

CASE REPORT

## Exacerbation of demyelinating syndrome after exposure to wireless modem with public hotspot

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### ABSTRACT

In August 2003, 48-year-old JS of Colorado, USA, a fitness therapist and sports nutritionist, contracted neuroinvasive West Nile virus which left her with disabilities due to spinal axonal damage.

In August 2014, she suddenly developed symptoms very much like her acute West Nile infection 11 years ago, including focal seizures, ataxia, vertigo and headaches. Her blood count looked normal so there was no obvious infection. What struck her as odd was that when she left her apartment for any length of time, the symptoms stopped. She found out that a new type of wireless modem, enabled for both personal use and functioning as a public hotspot designed to reach up to 100 m, had been installed in the flat under hers.

Her neighbor replaced the modem with a router without the hotspot feature. After that, the seizures stopped immediately, and the other symptoms faded gradually, after which she was fine and again could sleep well. Later, when another activated hotspot was installed in an adjacent flat, JS once again noticed symptoms.

A possible association between electrohypersensitivity, myelin integrity and exposure to low-intensity radiofrequency electromagnetic fields (RF-EMF) typical in the modern world has recently been proposed. Since the West Nile virus attacks both the nerve cells and the glial ones, one explanation to the above observed case effects is that the initial virus attack and the wireless modem's RF-EMF affect the nervous system through the very same, or similar, avenues, and maybe both via the oligodendrocytes.

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### Background

In August 2003, 48-year-old JS of Colorado, USA, a fitness therapist and sports nutritionist contracted neuroinvasive West Nile virus which left her with disabilities due to axonal damage in the cervical and thoracic spine. Laboratory tests at the time confirmed anti-myelin antibodies and anti-ganglioside antibodies. The subsequent damage led to focal seizures, headaches, ataxia, paresthesia and vision problems which gradually improved over the subsequent 2 years. She worked hard to overcome many of the effects of her illness, but still had to be very careful about attracting any form of inflammation and is still officially disabled. She could no longer live in her home because she had to have wheelchair access. It took a couple of moves to find an ideal living situation, but she was eventually able to secure a third-floor unit in a handicapped accessible senior complex (55+) where she lived happily since then.

The only regular medications she takes are replacement thyroxine, steady since 1982. She never takes non-steroidal anti-inflammatory drugs (NSAIDs) or aspirin.

In August 2014, she suddenly developed symptoms very much like her acute West Nile infection 11 years ago, including focal seizures, ataxia, vertigo and headaches. Her blood count looked normal so there was no obvious infection, but she was losing sensation in her face, neck and torso. What struck her as odd was that when she left her apartment for any length of time, the symptoms stopped. It took some investigating, but she found out that a new type of wireless modem had been installed in the unit under hers. She herself used a cell phone, a wireless router and a computer and had no problems with those products. However, she found out that this new wireless modem was enabled for both personal use and functioned as a public hotspot designed to reach up to 100 m, but was just feet below her floor.

Because of the severity of the reaction, she asked her neighbor if he would be willing to turn off his modem at night so that she could sleep without seizures preventing this. He was very concerned and turned off the modem completely and replaced it with a router that was compatible with the service in question but that did not have the hotspot feature. After that, the seizures stopped immediately, and the other symptoms faded gradually, after which she was fine.

Nine weeks later, on 7 November, the symptoms started again. It took some weeks to locate the source. Finally, she found out that another of these modems had been installed, this time across the hall from her unit. On 10 December, the owner disabled the hotspot component. JS found she was able to sleep in her bedroom for the first time in weeks with none of the symptoms.

From before the episodes occurred, JS has kept her mobile phone WiFi disabled while at home. The day after she began having symptoms in August, she had temporarily enabled the WiFi feature while out shopping and when she came home that day, a pop-up appeared informing her she was in a free Xfinity WiFi zone. She checked the connections and saw the new router name and signal strength on the list. Since a new tenant had just moved in below her, she asked him if he had had a new modem installed, which he confirmed. Because her own wireless modem had not been a problem, she did a search online and found out about the new marketing plan that Comcast was implementing using customers' personal modems to provide 1 h of free hotspot use along with advertisements encouraging users to sign up for their own account.

There are still strong signals in her unit from four modems, but none of them are hotspots, and do not cause her problems. There are also signals of the sort with hotspots from the far end of the building that have not caused JS any problems at the time of writing. Their pop-ups do not appear on her phone unless she walks along the corridor toward them.

There have been suggestions that the functional impairment electrohypersensitivity is psychosomatic (Landgrebe et al., 2008). This may be the case in some instances; however JS has never been diagnosed with or treated for depression, anxiety or related disorders, and the symptoms appeared well before she identified a source that, repeatedly, appeared correlated.

## Clinical

On 8 September 2014, JS revealed changes in her memory B cells (IgD+/CD27+ low; IgD-/CD27+ low; IgD+/CD27- high), and in 19 November 2014, she was tested

high for IL-4 (in a TH1/TH2 Panel Test). IL-4 is an inflammatory cytokine consistent with upregulated mast cell response. From such single tests it is, of course, very difficult to draw any conclusions; the blood test may merely be showing random alterations due to having had the West Nile virus poliomyelitis. But, it could also be due to the influence of electromagnetic field exposures (cf. Johansson (Johansson, 2009), including them affecting the mast cells.

## Reported fluctuations in response

JS noticed differences in symptoms according to the time of day/night and the distance from the router with the public hotspot, and whether or not the hotspot component was activated or disabled. Distance from, and activation of, the router was generally only ascertained after experiencing symptoms. This was done using a mobile phone application that graphs wireless connections when JS experienced symptoms.

When there was an activated hotspot in an adjacent unit, JS noticed symptoms. This occurred prior to knowing one was there and recurred when a new one was installed nearby without her knowledge.

On getting out of bed in the morning, she often experienced temporary vertigo, tinnitus and allergy symptoms like those of severe hayfever. Other common symptoms were headache, difficulty concentrating, poor fine motor control, impaired short-term memory and pain in the facial bones, especially the malar bone (cheeks) and mandible (jaw) including the roots of the teeth. There were no sinus infections or colds during the weeks the hotspots were active.

If she left the house for a while, mental symptoms diminished. Other daytime symptoms included numbness, tingling and difficulty breathing and swallowing and were also more pronounced after exertion. Other physical symptoms of ringing in ears and dizziness also diminished when leaving the house temporarily, but the November/December exposure was considerably longer and the numbness and other typical demyelination symptoms persisted for a while when out of the house.

In the evening, her appetite was much increased and she craved sweet food, which was not usual for her. She became sleepy at the usual time, settling down between 10.30 pm and 11 pm and could fall asleep, all as normal.

However, within 1–2 h, she routinely woke suddenly having had very vivid, disturbing dreams and with a pounding heartbeat. This was usually followed by a seizure, sometimes focal, where one part of her body (primarily right arm) would be shaking. Other times, her whole body was shaking. After a seizure, she slept

fitfully, unless she moved to sleep on the couch in another room. There, JS found she could fall asleep quite quickly and sleep through the rest of the night.

This type of seizure was documented as occurring twice during auditory evoked potential tests about 10 years ago. JS was told that she was having a seizure, but that it was related to the gray matter, not white matter part of the brain and therefore was not well defined on the electroencephalogram. Those seizures ceased within 2 years after contracting West Nile virus. This may indicate that the seizures were not epileptic, but due to myelin loss (Yarnykh et al., 2015).

After the recurrence of symptoms recently, JS discovered which neighbor had a WiFi system with public hotspot. The unit was diagonally across the hall which made the area with the modem just 20–30 feet from her bedroom, but about 50–60 feet from her living room (plus an additional wall), both of which would weaken the signal somewhat.

There was some sign of adaptation for some symptoms. The first time symptoms appeared in August 2014 the hotspot was only on for about 3 days. JS had very acute symptoms, and as soon as it was disabled they went away. The most recent exposure was over 4 weeks. During that time, she had the same acute symptoms and elevated morning fasting blood sugar levels (up 25% from usual to 100 mg/dL), but the neurological symptoms did seem to reduce with time. During the 4-week exposure, there was a fight or flight reaction for the first 2–3 weeks, which then turned into fatigue and apathy with little accomplished during the day. The day after the hotspot was disabled JS could focus on an activity for 4 h and felt much calmer. Her morning fasting blood sugar was back to normal 2 weeks later.

JS notices no effects from the private WiFi component once the hotspot component is disabled.

### Relevant wireless protocols and operating frequencies

The symptoms outlined above have reportedly been experienced in relation to the public hotspot component of Comcast's Xfinity Gateway WiFi service, which is supported by Technicolor.

Depending upon the model, it can operate on either IEEE 802.11a/b/g protocols (Comcast, 2012) simultaneously, or IEEE 802.11b/g/n protocols. These protocols specify characteristics of the beacon signal which is transmitted typically over 1 ms of each 100 ms leading to a 10.24 Hz pulse with 1% of the time taken by the beacon; other pulse durations are sometimes used. The beacon signal continues as long as the router is turned on. When in use, the resulting duty signal increases the percentage

of time the router is transmitting. All transmissions are at full power. The beacon signal contains all necessary information about the network to enable those within range to use the service. 802.11b and g are 2.4 GHz protocols, while 802.11a operates in a 5 GHz bandwidth. The most recent protocol, 802.11n, operates at either 2.4 GHz or in the 5 GHz bandwidth and has a greater range than the other three. Meter testing indicated the public hotspots near JS's apartment were functioning on 2.4 GHz. Reportedly, the Gateway contains two antennas, one of which is secured for the use of the paying customer and the other is available as a public hotspot (Hayes, 2014). The hotspot antenna almost certainly has a considerably higher transmit power as this would be needed to increase the effective transmit range for users in the area. WiFi signal range depends on several protocol factors including transmit power and transfer rate. Intensity falls away quickly with distance. Walls and vegetation reflect and absorb some of the signal, but do not block it. The 802.11b and 802.11g protocols fitted with standard antennae have a range of approximately 250 feet (76 m) (National Instruments, 2013), while that of 802.11n can be double of that (Belanger, 2007).

Measurements of the electric field and the power density were taken in the hallway, but are not presented as we were unable to determine the distance to the routers. JS declined a request to ask the residents as they are elderly and she did not want to worry them.

Signal strength (dBm) does not correlate well with her experienced symptoms. For instance, an Xfinity hotspot signal strength as low as  $-58$  dBm,<sup>1</sup> equal to  $0.002$   $\mu$ W, triggers the reported responses in JS, while other signal sources such as a mobile phone by the head and other WiFi signals prompt no symptoms, even with much higher exposures.

### Discussion

A recent paper (Redmayne and Johansson, 2014) has pointed to a possible association between electrohypersensitivity, myelin integrity and exposure to low-intensity RF-EMF typical in the modern world. Overall, evidence from in vivo and in vitro and epidemiological studies suggests an association between RF-EMF exposure and either myelin deterioration which weakens neuronal transmission resulting in loss of muscle function, or a direct impact on neuronal conduction, which may result in the neuron hyperactivity, paresthesias and severe pain which are sometimes characteristic of electrohypersensitivity.

Since the West Nile virus attacks both the nerve cells and the glial ones, one explanation to the above observed case effects is that the initial virus attack and the wireless modem's RF-EMF affect the nervous

system through the very same, or similar, avenues, and maybe both via the oligodendrocytes.

The trigger of effect in this case is hard to identify as full details of the transmit protocol are not available and the provider has not responded to queries on hotspot specifications.

JS does not have EHS responses to signals other than this hotspot one, even though this RF-EMF exposure intensity from several meters away will be considerably lower than that from using her own mobile phone or computer. Although it appears the strength of the exposure is one determining factor, characteristics of the signal that differ from those from her own regularly used equipment are likely to be involved. This could be the beacon interval, if this is different than those generally encountered (e.g. if the hotspot had an interval of 200 ms it would result in a 5 Hz pulse). However, an audio recording of the beacon signal indicates this does not appear to be the case.

A second factor that may be a trigger is the pulse width of the beacon signal (on time). If this is longer than the standard 1 ms, the body may “notice” and respond to the extended duration of each 10.24 Hz pulse more readily. As an illustration, it is easier to see a line of dashes that take up 3% of the line than a row of dots that take up 1% of the line. Another possible explanation is an additional pattern or stroboscopic effect, or double intensity set up by the simultaneous transmission of the private and public hotspots.

A high transmit power from the hotspot would have little effect on the average power of the beacon signal since it only occupies a small proportion of the transmission. But the beacon along with another component, such as a 10.24 Hz frequency, could conceivably stimulate or trigger certain biophysiological responses, such as seizures in some people.

This explanation fits the scenario as transmit power decreases rapidly with distance and JS finds the symptoms only appear within a certain radius of the hotspot. If the pulse of the beacon signal component is the trigger, we put forward a hypothesis that the responses may be similar to those experienced by some people in response to strobe lighting, to which responses are highly individual and occur in 1 in approximately 4000 people (Harding, 1994).

In this case, a distance of at least 30 m from an enabled Xfinity hotspot is the only reliable identified variable needed for no symptoms to appear.

This case raises some concern for those in the population with currently well-managed demyelinating diseases such as multiple sclerosis. Technologies based on various artificial electromagnetic fields, such as microwaves, are

increasing incrementally and public health infrastructure that could ameliorate harm remains inadequate. It will be a fundamental task to investigate the scientific background to our case observations, but they strongly indicate that emissions from these new wireless modems could cause physical harm for those susceptible to that type of radiation.

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## Declaration of interest

The study had no other involvement from these or other companies.

The authors have had no writing/editorial assistance in preparing the paper, although confirmation was sought from JS and her doctor regarding the accuracy of the details of the reporting and minor amendments made accordingly. Mary Redmayne is a member of the Stds. Australia technical committee TE-007.

## Note

1. Cornet ED 78S meter, margin of error +/-3.5 dBm.

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