

Magnitude and Cost-Effectiveness of Health Benefits from Stove Interventions in Laos

An analysis using the
Household Air Pollution Intervention Tool (HAPIT)

**Ajay Pillarisetti, Cooper Hanning,
and Kirk R. Smith**

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HOUSEHOLD ENERGY, CLIMATE, & HEALTH RESEARCH GROUP
UNIVERSITY OF CALIFORNIA, BERKELEY

**HAPIT
Overview**

**Advanced
Cookstoves in
Laos**

HAPIT

BETA

HAPIT Overview & Motivations

An easy-to-use & accessible software tool to calculate the health benefits of household energy interventions

Requires knowledge of

- average PM_{2.5} exposures before intervention
- average PM_{2.5} exposures after intervention
- expected usage fraction of intervention
- number of households receiving intervention
- number of individuals per household

HAPIT users are encouraged to conduct feasibility studies in advance of investments to obtain local field evidence on

- usage patterns of the proposed intervention
- pre- and post-intervention exposures to PM_{2.5}

HAPIT Overview & Motivations

An optional module calculates cost-effectiveness based on WHO CHOICE criteria in international dollars per DALY

- Very Cost Effective: less than GDP per capita / DALY (2374 Int'l \$)
- Cost Effective: more than one but less than 3 x GDP per capita / DALY (2374 – 7122 Int'l \$)
- Not Cost Effective: more than 3 x GDP per capita / DALY (>7122 Int'l \$)

Cost effectiveness analysis accounts for national program costs and health benefits. It does not

- consider costs or savings at the household level (payment for fuel or intervention)
- consider costs or savings at the societal scale (saved health costs, CAP reductions)
- discount or consider the time value of funds

Program costs can be altered to incorporate household scale benefits



HAPIT Overview & Motivations

Calculations are based on an attributable burden calculation parallel to that used in the GBD-2010:

- PM_{2.5} annual avg. exposures used as the indicator of risk
- Integrated Exposure-Response relationships distilled from the world epidemiology literature by disease
- Low counterfactual ($\sim 7.3 \text{ ug/m}^3$) used by GBD and HAPIT equivalent to gas cooking with no other sources present
- Population attributable fraction (PAF) metrics by disease
- Background national or regional disease conditions
- EPA cessation lag for chronic diseases; 80% of benefits by year 5 applied here as a 0.80 multiplier for simplicity.



Background Data

2010 Background Disease
Data – Deaths & DALYs
GBD Compare 2013

2010 Population Data
US Census Int'l Bureau

2010 Solid Fuel Use
Bonjour et al 2013

GDP per capita (Int'l \$)
IHME 2013

Average HH Size
GACC 2013 • UNPD

User Inputs

Pre-Intervention & Post-
Intervention PM Exposures

of Target HH, Fraction
Receiving, Fraction Using

Intervention & Maintenance Costs

Years to deploy & intervention life

Relative Risks + PAFs

Calculate relative risks for each
disease at each user-input
exposure level using mathematical
functions fit to exposure-response
data.

Calculate population attributable
fractions for each disease at each
exposure level.

Attributable Burden

Calculate attributable burdens for
each exposure scenario.

Averted Burden

Subtract post-intervention deaths
and DALYs from pre-intervention
values to determine the health
benefits of the intervention

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Relative Risks + PAFS

Calculate relative risks for each disease at each user-input exposure level using mathematical functions fit to exposure-response data.

Calculate population attributable fractions for each disease at each exposure level.



Attributable Burden

Calculate attributable burdens for each exposure scenario.



Averted Burden

Subtract post-intervention deaths and DALYs from pre-intervention values to determine the health benefits of the intervention

Relative risks are derived from equations fit to the Integrated exposure response curves.

$$AF = \frac{\text{Fraction Exposed} * (RR-1)}{\text{Fraction Exposed} * (RR-1) + 1}$$

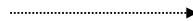
Fraction Exposed = % Solid Fuel Users

Attributable burden = AF × (DALYs or Deaths)

Repeat for both post-intervention and pre-intervention PM levels. Subtract post-intervention burden from pre-intervention burden to determine averted burden.

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Advanced Cookstove Introduction



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Cookstove Intervention

Pre-intervention exposure: 266 ug/m³

Targeted households: 25,000

People per household: 5

Annual Maintenance Costs: 10% of first year cost

100% of targeted households receive intervention

Six Scenarios

1. Chimney Stove - Post-intervention exposure: 150 ug/m³ – 10 USD / stove

2. Advanced Stove - Post-intervention exposure: 50 ug/m³ – 50 USD / stove

3. Advanced Stove - Post-intervention exposure: 30 ug/m³ – 75 USD / stove

Each first with 100% usage and then with 50% usage



Cookstove Intervention

	Scenario 1		Scenario 2		Scenario 3	
	150 ug/m3		50 ug/m3		30 ug/m3	
Exposure Reduction	44%		81%		89%	
Yearly Cost (USD)	66,667		333,333		500,000	
Intervention Use	50%	100%	50%	100%	50%	100%
Averted Annual DALYs	232	465	987	1975	1401	2803
Remaining Annual DALYs	4070	3837	3315	2327	2901	1499
% DALYs remaining	95%	89%	77%	54%	67%	35%
\$ / DALY	287	143	338	169	357	178
WHO-CHOICE CE	VCE	VCE	VCE	VCE	VCE	VCE



Thank you

for more information

Ajay Pillarisetti

ajaypillarisetti@gmail.com

Kirk R. Smith

krksmith@berkeley.edu



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