

E. Health and safety



What does this type of evaluation tell us?

Some household energy interventions are designed and implemented primarily to reduce IAP (and hence to have a major impact on respiratory disease), while for others the improvement of health is only one of many objectives. In general, the evaluation of the impacts of household energy interventions in developing countries on illness and death is considered to be of high importance.

In the assessment of any given intervention, the emphasis placed on the evaluation of various health outcomes will, among others, depend on the following critical factors:

- The objective measurement of certain health outcomes, such as childhood pneumonia, is technically complex and resource-intensive. It can therefore only be undertaken by appropriately qualified organizations and individuals.
- Several diseases associated with IAP, such as chronic obstructive pulmonary disease, cataract and tuberculosis, take many years

to develop. Therefore, studying the impact of interventions on these health outcomes prospectively requires long-term investigations. A cross-sectional study design can overcome this problem but is associated with caveats (see Chapter 5).

- Intervention impacts on health depend on the nature of the intervention. For example, changes that improve ventilation are unlikely to reduce the risk of burns.
- The importance and nature of information collected about health impacts will depend on how that information is to be used. Will any insights gained be used to demonstrate health improvements at community level or are they intended for arguing the case for the intervention being a cost-effective means of reducing serious illness at national or international level?

All of these issues, and their implications for the approach taken to evaluation, are discussed further below, structured around different health and safety impacts. The following section is intended to help decide how best to focus efforts and resources depending on the goals of a given intervention, the objective for evaluation and organizational capacity.

Direct health impacts of reduced indoor air pollution exposure

As described in Chapter 2, exposure to IAP is linked with varying strengths of evidence to a range of health outcomes (Table 1). Given their major contribution to the burden of disease in developing countries, childhood pneumonia and COPD are of primary health concern and a major stimulus for the development of interventions to reduce IAP. As more evidence becomes available on other important health issues including low birth weight, tuberculosis and cataract, these are also likely to become the focus of attention for studies evaluating the impacts of reduced exposure to IAP.

It is expected that, over time, a reduction in exposure to IAP will result in a reduced risk for many, if not all, of these health outcomes.

It is therefore desirable that – where resources and technical capacity can be made available – evaluation should be employed to demonstrate such impacts. However, not all risk reductions will become apparent in a short time period and therefore, studying the effects of reduced IAP on some health outcomes is not feasible in the short-term. For example, it is expected that a reduction in IAP levels will result in a fairly rapid reduction in incidence of conditions such as childhood pneumonia or low birth weight. On the other hand, it will probably take several years to demonstrate changes in the progression of COPD, and even longer to see reductions in the risk of lung cancer, cataract, tuberculosis and other chronic conditions.

The inherent complexity involved in defining and assessing most of these disease conditions demands that a range of practical, technical and study design issues need to be carefully examined. Assessment methods involve various combinations of questionnaires, measurements by trained field staff, clinical examination by physicians and investigations, such as chest X-ray and lung function tests. In practice, many of these assessment techniques present considerable challenges, as discussed further below.

Key questions related to direct health impacts of reduced indoor air pollution exposure

- Has the intervention led to a decrease in the incidence of pneumonia among children under five years of age?
- Has the intervention led to a reduction in other health outcomes, such as low birth weight or perinatal mortality?
- Has the intervention, over a period of several years, led to a reduction in chronic respiratory symptoms and an improvement in lung function among women?

Impacts on safety during the collection and use of fuel

In many developing countries women are responsible for fuel collection and, depending on the geographical setting, accessibility of fuel and the political situation, may be at risk of injuries and violence. Children are also often involved with fuel collection, either accompa-

nying adults or on their own. To date there has been little systematic study of the risks associated with fuel collection. Consequently, this is an important topic for evaluation work.

A number of published studies, together with anecdotal evidence, links the use of open fires or unsafe stoves to burns and scalds, in particular among young children and cooks. Less well studied, but also commonly reported, is the danger of fires (including major house fires) caused by knocking over candles or kerosene lamps.

Impacts on these aspects of safety depend on many factors, in particular the nature of the intervention. For example, it can be expected that a reduced need for fuel resulting from a more fuel-efficient stove might lead to a reduction in injury or physical assault during fuel collection.¹ A switch to a more enclosed stove can be expected to reduce the risk of burns and scalds, while a move from kerosene to LPG would reduce the risk of fires and eliminate the serious problem resulting from children drinking kerosene, which is often kept in soft drink bottles.

All of these safety impacts can be assessed relatively easily and reliably through questionnaires. Qualitative methods, such as focus group discussions, can provide more detailed information about the context of these risks. Thereby qualitative methods can help to understand how best to reduce risks, or why an intervention may not have had the desired benefit.

Key questions related to impacts on safety

- Has the intervention improved the safe use of the fire or stove (e.g. reduced risk of burns and scalds among children and women)?
- Has the intervention had an impact on health problems associated with fuel collection by women and children (e.g. backache, snake bites, physical assault)?

¹ It should be noted that this assumption does not necessarily hold true. For example, in the refugee camps in Darfur, Sudan, the introduction of more fuel-efficient stoves did not always protect women from assault, as they continued to collect wood for sale as an income-generating opportunity. This situation emphasizes the need for careful and in-depth study.

User perceptions of the health effects of indoor air pollution and intervention impacts

Users, based on their daily experience, may emphasize effects of IAP and traditional household energy practices on health that are very different from those considered to be important by health researchers and development organizations. For example, women cooks often report symptoms such as cough, chest discomfort, headache, stinging eyes and backache (in particular when switching from cooking on the ground to cooking on a raised stove) as being associated with smoke and traditional cooking practices, and describe that these have improved subsequent to the installation of an intervention. Local perceptions of health effects of IAP, as well as the perceived impacts of interventions on the health of various family members, are important both in terms of generating interest and demand, and in promoting acceptance and longer-term sustainability.

These commonly reported symptoms undoubtedly affect wellbeing and quality of life, particularly of women and young children, and hence are important in their own right. There is also some anecdotal evidence that the desire to avoid discomfort by the husband and other family members affects family relationships and interaction in the kitchen. An important issue for further study is how these commonly reported symptoms relate to the risk of serious disease outcomes.

When examining user perceptions, clinical examination of specific diseases is not required, unless in the context of a health impact study that intends to compare commonly reported symptoms with specific measures of these disease outcomes. Structured interview questionnaires and qualitative methods will both be useful in describing symptoms, and documenting and understanding what changes people ascribe to the intervention. It is very important to design questions and run focus groups in a balanced way, and to avoid creating the expectation that respondents should give answers that favour the intervention. This may happen all too easily, particularly where the implementing organization has a favourable long-standing relationship with the community, where respondents have received interventions free or subsidized, or where the perception exists that positive responses will increase the likelihood of further aid.

Key questions related to user perceptions

- What health risks do women and other household members associate with IAP and traditional cooking practices? Has the intervention brought about any change in these, for better or worse?
- Has there been any improvement, as perceived by the mother, in children's respiratory health (e.g. cough, rapid breathing, difficulty in breathing) or any other aspect of children's health and well-being (e.g. stinging eyes, headaches, burns, scalds, injuries during fuel collection)?
- Has there been any perceived improvement in women's respiratory health (e.g. wheezing, whistling, coughing) or any other aspect of women's health and well-being (e.g. eye irritation, headache, backache, physical assault during fuel collection)?

Indirect impacts on health

Household energy and health interventions can potentially bring about a range of changes to household livelihoods, to the way women, men and children use their time, and to the status of the dwelling itself. Many of these are dependent on the type of intervention as well as the local setting and culture. These impacts, as well as their assessment, are covered more fully in Section F *Time, socio-economic and other impacts*. They can, however, also have important indirect effects on the health and well-being of different family members, and this health perspective should be kept in mind. While the relationship between such changes and specific health benefits is complex and not easy to demonstrate, there are some important and well-accepted principles around how social, economic and gender-based development can impact health and wellbeing.

What are the challenges in the assessment of key health outcomes?

Respiratory health of children

One of the biggest challenges in assessing childhood acute respiratory infections (ARI) is the distinction between harmless acute upper respiratory infections (AURI, such as the common cough or cold) and potentially life-threatening

acute lower respiratory infections (ALRI, such as pneumonia and bronchiolitis).

AURI are very common (5–8 disease episodes per child per year during the first year of life), while pneumonia occurs at about one-tenth of this rate (0.3–1 disease episodes per child per year during the first year of life in developing countries).

An additional complication is that a child's vulnerability to respiratory infections decreases markedly during the first year of life and, more gradually, during the first five years of life. Consequently, a child's resistance to and experience of ALRI will be very different at the beginning and at the end of a 12-month intervention study and thus it will not be possible to attribute any changes in incidence to an intervention without the use of a control group. The study design and data analysis methods will need to take these features into account.

Current experience indicates that pneumonia and other ALRI in children can only be reliably diagnosed by a physician's examination of the chest with a stethoscope. Although field staff can be trained to recognize key symptoms and signs of pneumonia (cough or difficulty breathing, rapid breathing and chest indrawing¹), such assessments are rather non-specific and only about 30% of cases identified in this way actually have pneumonia. Most accurately, a physician's diagnosis of pneumonia is confirmed by an X-ray of the lungs. Therefore, an epidemiological study to assess the impact of an intervention on childhood pneumonia in a scientifically valid and statistically significant way requires frequent measurements, long-term follow-up and well-trained medical staff.²

On the other hand, if a reduction in exposure to IAP results in a reduction in childhood respiratory symptoms, such as cough, such changes can be assessed through a questionnaire. In this case mothers are asked to report on the respiratory health (cough and rapid breathing) of their

children during the last two weeks or month, and the responses can be used as an indication of general respiratory health – at least as perceived by the mother. As noted above, open-ended questions and discussions may be an even more informative way to reveal a mother's perception of the impact of the intervention on child health.

Changes in health visits or hospitalization rates may offer a means of assessing child ALRI incidence, but only in areas where most of the population has regular access to health services as well as the financial means to pay for treatment. Unfortunately, this is not common in countries with high levels of IAP exposure and high incidence of ALRI. Furthermore, this link is not well understood and it could be that greater awareness of respiratory disease problems resulting from the implementation of an intervention account for the increased demand for health care and hide a potential decrease in childhood respiratory disease.

In summary, there is a great need for the research community to examine the links between household energy interventions, reduced IAP levels and changed exposure patterns, morbidity and mortality from childhood pneumonia as well as health-care seeking and hospitalization rates. Scientific studies should be conducted for major types of interventions and in different settings. Accurately evaluating a reduction in childhood pneumonia is both too complex and too costly to be undertaken as part of the evaluation of small-scale intervention projects. A more realistic and valuable approach for such projects may be to examine perceived changes in the general respiratory health of children. Consequently, the methods referred to in this section aim to document perceived changes in children's health. Such an approach is particularly relevant where health messages form part of a promotional activity: knowing more about how families perceive the health impacts of smoke and different health benefits of the intervention will be helpful in designing effective health messages.

Chronic respiratory disease in adults

COPD is a group of lung diseases that are characterized by cough, phlegm and shortness of breath (due to limited airflow and airway inflam-

¹ Lower chest wall indrawing is defined as the inward movement of the bony structure of the chest wall with inspiration. It can be considered a useful indicator of severe pneumonia if it is consistently present in a calm child (American Thoracic Society).

² Lanata CF, Rudan I, Boschi-Pinto C, Tomaskovic L, Cherian T, Weber M, Campbell H. 2004. Methodological and quality issues in epidemiological studies of acute lower respiratory infections in children in developing countries. *International Journal of Epidemiology* 33:1362–1372.

mation) and progressive lung tissue destruction (Box 8). It is not clear how reduced exposure to IAP will impact on COPD: with mild disease (in particular among younger women), IAP reduction may lead to gradual symptom reversal; established disease is at least partly irreversible but a reduction in IAP may prevent or slow disease progression in the same way that is seen after quitting smoking.

BOX 8 Defining chronic obstructive pulmonary disease

While several definitions exist for COPD,¹ the classification by the Global Initiative for Chronic Obstructive Lung Disease continues to be most widely used:

‘COPD is a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases.’²

As with pneumonia, COPD can only be accurately diagnosed by a physician through a combination of lung function measurement (i.e. spirometry) and a reported history of key chronic symptoms (i.e. persistent cough and production of sputum). Questionnaires alone can be used to investigate levels of, and changes (over sufficient time) in these key respiratory symptoms. Great care is required to ensure that the expressions used to describe patterns of symptoms are meaningful in a given language and relevant to

local conditions such as seasons. While results from questionnaires can be strongly indicative and create persuasive evidence, they cannot be used as conclusive diagnostic tools. In addition, cultural factors may affect responses, for example in areas where tuberculosis (and associated coughing) is stigmatized, respondents may be unwilling to report the presence of a persistent cough.

Some organizations are currently using spirometry to assess women's respiratory health and to document any changes associated with the intervention. A spirometer is a device which can be used to measure lung volume and respiratory air flow. Analysis of these measures, in combination with symptoms, can be used to diagnose and measure the severity of COPD and other lung diseases. However, collecting accurate lung function data is challenging as it requires careful quality control and well-trained field staff. Field staff must be able to instruct the study participant effectively on how to carry out the breathing manoeuvre required (i.e. fast and complete exhalation). An element of learning usually occurs, which means that spirometry repeated over time will tend to improve in quality. Lung function tests also require specialist assistance in analysing and interpreting the data.






Available methods

Table 7 lists available methods to evaluate health and safety.

¹ Mannino DM. 2002. COPD: epidemiology, prevalence, morbidity and mortality, and disease heterogeneity. *Chest* 121:121S–126S.

² Global Initiative for Chronic Obstructive Lung Disease. 2005. *Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. Executive summary*. Available at <http://www.goldcopd.org/>

Table 7 Evaluating health and safety

ID	Method	Organization	Relevant section of method	Rating
Recommended methods				
A1	Demographic and Health Surveys	USAID/ORCMacro	Questions on health	
D5	House, household and monitoring	Practical Action/ University of Liverpool	Women's and children's health and well-being questionnaire (qualitative) (Section A.7)	
D7	Household energy practices, indoor air pollution and health perceptions survey	Winrock International	Questions on health impact perception (Section E)	
E1	Spirometry	Practical Action/ University of Liverpool	All	
E2	Guidelines for evaluating the impacts of household energy programmes	University of Liverpool	All	

A – Adoption; B – Market development; C – Performance; D – Pollution levels and personal exposure; E – Health and Safety; F – Time and socio-economic impacts; G – Environmental impacts; Y – Generic methods.