Preventing Home Injuries through Safety Modifications: A Review of the Evidence

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  - David Ormandy, Warwick University, Coventry, UK

Burden of Residential Injuries in the US

- Approximately 20,000 home-related deaths occur annually.
- 20 million home-related injuries require medical attention each year.
- One-third of all injury-related deaths occur at home for all populations.
- Children and older adults are at highest risk.

Methods

- Content experts served on a panel to review scientific evidence on prevention or correction of housing deficiencies that can result in injuries.
- Relevant literature identified and provided to panel by CDC and NCCH.
- Greatest weight placed on evidence from well-conducted, comprehensive systematic literature reviews, but also included controlled trials and observational studies.

Structural Deficiencies

- Includes deficiencies for which a builder, landlord or homeowner would normally take responsibility (e.g., design, construction, installation, repair, monitoring)
- Excludes behaviors of household residents to improve safety such as affixing loose rugs, purchasing non-slip bathmats, or safely storing poisons, matches or firearms.

Focus of Our 17 Interventions

- Fire Safety
- Drowning Prevention
- Scald Burn Prevention
- Fall Prevention
- Noise Reduction
- Carbon Monoxide Poisoning Prevention
- Air Temperature Control

Results of Analysis of Evidence for Interventions

- 3 are effective and ready for implementation
- 5 need more field testing but are promising
- 8 need formative research
- 1 is ineffective

Sufficient Evidence

- Fire Safety
  - Installed, working smoke alarms
- Drowning Prevention
  - 4-sided isolation fencing around pools
- Scald Burn Prevention
  - Legislation for pre-set safe temperatures for water heaters
  - Use of water heaters with pre-set safe temperatures

Promising Interventions Needing More Field Testing

- Fall prevention by home modifications such as handrails, grab bars, and improved lighting
- Temperature controlled mixer-faucets
- Safe ignition sources and ignition source controls to prevent fires and burns
- Home modification to aid escape from fires
- Working air-conditioning during heat waves

Interventions in Need of Formative Research

- Automatic fire sprinkler systems for housing
- Pool covers and alarms
- Bathtub design to reduce falls
- Stove control design to prevent burns
- Carbon monoxide poisoning prevention through design, engineering, legislation and education
- Noise reduction
- Design of residential construction materials
- Safety-related building codes and legislation

Intervention Shown to be Ineffective

- Use of 3-sided pool fencing instead of complete 4-sided pool fencing may actually increase risk because caregivers may believe that the incomplete fencing is adequate protection.

Issues, Research Gaps, Challenges, and Concerns

- Methodological issues:
  - Few studies evaluated injury outcomes and many had a small sample size, making it difficult to draw strong conclusions.
  - Investigators should develop and use standardized tools and measures of home hazards, interventions and outcomes to allow cross-study comparisons and pooling of data.
  - Multi-factorial interventions should be evaluated using a factorial design to assess specific interventions.

Issues, Research Gaps, Challenges, and Concerns

- Methodological issues (continued):
  - Hazard reduction studies should measure:
    - all applicable outcomes relevant to morbidity and mortality (e.g., stress resulting from loss of property in a house fire; risk of Legionnaires' disease with lower hot water heater temperature); and
    - injury outcomes that are directly relevant to the particular hazards being prevented (e.g., effects of reducing hot water temperature on scald burns rather than on total injuries).

Issues, Research Gaps, Challenges, and Concerns

- Federal support of small business innovation research may be a useful approach for intervention development and evaluation.

- Cost effectiveness and cost benefit analyses of home safety interventions (e.g., hard-wired smoke detection systems versus automatic sprinkler systems) are needed.

- Insurers and other third parties with potential economic interests should be included in development and implementation of interventions to reduce injuries & deaths.

Questions?

DiGuiseppi C, Jacobs DE, Phelan JK, Mickalide AD, Ormandy D. Housing interventions and control of injury-related structural deficiencies: a review of the evidence. *J Public Health Management Practice* 2010, 16(5) E-Supp, S34-43

Economic Evaluation of Smoke Alarm Giveaway and Installation Programs

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Centers for Disease Control and Prevention

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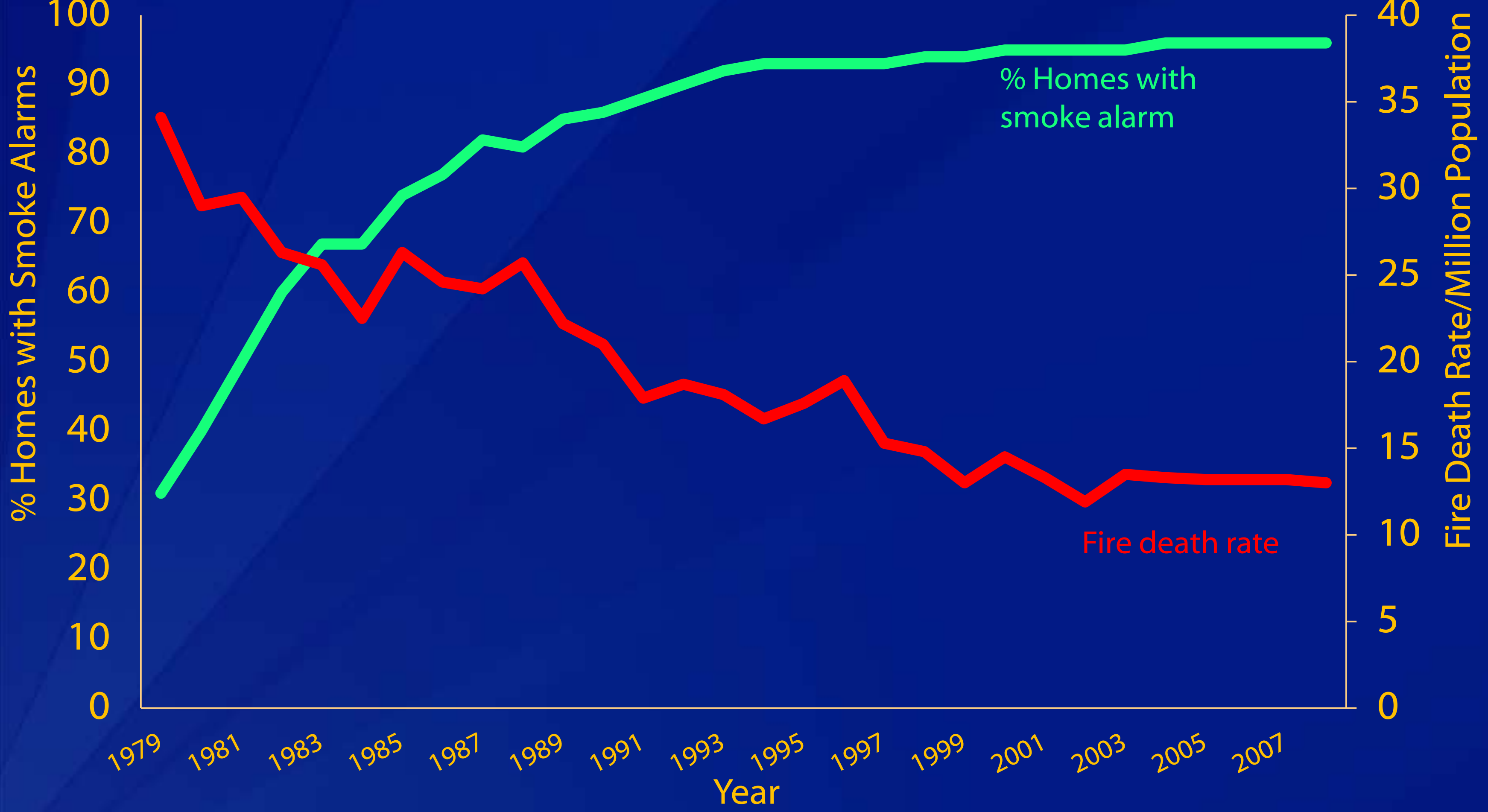
U.S. Residential Fire Problem

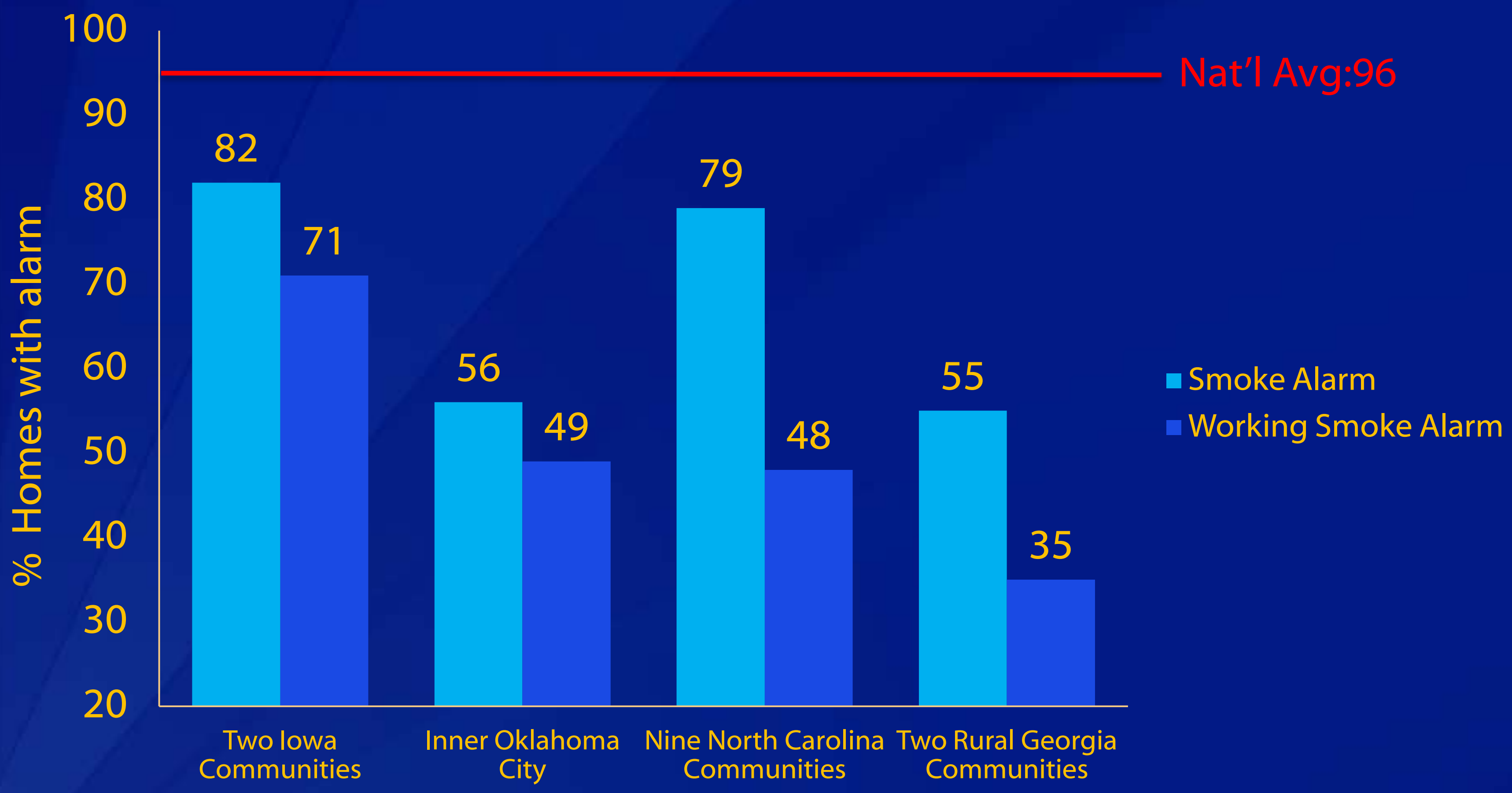
- In 2009 fire departments responded to more than 377,000 home fires
- 2,565 people were killed and 13,050 were injured in fires (not including fire fighters)
- Around 85% of all fire deaths occurred in homes
- Most victims of fire died from smoke or toxic gases and not from burns

US Fire Death Rate Declines as Smoke Alarm Ownership Increases



NFPA, *Fire Loss in the United States During 2009, by Michael J. Karter, Jr., NFPA, Quincy, MA, 02169*

Smoke Alarm Ownership in High Risk Communities



Ballesteros et al. (2007), Jones et al. (2001) and Poehlman et al. (2010)

Promoting Smoke Alarms in High Risk Communities

- **Giveaway programs**
  - E.g. Oklahoma City Lifesavers Residential Fire Injury Prevention Program (LRFIPP)

- **Installation programs**
  - E.g. CDC Smoke Alarm Installation and Fire Safety Education Program (SAIFE)

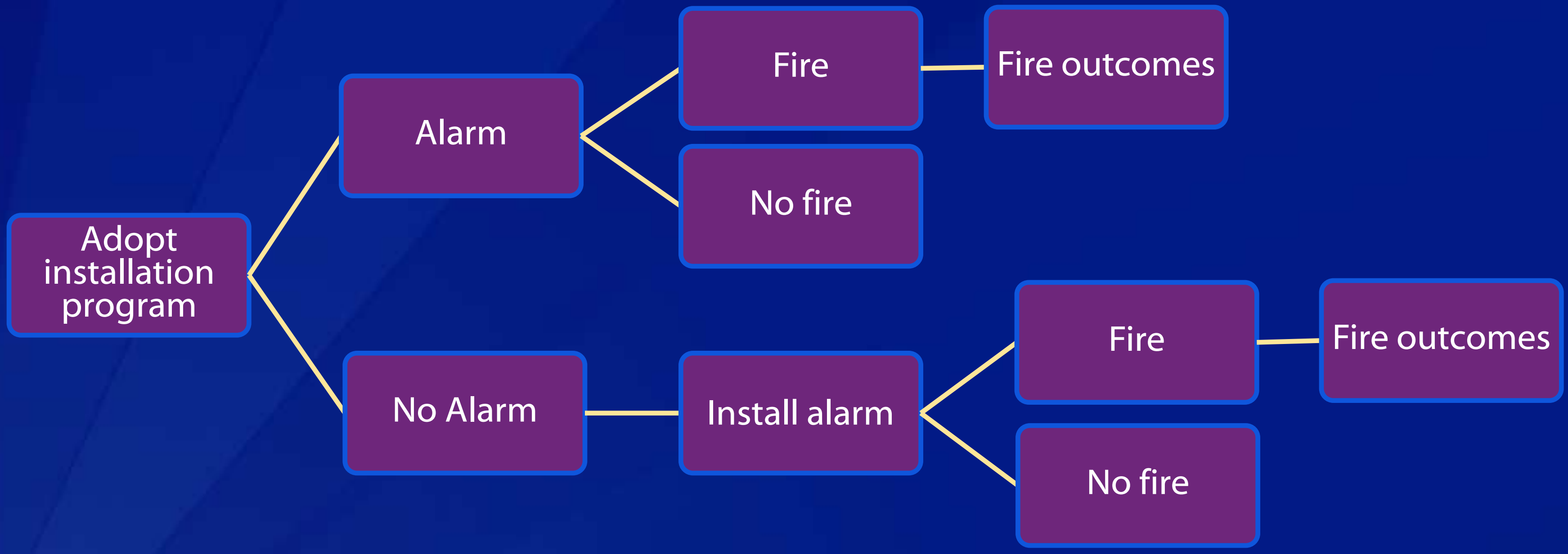
Objectives

- To evaluate the cost-effectiveness and cost-benefits of smoke alarm giveaway or installation program
- To identify the main drivers of the economic outcomes of smoke alarm programs

Methods

- **Two types of economic evaluation were performed**
  - Cost-utility analysis: cost-effectiveness ratios
  - Cost-benefit analysis: net benefits, cost-benefit ratios
- **Health outcomes were modeled using a decision tree model**
- **Health effects were quantified in quality-adjusted life years (QALYs)**
- **Costs were expressed in 2008 US dollars**
- **Future health effects and costs were discounted at 3%**

Decision Tree Model



Model Inputs

Parameters

- Medical costs per death
- Medical costs per injury
- Costs of giveaway program
- Costs of installation program
- Effectiveness of giveaway program
- Effectiveness: of installation program
- Work loss per death
- Work loss per injury
- Quality of life loss per death
- Quality of life loss per injury
- Fire incidence rate per 100 homes
- Baseline % homes without working smoke alarm
- Deaths per 100 fires without working smoke alarm
- Deaths per 100 fires with working smoke alarm
- % reduction in injury due to working smoke alarm
- Injuries per 100 fires without working smoke alarm

RESULTS

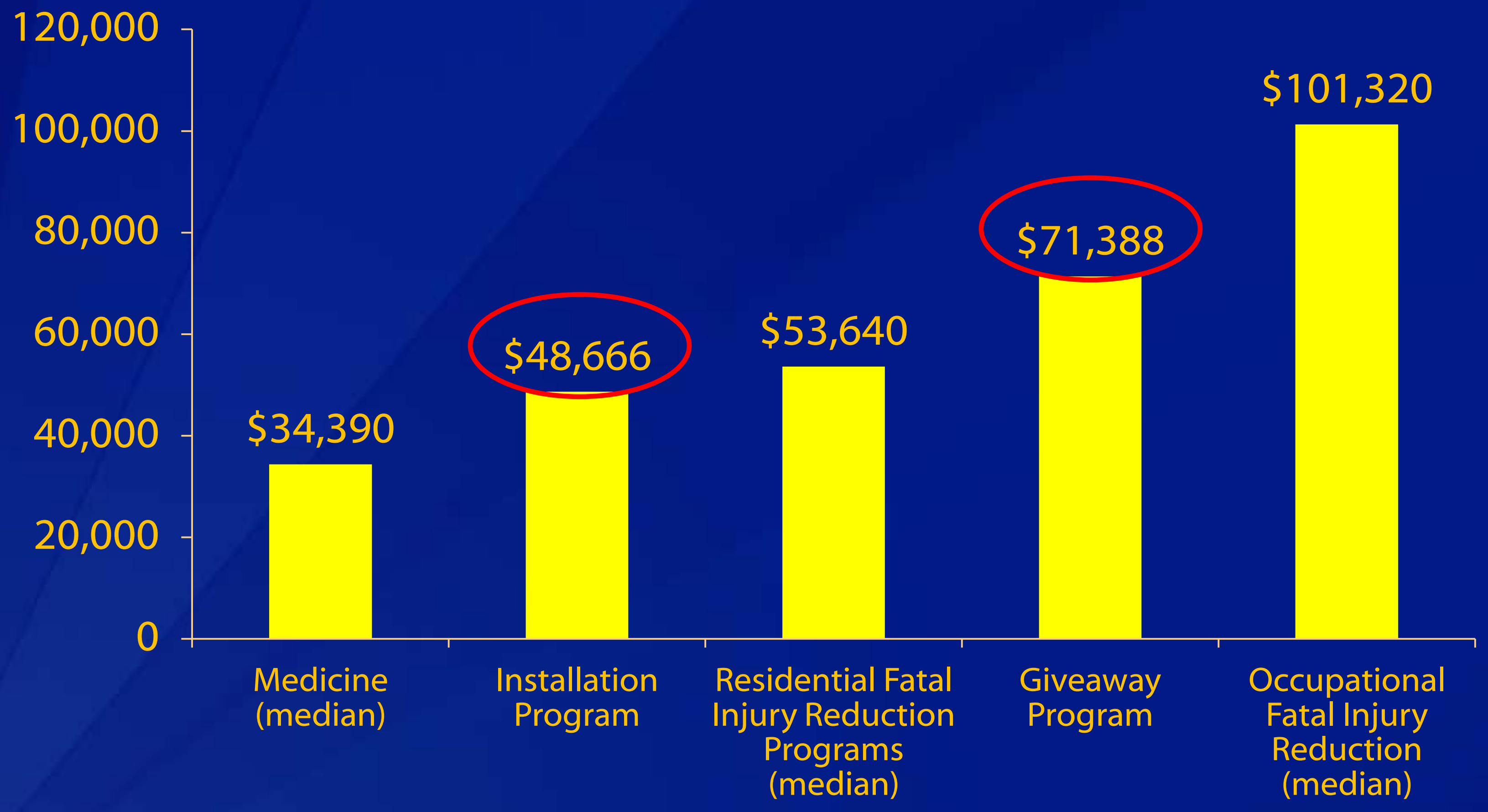
Costs, Effectiveness and Cost-Effectiveness

Program	Costs per life year saved ($)	Effect (QALYs saved)	C/E ($ per QALY saved)
Giveaway	$54,013	0.7	$71,338
Installation	$33,922	1.8	$48,666

Decision rule: cost-effective if C/E < $50,000

Comparative Cost-Effectiveness

Cost per QALY saved
(in 2008 dollar)



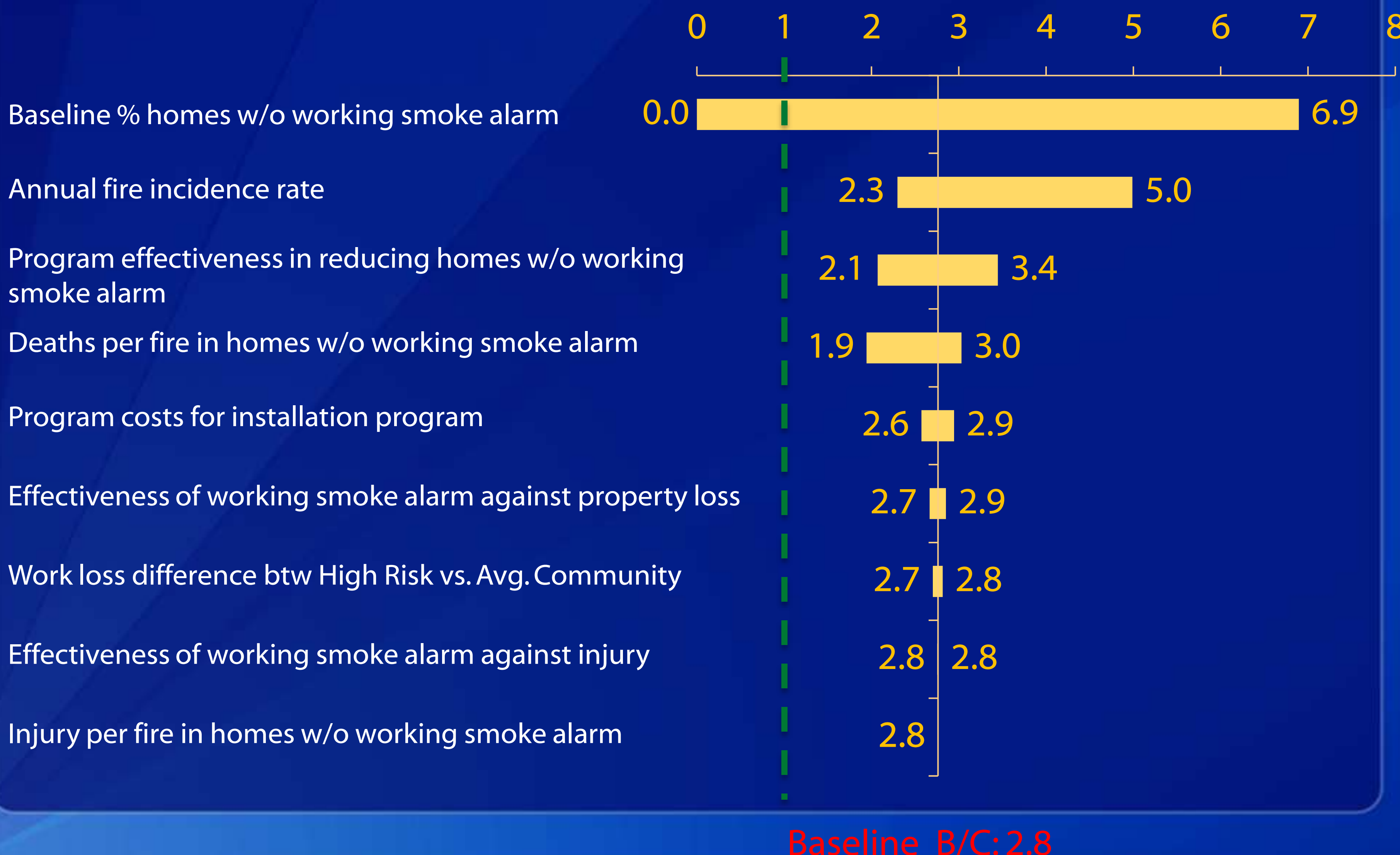
Source: Tengs et al. 2001, 500 Life-saving Interventions and Their Cost-Effectiveness

Net Benefits and Benefit/Cost Ratios

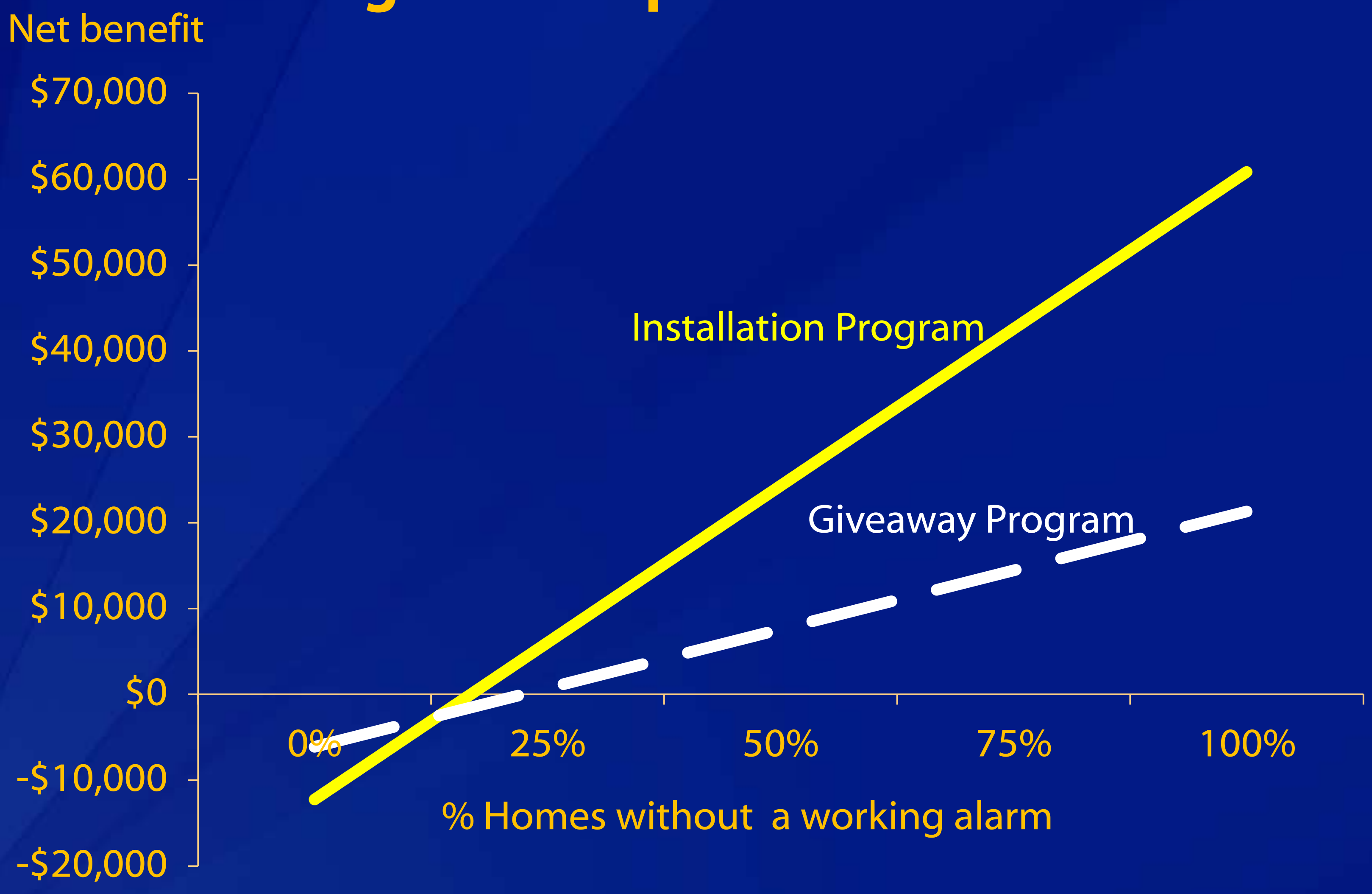
Scenario	Implementation costs (C)	Benefits (B)	Net Benefits (B-C)	Benefit Cost Ratio (B/C)
Giveaway	$46,596	$81,190	$34,594	1.7
Installation	$85,398	$179,296	$93,898	2.1

Decision rule: adopt if B-C > 0 or B/C >1

Multiple One-Way Sensitivity Analyses of B/C for installation program



Program Adoption Threshold



Policy Implications

- Giveaway program is generally not cost-effective
- Installation program is cost-effective and generates net social benefits in high risk communities
- Future programs should focus on communities where fire incidence rate is high and smoke alarm ownership is low

Thank You!

For more information please contact Centers for Disease Control and Prevention

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Model Inputs

Parameter	Baseline	Range	Sources
Medical costs per death	$16,549	-	Lawrence and Miller (2010)
Medical costs per injury	$4,836	-	Lawrence and Miller (2010)
Costs/ home giveaway program	$10	(7.5, 12.5)	Haddix (2001)
Costs/home installation programs	$20	(15, 25)	Parmer (2006); Poelhman (2010)
Work loss per death	$723,328	-	Lawrence and Miller (2010)
Work loss per injury	$6,038	-	Lawrence and Miller (2010)
Quality of life loss per death	4,276,672	-	Lawrence and Miller (2010)
Quality of life loss per injury	54,481	-	Lawrence and Miller (2010)
Effectiveness: giveaway program	0.3	(0.1, 0.5)	Systematic review
Effectiveness: installation program	0.7	(0.5, 0.9)	Systematic review
Fire incidence rate per 100 homes	0.3	(0.2, 0.4)	Karter (2010)
Baseline % homes without WSA	0.4	(0.2, 0.7)	Systematic review
death per 100 fires without WSA	1.4	(0.9, 1.6)	Karter (2010); Ahren (2009)
deaths per 100 fires with WSA	0.7	(0.5, 0.8)	Karter (2010); Ahren (2009)
% reduction in injury due to WSA	0	(-0.3, 0.3)	Istre(2001); Ahren (2009)
Injuries per 100 fires without WSA	0.0167	-	Karter (2010); Ahren (2009)