Secondhand Smoke and Cancer: An Emerging Story

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Why worry about secondhand smoke (SHS) exposure?

- Adverse health effects
  - Preclinical
  - Cancer
- Common exposure
- Amenable to public health action

Active cigarette smoking: a major cause of cancer

Accounts for approximately 1/3 of all cancer deaths

Active cigarette smoking: a major cause of cancer

Lung
Oral cavity
Larynx
Esophagus
Pancreas
Bladder
Kidney

2004 SG Report has added the following cancers:

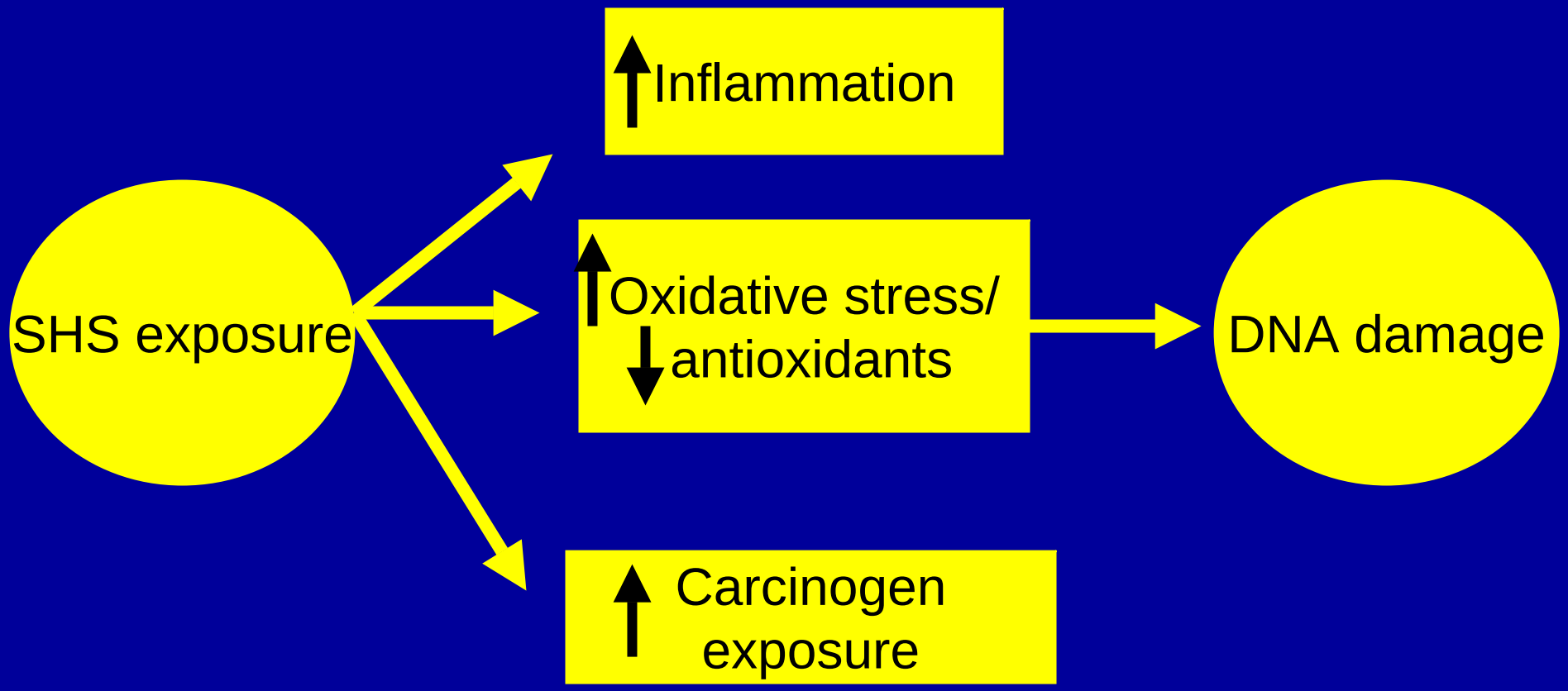
Cervical
Gastric
Acute myeloid leukemia

Protection:
Endometrial

Tumorigenic agents in cigarette smoke

- Polycyclic aromatic hydrocarbons
  (Benzo[a]pyrene)
- Aza-arenes (Quinoline)
- N-nitrosoamines (NNN, NNK)
- Aromatic amines (4-Aminobiophenyl)
- Aldehydes (Formaldehyde)
- Miscellaneous organic compounds
  (Benzene, Vinyl chloride)
- Inorganic compounds
  (Polonium 210, Arsenic, Nickel, Chromium, Cadmium)

SHS exposure and preclinical health effects: biologic plausibility



SHS and inflammatory markers: Leukocyte count

Nonsmokers: % difference between SHS exposed and nonexposed

	Occasional	Regular
Men	1.6%	13.1%
Women	3.4%	13.6%

Source: Pangiotakos DB et al . Am J Med 2005; 116: 145

SHS and inflammatory markers: C-reactive protein

Nonsmokers: % difference between SHS exposed and nonexposed

	Occasional	Regular
Men	27.3%	36.4%
Women	16.7%	33.3%

Source: Pangiotakos DB et al . Am J Med 2005; 116: 145

SHS and oxidative stress: Isoprostanes

12 nonsmokers exposed to smoke of 30 cigarettes per day for 12 consecutive days:

- Each day, >20% increase in isoprostanes after exposure to SHS.
- After 12 days, basal values approach smokers.

Source: Ahmadzadehfar H, et al. Life Sciences 2005

SHS and oxidative stress: Dehydroascorbic Acid (DHAA)

Nonsmokers: % difference between SHS exposed and nonexposed

	% Difference
SHS	+46%
Active smokers	+58%

Source: Barnoya J et al . Circulation 2005; 111: 2684

Active cigarette smoking reduces circulating micronutrient concentrations

	% Difference
Vitamin C	-27%
Alpha-carotene	-33%
Beta-carotene	-34%
Cryptoxanthin	-27%

Source: Alberg AJ. Toxicology 2002; 180: 121-137

SHS & antioxidant micronutrients: Provitamin A carotenoids

Nonsmokers: % difference between SHS exposed and nonexposed

	% Difference
Alpha-carotene	-22%
Beta-carotene	-19%
Cryptoxanthin	-27%

Source: Alberg AJ et al. Am J Clin Nutr 2000; 72: 1576-82

SHS and Antioxidant Micronutrients

Nonsmokers: % difference between SHS exposed and nonexposed

Husband # of cigs/day	β-carotene	Vit. C
1-10	-12%	-7%
11-20	-16%	-5%
>=21	-27%	-8%
P-trend	0.008	0.02

Source: Farchi S et al. CEBP; 2001: 10: 907

SHS and DNA Damage: 8-hydroxy-2-deoxyguanosine (8-OHdG) adducts

Marker of DNA damage from oxidative stress

Among nonsmokers, workers exposed to SHS had 8-OHdG adduct levels 63% higher than those not exposed to SHS.

Source: Howard DJ et al CEBP 1998; 7: 141--

SHS and Tobacco Specific Carcinogens:

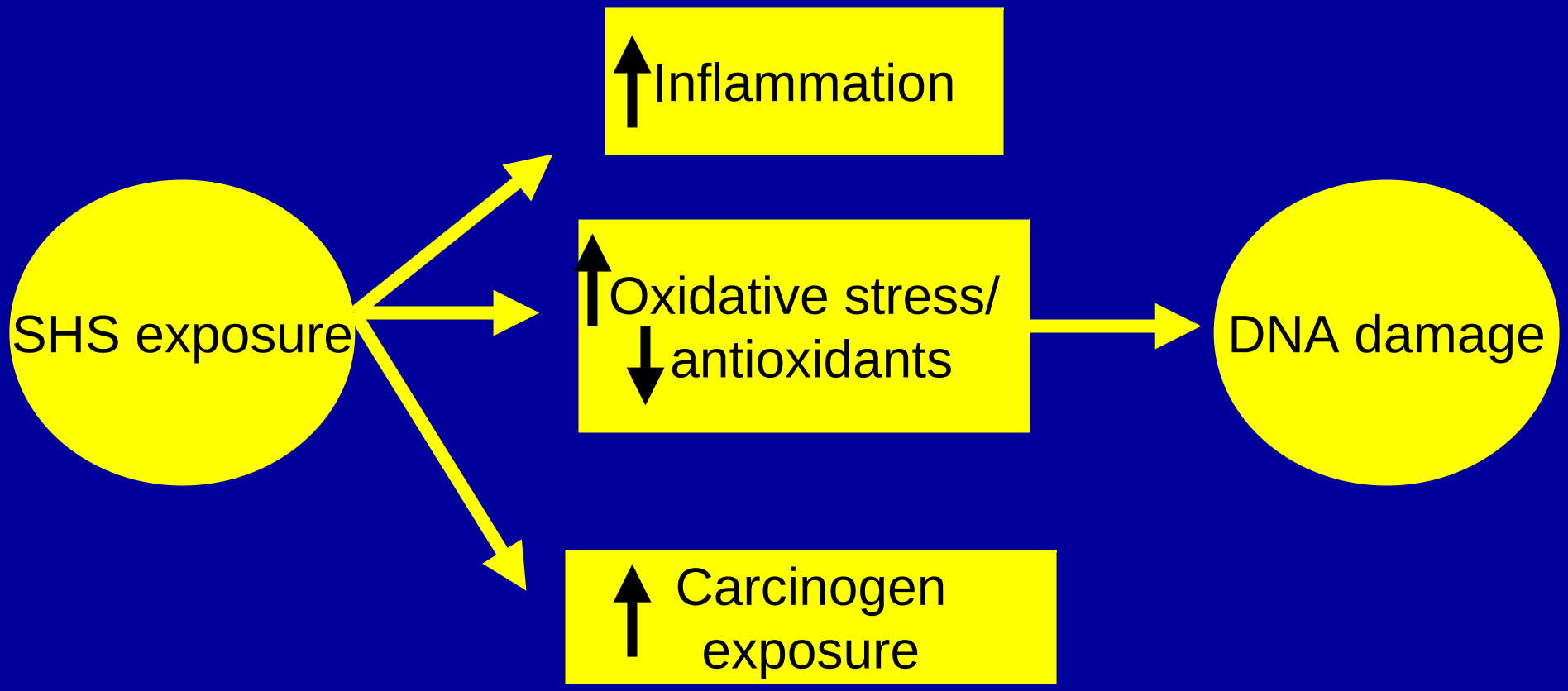
NNK (urinary metabolites NNAL, NNAL-gluc)

Nonsmokers: % difference between SHS exposed and nonexposed

	% Difference
Nicotine	+283%
Cotinine	+400%
NNK	+614%

Source: Anderson KE et al. J Natl Cancer Inst 2001; 93: 378

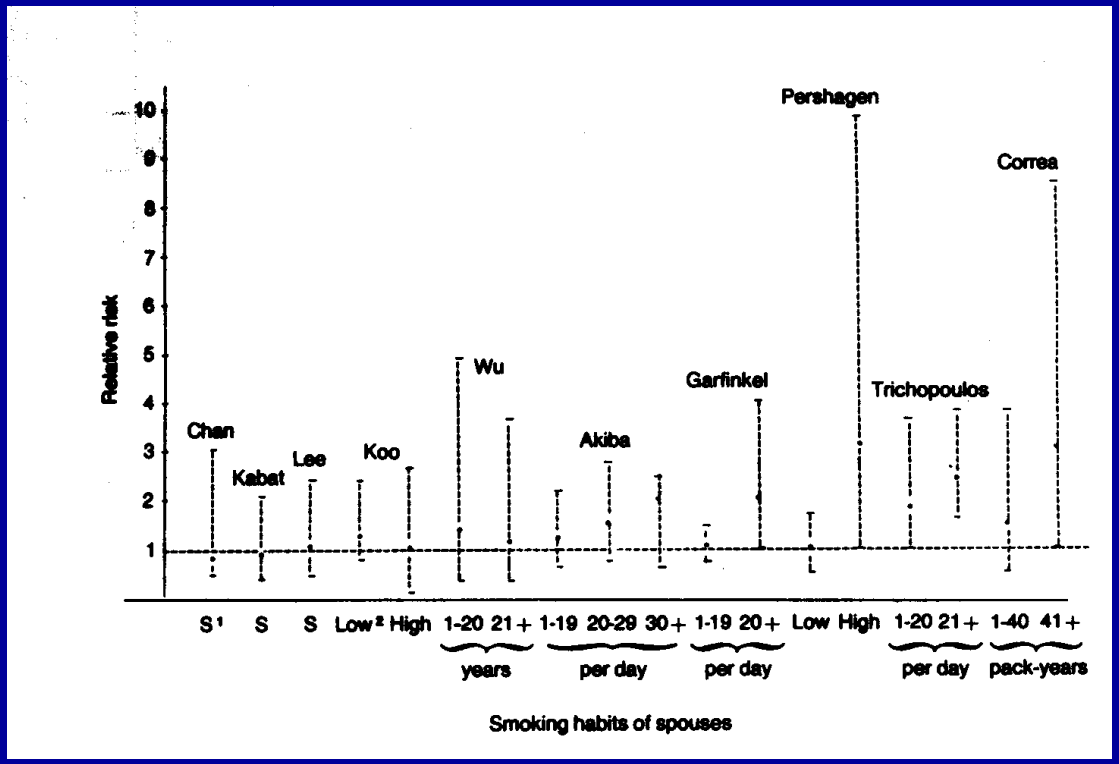
SHS exposure and preclinical health effects: biologic plausibility



SHS exposure and cancer: What do the data show?

- Lung
- Cervix
- Kidney, Bladder, CLL
- Breast

SHS and Lung Cancer
1986 Surgeon General's Report



C. Everett Koop, M.D.
Former U.S. Surgeon General

SHS and lung cancer: meta-analysis

Exposure	Pooled RR	(95% CI)
Husband smoker	**1.2**	(1.1–1.4)
Wife smoker	**1.3**	(1.0–1.8)

Significant dose–response relationship of lung cancer risk with both number of cigarettes smoked by the spouse and with exposure duration

Hackshaw *et al*., 1997.

Cigarette Smoke and Cervical Neoplasia

RRs and 95% CLs, Washington County, MD

Cohort	Active	SHS
1963	2.6 (1.5, 4.5)	2.1 (1.3, 3.3)
1975	1.7 (1.1, 2.6)	1.4 (0.8, 2.4)

Source: Trimble et al. Obstet Gynecol 2005

SHS and Renal Cancer

ORs and 95% CLs compared to non SHS exposed

Years of exposure	Men	Women
Lowest	1.2	1.7
Middle	3.0*	1.3
Highest	3.6*	2.9*
P-trend	<0.001	0.01

Source: Hu et al. Eur J Cancer; 2005: 41: 770

Cigarette Smoke and Bladder Cancer

RRs and 95% CLs, Washington County, MD

Cohort	Active (Total)	SHS (Women)
1963	2.7 (1.6, 4.7)	2.3 (1.0, 5.4)
1975	2.6 (1.7, 3.9)	0.9 (0.4, 2.3)

Source: Alberg et al. (In preparation)

SHS and CLL

ORs and 95% CLs compared to non SHS exposed

Years of exposure	OR
Lowest	0.6
Middle	1.4
Highest	2.2*
P-trend	0.001

Source: Hu et al. Eur J Cancer; 2005: 41: 770

SHS & Breast Cancer: Controversial

After intensive study:

- SOME: Evidence for active smoking null or questionable, evidence for SHS even moreso
- OTHERS: SHS is a cause of breast cancer (e.g., CalEPA)

Active & passive smoking and breast cancer

	OR
Never	1.0
SHS only	2.3
Active: <20 py	2.2
Active: >=20 py	3.2

Py= pack-years

Morabia A, et al/ Am J Epidemiol 1996; 143:918-28

Active & passive smoking and breast cancer

	OR
Never	1.0
SHS only	2.0
Active: <20 yrs	2.6
Active: 20-39 yrs	1.5

Source: Lash T, et al. Am J Epidemiol 1999; 149: 5-12

SHS and Breast Cancer

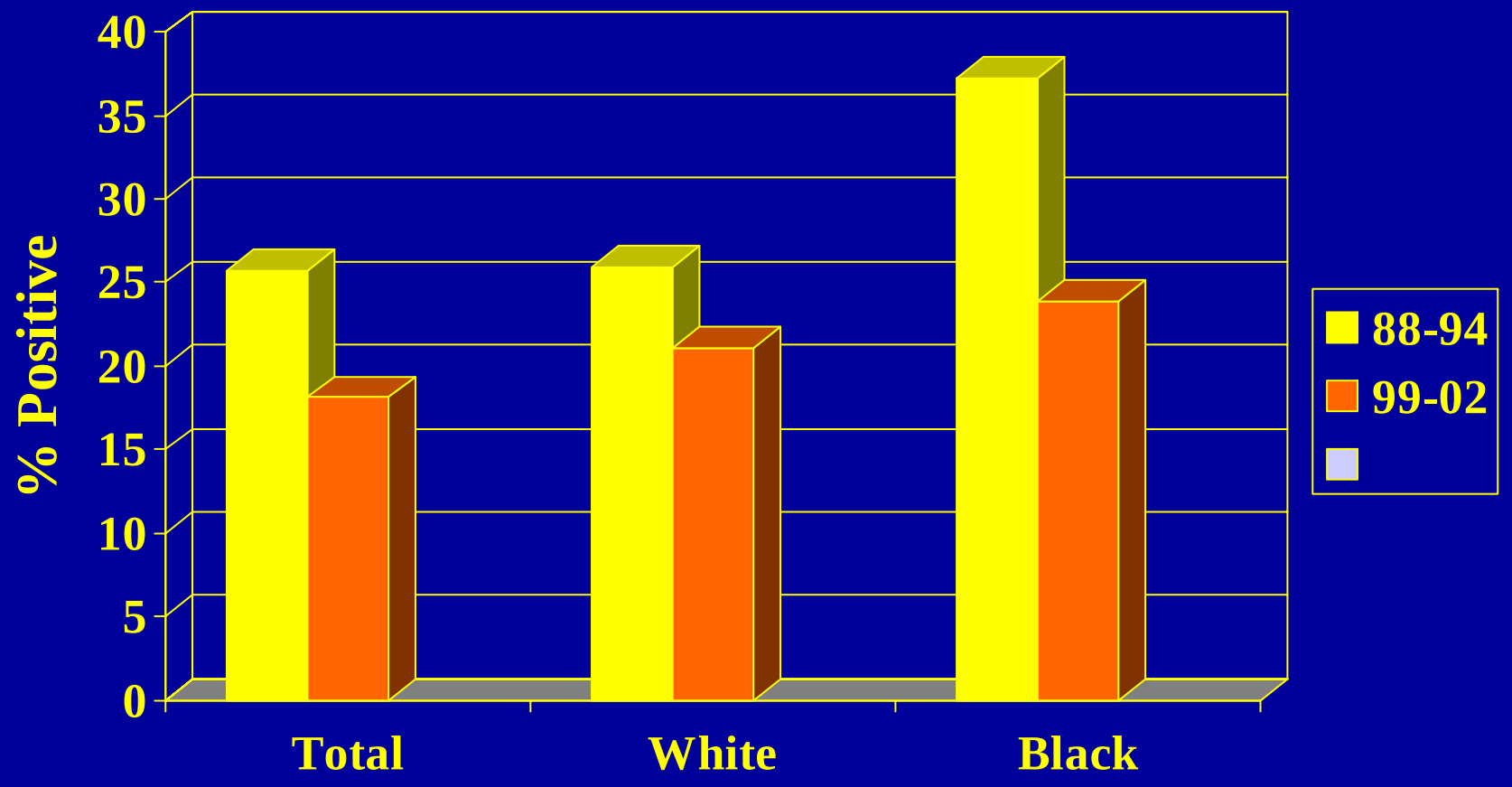
RRs and 95% CLs compared to non SHS exposed

Years of exposure	RR (95% CL)
Childhood only	0.92 (0.78, 1.07)
Adult only	0.94 (0.79, 1.12)
Both	0.93 (0.79, 1.09)

Source: Reynolds et al. J Natl Cancer Inst; 2004: 96: 29

Despite major gains, population exposure to SHS remains too common.

% US. children 4-11 yrs. with blood cotinine >1.0 ng/ml, NHANES



Source: America's Children, NCHS 2005

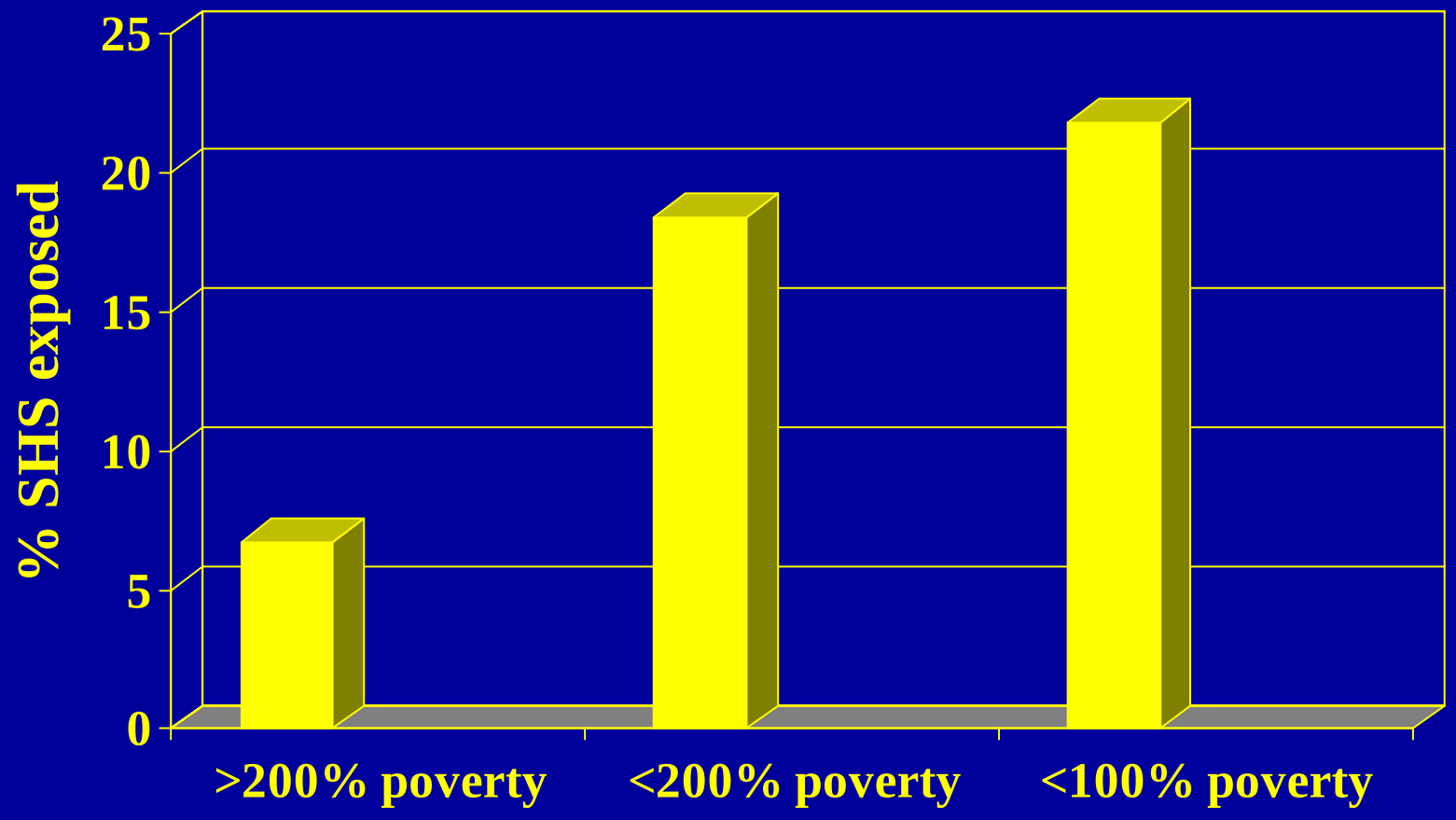
Prevalence of SHS in homes
Natl. Health Interview Survey, 1992 and 2000

	1992	2000
Total	36%	25%
White	37%	27%
African-American	37%	30%
Asian	12%	14%
Hispanic	24%	16%

Source: Solomon et al. Am J Public Health 2004

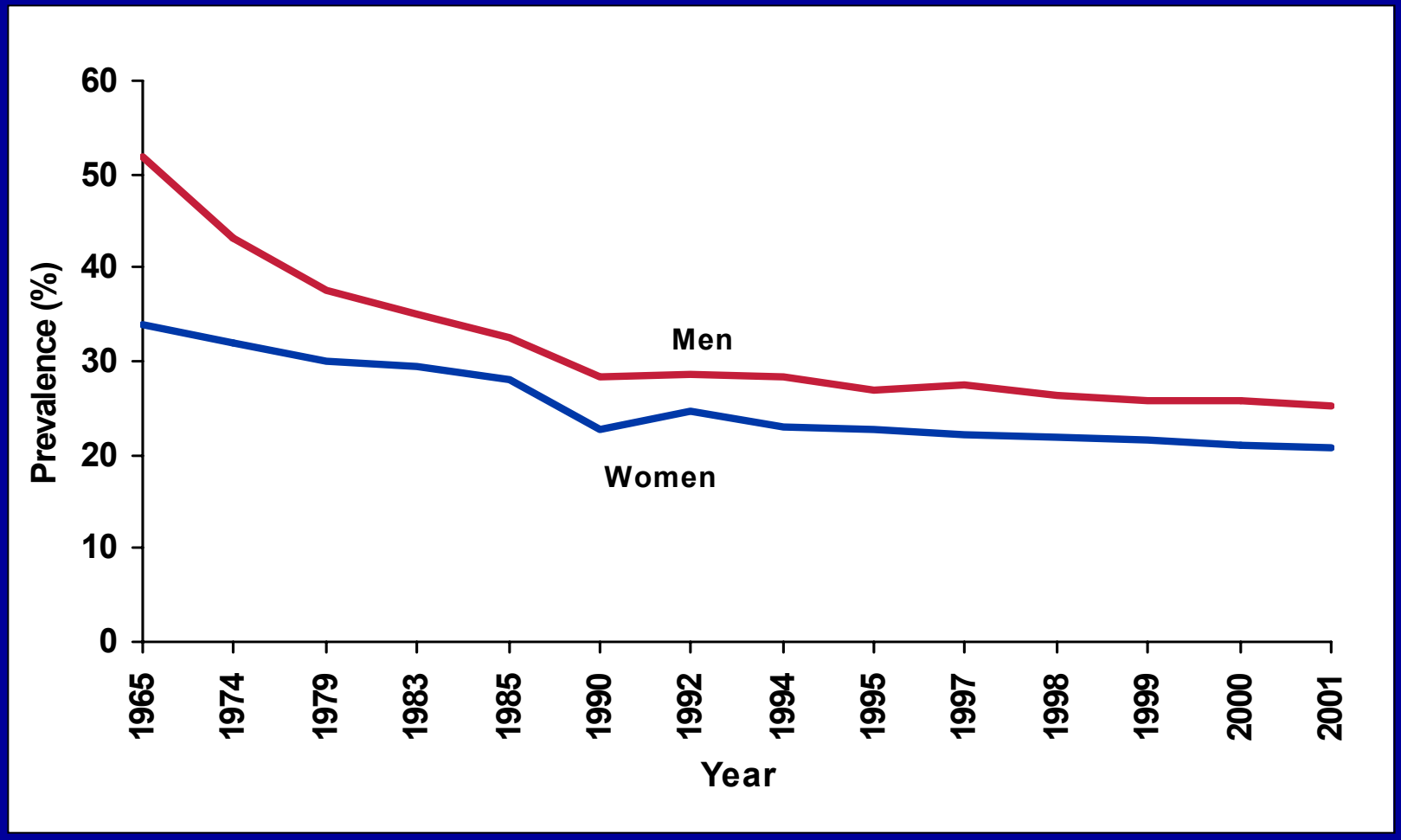
% US. children 0-6 yrs. living in homes with regular smoker, by poverty status

National Survey on Children's Exposure to ETS



Source: America's Children, NCHS 2005

Trends in Cigarette Smoking Prevalence (%) by Gender, Adults 18 years and Older, US, 1965--2001



Source: National Health Interview Survey, NCHS and CDC 2003; and the American Cancer Society, 2004. *Cancer Statistics.* www.cancer.org/downloads/ PRO/Cancer20Statistics202004.ppt

From evidence to action: What can be done to minimize SHS exposure?

- Smoke-free homes
  - Smoking cessation
  - No smoking in home
- Smoke-free workplaces
  - Importance of legislation

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