# Misunderstandings about radiofrequency electromagnetic field exposure and 5G misinformation<sup>1</sup>

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*Abstract* — Public concern about potential health risks of radiofrequency electromagnetic field exposure (RF-EMF) from mobile networks and devices has ebbed and flowed over time with new claims and misinformation around 5G deployments. There remain misunderstandings about the nature and level of RF-EMF exposure from both mobile networks and devices. Measurements on live networks show that typical RF-EMF exposure levels from mobile networks and devices are a small fraction of international guidelines. 5G deployments will have little impact on RF-EMF levels. The consensus of independent expert groups and the World Health Organization is that there are no established health risks from such exposures.

*Index Terms* — 5G mobile communication, cellular phones, electromagnetic fields, radio access networks, radiofrequency.

# I. INTRODUCTION

The level and nature of public concern about possible health risks from exposure to radiofrequency electromagnetic fields (RF-EMFs) have varied over the years [1] despite the consistent conclusion of independent expert groups and the World Health Organization (WHO) [2] that there are no established health risks at levels below the international guidelines produced by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) [3]. Many but not all countries have adopted national RF-EMF limits based on the ICNIRP guidelines [4]. The introduction of 5G mobile networks and devices has seen the repetition of previous unsubstantiated claims about potential health risks as well as new claims. We focus on some common misunderstandings about RF-EMF exposure and claims linking 5G to COVID-19 that emerged in early 2020.

# II. CORRECTING MISUNDERSTANDINGS ABOUT RF-EMF Exposure

A. No significant change in RF-EMF exposure from networks

It seems intuitive that the increased number of mobile network antennas means increased exposure but scientific publications and reports by government agencies show very low levels and no significant increase when assessed by measurements [5] or alternative approaches based on personal exposimeters [6]. Exposure from mobile network antennas is not influenced by proximity or the number of visible antennas, which means that network sharing has not been shown to have an impact on RF-EMF levels.

In addition, continuous RF-EMF monitoring systems confirm that levels are hundreds or thousands of times below the international guidelines [7]. Such systems do not provide new knowledge regarding levels of exposure but may be useful as part of an EMF risk communication program [8].

## B. A low SAR phone may not reduce personal exposure

The majority of personal RF-EMF exposure comes from nearby devices and not from fixed sources such as mobile networks and broadcast transmitters [9]. The basic restriction applicable to mobile devices operating below 6 GHz is the specific absorption rate (SAR) with units of watts per kilogram [3]. Some countries recommend choosing a low SAR phone to reduce personal exposure, however, the SAR compliance figure tells the consumer very little about RF-EMF exposure during actual use, which is affected by several factors including the efficiency of device power control in modern mobile communications standards. For a user wishing to reduce exposure choosing a personal hands-free kit or text based communications are effective [10].

## C. 5G deployments will have little impact on RF-EMF levels

Measurements on commercial 5G networks show similar RF-EMF levels to other mobile networks [11]. Some features of 5G such as the expanded use of massive MIMO antennas mean that the time averaged exposure is reduced as the narrow antenna beams change temporally and spatially [12]. The actual output

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power of 5G devices was similar to 4G devices when measured on commercial networks [13].

## D. A large body of relevant research exists

The website emf-portal.org summarizes the scientific literature on effects of EMF in a non-biased database and as of 9 September 2021 had over 34,000 publications [14]. The website provides study overviews showing (on the same date) 327 epidemiological studies on mobile communications; 1,359 experimental studies on mobile communications; 275 studies specific to 5G (the majority technical/dosimetric) and 755 studies on millimeter waves.

A particular focus of 5G RF-EMF misunderstandings has been the use of millimeter waves (variously taken as frequencies > 6 GHz or 30 GHz+). These frequencies have been used for point-to-point radio links, vehicular radar and medical applications (especially in Eastern Europe). Recent reviews conclude that there are issues with the quality of some biological studies in this frequency range, however, the higher quality studies are less likely to report effects and overall the results oy do not confirm an association between low-level millimeter waves and biological effects [15, 16].

# E. Established RF-EMF hazards relate to heating

For frequencies above about 10 MHz the established mechanism for RF-EMF health effects is heating of body tissue (local or whole-body) [3]. While other mechanisms have been proposed there are strong biophysical arguments may they are not applicable to mobile communication signals [17, 18].

## III. MISINFORMATION LINKING 5G TO COVID-19

Claims linking 5G to COVID-19 began to emerge in early 2020, spread on social media and culminated in attacks on telecommunication infrastructure that peaked in March/April 2020 but have continued into 2021 in some countries. The evolution of claims linking to COVID-19 and 5G on Facebook was analyzed with the authors concluding that conspiracy theorists both retro-fitted the new information into their pre-existing beliefs and 'cynically exploited the genuine fears of their fellow Facebook users' [19]. Another study [20] linked belief in conspiracy theories and anger, with a willingness to attack telecommunication masts.

In early April 2020, the WHO added 5G to their COVID-19 mythbusters stating [21]: '5G mobile networks DO NOT spread COVID-19.'

#### VII. CONCLUSION

The introduction of 5G has been associated with repetition of previous misinformation about the safety of RF-EMF exposure from mobile technology as well as new claims. Typical RF-EMF exposure levels from mobile networks and devices are a small fraction of international guidelines and the consensus of

independent expert groups and the WHO is that there are no established health risks from such exposures.

### CONFLICT OF INTEREST

The views expressed are those of the authors and may not represent the position of any organization with which they are associated.

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