

Technical Measures to Minimize the Effect of Wi-Fi Routers on *E. coli* Bacteria's Antibiotic Resistance in Buildings

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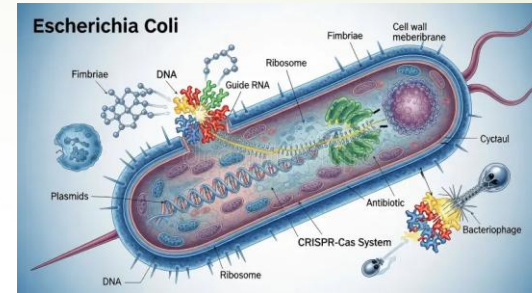
(Innovation competition proposal, Rakennusterveys-conference, Oulu)

Wi-Fi & Bacteria?

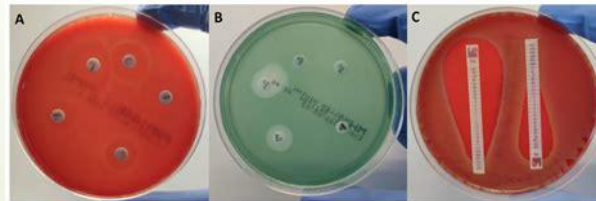
Several studies showing the effect of Wi-Fi router on *Escherichia coli* (*E. coli*) → Antibiotic resistance

- Said-Salman, I., Mortazavi, S. M. J., Khatib, S. E., Mortazavi, S. A., & Sihver, L. (2026). Bacterial Adaptation to Radiofrequency Electromagnetic Fields Based on Experiences from Ionizing Radiation. *Journal of Biomedical Physics & Engineering*, 16(3), 245–258.
<https://doi.org/10.31661/jbpe.v0i0.2405-1770>
- Said-Salman, I., Jebaii, F., Yusef, H., & Moustafa, M. (2019). Evaluation of Wi-Fi Radiation Effects on Antibiotic Susceptibility, Metabolic Activity and Biofilm Formation by *Escherichia Coli* 0157H7, *Staphylococcus Aureus* and *Staphylococcus Epidermis*. *Journal of Biomedical Physics & Engineering*, 9(5), 579–586. <https://doi.org/10.31661/jbpe.v0i0.1106>
- Taheri, M., Mortazavi, S. M. J., Moradi, M., Mansouri, S., Hatam, G. R., & Nouri, F. (2017). Evaluation of the Effect of Radiofrequency Radiation Emitted From Wi-Fi Router and Mobile Phone Simulator on the Antibacterial Susceptibility of Pathogenic Bacteria *Listeria monocytogenes* and *Escherichia coli*. *Dose-Response: A Publication of International Hormesis Society*, 15(1), 1559325816688527. <https://doi.org/10.1177/1559325816688527>

The exposure to Wi-Fi router's pulsed RF radiation alters motility and antibiotic susceptibility of *E. coli* bacteria after 8-24 hour exposure (Said-Salman, Jebaii *et al.* 2019; Taheri, Mortazavi *et al.* 2017).



An **Antibiotic Susceptibility Test** is needed to verify the **change of antibiotic susceptibility of *E. coli* bacteria**: first bacterial suspensions are spread on plates and cultured with a set of 6 antimicrobial substances and with long (24 hour) incubation periods. Then antimicrobial agents are further utilised. (Taheri, Mortazavi *et al.* 2017)



Picture: Antibiotic Susceptibility Test, <https://www.mdpi.com/2079-6382/11/4/427>

Reviews: Effect on bacteria, plants, bees, birds - Radiofrequency (RF) radiation + ELF

Already 4 peer-reviewed literature reviews indicate detrimental effects:

Cucurachi *et al.* (2013) <http://www.ncbi.nlm.nih.gov/pubmed/23261519>

Balmori (2009) <http://www.ncbi.nlm.nih.gov/pubmed/19264463>

Sivani & Sudarsanam (2012) http://www.biolmedonline.com/Articles/Vol4_4_2012/Vol4_4_202-216_BM-8.pdf

Levitt, Lai & Manville (2021) <https://doi.org/10.1515/reveh-2021-0026>

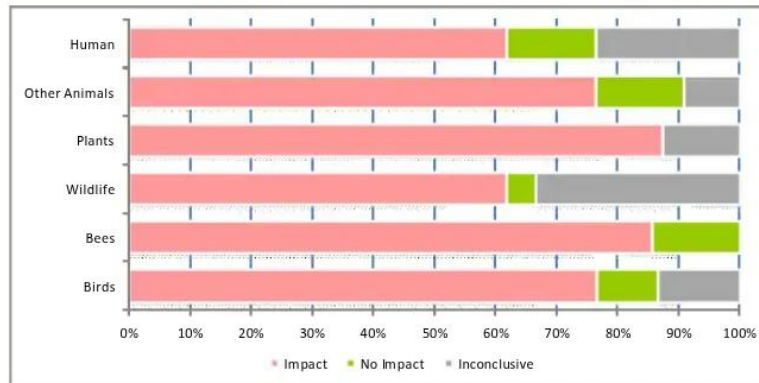


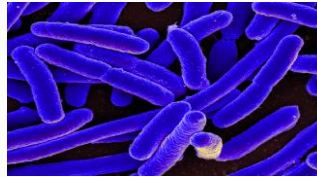
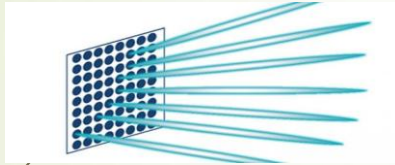
Fig 2. Proportion of study results in various groups of organisms (n=919). The 'Impact' (in red) indicates percentage of studies that reported harmful effect of EMR

Picture: Ministry of Environment (2010), Report, India, p.12.

<https://tinyurl.com/IndiaNatureReview>

Millimeter waves (MMW, 30-300 GHz) have an effect on bacteria
→ they become more **sensitive to biologically active chemicals,**
but **also to antibiotics.**

Additionally, MMWs have an **effect on cell membrane structure, permeability and functionality.**



Soghomonyan, D., Trchounian, K., & Trchounian, A. (2016). **Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?** *Applied Microbiology and Biotechnology*, 100(11), s. 4761–4771. <https://doi.org/10.1007/s00253-016-7538-0>

Belyaev, I. Y., Shcheglov, V. S., Alipov, E. D., & Ushakov, V. D. (2000). **Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vivo—dependence on physical, physiological, and genetic factors.** *IEEE Transactions on Microwave Theory and Techniques*, 48(11), 2172–2179. <https://doi.org/10.1109/22.884211>

My comment: This problem will probably get worse with 6G MMW and technical, correcting measures are needed.



Our earlier contribution – a research review on RF & MMW effects on bacteria growth :

Ahonen, M., Lehto, T. & Koppel, T. (2019). Radiotaajuuden säteilyn vaikutus hiivasientien, homeiden ja mikrobien kasvuun (**The effect of radiofrequency radiation on the growth of yeast, mold and microbes**). Sisäilmastoseminaari 2019 (Indoor Air 2019 Conference), SIY Raportti (Report) 37, p. 375-380.

https://www.sisailmauutiset.fi/Sisailmastoseminaari_2019.pdf

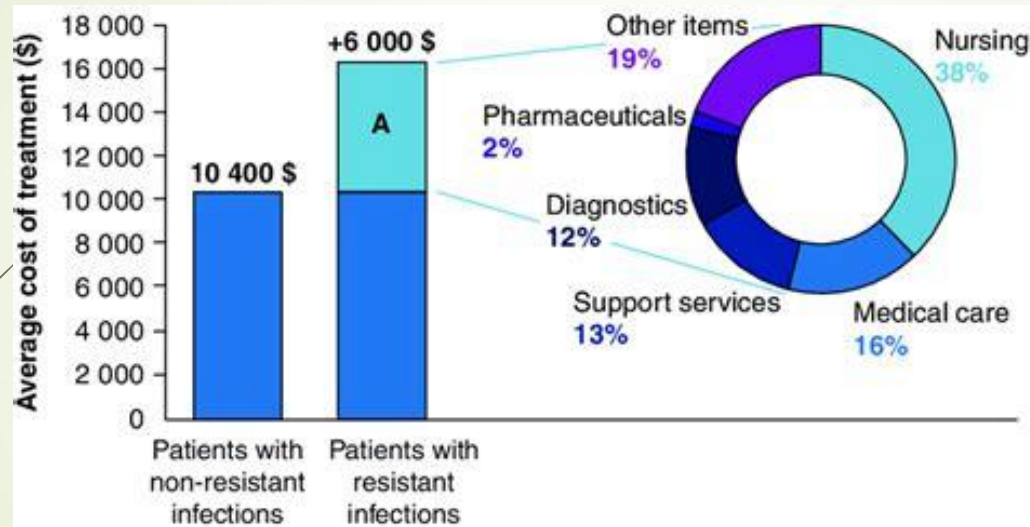
My comment: I have worked since 2010 in MD, professor Lennart Hardell's Bioelectromagnetics research group. Source of inspiration!



What are the Associated Risks and Costs of Antibiotic Resistance?

Substantial increase in Cost of Treatment.

- 6000 extra dollars / patient



Picture: North J. (2020). **Challenges to Tackling Antimicrobial Resistance: Economic and Policy Responses.** Anderson M, Cecchini M, Mossialos E, eds. Cambridge University Press, 2020.

+ https://www.researchgate.net/publication/340078456_Challenges_to_Tackling_Antimicrobial_Resistance_Economic_and_Policy_Responses/

My comment: WHAT IF we could make hospitals more healthier & more sustainable buildings?

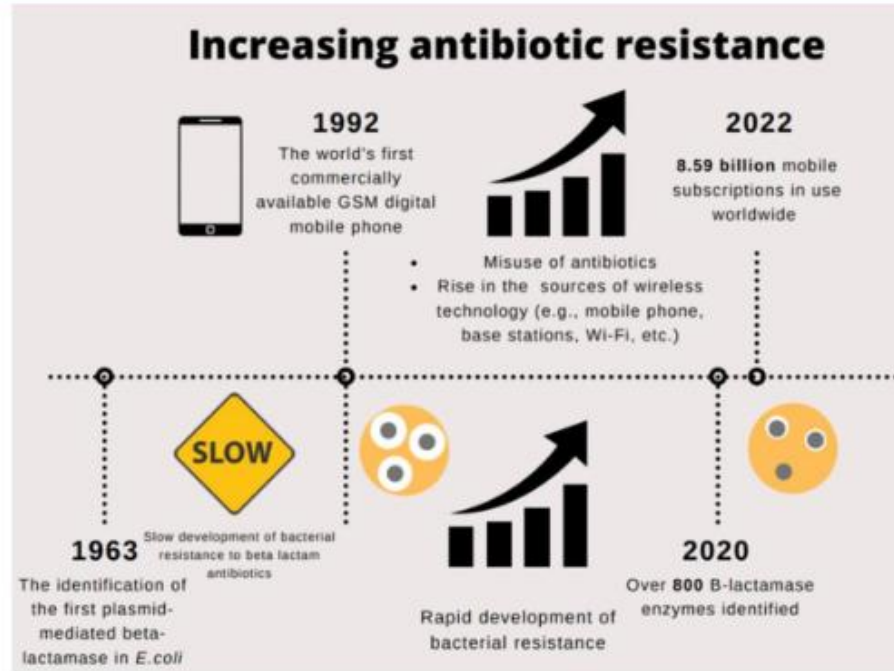


Figure 4: Cumulative number of beta-lactamase enzymes identified in bacteria in correlation with the estimated number of mobile phone subscriptions over the past years.

My comment: A growing risk area, which increases healthcare costs. Simultaneously it is also a rapidly growing R&D area, related to several bacteria, not just *E. coli*.



What is the potential?

My innovation allows technical optimization of various technologies, which minimises traffic and energy consumption (= is more sustainable)

My modifications related to Wi-Fi routers:

Wi-Fi beacon signal (sending every 100 ms) can be **modified in Wi-Fi routers' Settings**. Generally, bioelectromagnetics literature informs that **bioactivity is reduced, if pulse rise time is changed and/or pulse sending time is changed**. This means that the beacon signal's interval can be modified and **we modified this from 100 ms to 1000 ms**.

The validation of success was seen in **substantially reduced RF radiation power density levels** (measured with Gigahertz Solutions HFW 59D RF-meter, Langenzenn, Germany) and **in smaller RF**

WiFi tools / Beacon and SSID overhead calculator

Beacon and SSID overhead calculator

Every SSID broadcasts beacons that eat airtime before a single client connects. Calculate your airtime overhead and prune management traffic.

Estimate your beacon airtime overhead

QUICK PRESETS & DEPLOYMENT PROFILES

Standard 5 GHz (6 Mbps) Legacy 2.4 GHz (1 Mbps) Optimized Enterprise (12 Mbps) Multi-Tenant Sprawl (8 SSIDs)

SSIDs per radio: 1

Beacon Interval (ms): 1000

Lowest basic rate: 5.5 Mbps (2.4 GHz)

Beacon frame size (bytes): 256

AIRTIME CONSUMED BY BEACONS

0.06%

Healthy. Beacon overhead is low.

Beacons per second: 1

Airtime per beacon: 0.60 ms

PHY preamble & modulation: DSSS

Airtime left for user data: 99.94%

Copy calculation summary



Conclusions



- There are **plausible technical means to minimize the bioactivity** of Wi-Fi routers and other mobile technologies **to minimize (even to avoid) antibiotic resistance** of *E. coli* bacteria.
- This safety information is **essential when planning mobile network installations and when adjusting coverage and signal characteristics in sensitive areas like farms, food production facilities and hospitals.**
- All this has substantial **health-improving effects and these technical measures promote energy-saving & sustainability** in buildings.

Future possibilities with other bacteria

This opens new technical possibilities to deal with for example MRSA-bacteria problem in hospitals and mold problem in buildings.

So, technology can cause and solve problems.

To add one more mechanism: Each bacteria has its own Eigenfrequency [1] and by utilizing it, the bacteria growth can be impacted [2], even reduced, perhaps even with a frequency generator.

My comment: This opens an additional R&D area for sustainable mobile technologies' development. I am seeking partners for this development, also related to microbiology laboratory studies of various bacteria.

[1] Geesink, H. J. H & Meijer, D. K. F. (2018), Mathematical Structure for Electromagnetic Frequencies that May Reflect Pilot Waves of Bohm's Implicate Order. Journal of Modern Physics, 2018, 9, 851-897. https://www.scirp.org/html/5-7503432_83681.htm

[2] Adey, W. (1984). Nonlinear Electrodynamics in Biological Systems (1st ed.). Springer



Thank you. Questions welcome.

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