disorder,**
- **difficulty in concentration and**
- **cardiovascular problems**

# Health Effects from Mobile Base Station

4. ***Increased Incidence of Cancer near a Cell-phone Transmitter Station (Israel)***

**(Ronni Wolf & Danny Wolf, 2004)**

**Based on medical records of people living within 350 metres of a long-established phone mast,**

**Showed**

1. **A fourfold increased incidence of cancer generally compared with the general population of Israel**

2. **A tenfold increase specifically among women, compared with the surrounding locality further from the mast**

# Health Effects from Mobile Base Station

## *5. Naila Study, Germany (November 2004)*

**Report by researchers (five medical doctors)**

**The basis of the data used for the survey were PC files of the 1000 patients case histories between the years 1994 and 2004.**

**analyzed**

**the proportion of newly developing cancer cases was significantly higher among those patients who had lived during the past ten years at a distance of up to 400 meters from the cellular transmitter site, which has been in operation since 1993, compared to those patients living further away, and that the patients fell ill on average 8 years earlier.**

**In the years 1999-2004, i.e. after five years' operation of the transmitting installation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the installation compared to the inhabitants of Naila outside the area.**

# Health Effects from Mobile Base Station

## *6. Austrian Study 2005*

**Electro sensitive men (3) and women (9) were expose to three Radiation density emitted from a shielded cell phone base station**

- **first phase - 26 microWatt/m2,**
- **second phase 3327 microWatt/m2**
- **third phase 26 microWatt/m2 again.**

**Environmental parameters were measured, such as radiation by television and FM-radio, noise, CO2, temperature, relative humidity, low frequency magnetic fields and soherics (electrical discharges in the atmosphere, possibly causing radiation).**

**During the second phase the parameters of all the brainwaves, measured by EEG, changed significantly. Afterwards the testees were asked to describe their experiences. All of them felt unwell during the second phase. They reported symptoms like buzzing in the head, palpitations of the heart, unwellness, lightheadedness, anxiety, breathlessness, respiratory problems, nervousness, agitation, headache, tinnitus, heat sensation and depression.**

**This is the first worldwide proof of significant changes of the electrical currents in the brain by a cell phone base station at a distance of 80 meters.**

# The summary of the recommendation made by the Inter-Ministerial Committee on this subject

**Mobile Handsets: -**

1. **Adoption of SAR level for mobile handsets limited to 1.6 Watt/Kg, averaged over a 6 minutes period and taken over a volume containing a mass of 1 gram of human tissue as per the FCC norms of United States.**
2. **SAR value information is to be embossed and displayed in the handset.**
3. **Information on SAR values for mobile handsets should be readily available to the consumer at the point of sale so that one can make sure of the SAR value of the handset while buying a cell phone.**
4. **Government may consider amendments in the Indian Telegraph Act 1885 & rules notified there under and necessary legislations if any so that only mobile handset satisfying radiation standards should be permitted for import / manufacture or sold in the country.**
5. **Mobile hand set manufactured and sold in India or Imported from other countries should be checked for compliance of SAR limit and no hand sets of SAR value above the prescribed standard adopted in India should be manufactured or sold in the country.**

6. SAR data information of the mobile handsets should be available on the manufacturer’s web site and in the manufacturer’s handset’s manual.

7. To bring awareness, the manufacturer’s mobile handset booklet should contain the following for safe use :

a. Use a wireless hands-free system (headphone, headset) with a low power Bluetooth emitter to reduce radiation to the head.

b. When buying a cell phone, make sure it has a low SAR.

c. Either keep your calls short or send a text message (SMS) instead. This advice applies especially to children, adolescents and pregnant women.

d. Whenever possible, use cell phone when the signal quality is good.

e. People having active medical implants should keep their cell phone at least 30 cm away from the implant.

8. The Information is made available on Government website with list of SAR values of different mobile phones.

**Mobile Base Stations: -**

9. **The RF exposure limits in India may be lowered to 1/10th of the existing level keeping in view the data submitted by COAI/ AUSPI during presentation made to the committee and trend adopted by other developed countries.**

10. **To provide static continuous testing / measuring centers for online monitoring of radiation level at prominent places in metro/cities and the data to be sent to the central server for information.**

11. **Apart from self certification for compliance of radiation norms on EMF exposure as is presently being done, the mobile service providers should also measure the radiation level of certain prominent places and display it for information of the general public. They should also have mobile unit for its measurement wherever necessary.**

12. **DOT should create a national data base with the information of all the base station, their emission levels and display on public domain for public information.**

13. **Impose restrictions on installation of mobile towers near high density residential areas, schools, playgrounds and hospitals.**

14. For the future expansion of telecom network in the country use low power micro cell transmitters with in-building solutions in place of the present trend of using high power transmission over mobile towers / high rise buildings.
15. To conduct the long term scientific research related to health aspect of EMF radiation exposure and associated technologies in India in the following areas:

- Health effect of RF exposure in children.
- Health effect of RF exposure in Foetus, mothers and elderly persons.
- Combined electromagnetic field radiation effect exposure from multiple antennas of a shared infrastructure sites

16. It is recommended for use of hands free and ear phone technologies such as blue tooth handsets and ear phone so as to minimize the contact of head with cell phone.
17. Department of Telecom may create a document “Radio waves and safety in our daily life” indicating various Dos and Don’ts related to mobile users clarifying various myths regarding deployment and use of radio waves and mandate each operator to print and issue the same to their customer at the point of sale for enhanced customer awareness. This will help in facilitating the right inputs and creating an environment where everyone can use the radio waves safely.

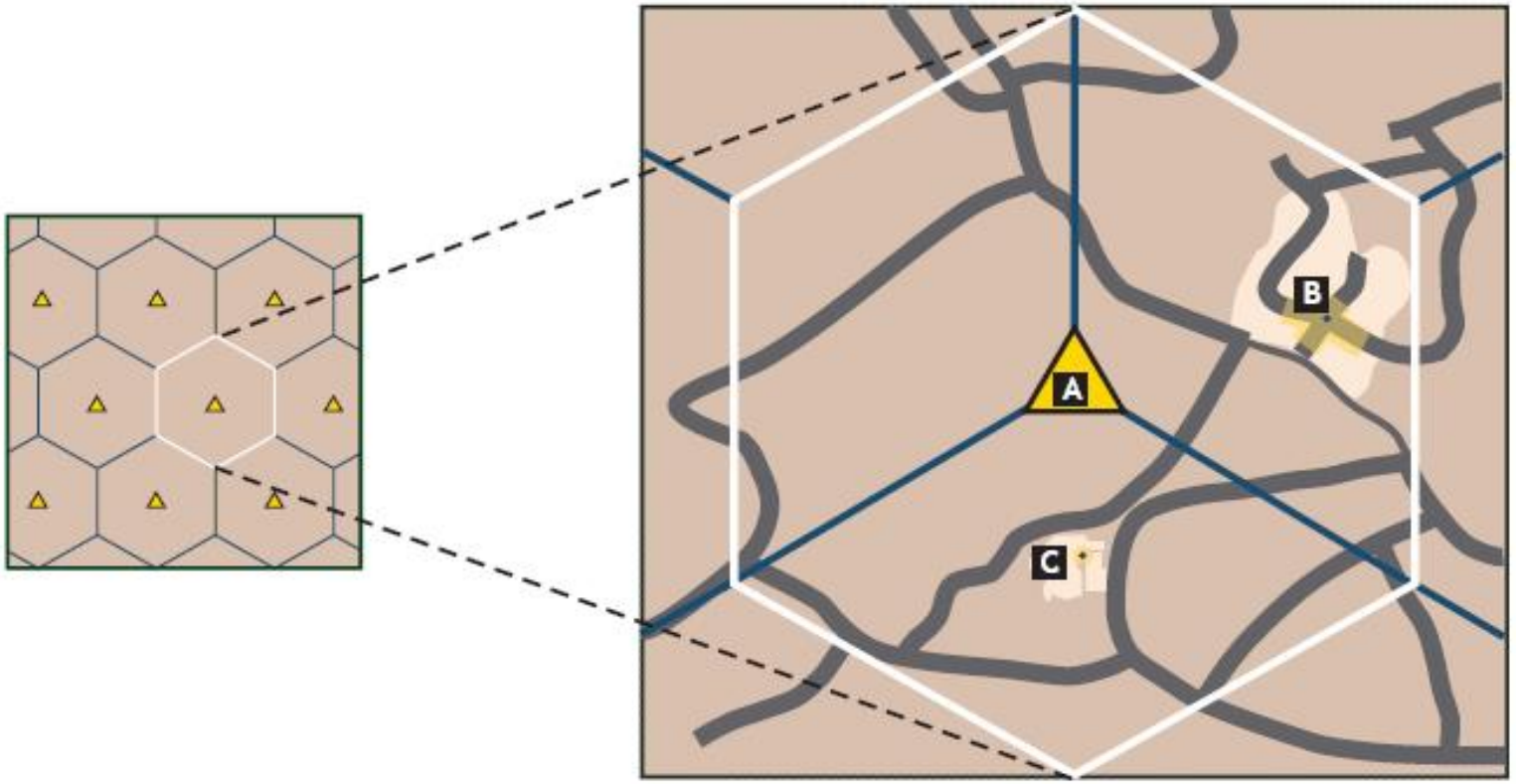
# Things you can do to reduce the adverse effects

- Children should only use cell phones next to their heads for emergencies
- While talking on your cell phone, try to keep the cell phone away from your body as much as possible
- Avoid using your cell phone when the signal is weak
- Avoid carrying your cell phone on your body at all times
- If you must carry your cell phone on you, make sure that the keypad is positioned toward your body

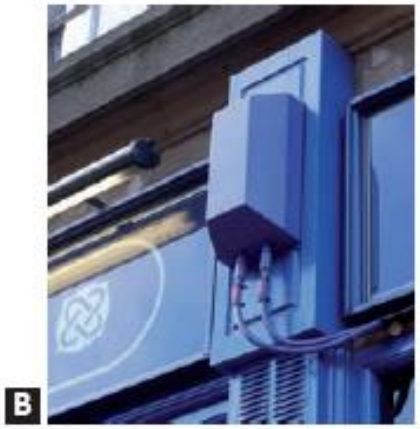
- **Only use your cell phone to establish contact or for conversations lasting a few minutes**
- **Switch sides regularly**
- **Communicate via text messaging rather than making a call**
- **Avoid using your cell phone in places like a bus**
- **Choose a device with the lowest SAR possible**

# Pulprilhad Pur, New Delhi

# Rahugupta T-10B Pulprahilad Pur New Delhi



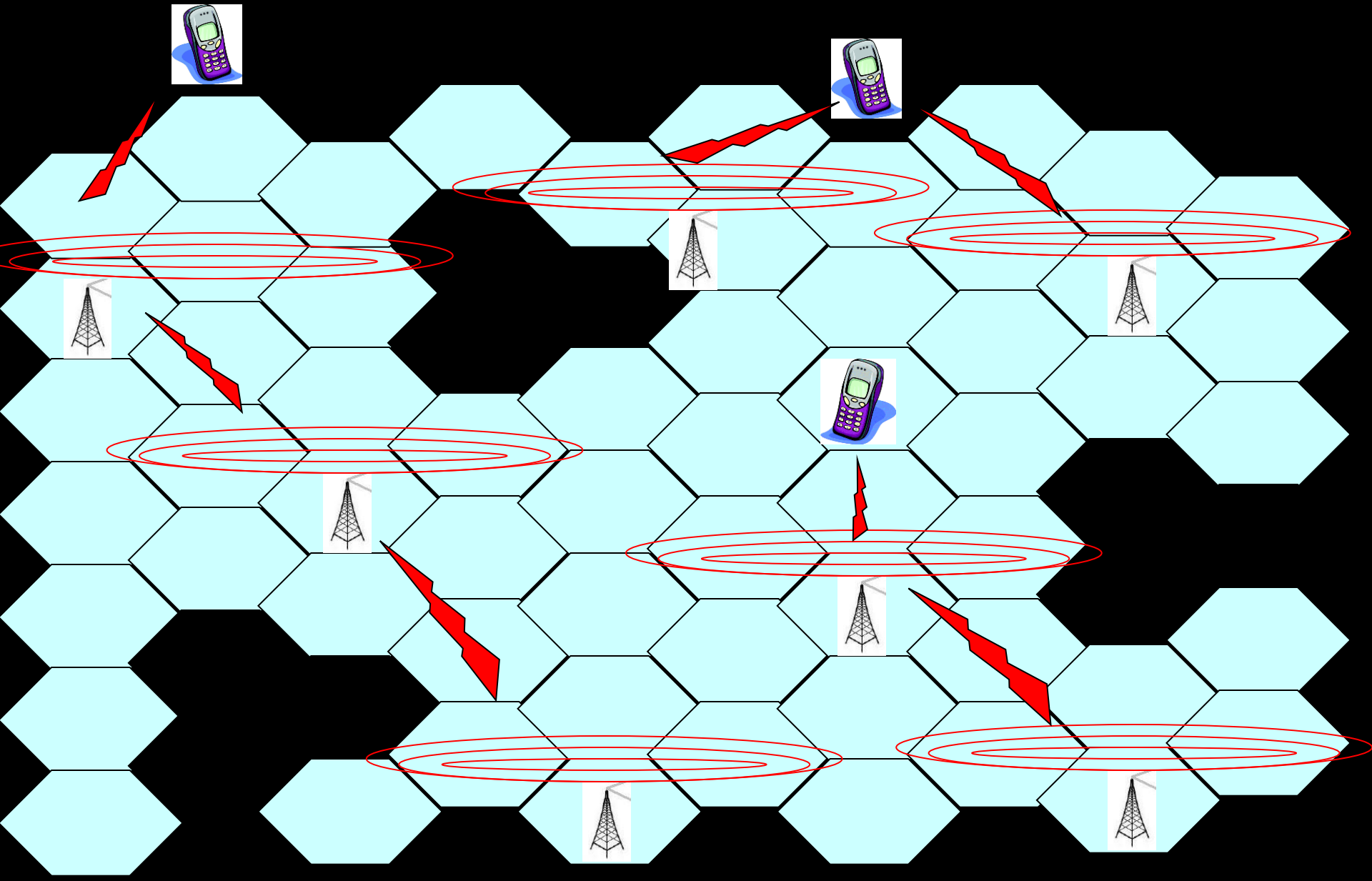





Microcell providing extra capacity in town centre


Picocell providing coverage in shopping centre

**FIGURE A2** *Arrangement of cellular networks showing macrocell, with microcell and picocell base stations used to provide additional coverage (figure courtesy of the Health Protection Agency)*



# Conclusion

**If an action or policy has a potential risk of causing harm to the public or to the environment, in the absence of scientific consensus, and that the action or policy is harmful, then the burden of proof that it is not harmful, falls those taking an action and not on the victims of such action**

**Need to develop health based precautionary guidelines in the Country**


भारतीय आयुर्विज्ञान अनुसंधान परिषद
INDIAN COUNCIL OF MEDICAL RESEARCH

# Thank you

# THERMAL EFFECTS – Limits and Guidelines for Mobiles

**Federal Communications Commission (FCC):**

- For exposure from wireless telephones, the allowable FCC SAR limit is 1.6 W/kg, as averaged over one gram of tissue

**International Commission on Non-Ionizing Radiation Protection (ICNIRP):**

- Guidelines for the general public recommend SAR value – 2.0 w/$m^2$

**National Radiological Protection Board (NRPB):**

- The limit on exposure to microwave radiation emitted on mobiles is 0.1 W in any 10g of tissue

**World Health Organization (WHO)**

- EMF radiation – 2B Carcinogen

# International Exposure Limits for RF Fields

| | |
|---|---|
| 9.2 W/m$^2$ | International Commission for Non-ionizing Radiation Protection (ICNIRP)[12] |
| 3 W/m$^2$ | Exposure limit in Canada (Safety Code 6, 1997)[8] |
| 2 W/m$^2$ | Exposure limit in Australia [1,6] |
| 1.2 W/m$^2$ | Belgium[9] |
| 0.92 W/m$^2$ | Recently implemented in India[2] |
| 0.9 W/m$^2$ | Slovenia[10] |
| 0.5 W/m$^2$ | Exposure limit in Auckland, New Zealand[1,6] |
| 0.1 W/m$^2$ | Exposure limit in Bulgaria, Lithuania, Russia, Poland[10] |
| 0.1 W/m$^2$ | Exposure limit in Italy [4] |
| 0.1 W/m$^2$ | Exposure limit in Switzerland[5] |
| 0.1 W/m$^2$ | Exposure limit in China[11] |
| 0.07 W/m$^2$ | Exposure limit in Switzerland in sensitive area[5] |
| 0.024 W/m$^2$ | Exposure limit in CSSR, Luxembourg, Belgium[9] |
| 0.045 W/m$^2$ | Exposure limit in Belgium in sensitive areas[9] |
| 0.02 W/m$^2$ | Exposure limit in Hungary[3] |
| 0.001 W/m$^2$ | “Precautionary limit” in Austria, Salzburg City only[7] |

# Conclusion

**The review of literature does not establish conclusive evidence on the safety or risk of RFR emitted from cell phone and cell phone tower but growing body of scientific evidences indicates some bio-effects and possible adverse health effects of RFR which merit further investigations**

**Need to develop health based precautionary guidelines in the Country based on Indian epidemiological studies**