CELL PHONE RADIATION HAZARDS AND SOLUTIONS

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Outline of Presentation

- Cell Phone Advantages
- Microwave Heating Principle
- Cell Phone – Specific Absorption Rate (SAR)
- International Findings
- Biological effects
- Newspaper Coverage
- Solutions
Cell Phone and Tower Statistics in India

- India Population – 1.2 billion
- Mobile Towers – 4.5 lakh
- Mobile subscribers – 800+ Million
Growth of Subscriber Base

Growth of Subscriber base (in million) from 2000 to 2010

At the end of Financial Year

2000: 28.53
2001: 36.29
2002: 44.97
2003: 54.62
2004: 75.54
2005: 98.41
2006: 140.32
2007: 206.83
2008: 300.49
2009: 429.72
2010: 621.28
### Subscriber Base in August 2011

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Wireless</th>
<th>Wireline</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total subscribers</td>
<td>865.71</td>
<td>34.07</td>
<td>899.78</td>
</tr>
<tr>
<td>Total Net addition</td>
<td>7.34</td>
<td>-0.11</td>
<td>7.23</td>
</tr>
<tr>
<td>% of monthly growth</td>
<td>0.86%</td>
<td>-0.33%</td>
<td>0.81%</td>
</tr>
<tr>
<td>Urban subscribers</td>
<td>570.54</td>
<td>25.73</td>
<td>596.27</td>
</tr>
<tr>
<td>Rural subscribers</td>
<td>295.17</td>
<td>8.34</td>
<td>303.51</td>
</tr>
<tr>
<td>Tele density</td>
<td>72.12%</td>
<td>2.84%</td>
<td>74.96%</td>
</tr>
<tr>
<td>Urban teledensity</td>
<td>157.76%</td>
<td>7.11%</td>
<td>164.87%</td>
</tr>
<tr>
<td>Rural teledensity</td>
<td>34.10%</td>
<td>24.48%</td>
<td>33.73%</td>
</tr>
</tbody>
</table>

*August 2011 – subscribers in millions*
Cell phones have several advantages.

Cell phones and cell towers have several disadvantages including microwave radiation, which has several harmful effects.
Microwave radiation effects are classified as:

- Thermal
- Non-thermal

The current exposure safety standards are mainly based on the thermal effects, which are inadequate.

Non-thermal effects are several times more harmful than thermal effects.
Sun Heating vs Microwave Heating

- Outside to inside heating
- Skin heating
- Sweating happens

- Inside to outside heating
- Internal heating
- Heat trapped
Microwave Heating Equation

The dependence between the microwave power applied in heating and the increase of temperature can be described by the equation:

$$\Delta T = \frac{P \times t}{V \times c_p \times \rho}$$  \hspace{1cm} (1)

where: $\Delta T$ – the increase of the mean temperature of the heated body (K)

$P$ – microwave power used for heating (W)

$V$, $c_p$, $\rho$ – volume, heat capacity, density ($m^3$, J/kg.K, kg/m$^3$)

$t$ – time of heating (s)
Microwave Radiation Standards vs. time in different countries in 1977

Fig. 10.2  Microwave personnel exposure standards
(Simplified from Dodge and Glaser, The Journal of Microwave Power, 1977.)

Figure from the book entitled “Industrial Microwave Heating” by Metaxas and Meredith, Peter Peregrinus, 1983, page 280.
Microwave Heating Concept

4.2 KW (4200 W) of microwave power raises temperature of 1 Litre of water by 1°C in 1 second.

In energy absorption term, 4.2 KW-sec microwave energy will increase the temperature of 1 Litre by 1°C.

For example, in a microwave oven, temperature of one cup of water increases from 30°C to 100°C in approx. 70 seconds with 500W of microwave power.

With 1W power (same as output power of cell phones), temp. will increase by 1°C in 500 seconds.
Cell Phone - Ear Warming?

Have you ever noticed warm sensation in ear after using mobile phone for a long time?

Temp. of ear lobes increases by 1°C when cell phone is used for approx. 20 minutes.

Warm sensation/pain > tinnitus > irreversible hearing loss

All these effects lead to Ear Tumor

Tinnitus or “Ringxiety”- sensation of cell phone ring
A Cell phone transmits 1 to 2 Watts of power

**SAR (Specific absorption rate)** - Rate at which radiation is absorbed by human body, measured in watts per kg (W/kg).

In USA, max. SAR limit for cell phones is **1.6W/Kg** which is for **6 minutes**. It has a safety margin of 3 to 4, so a person should not use cell phone for more than **18 to 24 minutes per day**.

This information is not given to people in India.
San Francisco Govt. has made it mandatory for the industry to display SAR value for each phone. (USA Today 14 July, 2010)
Warning from Blackberry

BlackBerry device: keep the BlackBerry device at least 0.98 in. (25 mm) from your body when the BlackBerry device is transmitting. When using any data feature of the BlackBerry device, with or without a USB cable, hold the BlackBerry device at least 0.98 in. (25 mm) from your body. If you use a body-worn accessory not supplied by RIM when you carry the BlackBerry device, verify that the accessory does not contain metal and keep the BlackBerry device at least 0.98 in. (25 mm) from your body when the BlackBerry device is transmitting.

To reduce radio frequency (RF) exposure consider these safety guidelines:

- Use the BlackBerry device in areas where there is a strong wireless signal. The indicator that provides information about the strength of the wireless signal is located in the upper-right corner of the Home screen and displays five ascending bars. Three or more bars indicate a strong signal. A reduced signal display, which might occur in areas such as an underground parking structure or if you are traveling by train or car, might indicate increased power output from your BlackBerry device as it attempts to connect to a weak signal.

- Use hands-free operation if it is available and keep the BlackBerry device at least 0.98 in. (25 mm) from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry device is turned on and connected to the wireless network. For more information about carrying your BlackBerry device, see the holster information in the "Additional safety guidelines" section of this document.

- Reduce the amount of time spent on calls.
Results of Re-evaluation of Interphone Study

INTERPHONE – WHO -10 years, 13 countries, largest (5,117 brain tumor cases), $25 million dollars to evaluate risk on brain tumors.

**Conclusion** - no overall ↑ risk, but suggestions of ↑ glioma - heavy users & ipsilateral exposures

**Re-evaluation - Risk underestimated by at least 25%**

- For every 100 hours of use -26% ↑ risk of meningioma
- Initial 24% risk of glioma ↑ to 55% over 10 years - regular users are taken as people who use it for 2hrs/month.
- Doubled - quadrupled brain tumor risk - heavy users (1/2 hour/day) over 8 to 10 years.
- Children, young adults – excluded. New study - Mobi-kids
WHO: Cell phone use can increase cancer risk

International Agency for Research on Cancer (IARC), a part of WHO designates cell phones as “possible human carcinogen” [Class 2B]

Found evidence of increase in glioma and acoustic neuroma brain cancer for mobile phone
BIOLOGICAL EFFECTS
Most common complaints:

- Fatigue
- Headaches
- Loss of sleep
- Memory loss
- Ringing ears
BIOLOGICAL EFFECTS

- Neurodegenerative Disorders – Alzheimer, Parkinson's
- Immune System Degradation
- Tinnitus and Ear Damage
- Irreversible infertility
- Effect on Skin
- DNA Damage
- Increase in Cancer risk

[Image: Breakdown of Blood Brain Barrier
Increased Risk of Eye Cancers
Increased Risk of Ear Tumors
Increased Risk of Other Cancers]
Use of mobile phones before bed disturbs Stage 4 sleep, the stage important for full recuperation of brain and body.

Keeping mobile phone next to head or below pillow while sleeping

NOT ADVISABLE
Children are more vulnerable as:

- Skulls are smaller & thinner - increases radiation absorption
- Rate of cell division - more susceptible to genetic damage
- Myelin sheath not developed - Electrical brain-wave activity
- Immune system not well developed - less effective against fighting cancer growth

RF penetration in the skull of an adult (25%), 10 year (50%) and a 5 year old (75%).
A pregnant woman and the fetus both are vulnerable as RF radiations can pass placental barrier & continuously react with the developing embryo and increasing cells.
**Effect on Eye/ Uveal Melanoma**

Good quality lens  Ability to focus the laser beam at the various locations is altered.

Prolonged exposure to microwave radiation can lead to macroscopic and microscopic damage to the lens and part of this damage does not heal and accumulates with time.
Irreversible infertility

Continuous exposure

30% sperm decrease in intensive mobile users, in addition to damage of sperms
Live Blood Cells and Electrosmog

Dr. Magda Havas
Trent University, Canada

Consequences

- Poor Circulation
- Reduces waste removal
- Lower Oxygen transport
Single and double strand breaks observed in DNA from microwave exposure at levels below the current FCC exposure standard.

When Damage to DNA > Rate of DNA repaired, there is the possibility of retaining mutations and initiating cancer.
NEWS COVERAGE
Cell Phone Radiation? Text, Don’t Talk, advises FCC

How dangerous is your cell phone? The unfortunate reality is that you can’t really know. Even so, only one year ago, progressive San Francisco Mayor Gavin Newsome proposed an ordinance that would have required that all retailers inform consumers about the amount of radiation that cell phones emit. Material printed in 11pt. type would have been posted next to phones disclosing their specific absorption rate (“SAR”), which is a measure of radio frequency energy (radiation) absorbed by the body. Last
HALF AN HOUR OF CELLPHONE USE A DAY INCREASES BRAIN CANCER RISK

A landmark 10-year study undertaken by the World Health Organisation has found that people who speak on their handset for more than half an hour a day for over 10 years are at risk of brain cancer...

Cellphone users worried about getting cancer won't be off the hook yet. A major international study into the link between cell phone use and two types of brain cancer has proved inconclusive, according to a report due to be published in the International Journal of Epidemiology today.

A 10-year survey of almost 13,000 participants found most phone users' increase in risk of developing meningioma -- a common and supposedly benign tumour -- or glial -- a rare but deadly form of cancer.

LONGER CALL TIMES INCREASE CANCER RISK

It found no increased risk of glioma or meningioma tumours after 10 years of using a mobile phone, although it found "suggestions of higher risk" for the heaviest users.

Given that the heaviest users in the study talked an average of half an hour per day on their phones, a figure which is not heavy by today's standards.

The heaviest users who reported using their phones on the Josh line of their heads had a 40 per cent higher risk for glioma and 18 per cent for meningioma, but the researchers said "errors" prevented making a claim link.

"The study doesn't reveal an increased risk, but we can't conclude that there is no risk because there are strong findings that suggest a possible risk," the study's chief editor, Elizabeth Camp.

Among the factors that weren't examined were the effects of using handheld devices during calls or the risk of having phones closer while not talking - such as in a pocket, or near the head at night.

The authors acknowledged possible inaccuracies in the survey results. They included participants who continued to talk on their cells for the entire decade, and not just half the time of the others.

The authors said further investigation is necessary before they can conclude with certainty that there is no link between phone radiation and brain cancer, partly because people's usage changed considerably over the past 10 years.

FUTURE STUDIES WILL LOOK AT RISK IN CHILDREN

Scientists are also planning to examine whether phone use increases the risk of meningioma in the back of the brain and the pituitary gland, which affects children. A separate study will look into the effects of cellphone use on children, who are believed to be more susceptible to the effects of radiation. The $6 million study was compiled by researchers on 15 countries whose participants included 12,548 participants, of which 4,670 had either meningioma or glioma tumours.

Network operators and handset manufacturers had long anticipated the results, which could shape the development of their products. This was an increased 4.7% of people in the population at the end of last year, according to the International Telecommunication Union.

A statement yesterday, the Mobile Manufacturers Forum welcomed the study. "The phone industry takes all reports regarding the safety of phones seriously and has a strong commitment to supporting ongoing scientific research," the industry group said.

MORE RESEARCH NEEDED

The other factors of cell- phone users may be more likely to cause damage. However, the health effects are generally lower in the amount of radiation, though it is shown that the radiation can cause damage, the extent of it is yet to be determined because most of the studies have been inconclusive.

A separate study, a study said that those to four hour of everyday cellphone use over a period of ten years will cause brain tumours. However, most of it has been speculation. The causes of most cases of tumour and similar disorders are genetic, and research is determined. For an outside stimulus to cause cancer in brain tissue, the brain would have to be exposed over a long time.

--- Dr. Keki Virani, Head of Department of Neurosurgery, Mumbai Hospital
Study by KEM Hospital proves hearing problems
Get off your mobile phone, now

Constant exposure to loud noise, overuse of phones can cause high frequency hearing loss

Sanstesh Andhale

If you cannot hear the sounds of the consonants f, s, t, and z or high pitched sounds, chances are you are suffering from high frequency hearing loss.

“Most healthy people are not aware that they suffer from high frequency hearing loss, which is very common,” said Dr Jaydi Mohite, associate professor, audiology and speech therapy department at Nair Hospital.

Every year, medical students at Nair and JJ hospitals are screened for health problems. This year, the results were startling—around 50% of the 300 students were found suffering from the high hearing frequency loss. “We found that those with high hearing frequency loss would talk on their mobile phones for hours and listened to loud music on their earphones,” said Dr Mohite.

“Currently, these students do not have any problem, but we have asked them not to use the mobile phone rigorously and avoid exposure to loud noise,” he added.

People with high frequency hearing loss can hear vowels, but not consonants f, s, t, and z. “People with high frequency hearing loss show symptoms like inability to hear consonants, failure to hear high pitched sounds, tinnitus (abnormally loud sounds in the ear canal for some duration), difficulty talking in groups and inability to hear when there is noise in the background,” explained Dr Mohite.

Dr Mohite, head of ENT department, Sir JJ group of hospitals.

He advised that before seeking treatment, people should visit an audiologist to find out what type of hearing loss they have and the extent of the damage. “If people with high frequency hearing loss people do not take proper precautions, they may need hearing aids soon,” said Dr Neelam Sathe, lecturer in the ENT department, KEM Hospital.

Apart from loud noise, diabetes, neuropathy, genetics, and infections like cold, flu and meningitis can cause high frequency hearing loss.

Gymkhana can host events with riders

DNA Correspondent

In a major relief to Dadar Parsi Gymkhana, the Bombay high court on Tuesday allowed them to use the ground for social functions and marriages, but asked them to adhere to the noise pollution control norms.

A division bench of Justice PB Majumdar and Madhur Malaviya asked the gymkhana management not to overlook comfort of the residents of the area who are disturbed by the noise during functions.

“There are so many communities and festivals in our country. We must learn to enjoy it without disturbing others,” remarked Justice Majumdar.

For enjoying your festival, you must not disturb somebody’s peace.”

The judges observed that while marriages and social functions are a part of our society, a balance has to be struck.

EP Bharucha, advocate for gymkhana, said they were willing to keep a check on noise pollution.

The court was hearing a petition filed by Dadar Parsi Gymkhana challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktा challenging the order of the Lokayuktа.

On Tuesday, when assistant government pleader Jasbir Saluja informed the court that the ground was surrounded by many buildings and it was a silent colony, Justice Majumdar replied: “To find silence one has to go 10km away from the city. This is the hazard of modern living.”

The judges directed the gymkhana to ensure peace of citizens in area is not disturbed at the next hearing on November 19, and instructed the police to verify and monitor the decibel level and submit a compliance report.

The matter will be next heard on December 7.
The radiation figure for each handset model must also be displayed prominently at all retail outlets that sell mobile phones.

**Radiation Norms Set for Mobiles, Towers**

Guidelines close to ones followed in US; Telecom min asked to prepare implementation road map

**JOGI THOMASPHILIP**

NEW DELHI

Concerned about impact on consumer health from excessive mobile usage, the government has finalised radiation emission guidelines for cellphones and towers. The guidelines are close to the norms followed in the US. ET has a copy of the new rules that specify upper limit for radiation for handsets that can be sold in the country.

Radiation emitted by cellphones is measured in terms of specific absorption rate (SAR) — the amount of radio waves absorbed by the body tissue when a mobile phone is in use. It is different for different phones.

The new rules state that cellphones can be imported and sold in India only if the SAR level is below 1.6 watts per kg (W/kg). So far India had unofficially followed European norms which state the maximum SAR level must not exceed 2 W/kg.

The guidelines state that SAR value, or the radiation emitted by the handset, must be specified on the device, its manual, the box as well as the websites of both the company and the telecom department.

The radiation figure for each handset model must also be displayed prominently at all retail outlets that sell mobile phones. Radiation limits for towers have also been tightened to a tenth of the existing exposure level.

For consumers, the cost of acquiring a cellphone is set to go up by a minimum of ₹400. This is because, the new rules make it mandatory for all handsets to be sold with a hands free device, as the government believes this step will help reduce the exposure to radiation significantly.

The telecoms department had finalised the rules on November 14, according to documents reviewed by ET. Leading handset makers did not comment, as the rules are not public yet. But an executive with a leading cellphone company said most handsets, except some Chinese brands, were already adhering to the US specified radiation limits. For instance, the Apple iPhone 4 has a SAR value of 1.17, the Samsung Galaxy S2 has a SAR of 0.38, while for the BlackBerry Curve 8310, the corresponding value is at 0.72. A significant part of the new guidelines are based on the recommendations of the inter-ministerial group that was set up to study health-related effects of radiation emitted by mobile phones and towers.

The communications ministry has accepted most of the recommendations and telecoms minister Kapil Sibal has directed his ministry to prepare the implementation road map, according to internal department documents reviewed by ET.
While the cell has become an additional appendage for most of us, all this, of course, does not mean that we have to stop using cell phones. Just ensure you take precautions:

- Limit your use
- Talk for short durations
- If possible, use SMS
- Use cell phone with lower SAR value
- Use the speakerphone or wired hands free or Bluetooth, but keep the cell phone at a distance of at least 12 inches from your body
- Use the land-line, when available
- Do not keep cell phones in your hand/pocket for long.
- At home/office, keep the phone away from you
Thank you