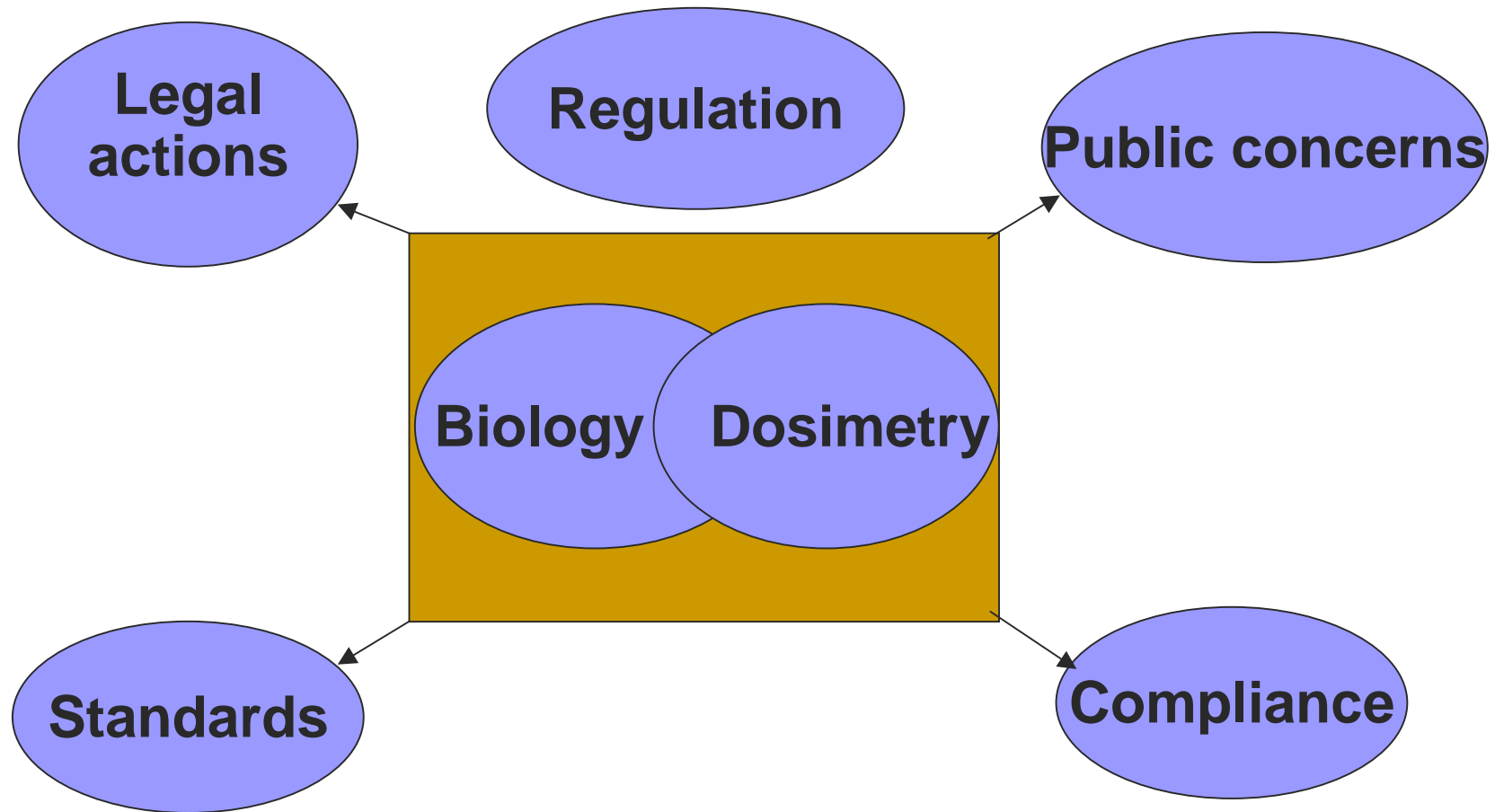




RF Health Effects: The State of the Science

**M. Swicord and K. Joyner
Motorola**

Science forms the basis of the debate



- The quality of the science determines the level of success

Health policy must be science based

- **A single study can form the basis of an hypothesis, but does not provide the basis for hazard identification.**
- **Confirmation of the results of any study is needed through replication and/or supportive studies.**
- **The resulting body of evidence forms the basis for science-based judgments by defining exposure levels for**
 - **adverse health effects and**
 - **no observable adverse effects.**

**What does a review of
published and ongoing
research tell us?**

Study Type Strengths and Weaknesses

Epidemiological studies:

Greatest weighting (WHO, IARC)

- **Distribution of disease in a population and factors affecting this**
- **BUT can be subject to bias and confounding**

Volunteer studies:

- **Response of people to an agent such as RF**
- **BUT short-term exposure and selection (of healthy volunteers)**

Animal studies:

- **Responses of mammals to an agent such as RF**
- **BUT differences in metabolism, physiology, lifespan, etc**

Cell studies:

Least weighting

- **Rapid cheap screening for possible interaction mechanisms**
- **BUT simple systems, normal growth constraints absent**



MOTOROLA SUPPORTED STUDIES

Study Type/Subtype	Completed w/Publication	Completed w/o Publication	Total
Epidemiology			
Cohort Epi Study	1	0	1
Human / Provocation			
Hormone changes	1	0	1
In Vitro			
DNA Breaks, Damage & Mutation	5	0	5
Gene & Protein Expression & Activity	2	4	6
Other Tissue/Cell Culture Studies	0	2	2
Oxidative Stress	1	0	1
Proliferation, Growth Rate, & Cell Cycle Analysis	2	2	4
Transformation	1	0	1
Total	11	8	19
In Vivo			
Blood Brain Barrier Permeability	3	0	3
Cell Line Injection Tumor Bioassay	1	0	1
Chemical-Radiation-Genetically Initiated Tumor Bioassay	2	1	3
DNA Breaks, Damage & Mutation	1	0	1
Gene & Protein Expression & Activity	4	2	6
Long Term Rodent Bioassay	7	0	7
Total	18	3	21
Grand Total	31	11	42

Biological Studies Partially Supported by MMF

Study Type/Subtype	Total
Epidemiology	
INTERPHONE: International Case-Controlled Studies of Cancer in Relation to Mobile Telephone	13
Human / Provocation	
Blood Pressure, Heart Rate, Circulation, and Respiratory Rate	1
EEG, Event Related Potentials, Sleep Disturbances, Cerebral Circulation	1
Headache & Fatigue	1
Hypersensitivity	1
Total Human Studies	4
In Vitro	
Gene & Protein Expression & Activity	3
Micronuclei & Chromosome Aberrations	3
Total In Vitro Studies	6
In Vivo	
Animal Behavior, Brain Biochemistry, Neuropathology, Drug Interaction	2
Blood Brain Barrier Permeability	1
Chemical-Radiation-Genetically Initiated Tumor Bioassay	3
Long Term Rodent Bioassay	4
Total In Vivo Studies	10
Grand Total	33

Other Studies Supported by MMF

- UK National Research Program (With UK Operators and UK Dept. of Health)
 - 19 Studies
- Theoretical Mechanisms studies
 - **Effects of RF fields on ion transport and on DNA**
 - **Modeling and simulating RF energy absorption in cellular systems**
 - **Energy accumulation in biologically active models due to RF absorption and possible biological effects**
 - **Theoretical investigation of the effects of low-level RF fields on molecular transport, chemical reaction rates and rectification**
 - **Micro and macroscopic study of RF absorption**

Dosimetry Supported by MMF

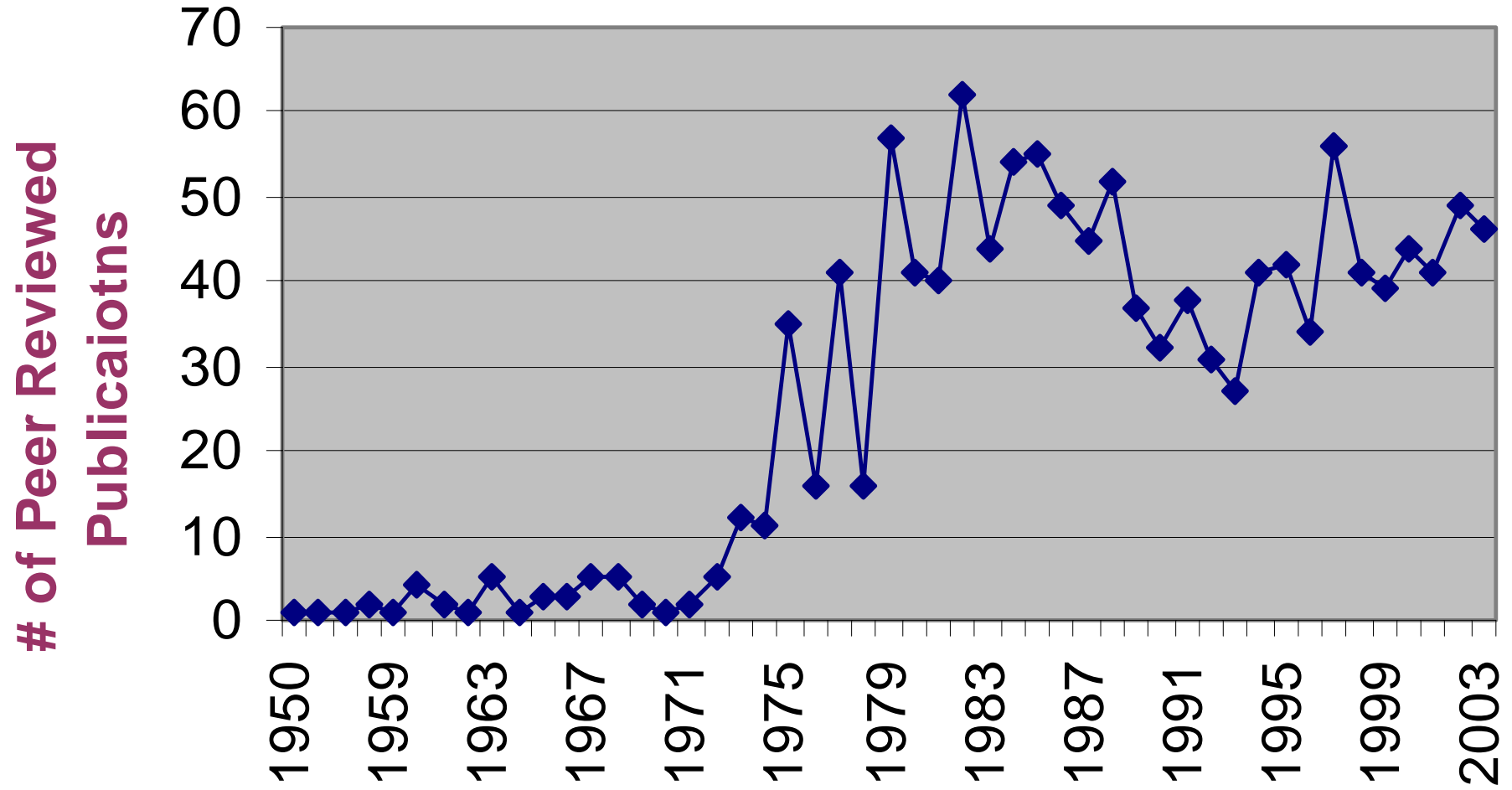
- **Current programs**
 - **IT'IS Foundation for Research on Information Technologies in Society**
 - **Development of simulated tissue equivalent dielectric materials**
 - **International Inter-laboratory SAR comparison program**
 - **Thermal and RF modeling of cellular phone exposure**
- **Call for proposals on standards related dosimetry in the coming months.**

RF Bioeffects

Peer Reviewed Publications Since 1950

Study Type/Subtype	Ongoing	Completed w/o Publication	Published studies
Epidemiology	30	8	178
Human / Provocation	21	22	152
In Vitro	42	38	396
Long Term Animal Studies			
Cell Line Injection Tumor Bioassay	0	0	4
Chemical-Radiation-Genetically Initiated	7	2	13
Long Term Rodent Bioassay	11	0	14
All Other Animal Studies	19	35	568
Grand Total	130	105	1325

Primary RF Biological Research Publications



Epidemiology

- Review by **Boice and McLaughlin (2002)**:
 - “In our view, a consistent picture has emerged from these studies that appear to rule out, with a reasonable degree of certainty, a causal association between cellular telephones and cancer to date.
 - No consistent evidence was observed for increased risk of...cancer...examined over a wide range of exposure measures, including
 - **type of phone (analogue or digital),**
 - **duration of use,**
 - **frequency of use,**
 - **total cumulative hours of use,**
 - **tumor location and laterality.”**

Epidemiology (cont.)

- **INTERPHONE Project**
 - **Case-control studies of head and neck tumors in populations of mobile phone users**
 - **Studies in 13 countries**
 - **Studies will be available for IARC evaluation**
 - **Denmark report: Christensen et al., Am. J. Epid. 2004**
 - **Included large number of long-term users**
 - **No association between mobile phone use for 10 years or more and risk of acoustic neuroma.**
 - **Swedish report: Lönn et al., Epidemiology, Nov. 2004**
 - **No statistically significant association between phone use in general and acoustic neuroma occurrence .**
 - **Statistically significance of small number of 10 year users with ipsilaterality grouping.**
 - **Both studies have small numbers for long term use.**
 - **Need to await final outcome of INTERPHONE with approximately 1000 acoustic neuromas cases.**

In vivo studies under review 11 years ago

PI	Endpoint	Status	IEEE ID
Prausnitz, MR	9.27 GHz (PW) exposure of Swiss albino mice	Critical reviews determined that report quality was poor therefore effects not accepted. IRE Transcripts Biomed Electron (1962) 9:104-108; Health Physics (1983) 44:430-433	1047
Spalding, JF	800 MHz (CW) exposure of RFM mice	No increased tumor formation. Health Phy. (1971) 20:421-424	1220
Preskorn SH	2450-MHz (CW) exposure of mice	Delayed tumor development. J. Surg. Oncol. (1978) 10:483 - 492	340
Szmigielski, S	2450 MHz exposure on breast tumors in C3H/HeJ mice, L1 sarcoma progression in mice, and benz(a)pyrene initiated skin tumors in Balb/C mice	Increased tumor formation. Bioelectromagnetics (1982) 3:179-191; Arch Dermatol Res (1982) 274:303-312	342, 466
Chou, CK	2450-MHz (CW) exposure of rabbits	No effect. Bioelectromagnetics (1983) 4:63-77	591
Santini, R	2450 MHz (CW & PW) exposure to mice and analysis of tumor progression following B16 melanoma injection	No effect. Bioelectromagnetics (1988) 9:105-107; J Microw Power (1986) 21(1):41-44; C R Soc Seances Soc Biol Fil (1985) 179(3):299-306; C R Soc Seances Soc Biol Fil (1985) 179(5):615-624	188
Chou, CK	2450 MHz (AM) exposure of rats for 25 months	Out of 155 parameters several showed effects. Bioelectromagnetics (1992) 13:469-496	217

Recently Published Long Term Animal Studies

PI	Endpoint	Status	IEEE ID
Adey, WR	836.55 MHz (TDMA) exposure in standard rat 2-y bioassay	No increased tumor formation. Rad. Res. (1999) 152:293-302	1298
Adey, WR	836.55 MHz (FM) exposure in standard rat 2-y bioassay	No increased tumor formation. Cancer Res. (2000) 60:1857-63	1406
Zook, BC	860 MHz (MiRS/TDMA) exposure in standard rat 2-y bioassay	No increased tumor formation. Rad. Res. (2001)155:572-583	1505
Zook, BC	860 MHz (FM) exposure in standard rat 2-y bioassay	No increased tumor formation. Rad. Res. (2001)155:572-583	1505
Roti Roti, JL	835.62 MHz (FM) exposure in standard rat 2-y bioassay	No increased tumor formation. Rad. Res. (2003)160:143-151	1903
Roti Roti, JL	847.74 MHz (CDMA) exposure in standard rat 2-y bioassay	No increased tumor formation. Rad. Res. (2003)160:143-151	1903

Recently Published Long Term Animal Studies (Continued)

PI	Endpoint	Status	IEEE ID
Utteridge, T	900 MHz (GSM) exposure of normal mice for 2 yr	No increase in tumor formation. Rad. Res. (2002) 158:357-364; Rad. Res. (2003) 159:274-278	1621, 1855
Frei, MR	2450 MHz exposure in standard mouse 2-year bioassay	No increase in tumor formation. Bioelectromagnetics (1998) 19:20-31; Rad. Res. (1998) 150: 568-576	1182, 1329
Toler, JC	435 MHz exposure in standard mouse 2-year bioassay	No increase in tumor formation. Rad. Res. (1997) 148:227-34	1157
Jauchem, JR	Ultra wide band exposure of C3H/HeJ mice (mammary tumor model)	No increase in tumor formation. Rad. Res. (2001) 155:369-377	1771
Anderson, LE	1616 MHz (IRIDIUM) exposure in standard rat 2-y bioassay	No increased tumor formation. Rad. Res. (2004 in Press)	2147

Ongoing Long Term Animal Studies

PI	Endpoint	Status	WHO ID
Dasenbrock, C	900 MHz (GSM & DCS) RF exposure for 2 y to B6C3F1 mice	Ongoing	244
Adang, D	HAWK and NIKE radar emission exposure in a rat tumor assay	Ongoing	524
Dasenbrock, C	1800 MHz (GSM & DCS) RF exposure for 2 y to B6C3F1 mice	Ongoing	944
Dotti, A	1800 MHz (GSM & DCS) RF exposure for 2 y to Wistar rats	Ongoing	945
Dotti, A	900 MHz (GSM & DCS) RF exposure for 2 years to Wistar rats	Ongoing	245
Shirai, T	1.5 GHz (PDC) exposure and standard NTP type bioassay	Ongoing	328
Yamaguchi, H	1.5 GHz (PDC) exposure and brain tumors	Ongoing	329

Published Sensitized In Vivo Studies

PI	Endpoint	Status	IEEE ID
Adey, WR	836.55 MHz (NAD - TDMA) exposure in ENU-induced rat brain tumor 2-yr bioassay	No increased tumor formation. Rad. Res. (1999) 152:293-302	1298
Adey, WR	836.55 MHz (FM) exposure in ENU-induced rat brain tumor 2-yr bioassay	No increased tumor formation. Cancer Res. (2000) 60:1857-63	1406
Zook, BC	860 MHz (MiRS/TDMA & FM) exposure in ENU-induced rat brain tumor 2-yr bioassay	No increased tumor formation. Rad. Res. (2001) 155:572-583	1505
Chagnaud, JL	900 MHz (GSM) exposure in benz(a)pyrene induced rat sarcoma bioassay	No effect. Int. J. Rad. Biol. (1999) 75:1251-6	1326
Imaida, K	929 (PDC) exposure in DEN induced-GSTp(+) rat hepatoma bioassay	No effect. Carcinogenesis (1998) 19:311-314	1349
Imaida, K	929 & 1500 MHz (PDC) exposure in DEN induced-GSTp(+) rat hepatoma bioassay	No effect. Jpn. J. Can. Res. (1999) 89:995-1002	1350
Wu, R.Y., Shao, B.J.	2450 MHz (CW) exposure to mice treated with DMH and analysis of colon tumors	No effect. BEMS (1994) 15:531-538	476
Mason, P.	94 GHz exposure to DMBA treated mice and analysis of skin papillomas	No effect. Carcinogenesis (2001) 22:1701-1708	1905
Heikkinen, P.	900 MHz (GSM) exposure on UV induced skin tumors in ODC transgenic & non-transgenic mice	No effect. Int. J. Rad. Biol. (2003) 79:221-233	16

Published Sensitized In Vivo Studies (cont.)

PI	Endpoint	Status	IEEE ID
Repacholi, MH	900 MHz (PW) exposure on lymphomas in PIM-1 transgenic mice	Increase tumors. Rad. Res. (1997) 147:631-640	1130
Utteridge, T	900 MHz (GSM) exposure on lymphomas in PIM 1 transgenic mice	No Increase in tumor formation. Rad. Res. (2002) 158:357-364;(2003) 159:274-278	1621, 1855
Heikkinen, P	902 MHz (GSM) exposure in radiation induced mouse lymphoma bioassay	No effect. Rad. Res. (2001) 156:775-85	1906
Heikkinen, P	900 MHz (GSM) exposure on UV induced skin tumors in ODC transgenic & non-transg. mice	No effect. Int. J. Rad. Biol. (2003) 79:221-33	2043
Bartsch, C.	900 MHz (GSM) exposure in DMBA induced rat mamary tumor bioassay	No effect. Rad. Res. (2002) 157:183-190	17
Anane, R	900 MHz (GSM) exposure in DMBA induced rat mamary tumor bioassay	No consistent change in tumors. Rad. Res. (2003) 160:492-497	18

Reported Sensitized In Vivo Studies

PI	Endpoint	Status	WHO ID
Shirai T, Fujiwara F	1.4 GHz exposure on the promotion of ENU induced brain tumors in rats	No effect. Ministry PRESS RELEASE (Oct. 2003)	1050
Sommer, AM	900 MHz (GSM) exposure of AKR/J mice 0.4 W/kg, 24 h/d, 7 d/wk for 42 weeks (spontaneous lymphoma within one year).	No effect. BEMS abstract P-B-113 (2004)	1148
Persson, BRR	900 MHz (GSM) exposure to GFAP (-/-) knockout mice on tumor development, micronuclei formation, ODC activity & polyamine / histamine levels	No effect. 21st Bioelectromagnetics Society Meeting (Long Beach, 1999)	287
Zook, BC	860 MHz (MiRS/TDMA) exposure in ENU-induced rat brain tumor latency	No increased tumor formation. Rad. Res. (manuscript in preparation); BEMS 2003	7

Ongoing Sensitized In Vivo Studies

PI	Endpoint	Status	WHO ID
Oberto, G	Replication of Pim-1 transgenic mouse study for lymphoma development	Ongoing	247
Hruby, E	Replication and re-evaluation of DMBA initiated mammary tumor bioassay	Ongoing	246
Chiang Huai	Replication and re-evaluation of DMBA initiated mammary tumor bioassay	Ongoing	593
Juutilainen, J	900 MHz (GSM) exposure of chemically initiated mice.	Ongoing	323
Ryan & Jauchem	mm wave exposure and skin tumors with DMBA initiation (+/- TPA co-promotion) in SENCAR mice	Ongoing	192
Lee J-S, Seo J-S	848.5 MHz and 1762.5 MHz RF exposure to hsp70.1 knockout and p53 knockout mice and analysis of histopathology, gene	Ongoing	994

Tumor Injection In Vivo Studies

PI	Endpoint	Status	IEEE ID
Salford, L.	915 MHz (FM) exposure on RG2 injected brain tumor progression in rats	No effect. Bioelectrochem & Bioenerget (1993) 30:313-318	464
Higashikubo, I	835.62 MHz (FM) exposure on 9L injected brain tumor progression in rats	No effect. Rad. Res. (1999) 152:665-671	1353
Higashikubo, I	847.74 MHz (CDMA) exposure on 9L injected brain tumor progression in rats	No effect. Rad. Res. (1999) 152:665-671	1353

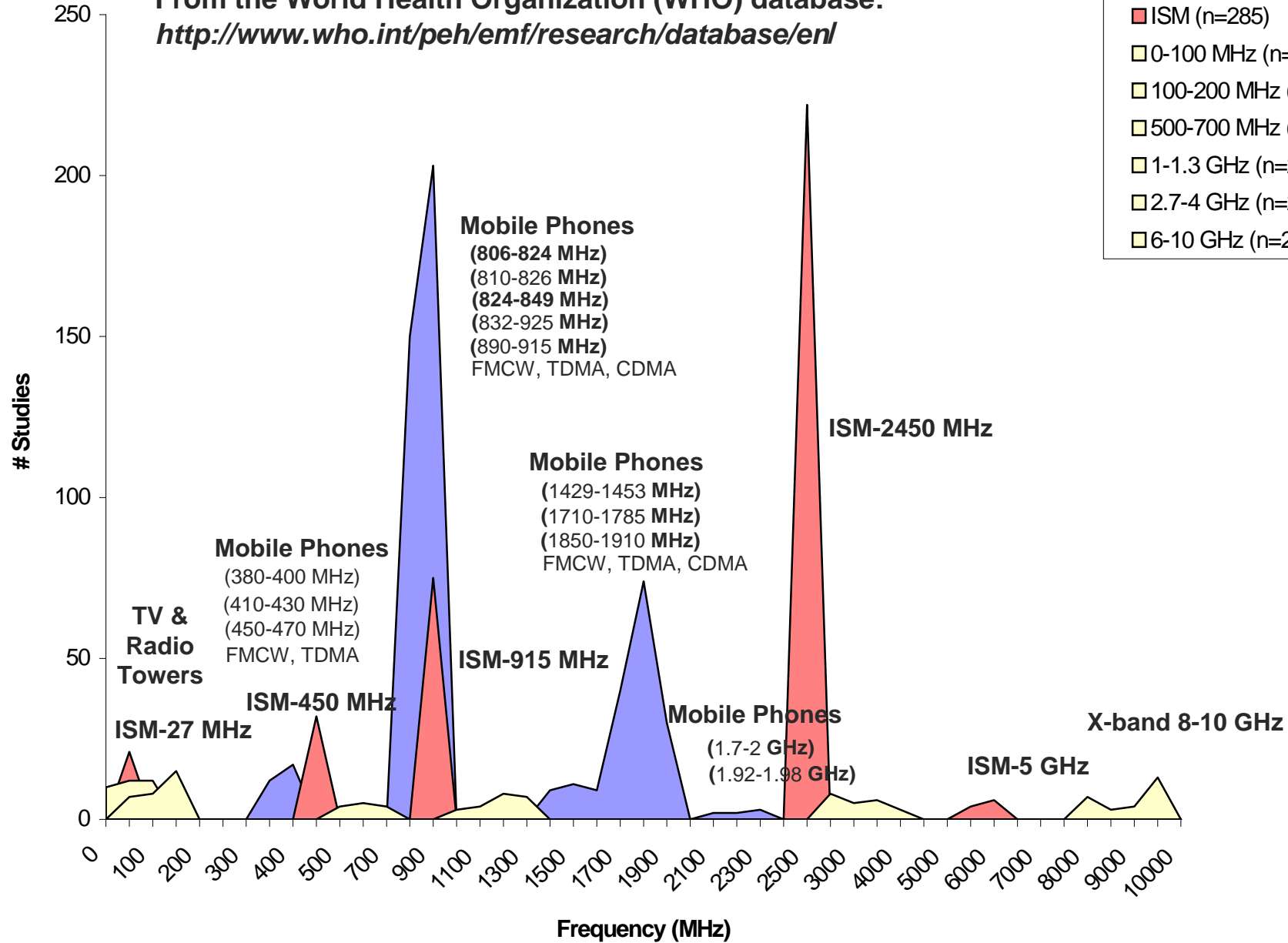
Long-term Animal Cancer Studies

- All 19 studies published since 1998 have shown no increase in cancer incidence.
 - Earlier studies reporting effects have not been confirmed by more recent and well-designed studies with good exposure assessment.
- Thus the weight of scientific evidence in 29 cancer studies show that RF exposure up to two years at dose rates up to 4 W/kg does not adversely affect carcinogenic processes (initiation, promotion or co-promotion).

RF Studies by Frequency

From the World Health Organization (WHO) database:
<http://www.who.int/peh/emf/research/database/en/>

- Mobile Phone (n=553)
- ISM (n=285)
- 0-100 MHz (n=34)
- 100-200 MHz (n=30)
- 500-700 MHz (N=13)
- 1-1.3 GHz (n=22)
- 2.7-4 GHz (n=22)
- 6-10 GHz (n=27)



Example Mobile Telephony Signals

<u>Signal Type</u>	<u>Frequency</u>	<u>Modulation</u>
TETRA	380 – 470 MHz	17 Hz (TDMA)
MIRS	806-821 MHz	11.1 Hz (TDMA)
NADC	824-849 MHz	50 Hz (TDMA)
CDMA	824-849 MHz	multichannel (800 Hz)
ANALOG	824-849 MHz	FM
GSM	890-915 MHz	17 Hz (TDMA)
PDC	929.2 MHz/1.5 GHz	50 Hz DMA)
IRIDIUM	1616-1626 MHz	11 Hz (TDMA)
CDMA	1765 MHz	multichannel (800 Hz)
PCS	1805-1880 MHz	217 Hz (TDMA)
GSM	1800 MHz	217 Hz (TDMA)
GSM	1900 MHz	217 Hz (TDMA)

Modulation and Future Technology (3G)

- **NCRP (2003):**

- “the scientific literature related to modulation-dependence of biological effects of RF energy is not sufficient to draw any conclusions about possible modulation-dependent health hazards of RF fields, nor is there any apparent biophysical basis from which to anticipate such hazards apart from exposure to very intense RF pulses produced by some specialized military equipment.”

- Biological Effects of Modulated Fields. NCRP Commentary No. 18*

- **Foster and Repacholi (2004):**

- “There remains a dearth (arguably, a complete lack) of replicated effects from low-level RF exposures. Equally important is the lack of a defensible theory that is capable of predicting the exposure conditions that will lead to modulation-dependent effects.”

- Radiation Research 162:219-225.*

**What do expert panels conclude
from a review of this literature?**

Conclusions from scientific research (on WHO website):

- *In the area of biological effects and medical applications of non-ionizing radiation approximately 25,000 articles have been published over the past 30 years.*
- *scientific knowledge in this area is now more extensive than for most chemicals.*
- *WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields.*

<http://www.who.int/peh-emf/about/WhatisEMF/en/index1.html>

Expert Scientific Reviews (1996-2004)

- Australian Committee on EM Energy Public Health Issues
- European Commission Expert Group
- European Committee on Toxicology, Eco-toxicology
- France's Commission for Consumer Safety (the French Expert Report) ('Zmirou report' to the French Health General Directorate,
- Health Council of the Netherlands
- Hong Kong - Office of the Telecommunications Authority
- International Commission on Non-Ionizing Radiation Protection (ICNIRP)
- Japanese Ministry of Post and Telecommunications
- New Zealand Ministry of Health and Ministry of Environment
- Royal Society of Canada Expert Panel and Health Canada
- Singapore Health Sciences Authority,
- Swedish State Radiation Protection Authority
- U.K. Advisory Group of Non Ionizing Radiation
- U.K. Independent Expert Group on Mobile Phones (Stewart Report)
- U.K. National Radiological Protection Board
- U.S. Food and Drug Administration
- World Health Organization
- Nordic Authorities (Denmark, Finland, Iceland, Norway and Sweden)

General Conclusion of Expert Scientific Reviews

- **No credible evidence that RF exposures within internationally accepted limits cause any adverse health effects, but...**
- **More research is needed**

Why do expert groups always say more research is needed?

- **One can never prove the null hypothesis and thus one can never prove that something does not exist.**
- **Infinite funds can be spent on any (null hypothesis) subject without definitive conclusion.**
- **More information is always helpful.**
- **The industry welcomes more quality research and continues to fund RF research.**
- **Additional research provides a better basis for safety standards and provides better assurance to the public of safety.**

Communicating the Science

- **However,' uncertainty' and 'recommendations for further research' seem to be misinterpreted in the media as raising doubt**
 - **therefore the overarching message of these expert reviews has been lost, that is, there are no established low-level effects.**
- **Time for greater clarity?**
 - **Simplify and clarify what it is that we know or don't know**
 - **Explain how that knowledge or lack of it led to the conclusions that the experts have reached.**

The question is how much research is sufficient for a public health policy?

- **The WHO agenda defines research needed for a public health assessment of RF exposure.**

Structure of the WHO RF Research Agenda: Geneva, 2003

Divided into broad research areas:

- Overarching issues: - rigorous study design, better dosimetry, etc
- Epidemiological studies **ongoing** **urgent** **future***
- Volunteer studies " " "
- Animal studies " " "
- Cell studies " " "

*Results not expected in WHO RF EHC timeframe

RF Research Agenda: Geneva, 2003

Epidemiological studies

- **Ongoing:** INTERPHONE - International case-control brain tumour studies
- **Urgent:** Improved individual exposure assessment*
- **Future:** International cohort study of mobile phone users

* CTIA/FDA CRADA addressing exposure assessment

RF Research Agenda: Geneva, 2003

Human laboratory studies

- **Ongoing:** Studies on reaction time and memory
- **Urgent:** Include children in cognitive studies*; further investigation of sleep and headache effects§
- **Future:** The effects of RF-induced heating on cognitive performance#

*Awaiting publication (Preece et al; Haarala et al)

§ EEG, headaches, sleep, cognition, BP & heart rate ongoing (Karolinska)

#Addresses further refinement of RF exposure standard

RF Research Agenda: Geneva, 2003

Animal laboratory studies

- **Ongoing:** NTP rodent bioassays; behavioural studies, balance and auditory function, etc
- **Urgent:** Immune system #, blood-brain barrier and neuropathology*, and sleep.
- **Future:** Consider evaluating: effects of novel RF pulse sequences

Franco/Russian study now proposed

*Ongoing (Brooks Air Force Base, Battelle, Finnie et al)

Future Reviews?

- IARC RF Review – Lyon, 2005/2006?
- ICNIRP Review – 2005/2006?
- WHO RF EHC – 2006/2007

CONCLUSIONS

- **No repeatable low-level effects associated with health have been observed.**
- **The conclusions from reviews of the scientific database have been remarkably consistent over time confirming the basis of current standards.**
- **Thermal effects of RF exposure have been confirmed (e.g., cataracts, teratogenesis, BBB permeation, behavioral effects, etc.) and provide the basis for human exposure guidelines.**
- **No established mechanism for adverse health effects other than thermal.**

CONCLUSIONS (Continued)

- **Extensive database allows risk assessors to define adverse effect level and/or no-observable-adverse-effect-level for numerous biological endpoints.**
- **Due to this current extensive database, it is unlikely that the results of ongoing studies will shift the weight of evidence.**

Standards IEEE/ICES & IEC

IEEE/ICES SCC28/SC2

C95.7 Draft “Recommended Practice for Radiofrequency Exposure Safety Programs”

- Designed to complement IEEE Std C95.1.
- To provide reasonable and adequate guidance for the controlled exposure to prevent or control hazards associated with RF sources
- Controls
 - engineering and administrative controls
 - personal protective equipment
 - RF safety signage
 - restricted access area
 - personal RF monitors
 - RF safety awareness training

IEEE/ICES SCC28/SC4

C95.1/D1.8 “Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”

- **Science-based recommendations are made to avoid all known adverse effects in human beings associated with RF exposure**
- **3 kHz to 5 MHz, protect against effects associated with electrostimulation**
- **100 kHz to 300 GHz, protect against effects associated with heating.**

Localized SAR Limits for Persons in Controlled Environments

- Draft 1.8 balloting (2004)
 - Now based on **10 W/kg averaged over 10 grams** of tissue except for hands, wrist, forearms, ankles, **lower legs and the pinnae** where SAR must not exceed 20 W/kg over any 10 grams.
 - The 10 W/kg local SAR limit is now **harmonized** with the value recommended by ICNIRP. However, limits for pinnae, upper arms and thighs are different from that specified by ICNIRP.

Limits for the General Public

- Localized SAR: Now based on **2 W/kg averaged over 10 grams** of tissue except for hands, wrist, **forearms**, ankles, **lower legs** and the **pinnae** where SAR must not exceed **4 W/kg over any 10 grams**.
- MPE: Harmonized with ICNIRP from 300 MHz to 100 GHz, then ramp up to 300 GHz to harmonize with the IEEE laser standard.

IEEE/ICES SCC28/SC4 next steps

- **Recirculation ballot to be distributed in October**
- **SC4 voting results available in November 2004**
- **If more than 75% approval is maintained, the final draft will be submitted in December 2004 to ICES for approval**
- **After approval by ICES, the draft will be voted finally by the IEEE Standards Board**

ICES SCC28/SC1

C95.3 “IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz–300 GHz” published December 2002

Currently is working on IEEE C95.3.1/D1.0

“Draft Recommended Practice for Measurements and Computation of Electric, Magnetic and Electromagnetic Fields With Respect to Human Exposure to Such Fields, 0 - 100 kHz”

IEEE SCC34 Subcommittee 2

- Mobile phone SAR measurement standard (1528)
“*Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Experimental Techniques*” was finally published in December 2003.
- Whether to continue P1529 is undecided:
“*IEEE Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Computational Techniques*”

International Electrotechnical Commission



IEC TC106 WG4 “Characterization of high frequency EM fields and SAR produced by specific sources”

Project 62209

- **Part 1 cellphone SAR measurement 300 MHz-3 GHz**
 - **To be published in January 2005**
- **Part 2 for testing**
 - **two-way radios, palm top terminals, desk top terminals, body worn devices including accessories, as well as multiple transmitters (30 MHz-6 GHz)**
 - **Committee Draft (CD) to be done by the end of 2004**

Project 62232 on base station just started in June