Lung Health Consequences of Exposure to Smoke from Domestic Use of Solid Fuels

A Guide for Low-Income Countries on what it is and what to do about it

2009
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The International Union Against Tuberculosis and Lung Disease (The Union) is the oldest international non-governmental agency dealing with health—its origin goes back to the first international conference on internal medicine held in Paris in 1867. At that meeting, delegates concluded that tuberculosis was one of the most frequent problems they had to deal with in their clinical practice. Much the same can be said today about the problem of lung diseases. Respiratory symptoms account for a high proportion of all visits to medical outpatient departments; respiratory symptoms and lung diseases are a frequent occurrence among patients treated in our hospitals. They account for millions of deaths each year and affect hundreds of millions of people, the majority of whom live in developing countries.

The Union is committed to showing the way to improve lung health throughout the world, giving priority to the poorest countries. It has an illustrious history of developing approaches that have improved the care of millions of patients with tuberculosis, asthma and pneumonia. It is a global leader in the fight against tobacco and is pioneering methods to provide care for persons living with HIV and AIDS.

Indoor air pollution resulting from the use of solid fuels for cooking and heating in homes is increasingly recognised as contributing to lung diseases, especially in the poorest countries. Because of this, The Union has joined with partners in low-income countries to find a way forward to address this problem.
<table>
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<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>ALRI</td>
<td>acute lower respiratory illness</td>
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<tr>
<td>CI</td>
<td>confidence interval</td>
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<tr>
<td>CO</td>
<td>carbon monoxide</td>
</tr>
<tr>
<td>COPD</td>
<td>chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>EpiLab</td>
<td>Epidemiological Laboratory, Khartoum, Sudan</td>
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<td>FIRS</td>
<td>Forum of International Respiratory Societies</td>
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<tr>
<td>IAP</td>
<td>indoor air pollution</td>
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<tr>
<td>OR</td>
<td>odds ratio</td>
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<tr>
<td>PEFR</td>
<td>peak expiratory flow rate</td>
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<tr>
<td>RR</td>
<td>relative risk</td>
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<tr>
<td>Solid fuels</td>
<td>These include coal (a fossil fuel) and agricultural wastes or products, grasses, wood, dung and straw (biomass fuels). In Africa and South Asia, most people who use solid fuels for cooking or heating use biomass fuels. In China, people who use solid fuels tend to use either coal or biomass fuels.</td>
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<tr>
<td>The Union</td>
<td>International Union Against Tuberculosis and Lung Disease</td>
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<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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<td>USAID</td>
<td>United States Agency for International Development</td>
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<td>WHO</td>
<td>World Health Organization</td>
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1

Introduction

The “cause” of disease is now recognised to be much more complex than was previously understood. We can no longer rely on the idea that a single agent determines the presence or effects of disease. In many ways, lung diseases, even conditions such as tuberculosis, are as much a “symptom” as they are a disease. They are symptoms of poverty, of inequality, of dysfunctional environments, of exposure to pollutants from tobacco smoke, and of other aspects of complex human ecology. While narrowly focused approaches can go a long way towards reducing the extent of the problems caused by lung diseases, ultimately they are not sufficient to finally overcome them.

The effects on lung health of exposure to smoke from domestic use of solid fuels, including biomass fuels and coal, illustrate this point. The use of biomass fuel and coal for cooking and heating is one part of the “social complex” characterised by poverty, poor access to services, undernutrition, poor ventilation and overcrowding, to name but a few of the components of this “complex”. Increasing attention to “indoor air pollution” caused by smoke from domestic use of solid fuels, particularly biomass fuels, has helped us to understand much better the extent and effect of exposure to such pollution, and its relation to lung disease can no longer be ignored.

Such knowledge demands action—it is unethical to know about a problem and do nothing to attempt to address it. It is particularly scandalous when those most at risk are the most vulnerable members of society, such as young children, the poor and the ill. It is this realisation and the opportunity afforded by support provided by the World Bank to a collaborative project between The Union, the EpiLab in Khartoum, Sudan, the Centre de Pneumophthysiole in Cotonou, Benin, and the Tuberculosis Institute in Hefei, China, that has led to this tentative offering aimed at providing an approach to addressing the lung health effects of exposure to smoke from the domestic use of solid fuels. We offer this guide as a first step towards recognising, reducing and preventing such exposure and we invite our partners and colleagues to use it critically, adapting it for use in their own communities and sharing their experiences in order that we may revise and improve it in years to come.
What is indoor air pollution?

The term “indoor air pollution”, as used in this text, refers to smoke from the burning of solid fuels (coal and biomass fuel) for cooking or heating in the home using open fires or traditional stoves.

The most common source of energy for daily life is that produced by burning various materials, which generates a mixture of dust, smoke and fumes that may be harmful to health. Among these fuels, the best known are coal and petroleum. However, other materials such as straw, wood and dung are the most widely used energy sources for cooking and heating in homes in low-income countries. These are called biomass fuels, and burning them creates smoke containing fumes, gases and small particles that are breathed by those living in the home. This is what is referred to as exposure.

In many low-income countries cooking is done indoors in poorly ventilated rooms, leading to high levels of indoor air pollution due to biomass and coal smoke. Half of all the people in the world, most living in low-income countries, rely on solid fuel for cooking, lighting and heating. Three-quarters of the population of India, China and nearby countries, and more than half of those in parts of South America and Africa continue to cook with solid fuels such as dung, wood, agricultural residues or coal. Cooking indoors with solid fuels in poorly ventilated rooms produces a great deal of smoke that those living in the home breathe.

The scientific evidence on “biomass fuels and respiratory diseases” has been reviewed by the task force of the Forum of International Respiratory Societies (FIRS).

While cooking is the most important activity that produces smoke from solid fuels, in some regions, especially in Asia and Africa, heating is another important source. The majority of rural households in developing countries burn biomass fuels or coal in open fireplaces or in stoves that are not airtight which, when there is also poor ventilation, produce very high levels of smoke that become even higher during periods of cooking. Burning solid fuels produces levels of air pollution that far exceed the health-based standards for safety in the household, especially with repeated episodes of intense emissions.
Cooking and/or heating with biomass fuels or coal, even in stoves or fireplaces vented to the outdoors (airtight stoves), can also produce high levels of indoor air pollution, greatly exceeding levels of outdoor pollution with regard to several important pollutants. Several studies have shown the impact of indoor pollution, especially on women and children.\textsuperscript{12,13} In China, almost all the exposure to small particles in the rural population comes from indoor air pollution from solid fuel; whereas this type of exposure is substantially lower in the urban population.\textsuperscript{14} Up to half of the total exposure in women who cook with solid fuel comes from the high levels of smoke produced when they are close to the fire, especially when starting or stirring the fire, and the duration of such exposure is long.

The solid fuels that produce indoor air pollution may be burned in a variety of containers (stoves) for cooking food or for heating houses. The amount of indoor air pollution that is created varies with the type of stove used and the way in which the fumes and gases (smoke) produced from the burning material are directed away from the air around the place where the burning is carried out (ventilation). The concentration of smoke is determined by the amount of smoke released during burning and by how quickly it is cleared from the environment through ventilation. The total exposure to the smoke that can result in health effects is determined by both the concentration of smoke and the duration of exposure.

To determine how much smoke an individual is exposed to, it is necessary to specify the type of fuel that is used; the type of stove; the location of the stove; the characteristics of the building; the type and amount of ventilation, which affect the concentration of smoke; and the duration of exposure.

The most dangerous parts of the smoke produced by burning these materials are the fine particles that are produced by burning, especially very small particles from solid fuels that are able to pass deep into the lungs when a person breathes the air containing the smoke. It is also these particles that make smoke visible, whereas gases in the smoke are not visible.
3

How does exposure to smoke from solid fuels affect lung health?

What evidence do we have that biomass fuel or coal smoke causes damage to the lungs?

The number and the quality of available studies associating exposure to solid fuel combustion products with respiratory diseases are limited but growing. Three types of lung disease have been judged to have strong evidence of association with exposure to solid fuel smoke: acute lower respiratory infections (ALRIs) in young children, chronic obstructive pulmonary disease (COPD) in women, and lung cancer in women exposed to coal smoke. Evidence for associations with COPD and lung cancer from coal smoke exposure in men is considered moderate, and association of biomass smoke with lung cancer, asthma in children and adults, and tuberculosis in adults is considered scarce. A few studies have established an association between lower values of lung function, airflow obstruction and chronic exposure to biomass fuel smoke. Other factors (confounders), associated with both the exposure and the disease that might be the true explanation for effects, may explain the results reported in many observational studies of indoor air pollution and health.

The information that is currently available suggesting that indoor air pollution causes these diseases is summarised as follows.

Childhood pneumonia

Pneumonia is more frequent in those who spend more time exposed to indoor air pollution. Young children are most affected—just over half of all deaths thought to be due to exposure to domestic smoke from biomass fuels occur among children aged 0–4 years. This means that the number of deaths from pneumonia caused by indoor air pollution each year among children less than 5 years of age is just under a million, of which slightly more occur in Africa than in South-East Asia.
The amount of time spent daily in the home where biomass fuels are being burned is closely associated with the frequency of pneumonia.\textsuperscript{19,20} Young infants carried on the backs of their mothers while they cook are the most affected.\textsuperscript{21} This situation is even worse when someone in the house where the children live is a tobacco smoker. Those children who are exposed to both domestic smoke from biomass fuels and household tobacco smoking have an increasing likelihood of developing pneumonia directly associated with the number of people within the household who smoke.\textsuperscript{22–24}

One study looked at the effect of introducing a safer way of cooking/heating to reduce the problem of childhood pneumonia.\textsuperscript{17} More research is needed to find an approach to improving the methods of cooking/heating that is acceptable to those who both use these fuels and are willing to use the improvements to reduce the exposure to smoke and thereby overcome the problem of pneumonia in children caused by domestic use of biomass fuels.\textsuperscript{25}

### Table

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Study group</th>
<th>Age, years</th>
<th>RR (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong ALRI</td>
<td>Children</td>
<td>&lt;5</td>
<td>2.3 (1.9–2.7)</td>
</tr>
<tr>
<td>COPD</td>
<td>Women</td>
<td>≥30</td>
<td>3.2 (2.3–4.8)</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>Women</td>
<td>≥30</td>
<td>1.9 (1.1–3.5)</td>
</tr>
<tr>
<td>Moderate I COPD</td>
<td>Men</td>
<td>≥30</td>
<td>1.8 (1.0–3.2)</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>Men</td>
<td>≥30</td>
<td>1.5 (1.0–2.5)</td>
</tr>
<tr>
<td>Moderate II Lung cancer</td>
<td>Women</td>
<td>≥30</td>
<td>1.5 (1.0–2.1)</td>
</tr>
<tr>
<td>Asthma</td>
<td>Children</td>
<td>5–14</td>
<td>1.6 (1.0–2.5)</td>
</tr>
<tr>
<td>Asthma</td>
<td>All</td>
<td>≥15</td>
<td>1.2 (1.0–1.5)</td>
</tr>
<tr>
<td>Cataracts</td>
<td>All</td>
<td>≥15</td>
<td>1.3 (1.0–1.7)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>All</td>
<td>≥15</td>
<td>1.5 (1.0–2.4)</td>
</tr>
</tbody>
</table>

*Adapted from FIRS document.\textsuperscript{6}

Asthma

Solid fuel smoke causes damage to patients with asthma through the particles, gases and fumes that it contains. The most dangerous particles
from solid fuel smoke are the smallest ones. Another important element is the sulphur dioxide produced by coal burning. These are the components of the smoke that have the most important immediate effects, causing irritation and inflammation of the lining of the airways. This results in the airways becoming increasingly irritable and reacting vigorously when dust particles, fumes or even cold air stimulate them. Irritation of the airways can then lead to wheezing and a worsening of the symptoms of asthma. The irritability causes the airways to close, producing airway obstruction and causing the chest to feel tight, which provokes breathing with wheeze or coughing, explaining the usual symptoms of asthma. When the smoke exposure is constant or regularly repeated, it can have a long-term effect and cause the airflow obstruction to progress.

An analysis of the results of three studies suggests that exposure to solid fuel smoke results in a worsening of asthma, with exposed persons showing a relative risk of 1.6 (95%CI 1.0–2.5) for children aged 5 to 14 years and 1.2 (95%CI 1.0–1.5) for adults. That is, children have a 60% greater risk and adults a 20% greater risk of having an asthma attack in the presence of biomass or coal smoke.

A study from India compared the effects of smoke from biomass or liquefied fuel in 100 non-smoking women living with asthma. The result was an increase of 22% to 30% in symptoms among those exposed to the smoke. The peak expiratory flow rate (PEFR) was lower than predicted every time it was measured. The airflow rate was lower after exposure to smoke from cooking than it was before cooking (P < 0.01). The study concluded that exposure to biomass fuels affects the airway function and symptoms of bronchial asthma in a similar manner.

Whether or not exposure to smoke from solid fuels causes asthma is more controversial. One study showed that elderly men and women living in households using biomass fuels are much more likely to have asthma compared with those living in households using cleaner fuels, with an OR of 1.6 (95%CI 1.3–1.9). The risk was higher among women (OR 1.8; 95%CI 1.3–2.5) than among men (OR 1.5; 95%CI 1.1–1.9).

**Tuberculosis**

Many published scientific articles that discuss the health effects of indoor air pollution list tuberculosis as a consequence of exposure, although general reviews indicate that the evidence is “not yet certain” or “very
There are currently not enough studies to make a clear statement that exposure to biomass or coal smoke causes tuberculosis.

The studies that have been reported have many problems. Most do not measure exposure to other sources of indoor air pollution; and others, such as the most widely cited study, did not take into account the effects of tobacco smoking. Although studies ask about the type of fuel used, they rarely determine the type of stove, whether there is a separate kitchen or the type of ventilation used. Most studies only record what the participants report and do not measure the level or variability of exposure within the homes. No studies examined fuel sources for heating. We must conclude, therefore, that the information is not strong enough to make a decision about whether tuberculosis is associated with exposure to smoke from biomass fuels.
How can we assess exposure to smoke from solid fuels?

Exposure to smoke from coal or biomass fuels used indoors occurs when such fuels are used for cooking or heating. Thus, the first step to determine whether or not this is a matter of concern in a locality or community is to identify whether or not such fuels are in use.

In some locations, information on the use of fuels is available from public documents, but in many locations in low-income countries, such information is not routinely available. A simple survey of vulnerable groups to determine if they use these fuels in their homes can provide the information necessary to assess whether or not this might be an important factor in disease. Those who suffer from illnesses that are caused by exposure to smoke from the use of biomass fuels or coal have, by definition, a much higher probability of having such exposure and become a “sentinel” group for this determination. Patients with exacerbation of asthma or small children with pneumonia are groups that can be accessed for this purpose.

Prior to carrying out a detailed survey, a simple pilot study can be undertaken in a group of these vulnerable patients. The pilot survey should use simple questions concerning whether or not solid fuels are used for domestic heating and cooking. If the pilot survey fails to identify the use of coal or biomass fuels in a vulnerable group, there is little value or need to undertake a more detailed evaluation or to organise interventions to reduce this exposure.

The questions recommended for a survey on the domestic use of solid fuels include:

1. What type of fuel does your household mainly use for cooking? [Specify: coal/lignite, charcoal, wood, straw, shrubs, grass, animal dung, agricultural crop residue, other and none]
2. What kind of fuel do you mainly use for heating your house? [Specify: coal/lignite, charcoal, wood, straw, shrubs, grass, animal dung, agricultural crop residue, other and none]
If the answer to both of these questions is either “other” or “none”, this is recorded as “no exposure to smoke from domestic use of coal or biomass fuels”. If use of the listed fuels is recorded, this is taken as exposure to smoke from domestic use of coal or biomass fuels.

If the pilot survey demonstrates that solid fuels are used in the domestic environment, a more detailed evaluation is indicated. A standard questionnaire is available for use in epidemiological surveys that focus on health outcomes resulting from solid fuel use. This has been adapted from tools developed for use in household health surveys, including the World Health Survey (WHO), the Demographic and Health Surveys (ORC Macro/USAID) and the Multiple Indicator Cluster Survey (UNICEF).

More detailed questioning is required only if the person indicates that one of the types of fuel previously listed is used for heating or cooking. These further questions should obtain information about when such fuel is used for cooking, including the type of stove, the location of cooking and the nature of ventilation.

- For type of stove, the types to choose from are:
  
  Open fire, surrounded fire, improved single pot stove, griddle stove or other.

- For the type of ventilation, the choices are:
  
  Chimney, hood or neither.

- When a chimney is used, a further question should determine when the chimney was last cleaned:
  
  In past month, between one and three months ago, more than three months ago, never, don’t know.

- When solid fuel is used for cooking, the following should be asked:
  
  Where is the cooking usually done? Select one:
  
  In a room used for living/sleeping, in a separate room used as a kitchen, in a separate building used as a kitchen, outdoors or other.

To collect information concerning the type of stove used for cooking, a chart illustrating the types of stove is recommended. This chart should include line drawings of open fires, surrounded fires, improved single pot stoves, improved multiple pot stoves and griddle stoves. The line drawings used should be created locally to illustrate the variety of cooking stove systems in each of these categories that is used in a given area or community.
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How can we assess the impact on health of exposure to smoke from solid fuels?

The mere documentation of the possibility of a problem is not sufficient to initiate—or even to justify—actions to address the problem. All activities within health services have “opportunity costs”. To illustrate this point, consider a public health service in a low-income country where human and financial resources are strictly limited. In such a setting, the decision to undertake any particular activity comes at the cost of not doing something else. For example, a decision-maker responsible for health services management might have to choose between introducing activities to reduce exposure to smoke from solid fuels or some other health service activity because the human and financial resources available may not be sufficient to do both.

A simple process can provide the knowledge necessary for the decision-maker to choose whether or not to introduce activities to limit/prevent domestic exposure to smoke from solid fuels among several alternatives for public health activities. The first, simplest and most essential piece of information is the extent to which such exposure actually takes place. This information is obtained from the limited pilot study (as described in Chapter 4) or from a vulnerable group of patients, such as small children hospitalised for treatment of severe/very severe pneumonia. These sources will indicate whether or not exposure is likely in the domestic environment of that locality.

A second piece of information that helps the decision-maker is an estimation of the risk associated with this exposure if it is occurring in the community. The most efficient way to create such knowledge is to undertake a case control study in the most vulnerable group in the community from which risk can be estimated by calculating an odds ratio. The knowledge derived from these two steps provides the decision-maker with a
“number” that clearly indicates the size of the problem; first, the frequency of exposure in the vulnerable group, and second, the size of its effect on the health of this group. With a little additional effort, further information can be obtained at the same time as the pilot and case control studies are carried out: who the vulnerable groups are, where they live and what are the characteristics of the environment that led to the dangerous exposures.

This information allows the health services manager to frame an appropriate, feasible and cost-effective approach to dealing with the problem. It also provides the information necessary to make the case for investing in such services to other officials and decision-makers who are responsible for providing the human and financial resources to deal with the problem. In this case, “forewarned is forearmed”, and it illustrates the powerful influence that knowledge plays in effecting change, as well as the important role of “in-built” programmes of operational research to show the way forward.

If and when activities are designed, organised and implemented to reduce or prevent exposure to smoke from the domestic use of biomass fuels or coal, a practical plan is needed to introduce, field test and modify these activities. When the robber was asked why he chose to rob the bank, he replied “because that is where the money is”. The approach to a health problem has a similar rationale. The place to start with such activities is with the subgroup in the population most affected by the problem before applying them generally in the community. The steps taken so far in addressing the problem also provide the information necessary to identify the place to start the interventions. Thus, if the problem is shown to be substantial in a vulnerable group such as small children who suffer severe pneumonia, this is an appropriate group with which to start—the extent and size of the problem has already been determined, and this information can be used to engage the community in the efforts to control the problem.
What can we do to reduce the impact on health?

To address a problem such as the type of fuel used and the way it is used in homes is a complex task and not easy to accomplish. For this reason, it is essential to be sure that the problem is sufficiently important to try to address it. This is the purpose of the approaches outlined in this guide. Before undertaking any of these steps, it is vital to decide how big the problem should be before actions are taken to correct it. In many communities, the health of children holds high value. If this is the case, a decision can be made about what level of the effect of exposure to smoke from domestic use of solid fuels for cooking or heating is important enough to trigger action: for example, if it causes twice as many, half again as many or one-third again as many cases of severe/very severe pneumonia. Only when it is agreed at what point to take action should the process of looking at this problem be started.

Who makes the decision as to what kind of problem needs to be addressed? Obviously those planning and/or providing the health services in the community have an interest. Beyond this group, however, are the members of the community themselves and their natural leaders. For people to change traditional ways of living, especially if this is going to be costly to them, they must understand and agree that something is to be done and examine the options of what can be done.

If and when it is decided that something needs to be done, there are four components that should be addressed to reduce the problem:

1. Make available alternative, cleaner types of fuel that produce less harmful smoke;
2. Improve access to better stoves used for cooking and heating;
3. Improve the quality of the ventilation used for the stoves; and
4. Provide education for behaviour change.

Efforts to change behaviour rarely succeed if people don’t recognise that the different types of fuel or stoves or ventilation will improve their lives. The outcome will be much better if people already see the need for
change. This can lead to actions focused on encouraging the desired behaviour changes. Information about the health effects of using solid fuel can help people make adjustments to their usual behaviour. For example, even if they do not change fuel or stove type, all mothers can be advised to avoid breathing the smoke and to keep children away from the area where cooking is taking place.

The types of fuel, in descending order of how much effect their smoke might have on health, are biomass, coal/charcoal, liquid fuel and electricity. Choosing a less hazardous type of fuel helps to reduce the risk. This, however, depends on a number of factors, most importantly on the relative cost of the fuel and the ability of the family to pay for it. The most hazardous types of fuel are often the cheapest. Nevertheless, the options and consequences can be presented to the family/community to help them make choices.

The type of stove used is largely dependent on tradition but, to some extent, it is also dependent on expendable income. The types of stove, in descending order of the extent to which they are likely to produce and expel smoke into the household environment, are the open fire, the surrounded fire, the improved single pot stove and the griddle stove.

The open fire is one in which the fire has no surrounding mechanism to deflect the smoke that is produced. For cooking, several stones are placed in a burning fire to support the cooking pot or skillet, with the smoke pouring out in all directions around the pot. A surrounded fire directs the smoke that is expelled by the fire in a particular direction. This enables the person who is working over the cooking fire to stay out of the direct line of the smoke coming from the fire. In attempting to improve the type of stove, it is almost always possible, at virtually no cost, to improve the open fire to at least the surrounded fire.

The improved single pot stove is, for example, a container in which the fire is placed with the pot on the top of the container. Traditional single pot stoves include a metal pot, which is common in various parts of Africa, or a clay pot, which is traditional in some Asian communities, for example in the Philippines.

The griddle stove holds the fire completely within an enclosed container, usually of metal, but sometimes of clay or mud, and the cooking pots are placed on top of the container. The classic type of griddle stove is the old-fashioned wood-burning range or pot-bellied stove typically seen in movies depicting the “wild west” of North America. This type of stove is almost always connected to a chimney of some type or other.
In most communities, it is necessary to buy the single pot stove, whereas the surrounded fire can be prepared by virtually anyone at little or no cost. Moving from the single pot to the griddle stove is the most important step to take to reduce the amount of smoke exposure, but it is substantially more costly than either of the other options.

Finally, the amount and efficiency of ventilation influences exposure. One of the most important steps to take to improve ventilation is to move the cooking fire out of the living environment and either into the open air or into an open structure away from the dwelling. This is more easily done for cooking fires than for heating fires. In any case, it is better to have some method to direct the smoke away from anyone around the fire, and preferably to the outside air. This is best done by using a type of chimney, but only if the chimney is regularly cleaned. If the chimney is blocked by ash, it is no better than having no form of ventilation at all. A much less effective, although cheaper, form of ventilation is to use a type of hood to direct the smoke away from the person working with the fire, preferably to the outside air.

Although the best ventilation for solid fuels is provided by a totally enclosed griddle stove with a built-in chimney, less costly solutions can be made locally even by poor families. In any case, all members of the family should avoid, as much as possible, exposure to the smoke from burning solid fuels.

One of the most effective ways to introduce changes to traditional practices is to start where the problem is worst, so that people can assess the results of not doing anything. In many communities, families with children who develop pneumonia may be willing to change, especially if they have experienced repeated episodes of pneumonia or if several children in the family have pneumonia. These families can quickly appreciate that smoke exposure is a problem for their children. If their children’s health improves when they reduce the smoke exposure, these families become “champions” for changing patterns of cooking or heating in their communities.

A significant part of the action plan depends on communicating effectively with the family and the community through health education. Communication campaigns must be carefully designed and tested to be sure that the messages meant to be passed on are truly understood and appropriate for those to whom they are directed. For this reason, as the health education programme is developed, it is very helpful to have assistance from someone in the health services who has the training and skills
to develop effective communications for the community where the action is to take place. Working with this expert and members of the community will go a long way to ensuring that the messages are effective. It is not good practice simply to adopt something that was developed for another culture and assume that the messages will be passed on effectively. Frequently, the people most at risk are also those with the least formal education and who rely the most heavily on traditional practices, so a great deal of attention should be given to this process.
How can we monitor progress?

If, and when, a decision is taken to organise an intervention to reduce or prevent exposure to smoke from domestic use of coal or biomass fuels, it is essential to determine whether and to what extent these activities actually achieve what is needed to be done.

Just as vulnerable populations are the best source of information necessary to decide on taking action to address this problem, the most efficient means to monitor the results of actions and activities is through the systematic monitoring of a vulnerable group, where the effects are magnified. An example would be surveillance by systematic collection of information about the domestic exposure patterns of small children in hospital for treatment of severe/very severe pneumonia. This is the approach that has been taken by The Union in its project “A comprehensive approach to lung health services” funded by the World Bank, and the experience gained is the basis on which this guide has been prepared.

Several questions about smoke exposure were added to the patient treatment card for children hospitalised for treatment of pneumonia and for adults presenting for care of persistent asthma (see Chapter 4 for the suggested questions). These questions need to be tested in the community where they are to be used and should be revised based on the results in order to ensure that they are clearly understood and appropriate. The information gathered allows the determination and monitoring of the trend in numbers and proportions of patients exposed to smoke from domestic use of biomass fuels or coal. It also provides a framework from which to undertake case control studies to estimate the size of the health effects (risk) due to this exposure, and it sets a framework to select a sample of patients from which information can be obtained to precisely characterise the type of exposure to solid fuel smoke.

Using this framework and the information collected, it is possible to select indicators that can be monitored to document any change in exposure that may accompany organised efforts to reduce or prevent exposure to solid fuel smoke. Theoretically, if safer stoves can be introduced into use, and if ventilation can be increased or if the way the fuel is used...
(including location, protection, and ventilation) is improved, then the number and/or proportion of vulnerable persons (children with pneumonia, asthma patients with unplanned visits to health facilities) who report the use of domestic biomass fuel should gradually diminish towards the prevalence of its use in the general community. In other words, the health effects of exposure should be reduced so that the patients will report the same experience as the general population and the “risk” will be reduced.
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