Study of electromagnetic radiation produced by household equipment

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Abstract. This paper presents the experimental study of electromagnetic radiation produced by different household equipment. Measurements were performed at various distances from the tested devices and in different operating modes of these, using the FA306 electromagnetic field analyzer. Also, it has been analyzed the cumulative effect of multiple sources. The experiments allowed the identification of measures to minimize the effects of exposure to artificial electromagnetic radiation produced by electrical household equipment.

1. Introduction
Cosmic radiation, energetic fields of the earth and man-made technology constantly interfere with the human body, because the human body is a form of electromagnetism.

Constant concern to improve the quality of life and the use of advanced industrial technologies determined an explosive increase in the number of non-ionizing electromagnetic radiation artificial sources, both in household and industry [1-8]. Today, millions of people are exposed to artificial electromagnetic fields of different frequencies and intensities throughout the day, and probably all night.

It is estimated that 63% of the population already use a mobile phone, and this number is growing [1]. In addition, in the last decade occurred the technologies of wireless data connection Wi-Fi, Bluetooth, etc. In fact, Wi-Fi is present almost in every home, school and institution.

Dependency of population (mostly young) from gadgets is growing, and will appear increasingly wide range of devices generating electromagnetic disturbance, with a growing variety of uses.

Electromagnetic pollution is probably the biggest problem of this century, being more dangerous than other forms of pollution [1-5]. In addition, electromagnetic pollution can not be feeling directly, but only through its effects on the health of population.

2. Aspects of electromagnetic biocompatibility
Currently, artificial electromagnetic radiation level has raised exponentially, due to the new disturbance devices. Artificial electromagnetic radiations have an enormous intensity (hundreds of thousands of times) compared to the natural microwave spectrum (Figure 1, [9]).

Although electromagnetic pollution issues have a huge psychological impact on the population, the biological effects of exposure and potential health risks are not sufficiently known.

Since 1960, thousands of studies have demonstrated the harmfulness of long-term exposure to artificial electromagnetic fields.
The effects of radio frequency fields on human tissue can be thermal and non-thermal. Thermal effects can occur due to electrical conductivity of most biological tissues. The electric fields, induced in the body, generate electrical currents, whose energy causes the increase of local temperature. Because many biochemical reactions are strongly dependent on temperature, the temperature change may cause biological effects. Some studies have shown that hyperthermia causes: burns, behaviour changes, reproduction alteration, blood-brain barrier alteration, cataract, etc. Also, malformations are detected under sustained hyperthermic exposure [3-5].

Non-thermal effects can occur due to many interactions between different components of the electric field and biological tissue.

Rules and limitations issued by ICNIRP [11], although obtained through scientific methods, represent some relative reference results, because they took into account only the effects of radiation in the short term.

At national level, was adopted the Government Decision no. 1136, from 30/08/2006 [12] (correspond to European Directive 2004/40/CE and further [13]), on the minimum health and safety requirements regarding the exposure of workers to the risks arising from electromagnetic fields (0-300
GHz). They refer to the safety risks due to recognized adverse effects on the human body at short-term (caused by the circulation of induced currents, by energy absorption and by contact currents), but does not envisage long-term effects.

In the last few decades, many studies established that adverse health effects occur at far lower levels of electromagnetic fields exposure (both extremely low frequency electromagnetic fields, ELF and radiofrequency radiation, RF), where no heating occurs; some effects are shown to occur at several hundred thousand times below the existing public safety limits.

Heart and brain are regulated by internal bioelectrical signals. Environmental exposures to electromagnetic radiation can interact with fundamental biological processes in the human body [1].

Exposure to electromagnetic radiation causes, for many peoples, the electromagnetic hypersensitivity (EHS), manifested by the following symptoms: inability to concentrate, panic state, disorientation, visual disturbances, skin rashes, muscle weakness and even fainting [14-17]. Essentially, artificial electromagnetic fields decrease the hormone melatonin production. Melatonin regulate the sleep, and play an important role in the immune system; therefore appear depression, sleep disturbances, fatigue, increased immune sensitivity.

The principal action of electromagnetic fields on the human body is to accelerate the emergence (or worsening) of cardiac, vascular and neurological disease, and psychiatric disorders. Electromagnetic pollution can cause: headaches, arrhythmia, Parkinson, back pain and even autism [18-28]. It was observed a continuous growth of many types of cancer (glandular and central nervous system), proportionally with increasing levels of electromagnetic fields (particularly in radiofrequency and microwave spectrum) [1], [2], [18]. The risk of acoustic neuroma, a benign tumor of the auditory nerve, was 50% higher in the case of people who used mobile phones for 6 years or more [1-3], [22]. The rate of death from brain cancer among the users of mobile phones without hands-free was higher than the rate of death from brain cancer among those who use hands-free phones, which were kept away from their head [1].

![Figure 3](image-url)  
**Figure 3.** Thermographic image of the head: (a) no expure to mobile phone radiation; (b) after a 15 minute phone call [1]

![Figure 4](image-url)  
**Figure 4.** Penetration of electromagnetic radiation from mobile phone in an adult brain (a), 10 years old child (b) and 5 years old child (c) [1]

The skull of children is deeply penetrated by electromagnetic radiation emitted by a mobile phone (Figure 4). Blood-brain barrier (which protects the brain from toxins blood) can be compromised by
Innovative Ideas in Science 2016  IOP Publishing
IOP Conf. Series: Materials Science and Engineering 200 (2017) 012014 doi:10.1088/1757-899X/200/1/012014

this radiation that creates micronuclei in blood cells (characteristic sign of cancer). Thus can be explained the increased number of brain tumors in children [1].

Depending on the value of power density, it was observed the occurrence of following adverse health effects [4], [9], [29]:

- sleep disturbances, weakness, fatigue and pain (if power density is over 0.001 μW/cm²);
- cells growth is affected, so epithelial tumors occur (if power density is above 0.1 μW/cm²);
- childhood leukemia; motor disturbances, memory and attention disturbances; leukocyte changes in children of school age (if power density is within 1...10 μW/cm²);
- hearing and speech disturbances, leukemia, melanoma and other types of cancer (if power density is 10 μW/cm²).

3. Experimental measurements for various household equipment

In the experiments we used the FA306 electromagnetic field analyzer. FA306 measures three kinds of fields: high frequency electromagnetic fields (f=800 MHz...2.5 GHz; power density may be in the range of 0.02...39000 μW/m²), low frequency electric fields (electric field intensity may be in the range of 0...99 V/m) and low frequency magnetic fields (magnetic flux density may be in the range of 0.01...3.99 μT) [30].

The normal levels and the risk levels of electric and magnetic fields are presented in Table 1. More studies [1-5, 9, 29] revealed that, for intensity of electric field under 6 V/m and magnetic flux density under 0.064 μT, corresponding electromagnetic fields do not cause biological effects, even for a long-term exposure.

| Field            | Normal levels | Dangerous levels | Very dangerous levels | Extremely dangerous levels |
|------------------|---------------|------------------|-----------------------|---------------------------|
| Electric, E(V/m) | 0...6         | 6.1...8.9        | 9...13.9              | > 14                      |
| Magnetic, B(μT)  | 0...0.065     | 0.066...0.069    | 0.1...0.249           | > 0.25                    |
| Magnetic, B(mGs) | 0...0.65      | 0.66...0.69      | 1...2.49              | > 2.50                    |
| Magnetic, H(A/m) | 0...1.625     | 1.65...2.475     | 2.5...6.225           | > 6.25                    |

In the cases of indoor living or working areas, the safe values are: 1 μW/m² for power density, 10 V/m for electric field intensity, and 0.2 μT for magnetic flux density.

For sleeping areas, the safe values are: 1 μW/m² for power density, 10 V/m for electric field intensity and 0.2 μT for magnetic flux density.

We analyzed following electrical devices: mobile phones, wired landline phone, wireless routers, laptop, microwave, induction hob, TV sets, fluorescent lamps with electronic ballast and electric power cable.

Measurements were performed at various distances from the tested devices and in different operating modes of these. Also, we analyzed the cumulative effect of multiple sources (i.e. wireless router and laptop, wireless router and TV).

3.1. Mobile phone Samsung Galaxy S6 Edge Plus

In stand-by mode, measurement results revealed that the mobile phone is not dangerous in working areas (Table 2). Instead, in stand-by mode, the mobile phone is dangerous in sleeping areas, because the power density exceeds the safety limit.

The experiments showed that dialing is the most dangerous operating mode of mobile phone (Table 3).

In dialing mode, at a distance of 0.5 cm, power density is very close to the limit of measurement range of FA306 analyzer. At a distance of 5 cm, power density decreases 800 times, and at a distance of 10 cm, power density decreases more than 10600 times.
We found that values of power density are lower if touchscreen is turned off. Magnetic flux density and electric field intensity are in the safety domain, in all operating modes of mobile phone.

Table 2. Mobile phone Samsung Galaxy S6 Edge Plus in stand-by

| d(cm) | S(μW/m²) Peak | B(μT) | E(V/m) |
|-------|---------------|-------|--------|
| 0.5   | 0.8           | 0.02  | 0.2    |
| 1     | 0.63          | 0.02  | 0.2    |
| 1.5   | 0.63          | 0.02  | 0.2    |
| 2     | 0.63          | 0.02  | 0.2    |
| 2.5   | 0.5           | 0.01  | 0.2    |
| 3     | 0.4           | 0.01  | 0.2    |
| 3.5   | 0.32          | 0.01  | 0.2    |
| 4     | 0.32          | 0.01  | 0.2    |

Table 3. Samsung Galaxy S6 Edge Plus mobile phone in other operating modes

| d(cm) | S(μW/m²) Peak | S(μW/m²) Peak Call with touchscreen off | S(μW/m²) Peak Call with touchscreen on | B(μT) | E(V/m) |
|-------|---------------|----------------------------------------|----------------------------------------|-------|--------|
| 0.5   | 32000         | 320                                    | 320                                    | 0.03  | 0.2    |
| 1     | 5000          | 250                                    | 250                                    | 0.03  | 0.2    |
| 1.5   | 4000          | 200                                    | 200                                    | 0.03  | 0.2    |
| 2     | 3200          | 160                                    | 160                                    | 0.03  | 0.2    |
| 2.5   | 2000          | 125                                    | 125                                    | 0.03  | 0.2    |
| 3     | 1500          | 80                                     | 80                                     | 0.03  | 0.2    |
| 3.5   | 1000          | 63                                     | 63                                     | 0.03  | 0.2    |
| 4     | 800           | 40                                     | 40                                     | 0.03  | 0.2    |
| 4.5   | 100           | 32                                     | 32                                     | 0.03  | 0.2    |
| 5     | 40            | 12.5                                   | 12.5                                   | 0.03  | 0.2    |
| 5.5   | 32            | 10                                     | 10                                     | 0.03  | 0.2    |
| 6     | 16            | 8                                      | 8                                      | 0.03  | 0.2    |
| 6.5   | 10            | 6.3                                    | 6.3                                    | 0.03  | 0.2    |
| 7     | 8             | 4                                      | 4                                      | 0.02  | 0.2    |
| 7.5   | 8             | 4                                      | 4                                      | 0.02  | 0.2    |
| 8     | 6.5           | 3.2                                    | 3.2                                    | 0.02  | 0.2    |
| 8.5   | 5             | 2                                      | 2                                      | 0.02  | 0.2    |
| 9     | 4             | 1.6                                    | 1.6                                    | 0.02  | 0.2    |
| 9.5   | 3.2           | 1.5                                    | 1.5                                    | 0.02  | 0.2    |
| 10    | 3             | 1.25                                   | 1.25                                   | 0.02  | 0.2    |

3.2. Digi mobile phone

If Digi mobile phone (2100 MHz and 900 MHz) is in dialing mode, power density values are extremely dangerous, exceeding very much the safety limit (Table 4).

In the first moment of dialing, at shortest distance from the phone, power density is about 13 times smaller than in the case of Samsung Galaxy S6 Edge Plus.

At a distance of 8 cm, power density decreases 50 times compared to the value corresponding to the distance of 0.5 cm, in both operating modes.

Magnetic flux density and electric field intensity are in the safety domain, in all operating modes of Digi mobile phone.
### Table 4. Digi mobile phone

| $d$ (cm) | $S_{\text{Peak}}$ (μW/m$^2$) Call | $S_{\text{Peak}}$ (μW/m$^2$) Dialing mode | $B$ (μT) | $E$ (V/m) |
|----------|----------------------------------|------------------------------------------|----------|-----------|
| 0.5      | 2500                             | 2500                                     | 0.04     | 0.3       |
| 1        | 1250                             | 500                                      | 0.03     | 0.3       |
| 1.5      | 1000                             | 400                                      | 0.03     | 0.3       |
| 2        | 800                              | 300                                      | 0.03     | 0.3       |
| 2.5      | 630                              |                                          | 0.03     | 0.3       |
| 3        | 500                              | 250                                      | 0.03     | 0.3       |
| 3.5      | 400                              |                                          | 0.03     | 0.3       |
| 4        | 320                              | 125                                      | 0.03     | 0.3       |
| 4.5      | 250                              |                                          | 0.03     | 0.3       |
| 5        | 200                              |                                          | 0.03     | 0.3       |
| 5.5      | 160                              |                                          | 0.03     | 0.3       |
| 6        | 125                              | 100                                      | 0.03     | 0.3       |
| 6.5      | 100                              |                                          | 0.03     | 0.3       |
| 7        | 80                               |                                          | 0.03     | 0.2       |
| 7.5      | 60                               |                                          | 0.03     | 0.2       |
| 8        | 50                               | 50                                       | 0.03     | 0.2       |

3.3. **Wired landline phone**

In stand-by mode of wired landline phone (Table 5, wireless deactivated), electric field intensity has values above 15 V/m (dangerous to health). Magnetic flux density is in the safety domain. Power density exceeds 2.5 times the safety limit at a distance of 5 cm from the phone, and falls below the safety value at distance of 30 cm, in stand-by.

If wireless is activated (Table 6), values of power density increase hundreds of times; electric field intensity is higher about 2.4 times at the distance of 10 cm from the phone, in this case.

### Table 5. Wired landline phone in stand-by, wireless deactivated

| $d$ (cm) | $S_{\text{Peak}}$ (μW/m$^2$) | $B$ (μT) | $E$ (V/m) |
|----------|-------------------------------|----------|-----------|
| 5        | 2.5                           | 0.02     | 20        |
| 10       | 2                             | 0.02     | 17        |
| 20       | 1.25                          | 0.02     | 16        |
| 30       | 0.8                           | 0.02     | 15        |

### Table 6. Wired landline phone in stand-by, wireless activated

| $d$ (cm) | $S_{\text{Peak}}$ (μW/m$^2$) | $B$ (μT) | $E$ (V/m) |
|----------|-------------------------------|----------|-----------|
| 10       | 2000                          | 0.02     | 42        |
| 17       | 800                           | 0.02     | 23        |
| 28       | 500                           | 0.02     | 12        |
| 48       | 320                           | 0.02     | 5.3       |

3.4. **Wireless routers**

At a distance of 0.32 m from the first analyzed wireless router (TP-LINK TL-WR941ND, 2.4 GHz-2.4835 GHz, 450 Mbps WAN), power density is extremely high. At a distance of 1.74 m, power density is extremely low.
density decreases more than 3000 times. Electric field intensity has dangerous levels at distances less
than 0.6 m, but at distances greater than 0.8 m, electric field intensity is normal (Table 7).

### Table 7. Wireless router TP-LINK TL-WR941ND

| d(m) | S(μW/m²) Peak | B(μT) | E(V/m) |
|------|---------------|-------|--------|
| 0.32 | 39000         | 0.03  | 10     |
| 0.41 | 16000         | 0.02  | 7.8    |
| 0.5  | 8000          | 0.02  | 7      |
| 0.6  | 6300          | 0.02  | 6.5    |
| 0.8  | 3200          | 0.03  | 5.5    |
| 1    | 200           | 0.03  | 4.9    |
| 1.2  | 100           | 0.03  | 2.6    |
| 1.48 | 80            | 0.02  | 3.36   |
| 1.74 | 12.5          | 0.02  | 1.8    |

Very close to the second analyzed wireless router (Tenda F300, 2.412 GHz-2.472 GHz, 300 Mbps),
at 0.1 m, power density is at the limit of measurement range of FA306 analyzer (Table 8). At a
distance of 2.37 m, power density decreases 250 times.

### Table 8. Wireless router Tenda F300

| d(m) | S(μW/m²) Peak | B(μT) | E(V/m) |
|------|---------------|-------|--------|
| 0.10 | 39000         | 0.02  | 20     |
| 0.15 | 25000         | 0.02  | 18     |
| 0.20 | 16000         | 0.02  | 15     |
| 0.40 | 12500         | 0.02  | 10.8   |
| 0.52 | 3200          | 0.02  | 9.1    |
| 0.97 | 1000          | 0.02  | 6.5    |
| 1.69 | 630           | 0.02  | 2.7    |
| 2.37 | 160           | 0.02  | 1.2    |

3.5. **Laptop Dell**

If wireless is deactivated (Table 9), power density emitted by laptop exceeds 2...4 times the maximum
safety value for living and working areas. Magnetic flux density and electric field intensity are low,
not dangerous. The negative influence of wireless is extremely high related to power density. At a
distance of 5 cm from the laptop, power density is very close to the limit of measurement range of
FA306 analyzer (Table 10).

### Table 9. Laptop Dell with wireless deactivated

| d(cm) | S(μW/m²) Peak | B(μT) | E(V/m) |
|-------|---------------|-------|--------|
| 5     | 4             | 0.06  | 0.4    |
| 10    | 4             | 0.05  | 0.4    |
| 15    | 3.2           | 0.04  | 0.4    |
| 20    | 3             | 0.04  | 0.4    |
| 25    | 2.5           | 0.04  | 0.4    |
| 30    | 2.3           | 0.04  | 0.4    |
| 40    | 2.1           | 0.03  | 0.3    |
| 60    | 2             | 0.03  | 0.2    |
Table 10. Laptop Dell with wireless activated

| d(cm) | $S(\mu W/m^2)_{\text{Peak}}$ | B(μT) | E(V/m) |
|-------|-----------------------------|-------|--------|
| 5     | 32000                       | 0.06  | 0.4    |
| 10    | 6300                        | 0.05  | 0.4    |
| 15    | 1250                        | 0.04  | 0.4    |
| 20    | 800                         | 0.04  | 0.4    |
| 40    | 125                         | 0.03  | 0.3    |
| 60    | 32                          | 0.03  | 0.2    |
| 5     | 32000                       | 0.06  | 0.4    |

3.6. TV sets
If Smart TV is switched on and wireless activated (Table 11), power density increases hundreds of times compared to stand-by mode. At a distance of 0.05 m from the Smart TV, power density exceeds over 800 times the safety value, and decreases about 100 times at a distance of 1.5 m.

At a distance of 0.20 m from TV (Table 12), power density exceeds 280 times the safety level. At a distance of 1.48 m, power density decreases 3.5 times, but remains 80 times higher than the maximum admissible value. Magnetic flux density and electric field intensity are below the safe values.

Table 11. Smart TV Sony

| Operation mode | d(m) | $S(\mu W/m^2)_{\text{Peak}}$ | B(μT) | E(V/m) |
|----------------|------|-----------------------------|-------|--------|
| Smart TV Sony in stand-by, wireless deactivated | 0.05 | 0.8 | 0.03 | 22 |
|               | 0.1  | 0.8 | 0.03 | 15 |
|               | 0.5  | 0.8 | 0.03 | 11.5 |
|               | 1    | 0.8 | 0.03 | 4 |
|               | 1.5  | 0.8 | 0.03 | 2.8 |
|               | 2    | 0.8 | 0.03 | 1.1 |
| Smart TV Sony switched on, wireless activated | 0.05 | 800 | 0.06 | 20 |
|               | 0.1  | 500 | 0.06 | 16 |
|               | 0.5  | 320 | 0.06 | 12.9 |
|               | 1    | 20 | 0.06 | 5 |
|               | 1.5  | 8  | 0.06 | 3.5 |
|               | 2    | 4  | 0.05 | 2 |

Table 12. Samsung TV switched on, wireless activated

| d(m) | $S(\mu W/m^2)_{\text{Peak}}$ | B(μT) | E(V/m) |
|------|-----------------------------|-------|--------|
| 0.20 | 280                         | 0.02  | 1.8    |
| 0.35 | 250                         | 0.02  | 1.2    |
| 0.68 | 200                         | 0.01  | 0.6    |
| 1.10 | 160                         | 0.02  | 0.5    |
| 1.48 | 80                          | 0.02  | 0.2    |

3.7. Microwave oven
In load operation, electromagnetic pollution produced by microwave oven (with technical data: microwave frequency: 2450 MHz, rated power: 1280 W, output power (microwave): 800 W) is very high (Table 13). At a distance of 2 m from the microwave oven, power density is 32000 μW/m².

Electric field has very dangerous values for distances between 5...20 cm from the microwave oven, and drops below 5 V/m at distances greater than 60 cm.
Magnetic flux density has values over 3.99 μT at a distance less than 20 cm, and decreases to 1.17 μT for a distance of 60 cm from the microwave oven.

Table 13. Microwave oven in load operation

| d(cm) | $S(\mu W/m^2)$ Peak | $B(\mu T)$ | $E(V/m)$ |
|-------|----------------------|-------------|-----------|
| 5     | 23                   | >3.99       | 16        |
| 10    | 22                   | 3.44        | 4.5       |
| 20    | >3.99                | 1.17        | 3.7       |
| 30    | 3.44                 | 16          | 4.5       |
| 60    | 0.8                  | 32000       | 1.17      |

3.8. Induction heat plate
In the case of an induction heat plate (with technical data: $P=1600$ W, $f=2500$ MHz), in operation mode, magnetic flux density exceeds 3.99 μT at distances less than 0.3 m from the plate, and decreases by almost 6 times at distance of 1 m (Table 14).

At a distance of 0.2 m from the plate, electric field intensity is close to the limit of the measurement range of analyzer, and remains at dangerous levels up to a distance of 1 m from the plate.

Table 14. Induction heat plate

| d(m) | $S(\mu W/m^2)$ Peak | $B(\mu T)$ | $E(V/m)$ |
|------|----------------------|-------------|-----------|
| 0.2  | 92                   | >3.99       | 77        |
| 0.3  | 1.25                 | >3.99       | 77        |
| 0.5  | 1                    | 3.48        | 36        |
| 1    | 0.8                  | 0.6         | 12.4      |

3.9. Fluorescent lamps with electronic ballast
We analyzed four fluorescent lamps (FLs) with electronic ballast (4x18 W), connected in parallel (Table 15). At a distance of 0.05 m from FLs, magnetic flux density exceeds 10 times the safety limit, and decreased to a value slightly larger than the safety, at a distance of 1 m.

Electric field intensity has very dangerous values for distances below 0.15 m, but falls below the safe limit at greater distances, over 1 m.

Table 15. Fluorescent lamps with electronic ballast

| d(m) | $S(\mu W/m^2)$ Peak | $B(\mu T)$ | $E(V/m)$ |
|------|----------------------|-------------|-----------|
| 0.05 | 0.8                  | 2.03        | 32        |
| 0.1  | 0.8                  | 0.44        | 20        |
| 0.15 | 0.8                  | 0.9         | 11.2      |
| 1    | 0.8                  | 0.03        | 1         |
| 2    | 0.63                 | 0.03        | 0.3       |

3.10. Power cable
At a distance of 2.5 cm from analyzed power cable (Table 16), power density exceeds 125 times the safety level. At a distance of 0.4 m, power density decreases 6.25 times, but remains 20 times higher than the maximum admissible value.
Values of magnetic flux density are below the safe limit. Electric field intensity is extremely high for distances below 0.4 m, the power cable functioning as an antenna.

| Table 16. Power cable of a switch |
|-----------------------------------|
| $d$(m) | $S(\mu W/m^2)$ | $B(\mu T)$ | $E$(V/m) |
|-------|----------------|-----------|----------|
| 0.025 | 125            | 0.03      | 99       |
| 0.05  | 100            | 0.03      | 73       |
| 0.1   | 80             | 0.03      | 40       |
| 0.15  | 40             | 0.02      | 23       |
| 0.2   | 25             | 0.02      | 17       |
| 0.4   | 20             | 0.01      | 14.8     |

4. Conclusions

All analyzed household electronic devices loss electromagnetic energy in the environment (“electrosmog”). Level of exposure depends on the proximity to the source that generates electromagnetic radiation.

For all analyzed equipment, operating in the radio frequency band, are available as protective measures, increasing the distance in use and avoid proximity to the source.

The experiments allowed us to identify several specific measures to minimize the effects of exposure to electromagnetic radiation produced by following household equipment:

a). mobile phones:
- when we appeal, we should expect the other person to respond, and then put the phone to the ear. Radiation intensity is highest when dialing (because the phone trying to contact the base), and greatly decreases with increasing the distance from the phone. Switching to speaker and using a hands-free device, increase the distance between the antenna and the head/body;
  - call duration should be limited as much as possible;
  - SMS communication limited duration of exposure and the proximity of the body;
  - when the signal is weak, should not be made calls, because radiation exposure is increased accordingly;
  - mobile phones should not be used in enclosed spaces with metal walls (because the metal walls captures the radiation and reflects it back to the occupants of such spaces);
  - should not purchase a mobile phone with a high specific absorption rate;

b). wireless router:
- router should be placed as far away from the place where we are staying during the day;
- router must be connected when needed, and disconnected when we sleep;
- it would be much better to use the Internet by optical fiber;

c). laptop:
- if wireless is enabled, keeping the laptop on the legs is very dangerous;
- it should be kept a minimum distance of 40 cm from the laptop;

d). TV/Smart TV:
- watching TV should be at least 2 m away;
- TV should not be kept in the bedroom;
- TV must be unplugged at night;

e). microwave oven:
- it should be used as seldom;
- should not stay near the microwave oven during food heating;

f). induction plate:
- should not stay near the induction plate during food preparation;

g). fluorescent lamps with electronic ballasts and compact fluorescent lamps (CFLs):
FLs (or CFLs) use should be avoided at distances less than 1 m;
it would be preferable to use LEDs.

Accordingly, should not sit near them, at a distance of less than 1 m.

Romania does not have a well-defined legal framework (as in other European countries, e.g. France), to regulate at least the placement of antennas and wireless use in hospitals and schools. Long-term consequences of this negligence could be serious, because electromagnetic pollution produced by wireless routers is very high.

For the safety of human health, it requires accurate information on exposure levels, and biomedical research concerning possible health effects.

It is necessary to develop an adequate logistics for monitoring electromagnetic fields and their effects, managed by the Public Health Institute, from structure of the Ministry of Health. Besides, national standard guidelines must be reviewed.

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