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Title:
High Frequency Transients on Electrical Wiring:
A Missing Link to Increasing Diabetes and Asthma?

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Objectives:
Articulate data showing elevation of blood glucose when exposed to high frequency electrical transients and alleviation of asthma when high frequency electrical transients are reduced.

Describe the generation and mitigation of high frequency electrical transients.

Discuss association of high frequency transients with other illnesses.

Discuss possible solutions for exposure to high frequency electrical transients.

Abstract:
In the past decade many illnesses have exhibited a troubling and equally baffling rise. The two most visible and alarming are diabetes and asthma. Since 1991 diabetes has increased by 61%.[1] Asthma prevalence from 1980 to 1996 increased from 6.975M in 1980 to 14.601M in 1996—an increase of 209%![2]

In about the same time frame as the increase in rates of asthma and diabetes incidence, high frequency transients on the electrical wiring in buildings began increasing due to technology changes in the mid-1980s. These increased transients (also known as "dirty power") are in a frequency range commonly called Radio Frequency or RF. Radio frequency "sickness" had long been documented.[3,4,5,6]

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[1] Deborah Ball, *Nestlé Aims at Diabetes Niche*, The Wall Street Journal; Page B1, July 20,2004.
[2] Mannino, D., et al.; *Surveillance for Asthma --- United States, 1980-1999*; Table 1, http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5101a1.htm#tab1
[3] Goldsmith JR; *Incorporation of epidemiological findings into radiation protection standards*; Public Health Review 1991/1992 19:19-34
[4] Marha, K., et al.; Electromagnetic Fields and the Life Environment (translated form the Czech) San Francisco Press, Inc. 1971
[5] Mitchell CL. (1985) U.S. FDA 85-8238: 1-8.
[6] Silverman C., (1973) Am J Epidemiology 97(4):219-24.

However, except for certain papers available only in Russian,[7] RF exposure associated with changes in blood glucose has not been documented. Though not an RF exposure, a 2004 study found insulin suppression from exposure to a 60Hz[8] Electromagnetic Field (EMF).[9] Similarly, RF exposure has been documented as associated with asthma in only a few studies.[10, 11]

In the past few years, thanks to milk production issues for cows in Wisconsin (see comments for Slide 24 on page 20), methods have now been developed to filter out the dirty power on the electrical wiring and to measure the intensity of the dirty power such that blood glucose levels can be compared with dirty power levels.

Data Results for Blood Glucose Studies: In the first study, blood glucose levels are affected by peak levels of dirty power ($p < 0.001$) in a 41-year old, non-diabetic male subject. In the second study, the post-meal blood glucose in one of the three related, non-diabetic subjects became elevated to a diabetic level at the higher dirty power level.
Data Results for Asthma Study: In 34 of 37 children, asthma symptoms have been eliminated after removal of dirty power from their elementary school.
Conclusions: Dirty power exposures have grown dramatically since the mid-80s. The concurrent dramatic increase in diabetes and asthma may be associated with this exposure.

Introduction:
Power frequency Electromagnetic Fields (EMFs) have long been associated with disease. In 1979 a strong association of childhood leukemia and brain tumors was shown to be associated with EMF exposures[12]. This original finding has been replicated[13].

Since the initial studies linking EMF exposure to leukemia and brain tumors in children, additional research has similarly connected EMF exposure to these cancers in adults. Between 1985 and 1995 there were 29 studies exploring the link to occupational EMF exposure (e.g., electrical power linemen, telecommunications workers, electricians) with brain tumor incidence. One of the most alarming of these brain tumor studies found a 3.9 fold risk increase in brain tumors for those exposed to EMFs as compared to non-exposed

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[7] Syngaevskaya V.A. and Sinenko G.F. *Changes in carbohydrate metabolism under the influence of ultra-high frequency electromagnetic radiation of various parameters. – In: Labor hygiene and biological effects of radio frequency electromagnetic fields*. – M.: GT and PZ Institute, p. 52-57.

[8] Hertz, abbreviated Hz, is the basic unit of frequency or cycles per second

[9] Sakurai, et al.; *An Extremely Low Frequency Magnetic Field Attenuates Insulin Secretion From the Insulinoma Cell Line, RIN-m*; Bioelectromagnetics 25:160^166 (2004).

[10] Gangi S, Johansson O.; *A theoretical model based upon mast cells and histamine to explain the recently proclaimed sensitivity to electric and/or magnetic fields in humans*.; Med Hypotheses. 2000 Apr; 54(4):663-71.

[11] Sadlonova J, et al.; *The effect of the pulsatile electromagnetic field in children suffering from bronchial asthma.* Acta Physiol Hung. 2003;90(4):327-34 [Slovakia]

[12] Nancy Wertheimer, Ed Leeper; *Electrical Wiring Configurations and Childhood Cancer*; American Journal of Epidemiology, Vol.109, No. 3 1979.

[13] Savitz, et al.; *Case-control Study of Childhood Cancer and Exposure to 60-Hz Magnetic Fields*; American Journal of Epidemiology, Vol. 128, No. 1, 1988.

controls.[14] Similarly, there are a significant number of adult leukemia studies that point to increased risk of leukemia with EMF exposures.[15, 16, 17]

Even the Electric Power Research Institute (EPRI), the research arm of the electrical utility industry, (and therefore imbued with a vested interest to not find anything) has concluded that there is indeed a link to brain tumors and EMF exposures. In a meta-study of 29 EMF exposure/brain tumor studies (in which 22 of the 29 studies showed an increased risk of brain tumors), EPRI confirmed an increased risk for brain tumors from occupational exposure to EMFs.[18] In addition, another EPRI study (one of the rare studies that looked at the electric field versus the magnetic field) found an elevated risk for occupational exposure to leukemia with electric field exposure.[19]

This information of the adverse effects associated with EMF exposures found its way into the popular press,[20] creating widespread public concern. As a result of this public concern, Congress allocated $65M in research funding for the EMF RAPID [Research And Public Information Dissemination] Program. Research results from the EMF RAPID program led the National Institute of Environmental Health Sciences (NIEHS) to conclude " . . . that ELF[21] EMF are **possibly carcinogenic to humans . . .** " [the bold type font is from the Report].[22] Shortly afterwards the World Health Organization's (WHO) International Agency for Research on Cancer (IARC) made the same finding of a "possible human carcinogen".[23]

With a few exceptions, all of the previous research into the health effects from EMF exposure has looked at the magnetic fields created when current flows in electrical wires. Very little research has been done looking at the electrical fields created by the voltage on the wires. Strong evidence exists indicating that the electric field is in reality the element of concern, not the magnetic field.[24]

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[14] Speers, et al.; *Occupational exposures and brain cancer mortality: a preliminary study of East Texas residents*. Am J Ind Med. 1988; 13: 629-638.

[15] Miller, et al.; *Leukemia following Occupational Exposure to 60-Hz Electric and Magnetic Fields among Ontario Utility Workers*; American Journal of Epidemiology, Vol. 144, No. 2, 1996, 150-159

[16] Sam Milham; *Leukemia in Husbands and Wives*; Science, Vol. 148, No. 3666, April 2, 1965, 98-100

[17] Dolk, et al.; *Incidence near Radio and Television Transmitter in Great Britain, I. Sutton Coldfield Transmitte*r; American Journal of Epidemiology, Vol. 145, No. 1, January 1, 1997 pp 1-9 Cancer

[18] Kheifets, et al.; *Occupational Electric and Magnetic Field Exposure and Brain Cancer: A Meta-Analysis*; Journal of Occupational and Environmental Medicine, Vol. 37, No. 12, December 1995, 1327-1340.

[19] Kheifets, et al.; *Leukemia Risk and Occupational Electric Exposure in Los Angeles, County, California*; American Journal of Epidemiology, 1997, Vol. 146, No. 1, 87-90.

[20] Paul Brodeur; *Currents of Death; Power Lines, Computer Terminals and the Attempt to Cover Up Their Threat to Your Health*; Simon and Schuster, 1989.

[21] ELF: Extremely Low Frequency, usually the electrical power frequencies of either 60Hz or 50Hz.

[22] Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields, Section 5.1, page 411, NIEHS Working Group Report, National Institute of Environmental Health Sciences of the National Institutes of Health, August 1998.

[23] Microwave News, July/August 2001, Page 1.

[24] During additional investigation by this author to reduce transients in several subject's homes it was noted that filtering increased the magnetic field by about 10% while decreasing the electric field by more than an order of magnitude.

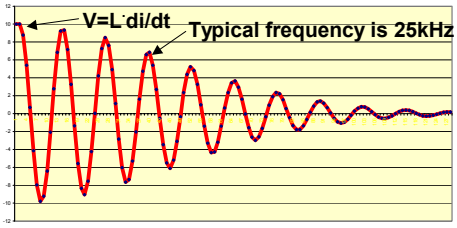
The electric field had been previously discounted because vegetation and buildings can substantially attenuate the electric field, while the magnetic field will result in almost no attenuation due to the presence of buildings or vegetation. The previous research had assumed that the only frequency of interest was the power distribution frequency of 60Hz.

The higher frequencies of dirty power (those between 15kHz and 150kHz), created by transient interruptions of the electrical current, were not even considered. These frequencies, called Radio Frequencies (RF) are up to 2,500 times higher than 60 Hz and therefore contain up to 2,500 times the energy. This same energy is coupled to our bodies by the capacitance between our bodies and the electrical wires within the walls of our homes and workplaces.

Solid-state (semiconductor) based electronics has fundamentally changed the way electrical power is used. Beginning in the late 1970s, light dimmer switches turned off the current twice per cycle (120 times per second) creating high frequency (RF) transients 120 times per second. In the mid-1980s, electrical equipment began to incorporate switching power supplies. Switching power supplies turn the current on and off from 20 to 60 thousand times per second. Each time the current is turned off, a high frequency transient is created. In 1999 EPRI estimated the use of such solid-state equipment at 30%, predicting that by 2002 it would be 70% of all the installed equipment.[25]

Since the electrical energy coupled to our bodies is proportional to the frequency, this impact of new technology has been called "A Ubiquitous Pollutant", that is, high frequencies are increasingly surrounding us whenever we enter a building.[26] We, as does the electrical utility industry, call these high frequency transients "dirty power".

The physics of these high frequency transients or "dirty power" works thus: When a flowing electrical current is suddenly stopped there is a resultant voltage spike that is proportional to how fast the current flow is stopped. The equation for this voltage spike is V=L·di/dt. "V" is the value of the voltage. "L" is the inductance[27] of the electrical circuit where the current is flowing. "di/dt" is the rate of change of the current in time. Therefore when the current is turned off, how fast the current is turned off determines the size of the voltage spike. The voltage spike will decay as it oscillates at a frequency that is the resonant frequency of the electrical circuit as seen in the following diagram:



[25] *Hot New Technologies for America's Factories*; Fortune Magazine, July 5, 1999.
[26] Martin Graham; *A Ubiquitous Pollutant*; Memorandum No. UCB/ERL M00/55; Electronics Research Laboratory, College of Engineering, University of California, Berkeley; 28 October 2000.
[27] Inductance is defined as the property of an electric circuit that opposes any change in current.

The mechanical analogy to this electrical phenomena is when we hear "hammering water pipes" as we shut off the water flow. In this example, the inertial of the water hits the water valve (the end of the pipe) creating a momentary pressure surge (equivalent to the voltage spike) followed by the sound of the pipes as they resonant mechanically (equivalent to the oscillating voltage).

Materials and Methods:

Blood Glucose Measurements In Two Experiments:

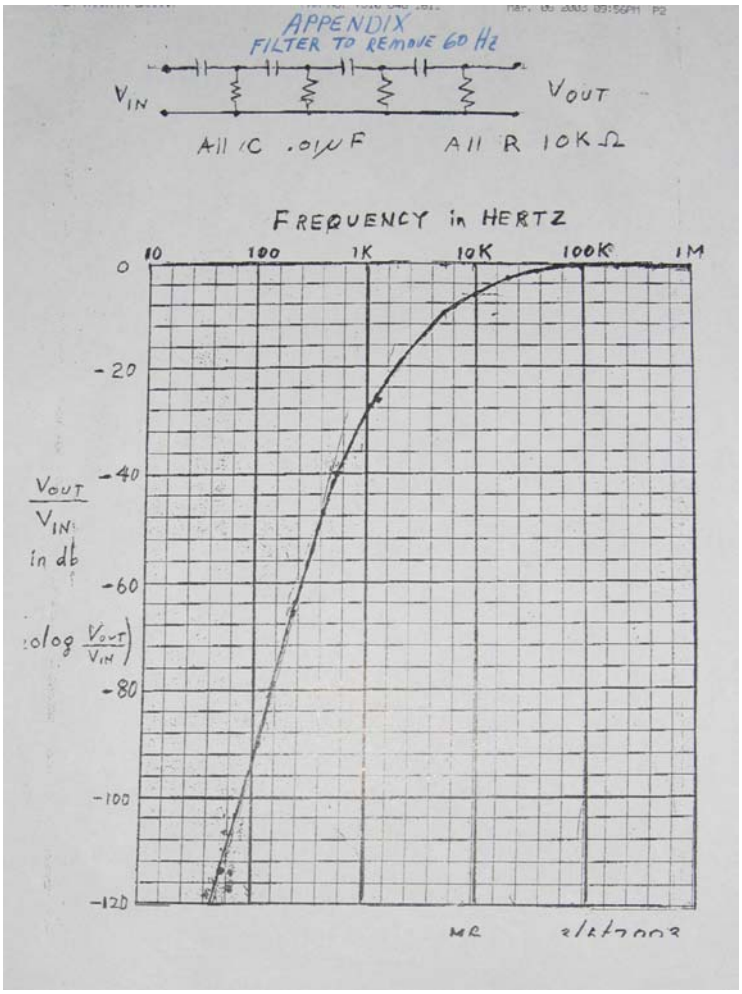
A 51-year old male and three related subjects (two females, 11 years and 36 years, and one male, 46 year), none with a history of diabetes, had blood glucose measured using an ACCU-CHEK Advantage blood glucose meter. With each blood glucose measurement, the peak value of dirty power was also measured.

A test was performed to determine that the dirty power levels had no affect on the blood glucose meter readings. This test found that dirty power levels had no effect on the readings of the blood glucose meter.

Dirty Power Measurements:

Simple electrical circuits have been developed to measure dirty power. Real time measurement using an oscilloscope was achieved by inserting a 10 kHz high pass filter in series between the electrical power from an outlet and the input to an oscilloscope. Figure One, below, shows a schematic diagram of the filter and the resultant characteristics of the filter.

Figure One

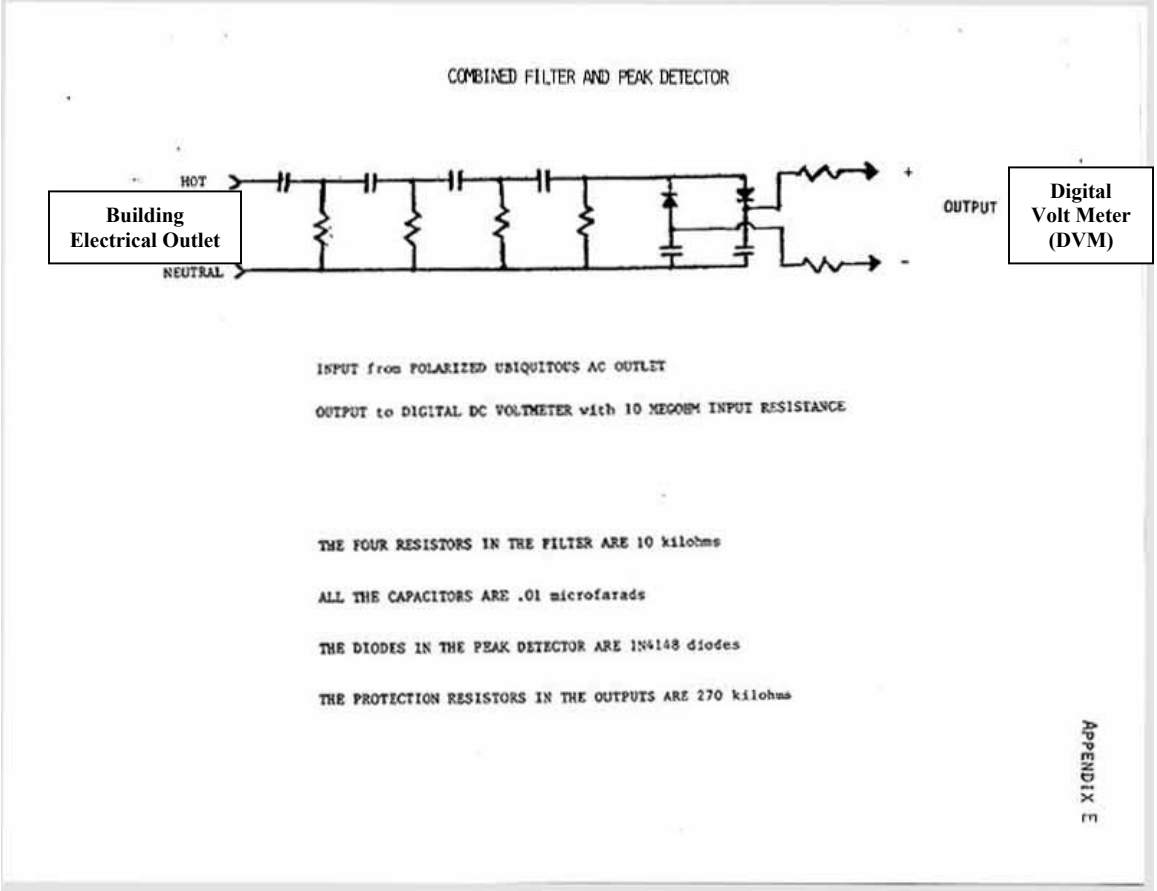


The filter in Figure One has the effect of reducing the amplitude of all frequencies below 10 kHz. The curve shows the attenuation in db, decibels, (Y-axis) with frequency in Hertz (X-axis). For non-electrical engineers the following translation is appropriate:
A 60Hz voltage is reduced by 124db, equivalent to an attenuation factor of 6.25×10^{-07}.
A 100Hz voltage is reduced by 92db, equivalent to an attenuation factor of 2.50×10^{-05}.
A 1,000Hz (1kHz) voltage is reduced by 28db, equivalent to an attenuation factor of 4.00×10^{-02}.
A 10kHz voltage is reduced by 6 db, equivalent to a 50% reduction.
A 13 kHz voltage is reduced by 4db, or 36%.
A 21 kHz voltage is reduced by 2 db, or 20% reduction.
And a 37 kHz voltage reduced by 1 db or 11%.

Figure Two shows an electric circuit diagram that was used to measure the peak values of the dirty power. Basically it is the same 10 kHz high pass filter (to remove the 60 Hz and its harmonics) with a rectifier circuit (to change the AC dirty power signal to DC) combined with a couple of capacitors that capture the peak values.

The input of this circuit is connected to an electrical outlet in a building. The output is attached to the input of a Digital Voltmeter (DVM) set to measure DC Voltage. The reading on the DVM is the peak-to-peak voltage of the dirty power as reported below.

Figure Two



Simple electrical filters connected to electrical outlets within a building were used to filter dirty power from the electrical wiring. The filter is a 20μF, 180VAC, dry film capacitor connected to the electrical outlet. A 27-kilohm, 2-watt resistor is connected across the capacitor for safety (to discharge any voltage when the filter is removed from the electrical outlet).

Results:

Blood Glucose First Experiment:

Our first attempt to correlate blood glucose levels with dirty power failed. The reason for this failure was that we were using the average (or more specifically the RMS or root mean square) value of dirty power. We found strong correlation with blood glucose levels when we used the peak value of dirty power instead of the average value.

Blood glucose elevation to diabetic levels is shown to be associated with peak levels of dirty power after partial correlation for time of day ($p<0.001$) for a 51-year old male non-diabetic subject.

Blood Glucose Second Experiment:
A simple experiment with three non-diabetic subjects (see Methods and Materials, above) was done. There were 4 sets of blood glucose measurements for each of the three subjects:

1. A fasting blood glucose measurement was taken in a low-level (4 mV) dirty power environment.
2. A second blood glucose measurement was taken thirty minutes after eating breakfast in the same low-level dirty power environment.
3. On the next day, a fasting blood glucose measurement was taken in a higher-level (10 mV) dirty power environment.
4. Again, a second blood glucose measurement was taken thirty minutes after eating, in a higher-level dirty power environment. Each of the three subjects ate identical breakfasts as on both days, though each chose different food products from each other.

Only the 46-year old male subject had his blood glucose elevated to diabetic levels. This is consistent with our observations that most people's blood glucose is unaffected by dirty power. We suggest that there is an allergic-like response by a roughly estimated 3 to 10% of the population.

Asthma:
Asthma symptoms are cleared in 34 of 37 children when their school was filtered to remove dirty power. The school had a total student body of 200. It is clear that dirty power does not effect everyone. Our observations suggest that the correlation between dirty power and asthma, as with blood glucose is akin to an allergic reaction, not unlike hay fevers or similar biologic and chemical allergies.

Other Diseases:
Other diseases reported by the staff and eliminated by the installation of dirty power filters at this same school were chronic fatigue syndrome, Fibromyalgia, foggy cognition, numbness along one whole side of the body (misdiagnosed as multiple sclerosis or MS) and a loss of a sense of smell.

Discussion:
Dirty power did not exist prior to the late 1970s. It has increased dramatically because the use of electricity by electrical equipment has changed from the previous continuous use to the now ubiquitous intermittent use. The transients created by dirty power are in a frequency range generally referred to as radio frequencies or RF. There is a large list of scientific papers reporting RF sickness.

Efforts to determine what measurement of dirty power correlates to effects on blood glucose have been wide ranging. Early efforts, using a spectrum analyzer provided no insights. Later we tried the total energy of the spectrum. This too was without success. Then, as noted above, we used the average or RMS value of dirty power. Again no correlation. What we report here is the peak-to-peak value of dirty power. This provides excellent correlation. We are continuing to improve and we have some evidence that the

average (over about 0.5 seconds) rate of change (i.e., Volts per second) of the dirty power is an ever better indicator for the observed health effects of dirty power compared to the peak-to-peak value.

Asthma and diabetes have reached epidemic proportions without a clear understanding as to causation. Could part of the missing causation link to increasing diabetes and asthma be found in the increasing exposure to dirty power?