

## Research Results from studies on Propylene Glycol

It is very difficult to listen to repeated comments about how there are "no studies" on the effects of electronic cigarettes and the second hand vapor given off by these devices. The main component of the liquid used in these devices is Propylene Glycol (also called PG in references below). There is much research on devices that parallel the effects of this device (fog/smoke machines) which put out a significantly higher amount of vapor than these devices and many studies on the individual components (PG, nicotine and water) which make up the vapor given off by the device. There is also a study on the actual vapor given off by the device when all components are combined. It is disappointing that the media and the people providing this misinformation are so poorly informed and would make statements which have no scientific basis.

I have omitted studies on Nicotine and water since I am sure you are already aware that there are relatively few harmful effects from nicotine use by the typical person and nicotine is FDA approved in other products like nicotine gum. Water vapor does not seem to be a concern. Content of nicotine in vapors emitted by exhaling after use of an e-cigarette are minuscule and negligible due to the fact that the majority of the nicotine is absorbed into the body.

There are studies regarding inhalation of propylene glycol and its safety dating back to the 1940's. In fact, it has been used extensively in situations where it would be inhaled in the US since the 1950's. It has been used in medical devices such as asthma inhalers, as an air disinfectant in places like hospitals and restaurants, and even in hundreds of thousands of entertainment venues such as bars and theaters, since it is the substance used for fog and artificial smoke machines.

Below are the studies on propylene glycol with explanations as to what the study is about along with some quotes from the articles and a link directly to each article in case you would like to read the entire article.

(PDF is available to print at the bottom of this page)

### [What is Propylene Glycol?](#)

"Propylene glycol is used in air sanitization and hard surface disinfection and dipropylene glycol is used in air sanitization."

"Propylene glycol and dipropylene glycol were first registered in 1950 and 1959, respectively, by the FDA for use in hospitals as air disinfectants."

"Indoor Non-Food: Propylene glycol is used on the following use sites: air treatment (eating establishments, hospital, commercial, institutional, household, bathroom, transportational facilities); medical premises and equipment, commercial, institutional and industrial premises and equipment; laundry equipment; hard non-porous surface treatments (bathroom facilities); automobiles; air conditioning filters; pet treatment, including cats, dogs, and caged birds; environmental inanimate hard surfaces; garbage containers/storage."

"Target Pests: Odor-causing bacteria, Fleas, Mites, Red lice, Animal pathogenic bacteria (G- and G+ vegetative), Shigella bacteria, Pasteurella bacteria, Listeria bacteria, Herpes Simplex I and II, Animal viruses, Influenza Virus A2, Aspergillus Niger Fungus, Mold/Mildew, Pseudomonas SPP., Shigella Flexneri, Shigella Sonnei."

**[Here are a few quotes from the 2007 EPA re-registration decision approving the use of propylene glycol in places like hospitals and food establishments:](#)**

	<p style="text-align: center;"><b>"General Toxicity Observations</b></p> <p>Upon reviewing the available toxicity information, the Agency has concluded that there are no endpoints of concern for oral, dermal, or inhalation exposure to propylene glycol and dipropylene glycol. This conclusion is based on the results of toxicity testing of propylene glycol and dipropylene glycol in which dose levels near or above testing limits (as established in the OPPTS 870 series harmonized test guidelines) were employed in experimental animal studies and no significant toxicity observed."</p> <p style="text-align: center;"><b>"Carcinogenicity Classification</b></p> <p>A review of the available data has shown propylene glycol and dipropylene glycol to be negative for carcinogenicity in studies conducted up to the testing limit doses established by the Agency; therefore, no further carcinogenic analysis is required."</p> <p>And there is much more information in the full document linked below:  <a href="http://www.epa.gov/oppsrrd1/reregistration/REDs/propylene_glycol_red.pdf">http://www.epa.gov/oppsrrd1/reregistration/REDs/propylene_glycol_red.pdf</a></p>
<p><b><u>Here is a link to a Time article about propylene glycol's germicidal properties when inhaled,</u></b> published in 1942.</p>	<p>They determined that inhaling Propylene Glycol in levels which were significantly higher than would be common under any circumstances did not have any ill effects on the monkeys used for the study. The only significant effect they noted was weight gain.</p> <p><a href="http://www.time.com/time/magazine/article/0,9171,932876-2,00.html">http://www.time.com/time/magazine/article/0,9171,932876-2,00.html</a></p>
<p><b><u>This article is about a study done</u></b> (in the 1940's since it is obviously unethical to do before they were aware of the potential results!) <b><u>where PG vapors were emmitted into a children's convalescent home.</u></b></p>	<p>Quote from this article:  "The report of the 3 years' study of the clinical application of the disinfection of air by glycol vapors in a children's convalescent home showed a marked reduction in the number of acute respiratory infections occurring in the wards treated with both propylene and triethylene glycols. Whereas in the control wards 132 infections occurred during the course of the three winters, there were only 13 such instances in the glycol wards during the same period."</p> <p><a href="http://www.ajph.org/cgi/reprint/36/4/390.pdf">http://www.ajph.org/cgi/reprint/36/4/390.pdf</a></p>
<p><b><u>Here is an incredibly long list of air sanitizing products in current commerce based on propylene glycol, many used in hospitals as approved by the EPA in the above PDF:</u></b></p>	<p><a href="http://www.scorecard.org/chemical-profiles/pesticides.tcl?edf_substance_id=57-55-6">http://www.scorecard.org/chemical-profiles/pesticides.tcl?edf_substance_id=57-55-6</a></p>
<p><b><u>Here is an article about long-term exposure of significantly high levels of PG vapor in monkeys and rats.</u></b></p>	<p>"With a view to determining the safety of employing the vapors of propylene glycol and triethylene glycol in atmospheres inhabited by human beings, monkeys and rats were exposed continuously to high concentrations of these vapors for periods of 12 to 18 months. Equal numbers of control animals were maintained under physically similar conditions. Long term tests of the effects on ingesting triethylene glycol were also carried out. The doses administered represented 50 to 700 times the amount of glycol the animal could absorb by breathing air saturated with the glycol.</p> <p>Comparative observations on the growth rates, blood counts, urine examinations, kidney function tests, fertility and general condition of the test and control groups, exhibited no essential differences between them with the exception that the rats in the glycol atmospheres exhibited consistently higher weight gains."</p> <p><a href="http://jpet.aspetjournals.org/cgi/content/abstract/91/1/52">http://jpet.aspetjournals.org/cgi/content/abstract/91/1/52</a></p>

**Article on the repeated exposure of rats to PG suggesting low priority for further study due to lack of ill effects.**

The first few lines of this study say:  
"Propylene glycol (PG) is not acutely toxic. The lowest oral LD50 values range between 18 and 23.9 grams (5 different species) and the reported dermal LD50 is 20.8 grams. PG is essentially nonirritating to the skin and mildly irritating to the eyes."

<http://www.inchem.org/documents/sids/sids/57-55-6.pdf>

**Here is a link to a study showing the safety of propylene glycol as the carrier for inhaled Cyclosporine, for lung transplant patients.**

Propylene Glycol is used as a drug delivery system, even for patients who have pulmonary complications and whose lungs are compromised specifically because of the germicidal and virucidal properties of the substance.

"There were no respiratory or systemic effects of high doses of propylene glycol relative to air controls. These preclinical studies demonstrate the safety of aerosolized cyclosporine in propylene glycol and support its continued clinical investigation in patients undergoing allogeneic lung transplantation."

<http://www.liebertonline.com/doi/abs/10.1089/jam.2007.0626>

**This article explains that the Entertainment and Services Technology Association hired two independent companies to test the toxicology of propylene glycol in vaporized form in a work environment.**

[http://www.esta.org/tsp/working\\_groups/FS/cihintro.htm](http://www.esta.org/tsp/working_groups/FS/cihintro.htm)

"The [Cohen Group report](#) and the [HSE Consulting report](#) are not identical documents, but are substantially congruent in their findings. Both reports state that all of the chemicals they studied (glycerin and five dihydric alcohols) are of low toxicity. Some of the chemicals are of such low toxicity that no maximum allowable concentrations have ever been established, even though they are used in a wide variety of industrial applications. A few of the chemicals have permissible exposure limits defined by a variety of governmental bodies in the US, UK and Germany, but these exposure limits are believed to be higher than the levels needed to produce a heavily fogged theatrical environment. Neither report gives any indication that performance environments should be evaluated in a manner different than that used for other industrial work sites. "

**Below are links to the independent studies completed for the ESTA.**

[http://www.esta.org/tsp/working\\_groups/FS/docs/cohen.pdf](http://www.esta.org/tsp/working_groups/FS/docs/cohen.pdf)

Statement from the Cohen Study:

"Prolonged and repeated inhalation of triethylene glycol and propylene glycol concentrations well above those present in high-density fog theatrical productions has been repeatedly demonstrated to not pose a health hazard to human subjects. Both glycols have generally been found to be not irritating to the eyes and skin, although splashing the pure compound into the eye may produce transient irritation."

[http://www.esta.org/tsp/working\\_groups/FS/docs/HSE.pdf](http://www.esta.org/tsp/working_groups/FS/docs/HSE.pdf)

Statement from HSE study in which PG refers to Propylene Glycol:  
"PG, G, and TEG's toxicity data appears to be well studied and demonstrates low occupational hazards."

**Article about E-cigarette safety and study confirmation**

"Toxic emissions scores for the Ruyan brand of e-cigarettes tested compared to tobacco cigarette brands such as Marlboro revealed what most e-cigarette consumers already knew: tobacco cigarettes emit over 100 times more toxic chemicals than e-cigarettes do. From a list of more than 70 of toxic substances found in tobacco cigarette smoke, 0 of those toxicants were found in e-cigarette emissions."

<http://www.24-7pressrelease.com/press-release/ecigarette-safety-for-consumers-and-bystanders-confirmed-by-medical-study-101013.php>

**Actual study on E-cigarette liquid.**

"Several toxicants in headspace of the Ruyan® e-cigarette cartridge have, on some tests, been found, specifically acrolein and acetaldehyde, at very low levels, and at levels below those determined to be harmful, and well below the minimum risk levels accepted by the US Public Health Service and OSHA.

The results obtained to date do not mitigate this report's overall conclusion that the Ruyan® e-cigarette is designed to be a safe

	<p>alternative to smoking, and appears to be safe in absolute terms on all measurements we have applied."</p> <p><a href="http://healthnz.co.nz/RuyanCartridgeReport21-Oct-08.pdf">http://healthnz.co.nz/RuyanCartridgeReport21-Oct-08.pdf</a></p>
<p><b><u>An expert in tobacco harm reduction argues that there is no evidence that the electronic cigarette increases the risk of smoking in children or adults.</u></b></p>	<p>"During the interview Adrian Payne expressed cautious support for the electronic cigarette, arguing that due to the different way in which nicotine was taken in by the user the effect was likely to be two to three orders of magnitude safer than regular cigarettes. He also discussed worries over the safety of inhaling propylene glycol, stating: '...based on current knowledge, these concerns seem vastly overplayed when compared to the risks of cigarette smoking.' "</p> <p><a href="http://www.officialwire.com/main.php?action=posted_news&amp;rid=3507">http://www.officialwire.com/main.php?action=posted_news&amp;rid=3507</a></p>
<p><b><u>Smoking reduction with oral nicotine inhalers: double blind, randomised clinical trial of efficacy and safety</u></b></p>	<p>"Nicotine inhalers effectively and safely achieved sustained reduction in smoking over 24 months. Reduction with or without nicotine substitution may be a feasible first step towards smoking cessation in people not able or not willing to stop abruptly."</p> <p><a href="http://www.bmj.com/cgi/content/full/321/7257/329">http://www.bmj.com/cgi/content/full/321/7257/329</a></p>
<p><b><u>Product Safety Assessment (PSA): Propylene Glycol</u></b></p>	<p>"Inhalation of the PG vapors appears to present no significant hazard in ordinary applications. "</p> <p>"PG does not cause sensitization and shows no evidence of being a <a href="#">carcinogen</a> or of being <a href="#">genotoxic</a>"</p> <p><a href="http://www.dow.com/productsafety/finder/prog.htm">http://www.dow.com/productsafety/finder/prog.htm</a></p>

**Below are links to some statements and interviews from doctors sharing their feelings on these devices.**

**Dr. Joel Nitzkin:** <http://www.ecigarettdirect.co.uk/interviews/joel-nitzkin-electronic-cigarette.html>

**Dr. Michael Siegel:** <http://tobaccoanalysis.blogspot.com/2009/03/senator-and-anti-smoking-groups-want-to.html>

**Dr. Carl Phillips:** <http://www.tobaccoharmreduction.org/faq/ecigs.htm>

And I'll add an interview with **David Swenor:** <http://www.ecigarettdirect.co.uk/interviews/david-swenor.html>

Here is a video by former **US Congressman Matt Salmon**, the current **president of the ECA** (Electronic Cigarette Association): <http://www.ecassoc.org/>

The bottom line is this: Propylene glycol as the base carrier liquid for the small percentage of liquid nicotine found in e-cigarettes is a safe and well-studied substance. It truly amazes me to hear such misinformation spread, even by doctors and health groups, about propylene glycol and e-cigarettes. **Experts in Tobacco Harm Reduction** state e-cigarettes are 100 to 1000 times less harmful than traditional cigarettes. I believe the misinformation is deliberately propagated by people with a vested interest in seeing these devices do not succeed in replacing traditional cigarettes. The media may succeed in scaring consumers, but the government cannot justifiably ban this device without at least one study showing certain detriment to the body of the user or the people around the user.

**By condemning e-cigarette users to a smoking environment, you risk the health of those who have quit**

smoking for a healthier lifestyle and to protect the health of their children, families and those around them.

With no proof of any ill effects in the quantities of PG vapor dispersed by exhalation after use of the e-cigarette, there is NO reasonable basis for these restrictions. Now that you have the above information, the justification that we "do not know" what is in the vapor or if it "causes any damage to body systems" is NO longer acceptable.

## **[PDF of above Information](#)**