Thirdhand Smoke Exposure and Health Effects

Lara Gundel, Hugo Destaillats, Mohamad Sleiman, Jennifer Logue and Brett Singer

Indoor Environment Group
Energy Analysis & Environmental Impacts Division
Energy Technologies Area

THS is receiving increasing attention …

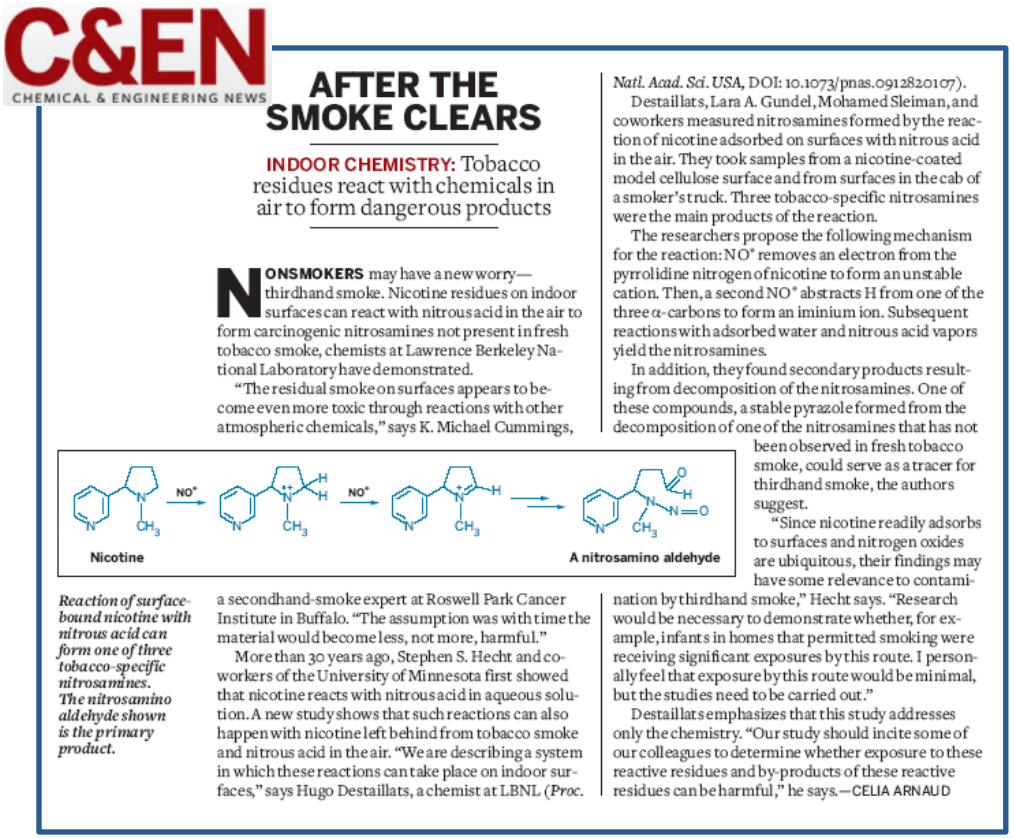
Does the Smoke Ever Really Clear?

Thirdhand Smoke Exposure Raises New Concerns

You may never have heard of thirdhand smoke, or THS, but chances are you've smelled it. THS is, in the words of *The New York Times*, "the invisible yet toxic brew of gases and particles clinging to smokers' hair and clothing, not to mention cushions and carpeting, that lingers long after secondhand smoke [SHS] has cleared from a room."[1] Recent research exploring potential dangers of THS has received a flurry of coverage in the international media[2,3,4] and the scientific press.[5,6,7] And in the United States, court cases are beginning to appear in which plaintiffs are citing these alleged dangers,[8,9] despite a lack of human health studies on the long-term health effects of THS exposure.

So how dangerous might THS really be? The answer, still to be pronounced, will depend on many factors.

Thirdhand smoke consists of residual tobacco smoke pollutants that 1) remain on surfaces and in dust after tobacco has been smoked, 2) are re-emitted back into the gas phase, or 3) react with oxidants and other compounds in the environment to yield secondary pollutants.



C&EN
CHEMICAL & ENGINEERING NEWS

AFTER THE SMOKE CLEARS

INDOOR CHEMISTRY: Tobacco residues react with chemicals in air to form dangerous products

NONSMOKERS may have a new worry—thirdhand smoke. Nicotine residues on indoor surfaces can react with nitrous acid in the air to form carcinogenic nitrosamines not present in fresh tobacco smoke, chemists at Lawrence Berkeley National Laboratory have demonstrated.

"The residual smoke on surfaces appears to become even more toxic through reactions with other atmospheric chemicals," says K. Michael Cummings, a secondhand-smoke expert at Roswell Park Cancer Institute in Buffalo. "The assumption was with time the material would become less, not more, harmful."

More than 30 years ago, Stephen S. Hecht and coworkers of the University of Minnesota first showed that nicotine reacts with nitrous acid in aqueous solution. A new study shows that such reactions can also happen with nicotine left behind from tobacco smoke and nitrous acid in the air. "We are describing a system in which these reactions can take place on indoor surfaces," says Hugo Destaillats, a chemist at LBNL (*Proc. Natl. Acad. Sci. USA*, DOI: 10.1073/pnas.0912820107).

Destaillats, Lara A. Gundel, Mohamed Sleiman, and coworkers measured nitrosamines formed by the reaction of nicotine adsorbed on surfaces with nitrous acid in the air. They took samples from a nicotine-coated model cellulose surface and from surfaces in the cab of a smoker's truck. Three tobacco-specific nitrosamines were the main products of the reaction.

The researchers propose the following mechanism for the reaction: NO^+ removes an electron from the pyrrolidine nitrogen of nicotine to form an unstable cation. Then, a second NO^+ abstracts H from one of the three α-carbons to form an iminium ion. Subsequent reactions with adsorbed water and nitrous acid vapors yield the nitrosamines.

In addition, they found secondary products resulting from decomposition of the nitrosamines. One of these compounds, a stable pyrazole formed from the decomposition of one of the nitrosamines that has not been observed in fresh tobacco smoke, could serve as a tracer for thirdhand smoke, the authors suggest.

"Since nicotine readily adsorbs to surfaces and nitrogen oxides are ubiquitous, their findings may have some relevance to contamination by thirdhand smoke," Hecht says. "Research would be necessary to demonstrate whether, for example, infants in homes that permitted smoking were receiving significant exposures by this route. I personally feel that exposure by this route would be minimal, but the studies need to be carried out."

Destaillats emphasizes that this study addresses only the chemistry. "Our study should incite some of our colleagues to determine whether exposure to these reactive residues and by-products of these reactive residues can be harmful," he says.—CELIA ARNAUD

Reaction of surface-bound nicotine with nitrous acid can form one of three tobacco-specific nitrosamines. The nitrosamino aldehyde shown is the primary product.

Review

ehp

Thirdhand Tobacco Smoke: Emerging Evidence and Arguments for a Multidisciplinary Research Agenda

Georg E. Matt,[1] Penelope J. E. Quintana,[2] Hugo Destaillats,[3] Lara A. Gundel,[3] Mohamad Sleiman,[3] Brett C. Singer,[3] Peyton Jacob III,[4] Neal Benowitz,[4] Jonathan P. Winickoff,[5] Virender Rehan,[6] Prue Talbot,[7] Suzaynn Schick,[4] Jonathan Samet,[8] Yinsheng Wang,[9] Bo Hang,[10] Manuela Martins-Green,[11] James F. Pankow,[12] and Melbourne F. Hovell[2]

… and impacting the media, regulators and advocacy groups

Bill bans smoking at all times in home day cares

By FENIT NIRAPPIL - *Associated Press - Monday, April 21, 2014*

The Washington Post

SACRAMENTO, Calif. (AP) - The Assembly approved a bill Monday that would ban smoking inside home day care centers even after the children have left, a regulation that targets lingering "third-hand smoke" and has been adopted by 12 other states.

The California Consortium on THS

TOBACCO-RELATED DISEASE RESEARCH PROGRAM

Principal Investigator
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Chemistry, Remediation DNA damage

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B. Hang

Human exposure Biomarkers

N. Benowitz
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Toxicology Health effects

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Exposure Behavior Persistence

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M. Hovell
P. Quintana
E. Hoh

Exposure Policy Economics

J. Samet
H. Wipfli

What is thirdhand smoke (THS)?

Working definition:

Tobacco toxins that <u>remain,</u> <u>react,</u> <u>re-emit</u> and/or <u>re-suspend</u> in indoor environments

Secondhand smoke

- ✓ primarily inhalation
- ✓ short time scales (min to hs)

Indoor surfaces

Thirdhand exposures

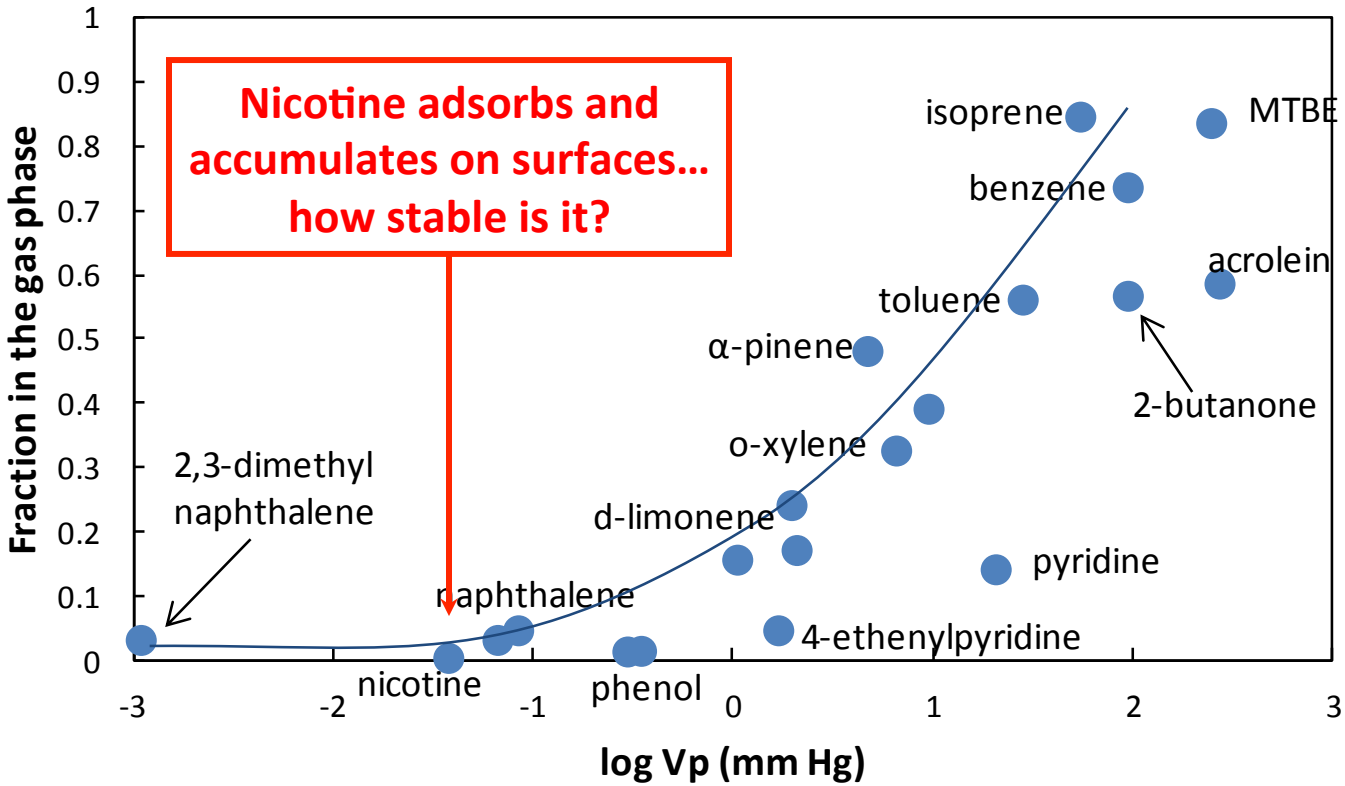
- ✓ inhalation + dermal + ingestion
- ✓ long time scales: up to months

Our goals

1. Refine the definition of THS
2. Understand THS chemistry on indoor surfaces (e.g., nicotine reaction with O_3 and other species)
3. Identify key inhalable THS constituents (harmful pollutants and THS tracers)
4. Quantify the harm caused by secondhand and thirdhand smoke
5. Evaluate THS remediation approaches

Berkeley Lab's early work on THS

Partitioning of tobacco pollutants in furnished 50-m^3 chamber

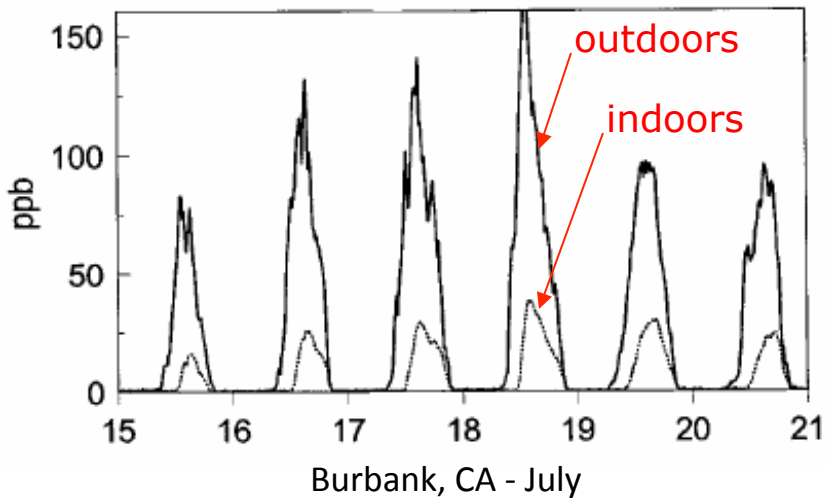


"…airborne concentration of some ETS constituents can be significantly affected by sorptive interactions with indoor surfaces… Exposure-relevant emission factors implicitly incorporate sorption effects under realistic furnishing and ventilation conditions."

Singer et al, *ES&T* 2002
Singer et al, *Atmos Environ* 2003
Singer et al, *Atmos Environ* 2004
Nazaroff and Singer, *JEAEE* 2004
Singer et al, *Atmos Environ* 2007

What is the effect of indoor ozone?

MAIN OZONE SOUCE: OUTDOOR AIR



Weschler, 2000 (Indoor Air)

OTHER INDOOR SOURCES: AIR "PURIFIERS"

O_3

- used to remove odors
- up to hundreds of ppb

1) Ozone quickly oxidizes nicotine on indoor surfaces

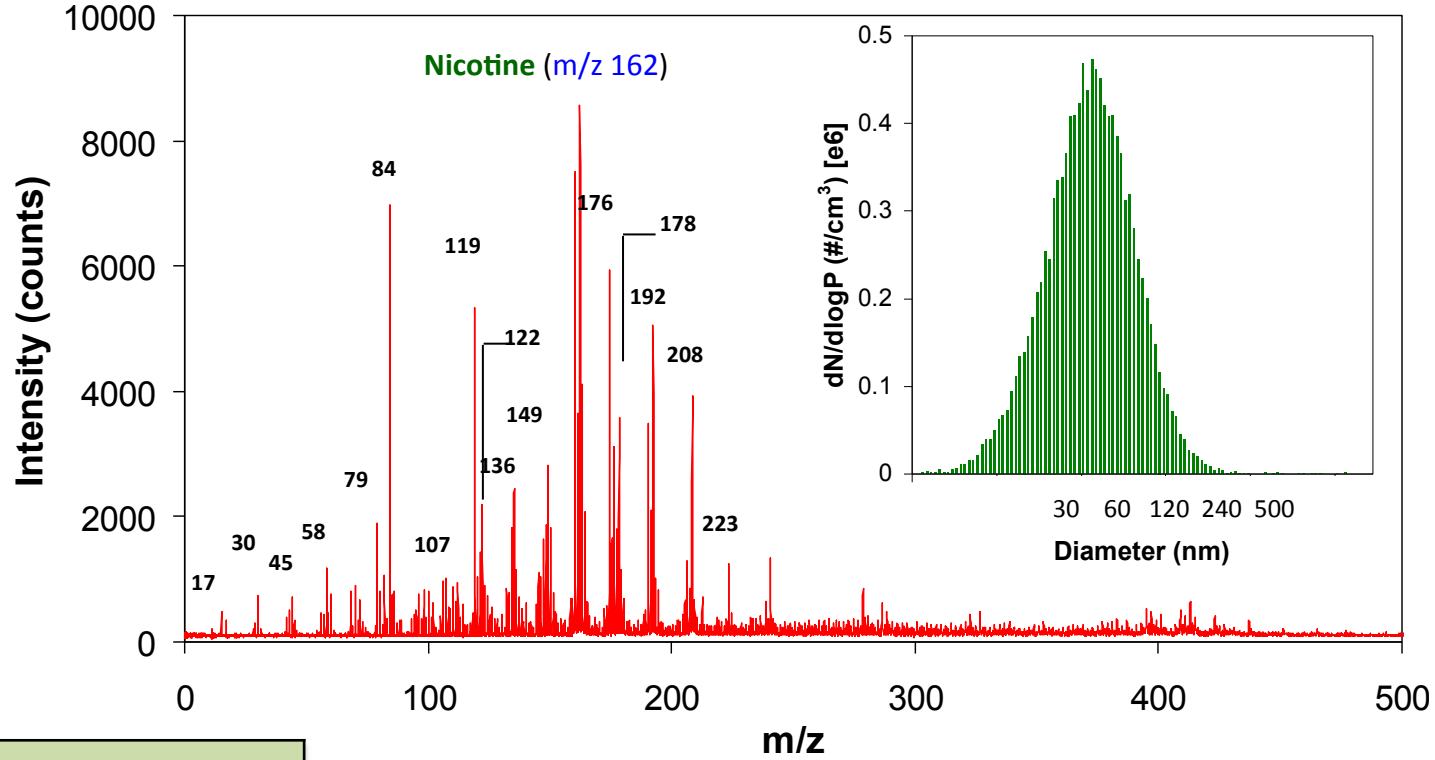
2) We observed gas phase and particle-bound byproducts: cotinine, nicotinaldehyde, N-methyl formamide

Destaillats et al. *ES&T* 2006

Ozone reactions with nicotine create new ultrafine particles

Advanced Light Source

Analysis of chemical composition and particle size distribution



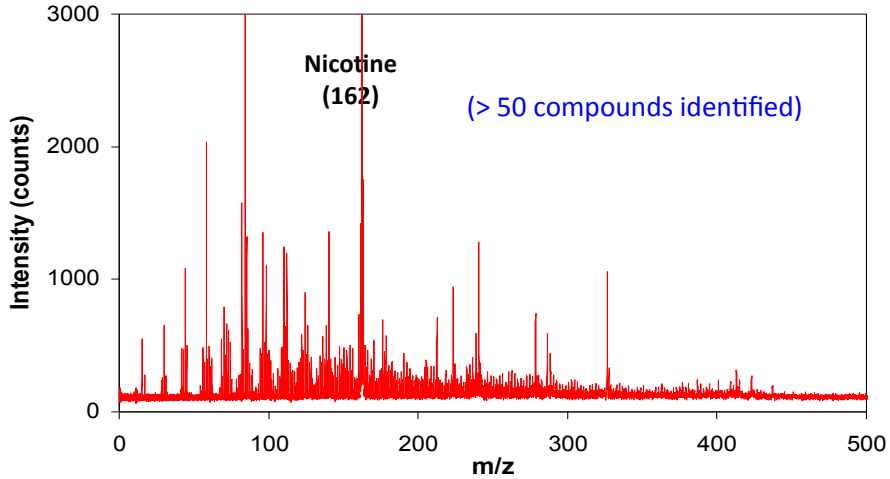
$[O_3]_0$ = 100 ppb	Humidified air (RH: 50%)
Secondary Organic Aerosol (SOA) yield (%)	9.2
Concentration (µg m^{-3})	186
Diameter (nm)	70 and 120

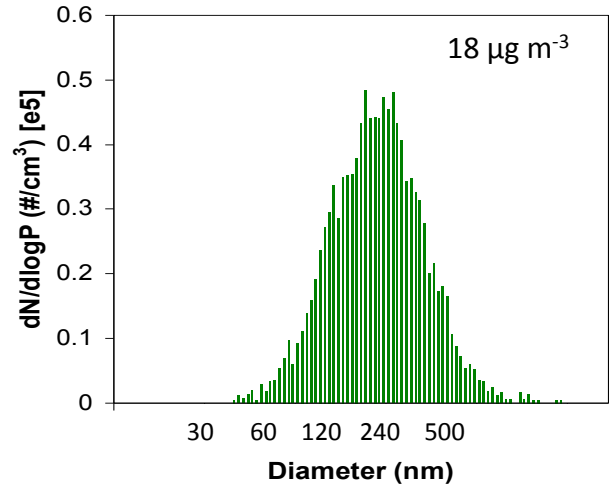
… also oxidation products that are more irritating than nicotine.

Sleiman et al., *Atmos. Environ*. 2010

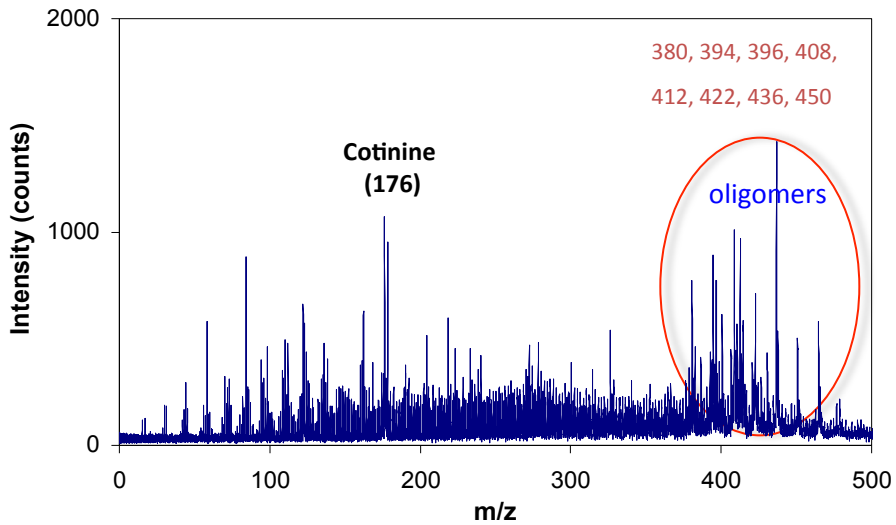
Ozone reactions with full cigarette smoke: smaller particles & more complex compounds

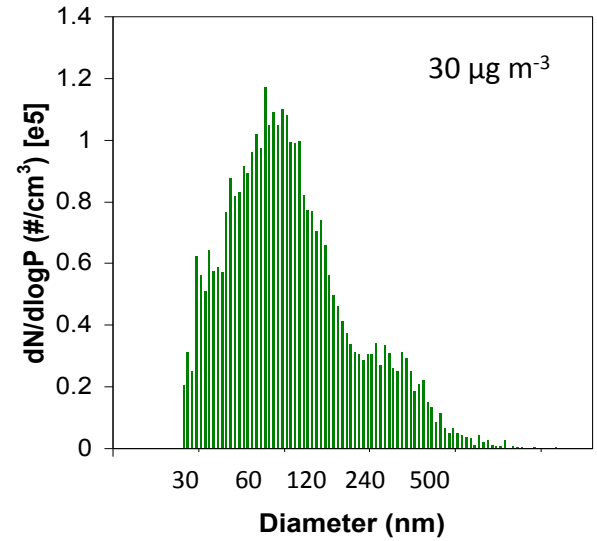
smoke before exposure to O_3





smoke after 1 hour of exposure to O_3 (< 100 ppbv)





Sleiman et al., *Atmos. Environ.*, 2010

Carcinogens are created by reaction of nicotine with nitrous acid (HONO) from cooking with gas

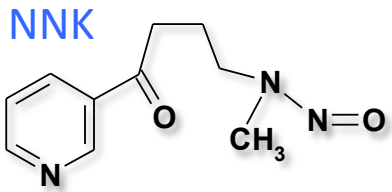
Sources of HONO and NOx

- ❑ combustion (indoor and outdoor)
- ❑ heterogeneous conversion of NOx on indoor surfaces yielding HONO (g)
- ❑ typical indoor HONO levels are 10-40 ppb (higher than outdoors)

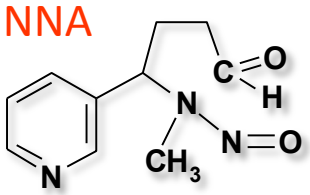
Formation of nitrosamines

- ❑ Reaction of surface-bound nicotine with HONO formed carcinogenic **tobacco-specific nitrosamines (TSNAs)**

NNK



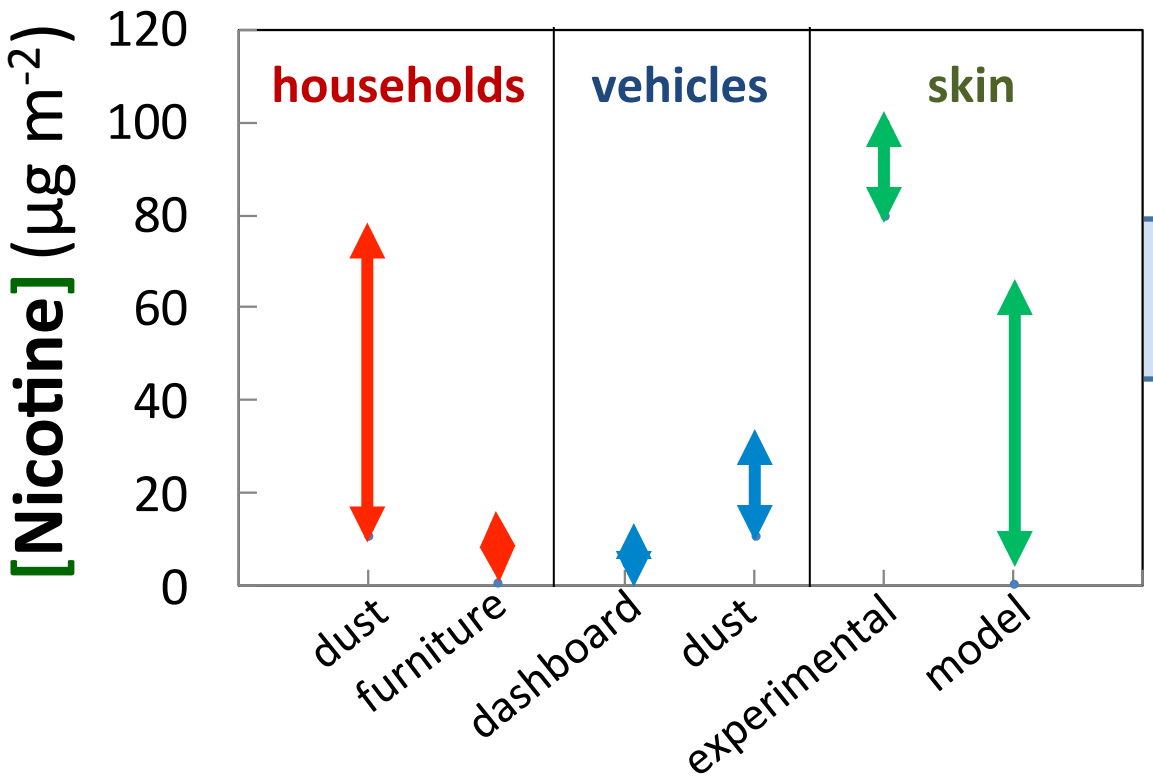
NNA



- ❑ NNA is not present in fresh smoke
- ❑ TSNAs were found on cabin surfaces of a smoker's vehicle
- ❑ We determined the TSNA yield of formation

Sleiman et al., *PNAS*, 2010

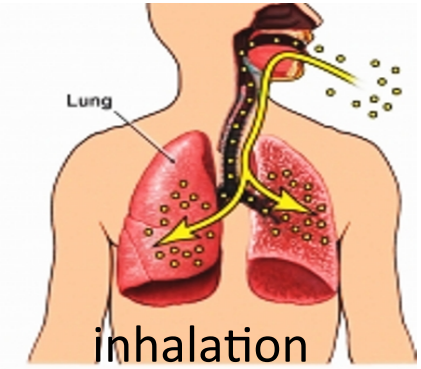
Implications for indoor exposures



[TSNA]
3 – 300
ng m^{-2}

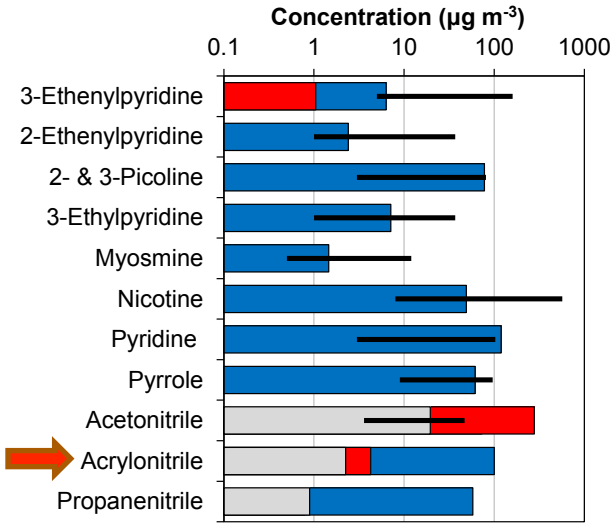
Do these TSNA levels pose a significant health hazard ?

Exposure pathways

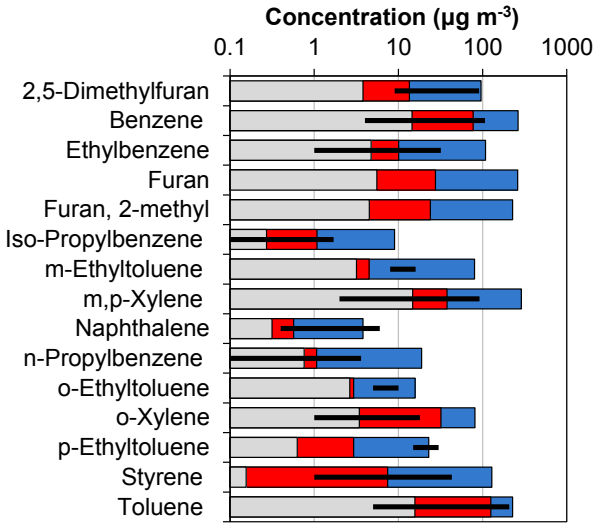


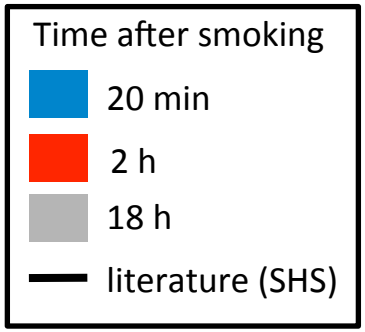
Exposure to THS via inhalation

Amines and nitriles

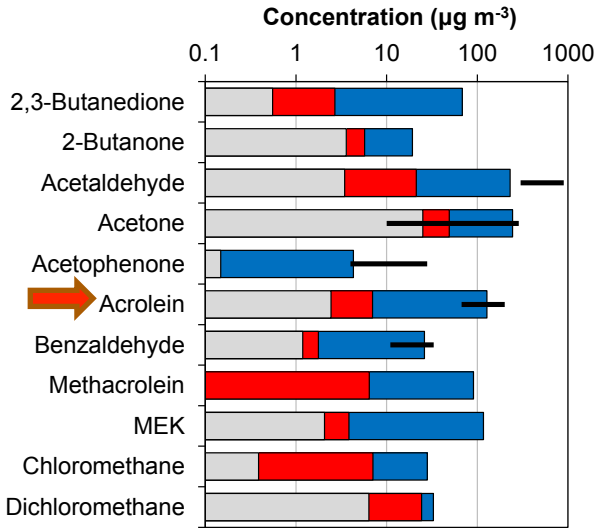


Aromatic hydrocarbons

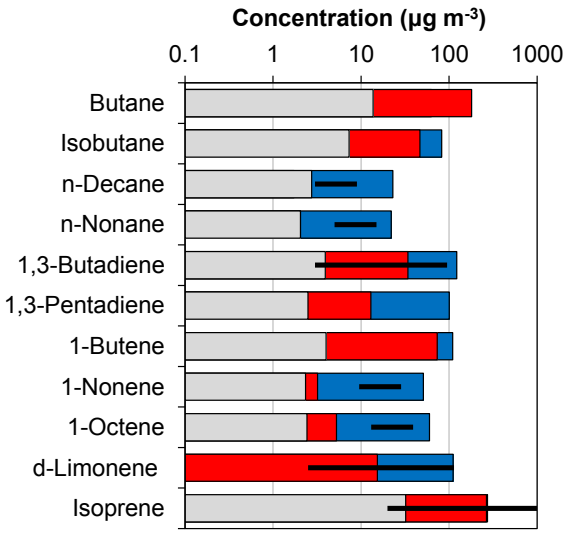




Carbonyls and chlorinated VOCs



Alkanes and alkenes



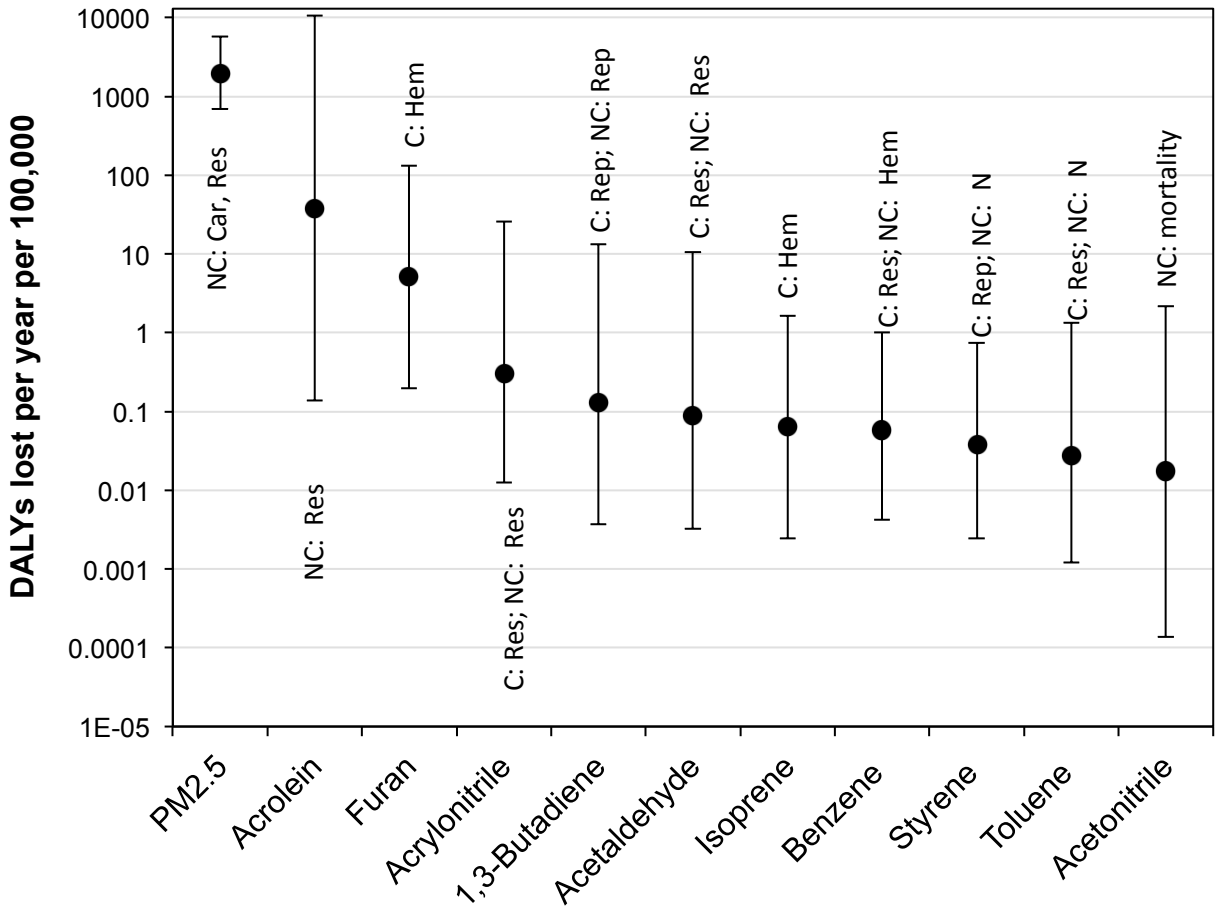
- acrolein & acrylonitrile exceeded CA reference levels after 18 h ( )

Sleiman et al, *ES&T* 2014

Quantifying the harm caused by inhalable THS constituents

DALYs: Disability-Adjusted Life Years

- Metric developed by WHO to assess the burden of diseases
- Accounts for years of life lost + equivalent years lost to disease or disability
- Integrates different health outcomes
- Enables identification and prioritization of top toxicants

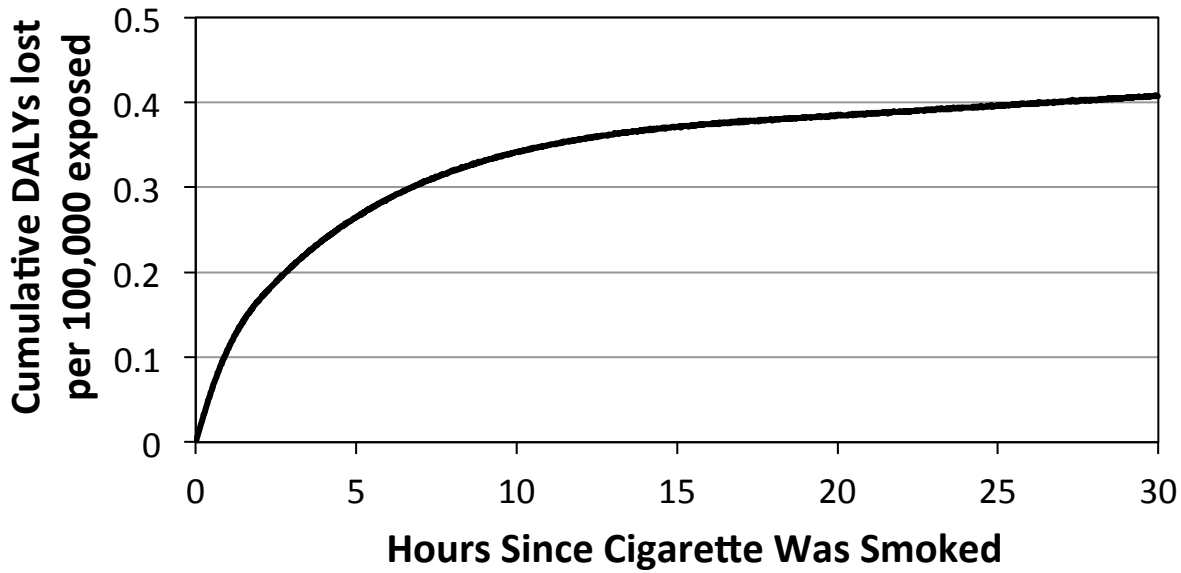


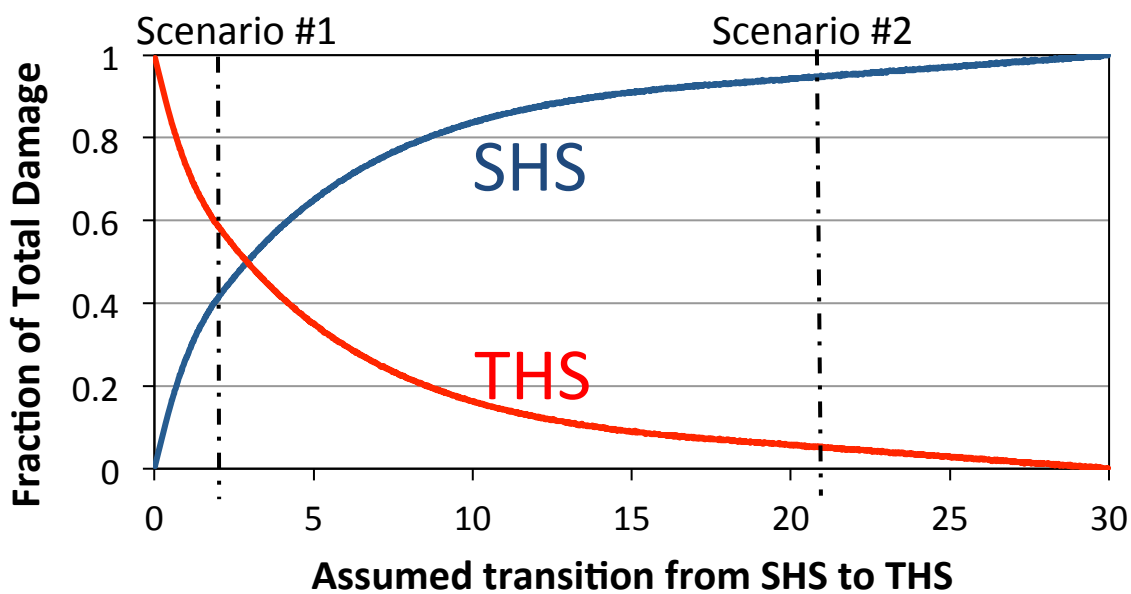
C: cancer	D: developmental	N: neurological	Res: respiratory
NC: noncancer	Hem: hematological	Ren: renal	S: skin
Car: cardiovascular	Hep: hepatic	Rep: reproductive	

Sleiman et al, *ES&T* 2014

Apportioning SHS and THS contributions to harm

Between 5% and 60% of the health impacts can be attributed to THS exposure





Sleiman et al, *ES&T* 2014

A very high profile thirdhand smoke case…

POLITICS

Speaker Paul Ryan Moves Fast to 'Detoxify' Boehner's Smoky Suite

By JENNIFER STEINHAUER NOV. 2, 2015

The speaker's office at the Capitol had been relabeled by Friday, if not redecorated. Stephen Crowley/The New York Times

The New York Times

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WASHINGTON — There are many things Americans cannot yet know about Speaker Paul D. Ryan's plans for his fancy new digs on Capitol Hill. Dark curtains or sheers? Memorabilia from the 2012 presidential campaign or his first House race in 1998? Will he hang a poster of his favorite band, Rage Against the Machine?

One thing is known: He wants to get rid of the smoke left behind by his predecessor, John A. Boehner. "You know when you ever go to a hotel room or get a rental car that has been smoked in? That's what this smells like," Mr. Ryan said in an interview on NBC's "Meet the Press" on Sunday in reference to the speaker's suite, which is of perhaps even greater interest to Mr. Ryan

Mr. Ryan said he would most likely rely on an "ozone machine" to "detoxify the environment" of the speaker's office…

Summary and future steps

- THS ages to form irritants, particles and carcinogens.
- There are still major information gaps.
  - Information on composition is limited by **sampling and analytical methods; especially for exposure to TSNAs & other toxicants**
- Health impact assessment should be refined and expanded.
  - Identify key compounds for further **toxicological evaluation**
- Remediation of THS: does it really work?
  - **Ozonation**: short-term and long-term residuals
  - Develop **guidelines** to help practitioners and the public

Acknowledgement

- Anwer Mujeeb & colleagues (TRDRP)
- Brett Singer, Marion Russell, Randy Maddalena (LBNL-Indoor Environment Group)
- Musahid Ahmed, Kevin Wilson (LBNL-Advanced Light Source)
- James F. Pankow (Portland State University)
- Peyton Jacob III, Suzaynn Schick (UCSF)
- California THS Consortium partners

TOBACCO-RELATED DISEASE RESEARCH PROGRAM

BERKELEY LAB
Lawrence Berkeley National Laboratory

Potentially harmful emissions from electronic cigarettes

H. Destaillats, M. Sleiman,
J. M. Logue, N. Montesinos,
M. Russell, L. Gundel

Indoor Environment Group
Energy Analysis & Environmental Impacts Division
Energy Technologies Area

Are e-cigarettes really as innocuous as advertised?

COMMONLY HEARD CLAIMS:

1. E-liquids are ***healthy*** ("food grade", "natural", "organic", "kosher", etc)

2. Emissions are just ***"harmless water vapor"…***

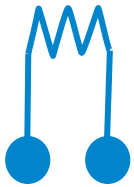
E-liquids and devices used in this study

E-liquids

	CT	BUB	MOJ
Nicotine	18 mg	24 mg	18 mg
PG:VG	50/50	?	?

Clearomizers

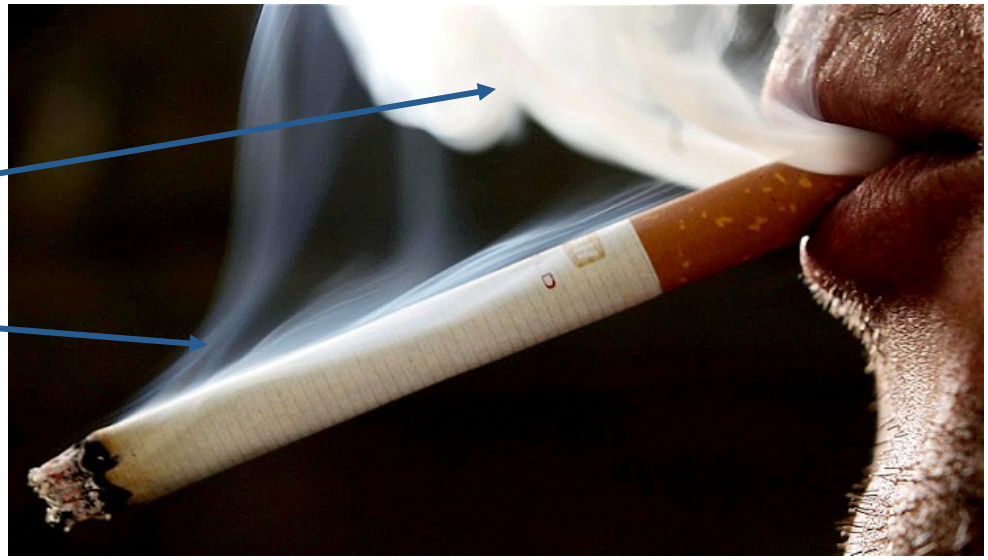
EGO
2.6 Ω



AERO
2.0 Ω

Secondhand vaping

Exhaled mainstream smoke
+
Sidestream smoke
(smoldering)



ONLY
Exhaled mainstream vapor

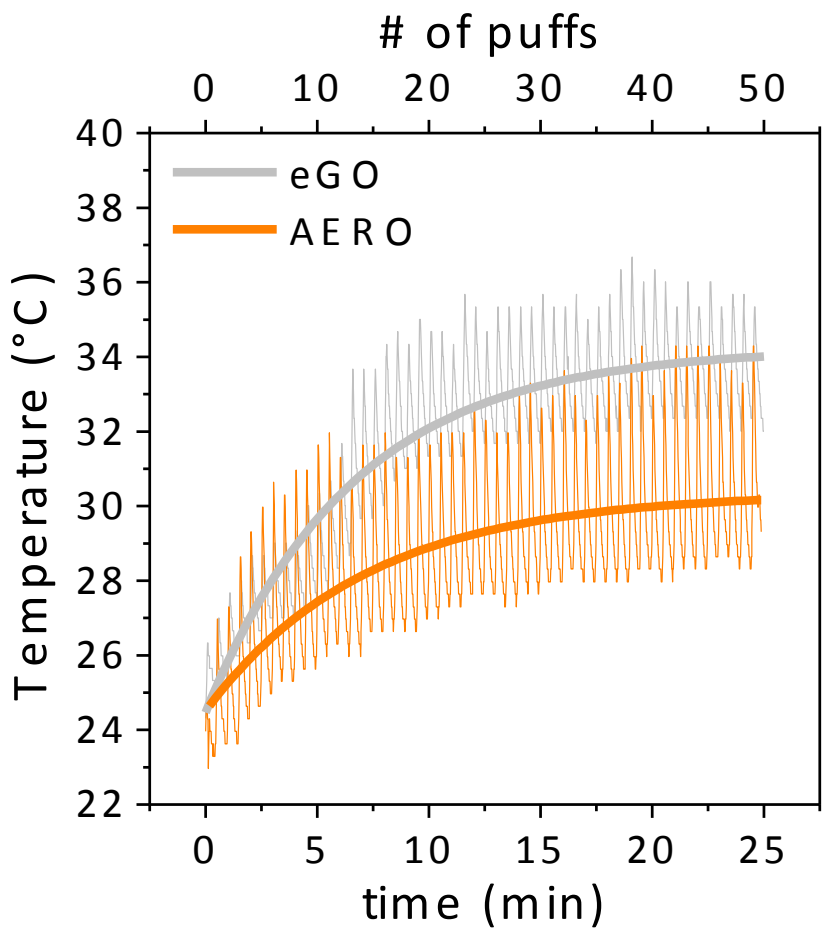
Also, topography of vaping can be very different from that of smoking…

Vaping in the laboratory

Typical e-cigarette topography:
- vaping rate: 2 – 4 puff min^{-1}
- puff volume: ~50 mL
- puff duration: 2 – 8 s
- inter-puff interval: 18 – 30 s
- puffing flow rate: ~ 20 mL s^{-1}

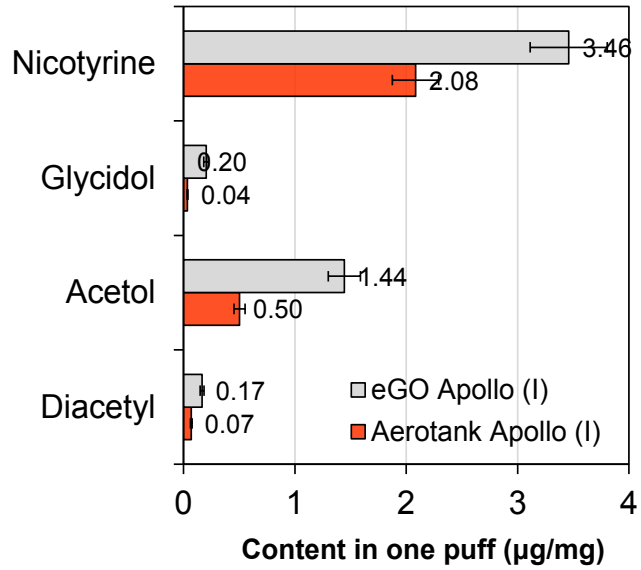
- Used mechanical system to simulate puffing topography
- Thermocouple placed in mouthpiece
- AERO (2 coils) had consistently lower temperatures than EGO (one coil)
- Samples were collected for two different vaping regimes:
  INITIAL: first 5 puffs
  STEADY-STATE: after puff #30

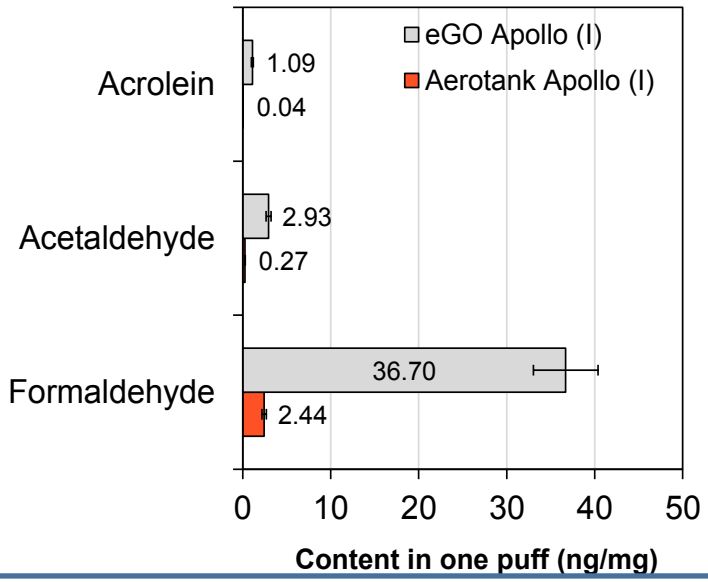
Profiles of vapor temperature at 3.8 V



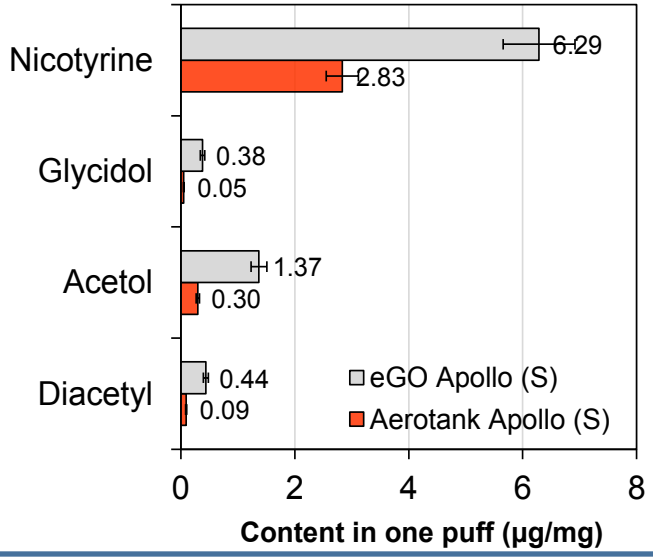
VOCs emitted at 3.8 V

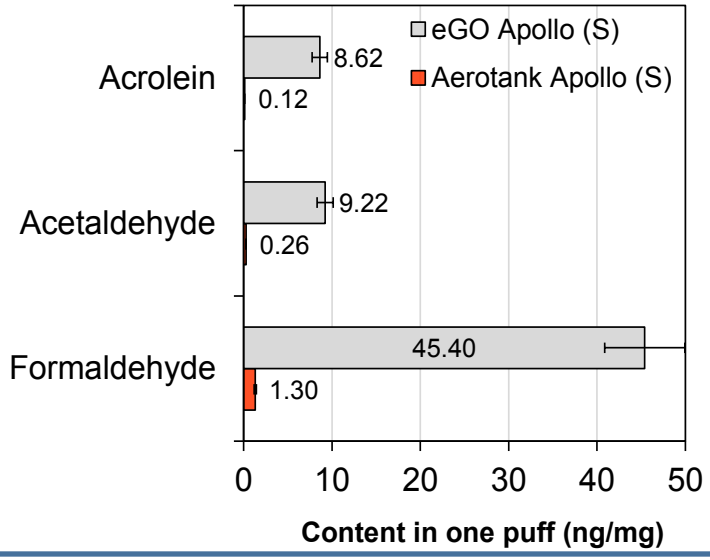
INITIAL





STEADY STATE





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TOBACCO-RELATED DISEASE RESEARCH PROGRAM

BERKELEY LAB
Lawrence Berkeley National Laboratory

2015 (Nov) Berkeley Lab Community Advisory Group Meeting

Health Impact of Thirdhand Smoke: DNA Damage and Other Adverse Changes

Bo Hang, Ph.D.
Biological Systems & Engineering Division
Lawrence Berkeley National Lab

BERKELEY LAB
Lawrence Berkeley National Laboratory

2010: my first grant on THS

ISSN 0027-8874 (Print)
ISSN 1460-2105 (Online)

Journal of the National Cancer Institute

JNCI

July 21, 2010, Volume 102, Number 14
jnci.oxfordjournals.org

OXFORD OPEN

NEWS

Thirdhand Smoke: Studies Multiply, Catchy Name Raises Awareness

By Rabiya S. Tuma

Health agencies have warned of the danger of secondhand smoke for decades. Now a small but growing number of scientists are testing the possible health effects associated with the residue that cigarette smoke deposits on furniture, clothing, and other surfaces, a substance some are calling "thirdhand smoke."

dividuals who thought thirdhand smoke was dangerous were more likely to ban smoking entirely from their homes than were individuals who did not perceive a health risk from smoke residue. The study attracted widespread media attention. Many of the news stories, though, focused not on the survey results but on the phrase "third-

perception of secondhand smoke was visible tobacco smoke. That is why this concept of thirdhand smoke is so important: It takes something from an annoyance and bad smell to something that could be harmful."

Not everyone agrees with his definition, though. "As far as I'm aware, almost everyone includes the smoke that has curled off

Health Implications

Exactly how toxic thirdhand smoke and its derivatives might be is now under investigation. The University of California Tobacco-Related Disease Research Program, which is funded by a state cigarette tax and which supported the work by Gundel and her collaborators, awarded three new grants in June. One recipient, Bo Hang, M.D., Ph.D., a staff scientist at the Lawrence Berkeley National Laboratory, will test the thirdhand smoke's effect on DNA. "If it can cause DNA damage, then you have the possibility to form cancer," Hang said. "We need to look for the evidence experimentally to assess the genotoxicity of thirdhand smoke. At this stage, that is all we can do."

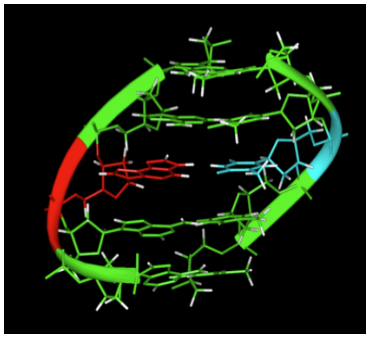
"We also found out that we could not actually measure a limit to the uptake of nicotine in . . .painted wallboard."

Is thirdhand smoke (THS) harmful to human health?

THS has become an increasing public health concern. However, little is known about its health impact

Next generation of toxicology tests

Genotoxicity and other biological effects



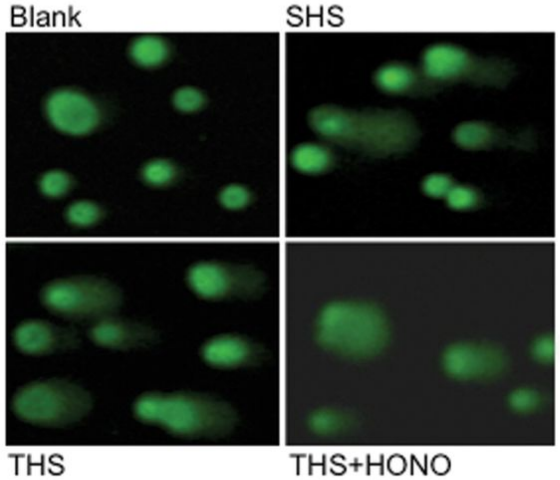
What have we done regarding the effects of THS exposure?

2010-2015

- Genotoxicity studies:
  - DNA strand breaks
  - Oxidative DNA damage (gene damage)
  - DNA adducts (esp. bulky adducts)
- Metabolomics studies
- Development studies (windows of susceptibility)
- Immunological function studies

Strand beaks: THS causes DNA strand breaks in human cells

A. Acute THS and THS+HONO



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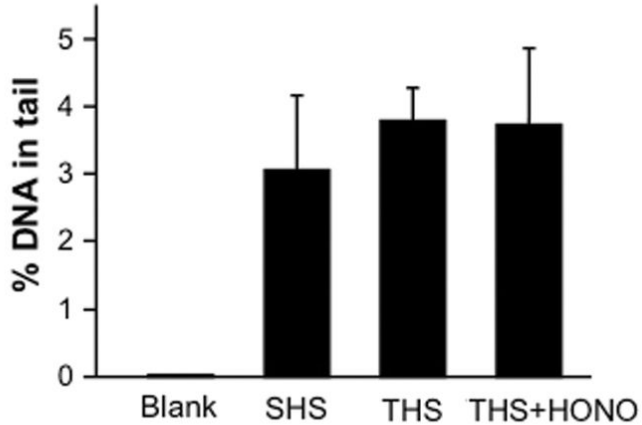
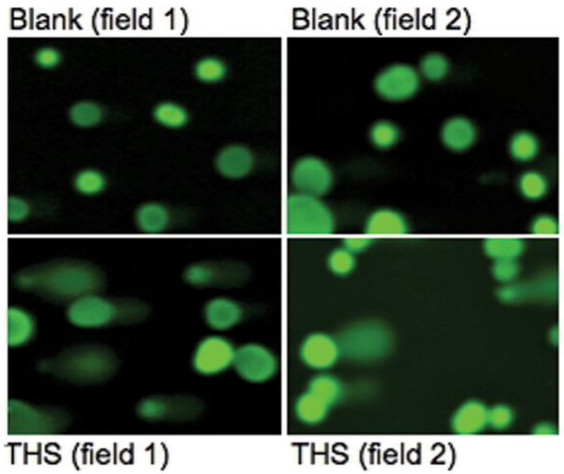
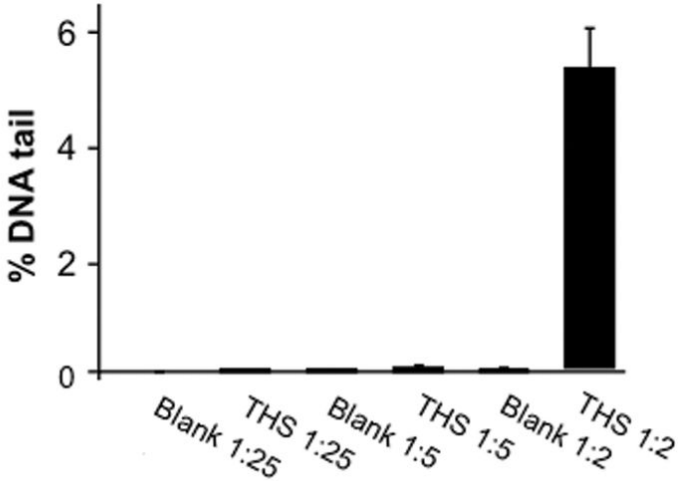


B. Chronic THS





Oxford Journals › Life Sciences & Medicine › Mutagenesis › Volume 28, Issue 4 › Pp. 381-

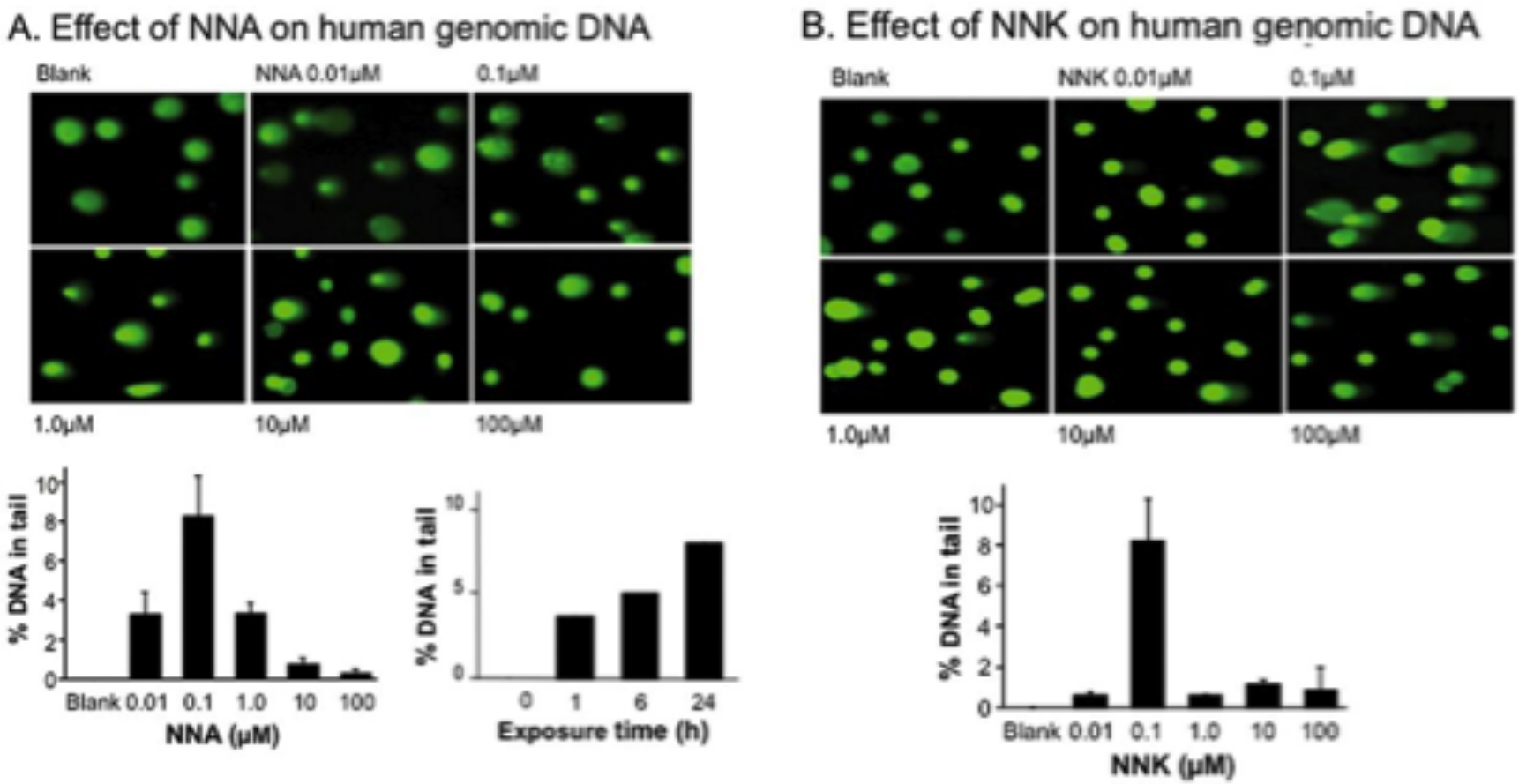
Thirdhand smoke causes DNA damage in human cells

Bo Hang[1,*], Altaf H. Sarker[1], Christopher Havel[2], Saikat Saha[3], Tapas K. Hazra[3], Suzaynn Schick[2], Peyton Jacob III[2], Virender K. Rehan[4], Ahmed Chenna[5], Divya Sharan[1], Mohamad Sleiman[6], Hugo Destaillats[6] and Lara A. Gundel[6]

+ Author Affiliations

*To whom correspondence should be addressed. Department of Cancer & DNA Damage Responses, Life Sciences Division, Lawrence Berkeley National Laboratory, 1 Cyclotron Rd, Berkeley, CA 94720, USA. Tel: +1 510-495-2537; Fax: +1 510-486-6488; Email: Bo_Hang@lbl.gov

NNA induces DNA strand breaks in human cells



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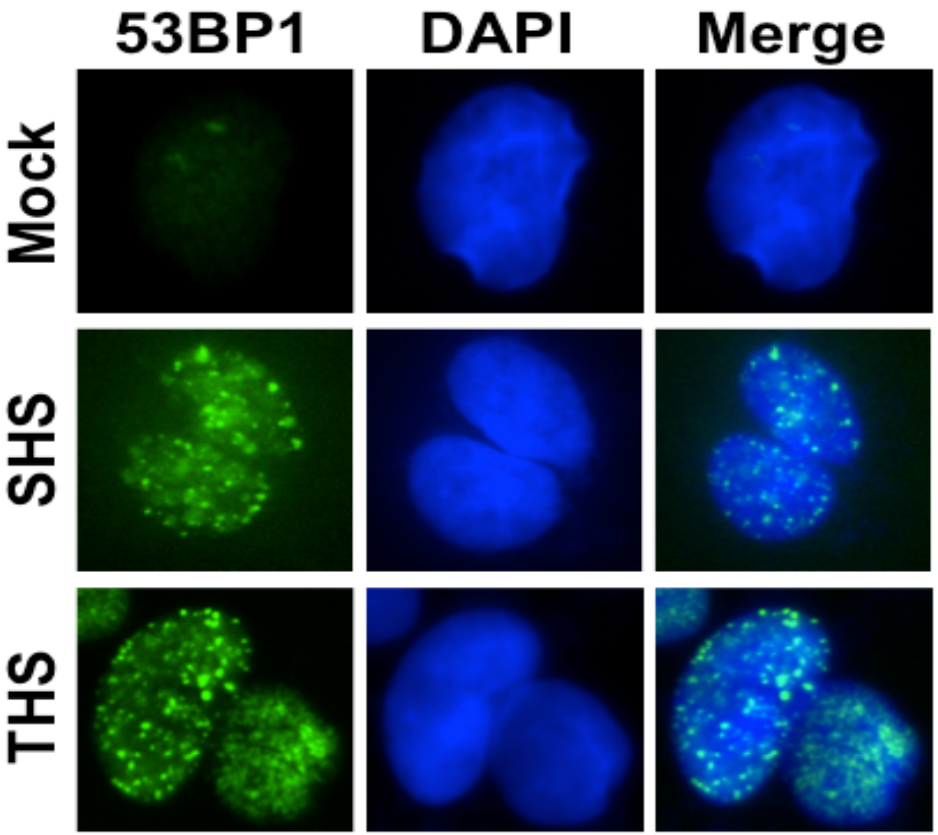

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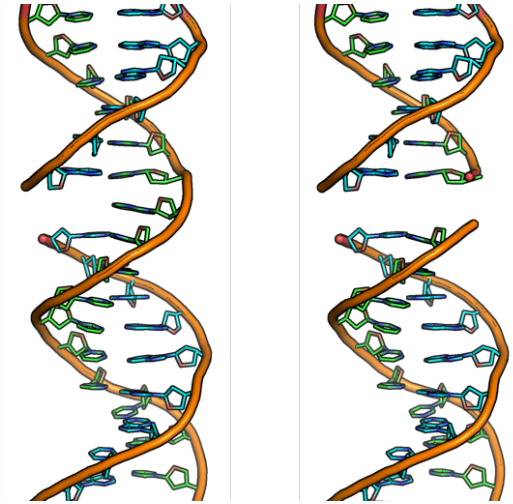

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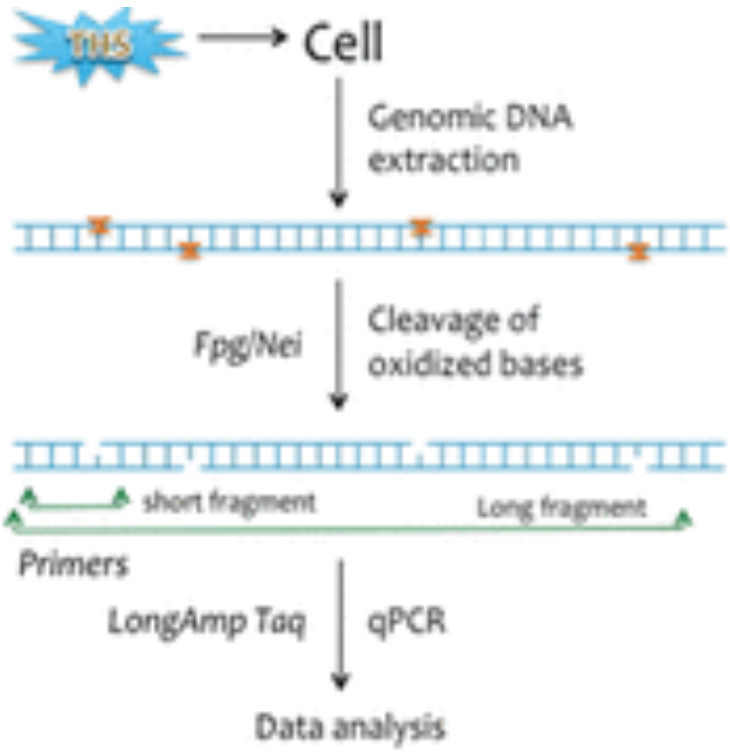

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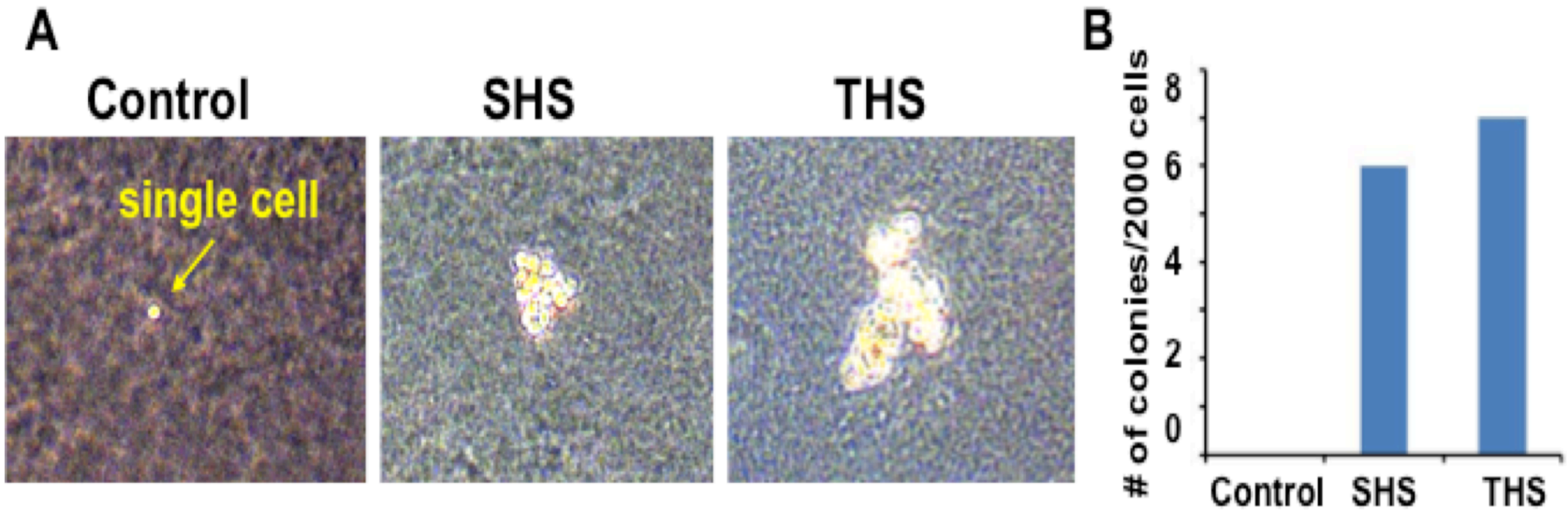

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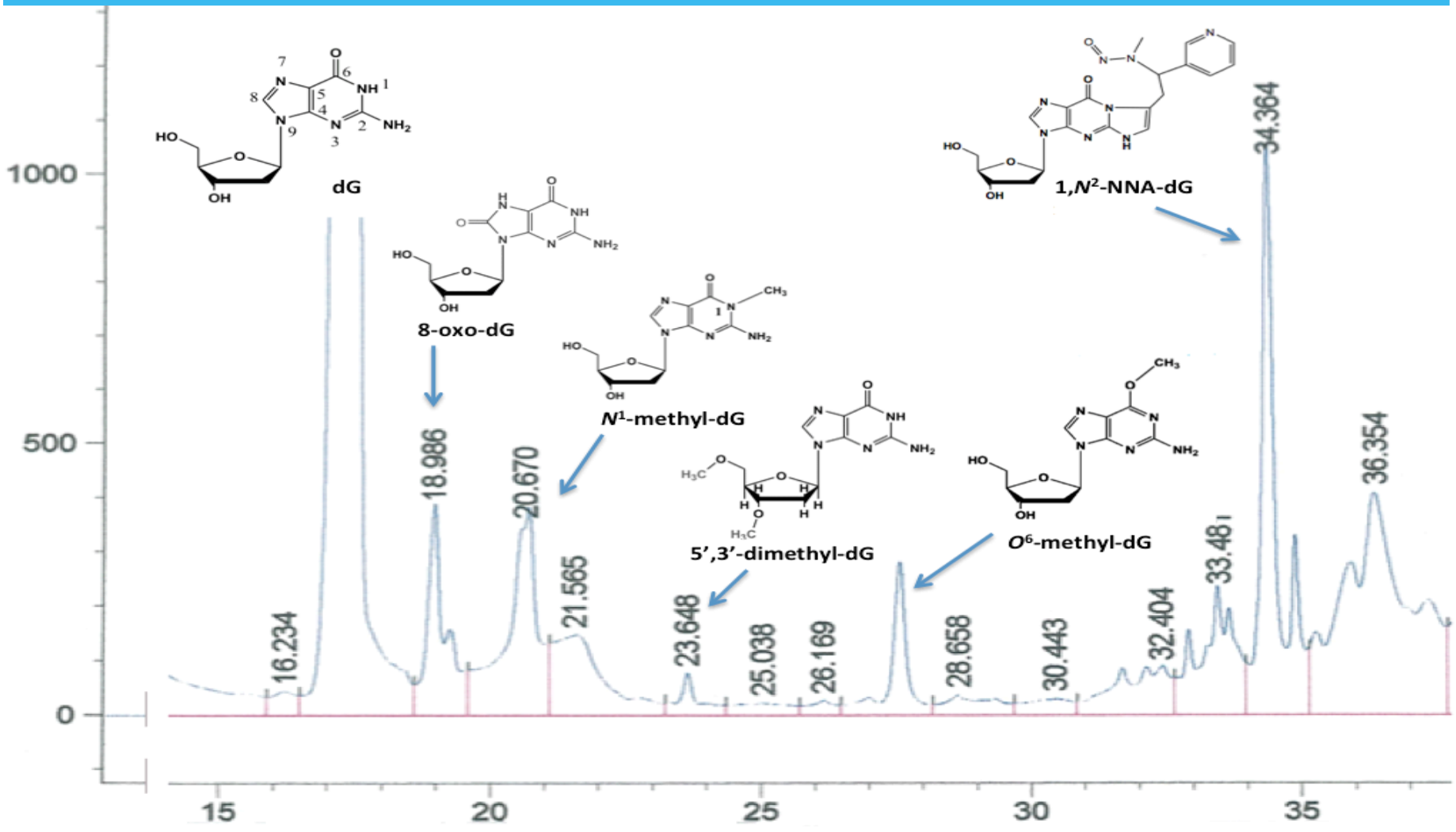

THS compound NNA forms a novel covalent dG adduct, 1,N²-NNA-dG

MAJOR 'THIRD-HAND SMOKE' COMPOUND CAUSES DNA DAMAGE—AND POTENTIALLY CANCER

Leftover cigarette smoke that clings to walls and furniture is a smelly nuisance, but now research suggests that it could pose a far more serious threat, especially to young children who put toys and other smoke-affected items into their mouths. Scientists reported today that one compound from this "third-hand smoke," which forms when second-hand smoke reacts with indoor air, damages DNA and sticks to it in a way that could potentially cause cancer.

Indoor smoking could pose a health threat long after cigarettes are put out

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"The best argument for instituting a ban on smoking indoors is actually third-hand smoke," said Hang, a scientist at Lawrence Berkeley National Laboratory (LBNL).

Researchers have found that many of the more than 4,000 compounds in second-hand smoke, which wafts through the air as a cigarette is smoked, can linger indoors long after a cigarette is stubbed out. Based on studies led by Hugo Destaillats, also at LBNL, these substances can go on to react with indoor pollutants such as ozone and nitrous acid, creating brand-new compounds, some of which may be carcinogenic.

One of those compounds goes by the acronym NNA. Hang's research has shown that NNA, a tobacco-specific nitrosamine, locks onto DNA to form a smoke that is inhaled as a person breathes in directly from the cigarette, making the connection between third-hand smoke or NNA and cancer could take a long time, Hang said.

But early research into its nature, exposure and health effects is compelling enough that a research consortium dedicated to investigating third-hand smoke was formed in California in 2010. That consortium helped fund Hang's work on NNA-induced DNA damage, which he said could eventually be used as biomarkers to identify people who have been exposed to third-hand smoke.

The biggest potential health risk is for babies and toddlers, he noted. As they crawl and put their hands or toys in their mouths, they could touch, swallow or inhale compounds from third-hand smoke. Their small size and early developmental stage make them more vulnerable than adults to the effects of environmental hazards.

Although many public places prohibit smoking, Hang noted that people can still smoke in most rental apartments and private residences — and smoking remains a huge public health issue. In 2011, nearly 44 million American adults reported smoking cigarettes, which ranks as the leading cause of preventable death in this country. And 34 million people smoke every day, according to data from the Centers for Disease Control & Prevention.

2013 THS is becoming a national concern 2014

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Pioneering study claims THIRD-HAND

Thirdhand Smoke Spurs DNA Damage, Study Finds

Posted: 06/24/2013 7:34 am EDT | Updated: 06/24/2013 10:41 pm EDT

We know firsthand smoke is bad ... hand smoke is also bad. But now, research ... the surface-clinging residue left over ... to our DNA.

"This ... is mutagenic," study resea... ley National laboratory, said in a st... mes, some of the chemical compounds in thirdh... among the most potent carcinogens there are. They stay on surfaces, and when those surfaces are clothing or carpets, the danger to children is especially serious."

The study, published in the journal Mutagenesis, doesn't just show that thirdhand smoke can harm cells -- it also shows that the harm it can cause could become worse with time.

THE HUFFINGTON POST

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美国华人科学家主导研究发现三手烟损害人体基因

2013-06-27 13:31:36 来源：中国新闻网

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[提要] (记者 刘丹)一项由美国华人科学家主导的跨学科研究发现，三手烟在人体细胞会引起基因突变，从而造成癌症和其他疾病的可能性。机渤26日接受中新社记者访问时说，三手烟指吸烟后残留在空间里物体表面的化学物质。

THE TIMES OF INDIA

...gering smoke can harm DNA

...eya Sinha, TNN Jun 22, 2013, 05.13AM IST

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... Touch | Smoking | Genetic |

...DON: The direct hazards o... known and so are the ill-effects ... hand smoke. But scientists have ... first time that third-hand smok... that clings to hair, skin, clothes, walls, furniture, drapes, beddin... long after smoking has stopped ... genetic damage to human cells ... an independent causative ager...

'Thirdhand' smoke poses cancer risk

By John Roberts / Published March 17, 2014 / FoxNews.com

New research out of the Lawrence Berkeley National Laboratory has found that the residue from smoking indoors – so-called "thirdhand smoke" – has the potential to cause cancer.

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DNA damage seen from "thirdhand smoke"

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A NEWSLETTER FROM THE UNIVERSITY OF CALIFORNIA PRESIDENT FOR THE UC COMMUNITY
June 2013
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Systemwide News

Legislators tap grad students for expertise

After presentations at Graduate Research Day in Sacramento, legislators ask students for input on issues ranging from urban planning to protecting marine ecosystems.

Read more about grad students in Sacramento.

UC launches magazine for mobile devices

Fiat Lux, a new digital magazine, highlights the public value UC brings to the state and the world.

Read more about Fiat Lux.

Fighting breast cancer

For 20 years, UC's California Breast Cancer Research Program has fought the disease through innovative research and community outreach.

Watch this video about the

More Systemwide News

- Faculty, non-represented academic and staff employee... get salary increase July 1
- UC Irvine ranked fifth in world among universities und... 50 years old
- Lawrence Berkeley Lab confirms thirdhand smoke causes DNA damage
- UCLA's Bruin Woods camp has August openings

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Science on NBCNEWS.com

Thirdhand Smoke Damages Human Cells

...brain may ...birth, autism

...the legacy of

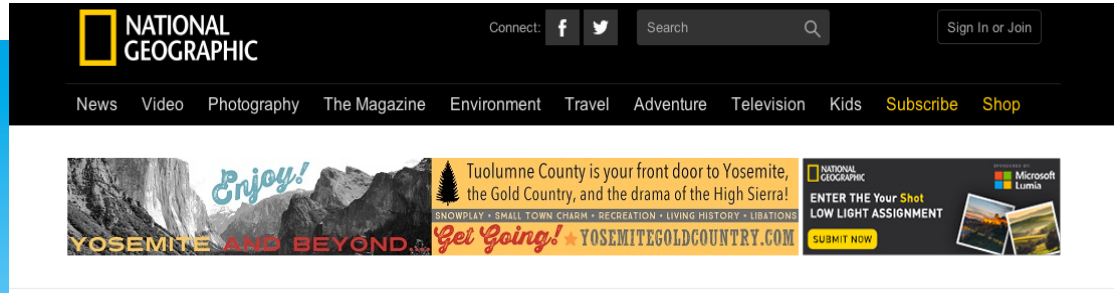
From the media

National Public Radio:
Scientists search for toxins in cigarette smoke residue (2014.3.17)

National Geographic:
Thirdhand smoke is real - and risky to your health (2014.3.20)

Men's Health: Health danger: thirdhand smoke (2014.3.24)

American Baby Magazine (2014.8)



Thirdhand Smoke Is Real—And Risky to Your Health

Indoor cigarette smoke combines with air pollutants to form compounds that might cause cancer—and that can linger for decades.

Local

California Bill Targets Third-Hand Smoke In Home Day Care Centers

April 21, 2014 4:21 PM

Related Tags: Assembly

SACRAMENTO, Calif. (AP) – The Assembly approved a bill Monday that would ban smoking inside home day care centers even after the children have left, a regulation that targets lingering "third-hand smoke" and has been adopted by 12 other states.

The chamber passed the measure by Assemblyman Isadore Hall, D-Compton, on a 55-8 vote, with some Republican lawmakers opposed.

Assembly Bill No. 1819

CHAPTER 459

An act to amend Section 1596.795 of the Health and Safety Code, and to amend Section 6404.5 of the Labor Code, relating to public health.

[Approved by Governor September 19, 2014. Filed with Secretary of State September 19, 2014.]

LEGISLATIVE COUNSEL'S DIGEST

AB 1819, Hall. Family day care home: smoking prohibition.

Existing law, the California Child Day Care Facilities Act, governs the licensing and operation of family day care homes and requires the State Department of Social Services to administer these provisions. Among other things, the act prohibits the smoking of tobacco in a private residence that is licensed as a family day care home during the hours of operation as a family day care home. A person who willfully or repeatedly violates a provision of the act is guilty of a misdemeanor.

This bill would prohibit the smoking of tobacco in a private residence that is licensed as a family day care home without regard to whether the act occurs during the hours of operation of the home. By expanding the scope of a crime, the bill would impose a state-mandated local program. The bill would also make a conforming change.

The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

The people of the State of California do enact as follows:

SECTION 1. Section 1596.795 of the Health and Safety Code is amended to read:

1596.795. (a) The smoking of tobacco in a private residence that is licensed as a family day care home shall be prohibited in the home and in those areas of the family day care home where children are present. Nothing in this section shall prohibit a city or county from enacting or enforcing an ordinance relating to smoking in a family day care home if the ordinance is more stringent than this section.

Conclusions

- This was the first genotoxic study of its kind on thirdhand smoke (THS)
- Our findings show that thirdhand smoke present health hazards and potential cancer risk to the public
- Our findings have raised awareness around the health issues of thirdhand smoke and have already led to a change in state policy

2015 (Nov) Berkeley Lab Community Advisory Group Meeting

Health Impact of Thirdhand Smoke: DNA Damage and Other Adverse Changes

Bo Hang, Ph.D.
Biological Systems & Engineering Division
Lawrence Berkeley National Lab

BERKELEY LAB
Lawrence Berkeley National Laboratory

2010: my first grant on THS

ISSN 0027-8874 (Print)
ISSN 1460-2105 (Online)

Journal of the National Cancer Institute

JNCI

July 21, 2010, Volume 102, Number 14
jnci.oxfordjournals.org

OXFORD OPEN

NEWS

Thirdhand Smoke: Studies Multiply, Catchy Name Raises Awareness

By Rabiya S. Tuma

Health agencies have warned of the danger of secondhand smoke for decades. Now a small but growing number of scientists are testing the possible health effects associated with the residue that cigarette smoke deposits on furniture, clothing, and other surfaces, a substance some are calling "thirdhand smoke."

dividuals who thought thirdhand smoke was dangerous were more likely to ban smoking entirely from their homes than were individuals who did not perceive a health risk from smoke residue. The study attracted widespread media attention. Many of the news stories, though, focused not on the survey results but on the phrase "third-

perception of secondhand smoke was visible tobacco smoke. That is why this concept of thirdhand smoke is so important: It takes something from an annoyance and bad smell to something that could be harmful."

Not everyone agrees with his definition, though. "As far as I'm aware, almost everyone includes the smoke that has curled off

Health Implications

Exactly how toxic thirdhand smoke and its derivatives might be is now under investigation. The University of California Tobacco-Related Disease Research Program, which is funded by a state cigarette tax and which supported the work by Gundel and her collaborators, awarded three new grants in June. One recipient, Bo Hang, M.D., Ph.D., a staff scientist at the Lawrence Berkeley National Laboratory, will test the thirdhand smoke's effect on DNA. "If it can cause DNA damage, then you have the possibility to form cancer," Hang said. "We need to look for the evidence experimentally to assess the genotoxicity of thirdhand smoke. At this stage, that is all we can do."

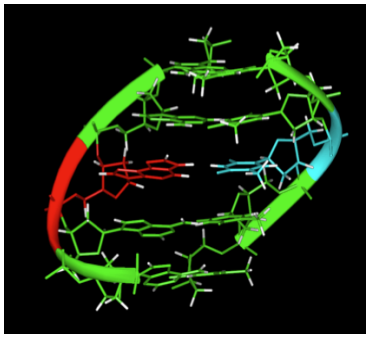
"We also found out that we could not actually measure a limit to the uptake of nicotine in . . .painted wallboard."

Is thirdhand smoke (THS) harmful to human health?

THS has become an increasing public health concern. However, little is known about its health impact

Next generation of toxicology tests

Genotoxicity and other biological effects



What have we done regarding the effects of THS exposure?

2010-2015

- Genotoxicity studies:
  - DNA strand breaks
  - Oxidative DNA damage (gene damage)
  - DNA adducts (esp. bulky adducts)
- Metabolomics studies
- Development studies (windows of susceptibility)
- Immunological function studies

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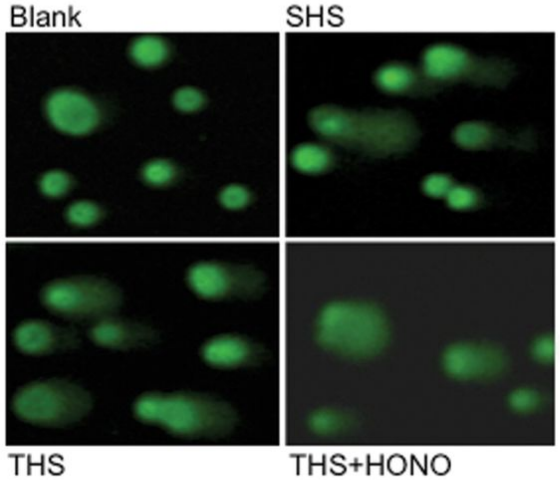

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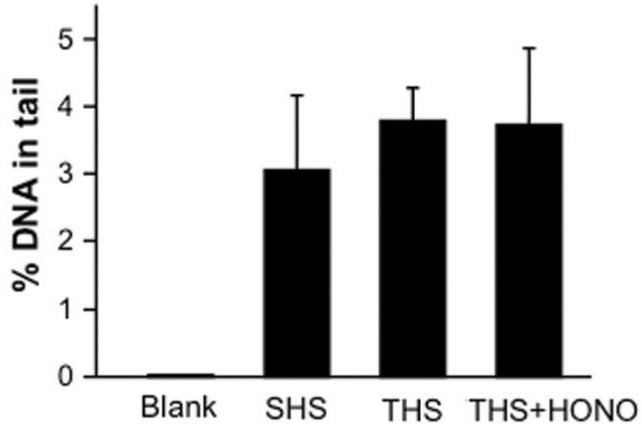

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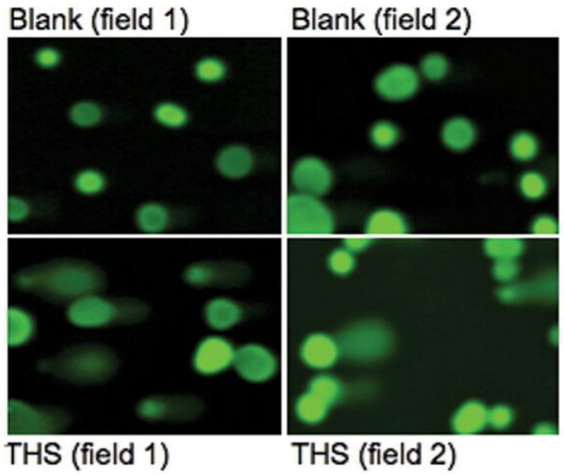

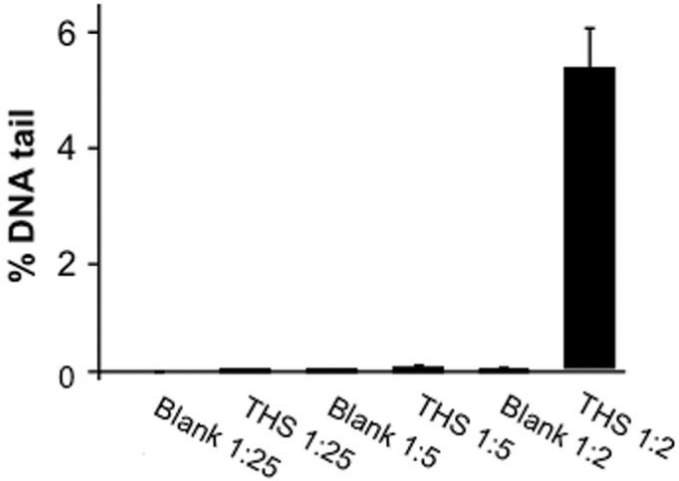

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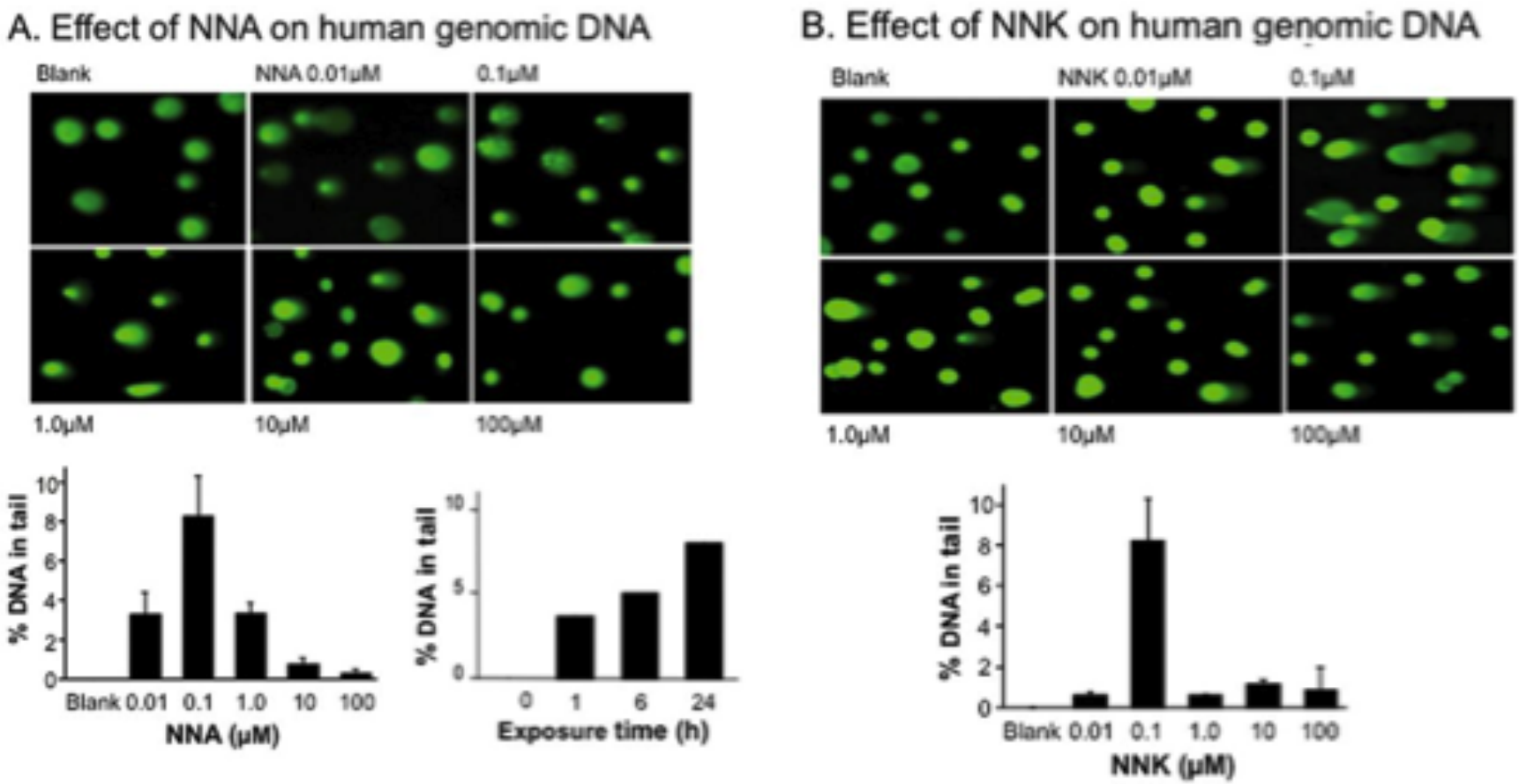

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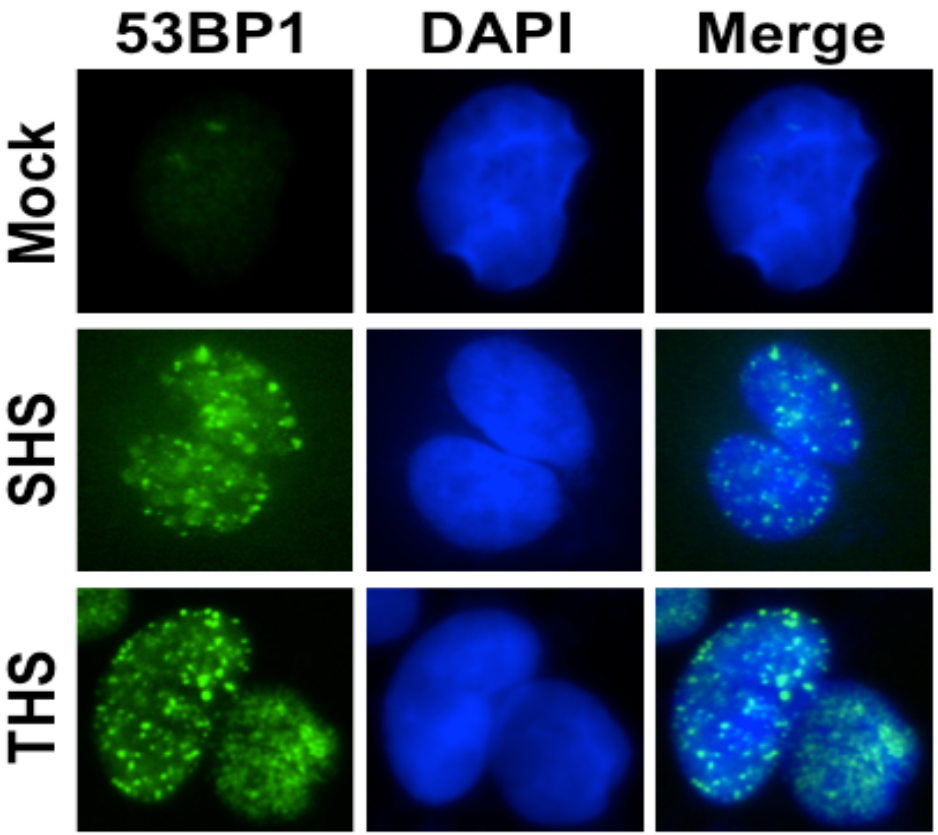

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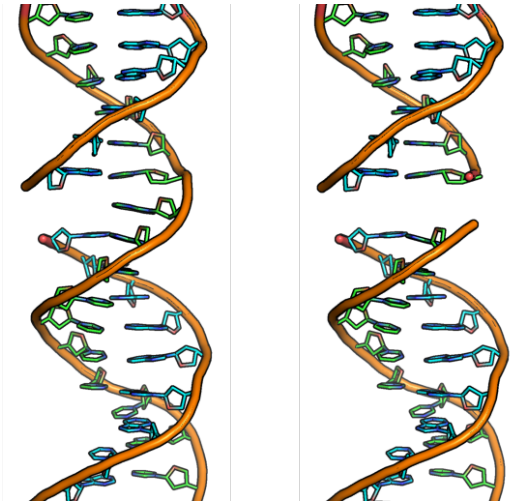

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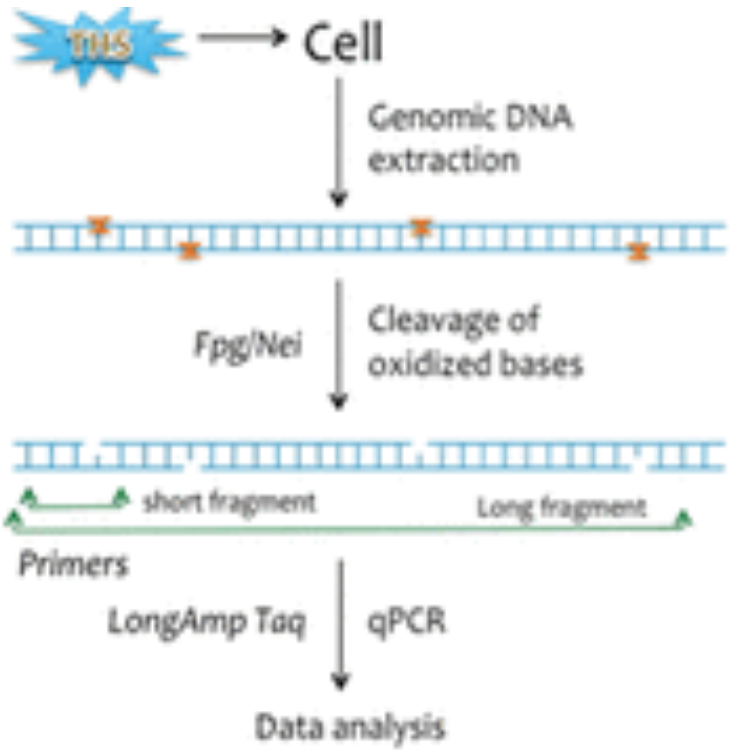

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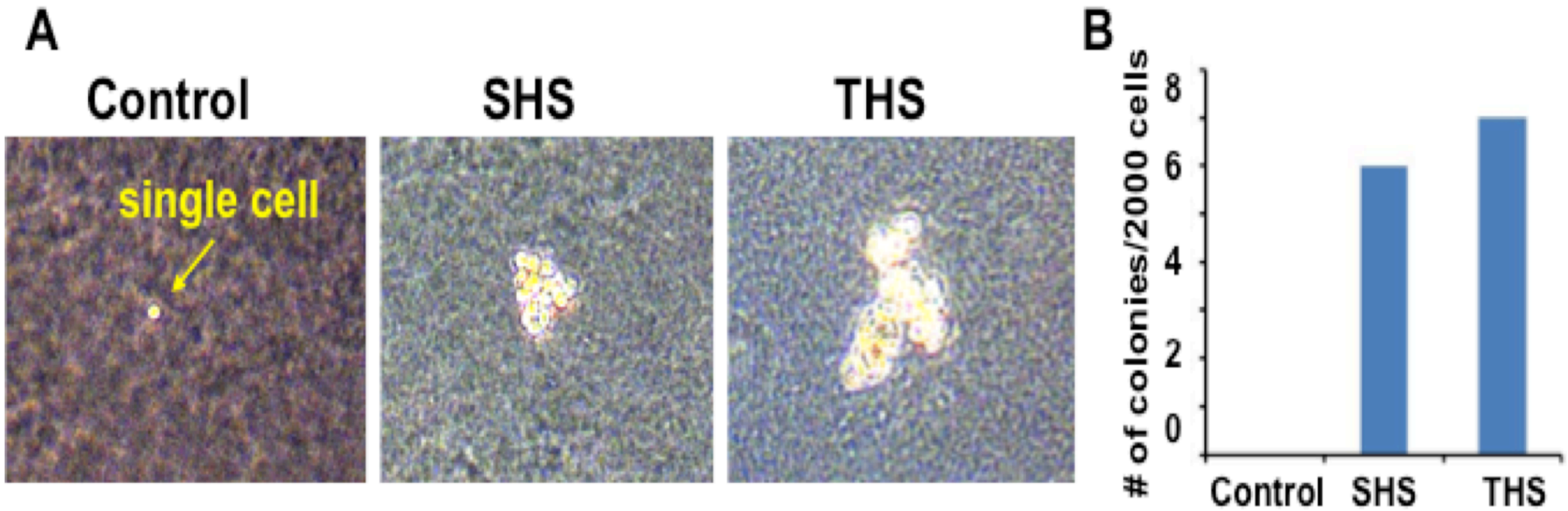

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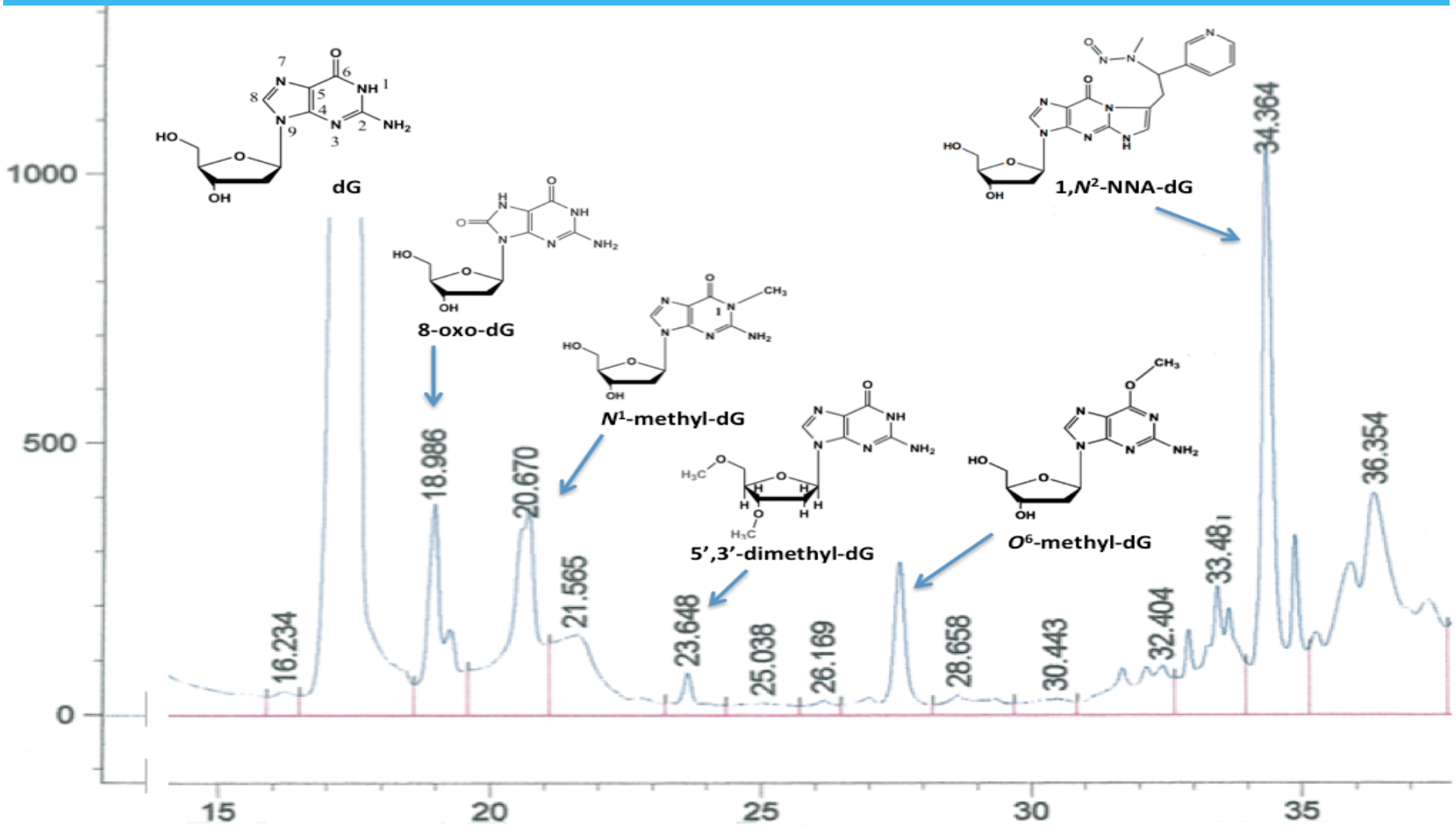

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Pioneering study claims THIRD-HAND

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美国华人科学家主导研究发现三手烟损害人体基因

2013-06-27 13:31:36 来源：中国新闻网

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[提要] (记者 刘丹)一项由美国华人科学家主导的跨学科研究发现，三手烟在人体细胞会引起基因突变，从而造成癌症和其他疾病的可能性。机渤26日接受中新社记者访问时说，三手烟指吸烟后残留在空间里物体表面的化学物质。

THE TIMES OF INDIA

...gering smoke can harm DNA

...eya Sinha, TNN Jun 22, 2013, 05.13AM IST

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...DON: The direct hazards o... known and so are the ill-effects ... hand smoke. But scientists have ... first time that third-hand smok... that clings to hair, skin, clothes, walls, furniture, drapes, beddin... long after smoking has stopped ... genetic damage to human cells ... an independent causative ager...

'Thirdhand' smoke poses cancer risk

By John Roberts / Published March 17, 2014 / FoxNews.com

New research out of the Lawrence Berkeley National Laboratory has found that the residue from smoking indoors – so-called "thirdhand smoke" – has the potential to cause cancer.

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DNA damage seen from "thirdhand smoke"

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June 2013
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After presentations at Graduate Research Day in Sacramento, legislators ask students for input on issues ranging from urban planning to protecting marine ecosystems.

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UC launches magazine for mobile devices

Fiat Lux, a new digital magazine, highlights the public value UC brings to the state and the world.

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Fighting breast cancer

For 20 years, UC's California Breast Cancer Research Program has fought the disease through innovative research and community outreach.

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- Faculty, non-represented academic and staff employee... get salary increase July 1
- UC Irvine ranked fifth in world among universities und... 50 years old
- Lawrence Berkeley Lab confirms thirdhand smoke causes DNA damage
- UCLA's Bruin Woods camp has August openings

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Science on NBCNEWS.com

Thirdhand Smoke Damages Human Cells

...brain may ...birth, autism

...the legacy of

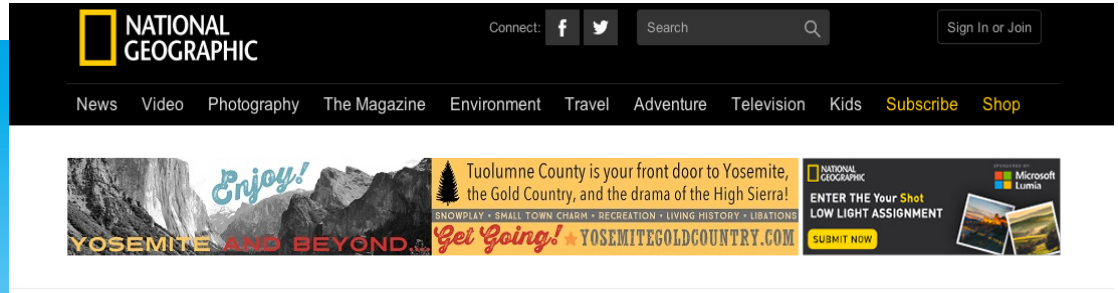
From the media

National Public Radio:
Scientists search for toxins in cigarette smoke residue (2014.3.17)

National Geographic:
Thirdhand smoke is real - and risky to your health (2014.3.20)

Men's Health: Health danger: thirdhand smoke (2014.3.24)

American Baby Magazine (2014.8)



Thirdhand Smoke Is Real—And Risky to Your Health

Indoor cigarette smoke combines with air pollutants to form compounds that might cause cancer—and that can linger for decades.

Local

California Bill Targets Third-Hand Smoke In Home Day Care Centers

April 21, 2014 4:21 PM

Related Tags: Assembly

SACRAMENTO, Calif. (AP) – The Assembly approved a bill Monday that would ban smoking inside home day care centers even after the children have left, a regulation that targets lingering "third-hand smoke" and has been adopted by 12 other states.

The chamber passed the measure by Assemblyman Isadore Hall, D-Compton, on a 55-8 vote, with some Republican lawmakers opposed.

Assembly Bill No. 1819

CHAPTER 459

An act to amend Section 1596.795 of the Health and Safety Code, and to amend Section 6404.5 of the Labor Code, relating to public health.

[Approved by Governor September 19, 2014. Filed with Secretary of State September 19, 2014.]

LEGISLATIVE COUNSEL'S DIGEST

AB 1819, Hall. Family day care home: smoking prohibition.

Existing law, the California Child Day Care Facilities Act, governs the licensing and operation of family day care homes and requires the State Department of Social Services to administer these provisions. Among other things, the act prohibits the smoking of tobacco in a private residence that is licensed as a family day care home during the hours of operation as a family day care home. A person who willfully or repeatedly violates a provision of the act is guilty of a misdemeanor.

This bill would prohibit the smoking of tobacco in a private residence that is licensed as a family day care home without regard to whether the act occurs during the hours of operation of the home. By expanding the scope of a crime, the bill would impose a state-mandated local program. The bill would also make a conforming change.

The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

The people of the State of California do enact as follows:

SECTION 1. Section 1596.795 of the Health and Safety Code is amended to read:

1596.795. (a) The smoking of tobacco in a private residence that is licensed as a family day care home shall be prohibited in the home and in those areas of the family day care home where children are present. Nothing in this section shall prohibit a city or county from enacting or enforcing an ordinance relating to smoking in a family day care home if the ordinance is more stringent than this section.

Conclusions

- This was the first genotoxic study of its kind on thirdhand smoke (THS)
- Our findings show that thirdhand smoke present health hazards and potential cancer risk to the public
- Our findings have raised awareness around the health issues of thirdhand smoke and have already led to a change in state policy