Electromagnetic Hypersensitivity:

Current Knowledge
&
Future Research Needs
Mobile Phone Use is Ubiquitous

Global mobile-cellular subscriptions, total and per 100 inhabitants, 2001-2017*

Note: * Estimate
Source: ITU World Telecommunication /ICT Indicators database
Increasing Concerns About EMF Exposure
What is Electromagnetic Hypersensitivity (EHS)?

Common symptoms include:
- Headaches
- Nausea
- Skin Irritations
- Tinnitus
- Fatigue
- Concentration Difficulties

What is Electromagnetic Hypersensitivity (EHS)?

- Characterised by the occurrence of a range of non-specific symptoms which a person attributes to EMF exposure

- Often associated with:
  - Distress
  - Health service use
  - General health status
  - Occupational and social functioning

Common symptoms include:
- Headaches
- Nausea
- Skin Irritations
- Tinnitus
- Fatigue
- Concentration Difficulties
Electromagnetic Hypersensitivity
Chuck McGill’s Condition
Insights into EHS

• Qualitative case studies and survey studies have revealed no consistent pattern in the:
  – Types of symptoms reported
  – Time course of symptoms
  – Sources of EMF that are claimed to trigger symptoms

Hagstrom et al., 2013; Hocking, 1998, 2014; Kato & Johansson 2012; Roosli et al., 2004; Schuz et al., 2006
How has science investigated EHS?

• Epidemiological Studies:
  – Test for associations between symptom reports and exposure
  – Require large sample sizes to account for error variance
  – Allow for the investigation of long exposure periods under normal living conditions

• Laboratory Provocation Studies:
  – Test whether the presence of EMF is sufficient to trigger symptoms
  – Involve volunteers being exposed to active and sham EMF under double-blind conditions
Summary of Findings: Epidemiological Studies

- Epidemiological studies have:
  - Generally failed to find an association between symptoms and exposure

- Results dependent on crude vs sophisticated exposure assessment measures

- Epidemiological studies suffer serious methodological limitations
  - Recall bias
  - Confounding factors

Roosli et al., 2010
Summary of Findings: Provocation Studies

• Double-blind provocation studies have shown EHS participants:
  – Are unable to accurately detect active from sham exposures
  – Report no differences in symptoms in active compared to sham exposures

• Sham exposures and a persons belief that they are being exposed are sufficient to trigger symptoms $^{3, 4, 5}$.

Rubin et al., 2010; Roosli et al., 2010; Nam et al., 2009; Oftedal et al., 2007; Wilèn et al., 2006
Alternative Hypotheses

• Symptoms may be the result of a nocebo effect

Rubin et al., 2010; Oftedal et al., 2007; Hillert et al., 2008; Landgrebe et al., 2008
Methodological Concerns

Some researchers and many of the individuals who suffer from EHS believe that it is caused by an as yet unrecognized bioelectromagnetic mechanism.

A number of methodological issues have been raised which may explain the null findings. These issues are associated with:

1. Recruitment and sample heterogeneity
2. Signal relevance
3. The testing environment
4. Symptom time course

After accounting for these possible methodological issues, can individuals be sensitive to low level EMF?
Results: ACEBR Case Study 1
Results: ACEBR Case Studies

• The relationship between belief of exposure and symptoms

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Spearman's rho</th>
<th>Significance</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>.833</td>
<td><em>p &lt; .01</em>*</td>
</tr>
<tr>
<td>2</td>
<td>.769</td>
<td><em>p &lt; .01</em>*</td>
</tr>
<tr>
<td>3</td>
<td>.764</td>
<td><em>p &lt; .01</em>*</td>
</tr>
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</table>
Are the results of provocation studies reliable?

- Self-report measures directly test the claims of EHS sufferers
- There are no objective tests of symptom experiences
- First need to establish that EMF exposures are capable of eliciting a symptom response
The Nocebo Effect: Contributing Factors

Explicit Suggestions → Negative Expectations → Nocebo Effect

Webster et al., 2016
Explicit Suggestions about EMF Exposure

- Precautionary information negatively influences people’s beliefs about EMF exposure

- Viewing sensationalist media reports:
  - Increases worries about EMF exposure
  - Increase the likelihood of experiencing symptoms following a sham exposure and developing an apparent sensitivity to EMF

Barnett et al., 2007; Nielsen et al., 2010; Rubin et al., 2013; Wiedemann et al., 2014; Wiedemann et al., 2013; Wiedemann and Schütz, 2005; Wiedemann et al., 2006; Köteles et al., 2016; Witthöf et al., 2017
Methods
Design and Procedure

**Provocation Protocol**
2 Open-label Trials
12 Randomised Double-blind trials

**Baseline**

**Exposure (Active or Sham)**

**Post Exposure**

Symptoms Checklist

0 5 15 20 (mins)

N = 22

Alarmist Video OR Control Video

N = 22
Results: Effect of Exposure

Symptoms

<table>
<thead>
<tr>
<th>Condition</th>
<th>Median Symptoms Rating</th>
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</thead>
<tbody>
<tr>
<td>Open-Label</td>
<td></td>
</tr>
<tr>
<td>RF OFF</td>
<td>0</td>
</tr>
<tr>
<td>RF ON</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>** p &lt; .001</td>
</tr>
<tr>
<td>Double-Blind</td>
<td></td>
</tr>
<tr>
<td>Sham</td>
<td>0</td>
</tr>
<tr>
<td>RF ON</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>p = .183</td>
</tr>
</tbody>
</table>
Results: Effect of Video Open-Label Trial Symptoms

Symptom Difference Score (RF ON - RF OFF)

Video Group

Control
Alarmist

*p = .041
Exploratory Analysis: Pre-existing Anxiety & Symptoms

RF-ON Open-Label Trial

$\text{p} = 0.402$

<table>
<thead>
<tr>
<th>Pre-existing State Anxiety Level</th>
<th>Median Symptoms Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>20</td>
</tr>
<tr>
<td>Medium</td>
<td>10</td>
</tr>
<tr>
<td>High</td>
<td>30</td>
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</tbody>
</table>
Media Study: Conclusions

- Healthy participants respond with higher symptom ratings in a known exposure condition compared to a known non-exposure condition (not EMF-related).

- The EHS response, although unrelated to EMF, may be a normal human response.

- Alarmist media reports:
  - Contribute to a nocebo response in healthy participants.
  - May contribute to EHS.
Future Directions for EHS Research

- Further examination of the factors which contribute to nocebo responses
- Develop strategies to better communicate the current state of knowledge
- Clarify the efficacy of psychological approaches to treating EHS
  - CBT
  - Framing of health information
Electromagnetic Hypersensitivity:

Current Knowledge &
Future Research Needs

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