

Exhibit C: Reference List for Important Fertility and Reproduction Papers

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Exhibit B-1
RF Color Charts for Fertility and Reproduction Studies with Exposures

**PUBLISHED STUDIES RELEVANT TO SCENIHR REVIEW OF EMF –
 FERTILITY AND REPRODUCTION**

C. SAGE, BIOINITIATIVE WORKING GROUP, APRIL 2014

Agarwal A, Deepinder F, Sharma RK, Ranga G, Li J. 2008. Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study. *Fertil Steril.* 89(1):124-8.

1.0 W/Kg	Motility, sperm count, sperm morphology, and viability reduced in active cell phone users (human manner).
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Agarwal A, Desai NR, Makker K, Varghese A, Mouradi R, Sabanegh E, Sharma R. 2009. Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an in vitro pilot study. *Fertil Steril.* 92(4) 1318-1325.

1.0 W/Kg	Motility, sperm count, sperm morphology, and viability reduced in active cell phone users (human manner).
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Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. 2005 Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline 28:171-179.

0.09 W/Kg	900 MHz study of mice for 7 days, 12-hr per day (whole-body) resulted in significant effect on mitosis
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Aldad TS Gan G Gao XB Taylor HS. 2012. Fetal radiofrequency radiation exposure from 800-1900 MHz rated cellular telephones affects neurodevelopment and behavior in mice. *Sci. Rep.* 2, 312. DOI: 10.1038/srep00312

0.0003 - 0.06 W/Kg	Neurobehavioral disorders in offspring of pregnant mice exposed in utero to cell phones - dose-response on synaptic transmission onto layer V pyramidal neurons of the prefrontal cortex. Hyperactivity and impaired learning in offspring. Altered brain development.
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Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G. 2012 Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. *J Pediatr Urol.* [Epub ahead of print]

0.091 W/Kg	Wireless internet 2400 MHz, 24-hrs per day/20 weeks increased DNA damage and reduced DNA repair. Authors say "findings raise questions about safety of radiofrequency exposure from Wi-Fi internet access for organisms of reproductive age, with a potential effect on fertility and integrity of germ cells" (male germ cells=sperm)
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Avendano C, Mata A, Sanchez Sarmiento CA, Doncei GF. 2012. Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation. *Fertility and Sterility.* American Society for Reproductive Medicine, Published by Elsevier Inc. doi:10.1016/j.fertnstert.2011.10.012.

0.5 - 1.0 uW/cm2	Wi-Fi level laptop exposure for 4-hr resulted in decrease in sperm viability, DNA fragmentation with sperm under a laptop connected via WI-FI to the internet.
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Behari J, Kesari KK 2006. Effects of microwave radiations on reproductive system of male rats. Embryo Talk 1 (Suppl.1):81-5.

0.00034 uW/cm²

Chronic exposure to mobile phone pulsed RF significantly reduced sperm count,

Dasdag, S et al, 1999. Whole-body microwave exposure emitted by cellular phones and testicular function of rats. Urological Research 27(3):219-223.

0.141 W/Kg

Structural changes in testes - smaller diameter of seminiferous

De Iuliis GN, Newey RJ, King BV, Aitken RJ. 2009. Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. PLoS One 4(7):e6446.

0.4 - 1.0 W/Kg

One 6-hr exposure to 1800 MHz cell phone radiation in human sperm cells caused a significant dose-dependent decrease in sperm motility and viability; reactive oxygen species levels were significantly increased after exposure to 1.0 W/kg. These findings have clear implications for the potential detrimental effects of RF/MW to human sperm. The authors conclude "(T)hese findings have clear implications for the potential detrimental effects of extensive mobile phone use by males of reproductive age, potentially affecting both their fertility and their offspring."

De Iuliis GN, Newey RJ, King BV, Aitken RJ. 2009. Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. PLoS One 4(7):e6446.

1.0 W/Kg

Human semen degraded by exposure to cell phone frequency RF increased free-radical damage.

Forgács Z, Somosy Z, Kubinyi G, Bakos J, Hudák A, Surján A, Thuróczy G. Effect of whole-body 1800 MHz GSM-like microwave exposure on testicular steroidogenesis and histology in mice. Reprod Toxicol. 2006; Jul;22(1):111-7.

45 uW/cm²

Pulsed RFR affected serum testosterone levels in mice

A.F. Fragopoulou, et al., Cranial and postcranial skeletal variations induced in mouse embryos by mobile phone radiation, Pathophysiology (2009), doi:10.1016/j.pathophys.2009.10.002

0.6 - 0.9 W/Kg

Mouse embryos develop fragile cranial bones from in utero 900 MHz The authors say "(O)ur results show that a modest exposure (e.g., 6 min daily for 21 days) is sufficient to interfere with the normal mouse development."

Gul A, Celebi H, Ugras S. The effects of microwaves emitted by cellular phones on ovarian follicles in rats. Archives of Gynecology

< 1.0 W/Kg

Rats exposed to mobile phone radiation on STANDBY ONLY for 11-hr 45-min plus 15-min TRANSMISSION mode for 21 days showed decreased number of ovarian follicles in pups born to these pregnant rats. The authors conclude "The number of follicles in pups exposed to mobile phone microwaves suggest that intrauterine exposure hampers the normal development of the ovaries."

Kumar S Behari J Sisodia R. 2012. Impact of Microwave at X-Band in the aetiology of

male infertility. *Electromagnetic Biology and Medicine*, 31(3): 223–232. online DOI: 10.3109/15368378.2012.700293.

0.014 W/Kg

Sperm damage from oxidative stress and lowered melatonin levels resulted from 2-hr per day/45 d

Magras, IN & Zenos, TD, 1997. RF Radiation-induced changes in the prenatal development of mice. *Bioelectromagnetics* 18:455-461.

0.168 - 1.053 uW/cm2

Irreversible infertility in mice after 5 generations of exposure to RFR from an 'antenna park'

Navakatikian, MA & Tomashevskaya, LA, 1994 Phasic behavioral and endocrine effects of microwaves of nonthermal intensity. In: *Biological Effects of Electric and Magnetic Fields*, Volume 1, Carpenter, DO, (Ed.) Academic Press, Inc., San Diego, CA., pp. 333-342.

100 uW/cm2

A 24.3% drop in testosterone after 6 hours of CW RFR exposure

Otitolaju AA, Obe IA, Adewale OA, Otubanjo OA, Osunkalu VO. 2010. Preliminary study on the induction of sperm head abnormalities in mice, *Mus musculus*, exposed to radiofrequency radiations from global system for mobile communication base stations. *Bulletin of Environmental Contamination and Toxicology* 84(1):51-4.

0.07 - 0.1 uW/cm2

Sperm head abnormalities in mice exposed for 6-months to base station level RF/MW. Sperm head to 46% exposed mice (only 2% in controls) abnormalities was also found to be dose dependent. The banana-shaped sperm head. The occurrence of sperm head observed increase occurrence of sperm reproductive health of humans living in close proximity to GSM base stations were discussed."

Panagopoulos DJ. 2012. Effect of microwave exposure on the ovarian development of *Drosophila melanogaster*. *Cell Biochem Biophys*. 63(2):121-132.

0.795 W/Kg

GSM 900 MHz, 217 Hz significantly decreases ovarian development and size of ovaries, due to DNA death of nurse cells and follicles in ovaries (that nourish egg cells)

Salama N, Kishimoto T, Kanayama HO. Effects of exposure to a mobile phone on testicular function and structure in adult rabbit. *International Journal of Andrology* 2010;33(1):88-94.

0.43 W/Kg

Significant decrease in sperm mobility; drop in sperm concentration; and decrease in seminiferous 12 weeks, with mobile phone radiation level on STANDBY ONLY (in rabbits)

Somogyi, Z et al, 1993. Effects of modulated and continuous microwave irradiation on pyroantimonate precipitable calcium content junctional complex of mouse small intestine. *Scanning Microsc* 7(4): 1255-1261

60 uW/cm2

RFR caused structural changes in cells of mouse embryos

Chart References

Agarwal A, Desai NR, Makker K, Varghese A, Mouradi R, Sabanegh E, Sharma R (2009). Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an in vitro pilot study. *Fertil Steril*, 92(4), 1318-25.

Al-Damegh MA (2012). Rat testicular impairment induced by electromagnetic radiation from a conventional cellular telephone and the protective effects of the antioxidants vitamins C and E. *Clinics (Sao Paulo)*, 67(7), 785-92.

Kesari KK, Behari J (2012). Evidence for mobile phone radiation exposure effects on reproductive pattern of male rats: role of ROS. *Electromagn Biol Med*, 31(3), 213-22.
Kesari KK, Kumar S, Behari J (2010). Mobile phone usage and male infertility in Wistar rats. *Indian J Exp Biol*, 48 (10), 987-92.

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Ribeiro EP, Rhoden EL, Horn MM, Rhoden C, Lima LP, Toniolo L (2007). Effects of subchronic exposure to radio frequency from a conventional cellular telephone on testicular function in adult rats. *J Urol*, 177(1), 395-9.

Salama N, Kishimoto T and Kanayama HO (2010a). Effects of exposure to a mobile phone on testicular function and structure in adult rabbit. *Int J Androl*, 33(1), 88-94.

Salama N, Kishimoto T, Kanayama HO and Kagawa S (2009). The mobile phone decreases fructose but not citrate in rabbit semen: a longitudinal study. *Syst Biol Reprod Med*, 55(5-6), 181-7.

Salama N, Kishimoto T, Kanayama HO and Kagawa S (2010b). Effects of exposure to a mobile phone on sexual behavior in adult male rabbit: an observational study. *Int J Impot Res*, 22(2), 127-33.