

**Burns and Injuries from Non-electric-Appliance Fires:
Part II. A Strategy for Intervention Using the Haddon Matrix**

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SUMMARY

Background

A large proportion of burn injuries in developing countries are related to the nature of domestic appliances that are used for cooking, heating, lighting or all three. Issues raised in our overview of the scope of the problem included the need for better surveillance with formal epidemiologic studies, which will more accurately assess the true incidence in vulnerable populations. The purpose of this paper is to create a framework for envisaging new approaches to the problem, as well as to begin to evaluate the strengths and weaknesses of proposed interventions.

Materials and Methods

We used the Haddon Matrix to begin accumulating proposed interventions that encompass a pre-event, event, and post-event timeline.

Results

The criteria used to evaluate potential interventional strategies should be based on values that are suited to the problem and the setting, are culturally appropriate, and can be employed in a reasonable period of time for a sustained period to ensure success. We propose an initial strategic outline plan for interventions.

Conclusions

Recommended action steps to address the problem include promoting the use of alternative energy sources, encouraging an integrated approach to finding interdisciplinary solutions, devising a better system of kerosene containerization, re-engineering appliance designs, legislating for enforcement of health and safety standards, taking a holistic approach through government's inter-departmental collaboration, formally discouraging dishonesty and corruption, encouraging ventilation of cooking or living (in the case of heaters) areas, implementing basic building codes, educating consumers, and training caregivers and community health and emergency workers.

BACKGROUND

The general approach to injury prevention includes four stages: surveillance, analysis, intervention and evaluation. A previous paper addressing the subject of burns and injuries from non-electric domestic appliances (“Burns and Fires from Flammable Non-electric Domestic Appliances: Part I. The Scope of the Problem”) was a review of our current understanding of the incidence and impact of injuries resulting from the use of small domestic appliances (non-electric stoves, heaters, and lamps) that utilize flammable fuels.* One of the issues raised by that review was the need for better surveillance with formal epidemiologic studies, which will more accurately assess the true incidence in vulnerable populations.

Nonetheless, enough information is available to clearly indicate that this is an issue of critical importance, particularly in developing nations. Because there is already convincing evidence of the magnitude of this problem, even in the absence of forensic investigations and comprehensive surveillance and analysis, discussions regarding potential intervention programs should begin. The purpose of this paper is to create a framework for envisaging new approaches to the problem, as well as to evaluate the strengths and weaknesses of proposed interventions.

To help drive more scientifically the bases of epidemiologic research and preventive practice, Dr William Haddon, Jr developed two complementary conceptual frameworks.(1, 2) In creating what came to be known as the Haddon Matrix, he crossed the concept of epidemiologic component (agent-host-environment) interactions with that

* There are at least two terms in this text that may be used interchangeably. Both “petrol” and “gasoline” refer to the fuel commonly used for internal combustion engines. Similarly, “paraffin” and “kerosene” refer to the same hydrocarbon liquid. In addition, there are two types of stoves mentioned in this document: the flame (non-pressure) stove and the Primus (pressure) stove.

of temporal components (pre-event, event, post-event). Thus, the multidimensional aspects of the matrix emphasize the multifactorial etiology of injury and clarify that interventions can occur at many different points along the continuum of process and outcomes.

METHODS

Haddon's matrix was employed in all three dimensions to create a variety of options for interventions as well as to evaluate them critically for potential effectiveness.(1, 2)

(Table 1) Within the matrix we attempted to bear in mind the wide breadth of potential solutions available, including education programs, environmental modification, and enforcement of existing or creation of new legislation.

More generally, to create the interventional options, we attempted to follow Haddon's ten strategies:

1. Do not create the hazard.
2. Reduce the amount of hazard.
3. Prevent the release of the agent.
4. Modify release of the agent.
5. Separate in time and space the hazard from that which is to be protected.
6. Separate the hazard with a physical barrier.
7. Modify surfaces and basic structures.
8. Increase resistance of the structure or person to be protected.
9. Provide first aid and emergency response.
10. Provide acute care and rehabilitation.

Although some of these strategies can be employed at any time in the prevention matrix (that is, before the event, during the event, or after the event), the last two strategies are clearly focused on enhancing the post-event phase.

We completed the two-dimensional matrix and then arranged the description of the options in this paper according to the relationship of timing to the event itself; that is, pre-event, event, post-event options.

TABLE 1 HERE

Pre-event

Human factors — Human factors that can be altered to prevent these types of injuries are most often related to educational issues. Clearly, better understanding the proper functioning and maintenance of small non-electric appliances and the potentially serious risks of injury and even death from their use are critically important. Also important is improving knowledge of safer techniques for purchasing and storing fuels. One safer technique involves refusing to purchase illicit appliance models on the black market; in communities where there are restrictions imposed upon the purchase of these models that are considered to be unsafe, education can help consumers accept these restrictions and be more willing to forego such purchases.

Object/substance — There are at least four objects and substances involved, including the appliance (stove, heater or lamp), the fuel (kerosene), the ignition source (match or

lighter), and the flame itself. The design of the appliance can be altered to make it more stable and less likely to malfunction. Flammable or combustible fuels can be stored safely in appropriately safety-designed and labeled containers out of the reach of small children. Matches and lighters can be guarded by responsible adults and older children. Placing the stove off the floor can distance the flame from contact with clothing and placing it out of the reach of children can reduce the risk of stumbling or pushing over the stove.

Physical environment — The home is the most common setting for injuries caused by these appliances. The kitchen is usually the site of injuries caused by cooking stoves. This environment can be altered to create more distance between the appliance and people in the room; or, at the very least, to use less combustible building materials and incorporate at least two points of escape in the design of the room or home. The person involved with the cooking can be advised to move small children to a second room or even outside while the stove is used. Barriers can be created to prevent small children from playing near the appliances. The elevated structures on which the appliances are placed or mounted (such as tables and shelves) can be optimally stabilized.

Sociocultural environment — There is little doubt that the origin of all aspects of the problem is poverty. Poverty affects the choice, quality, and condition of appliances or fuel-type used; it forces young children to act as caregivers and cooks in cramped and crowded quarters; it deprives users of necessary education to safely operate the appliances in order to remain unharmed. One expectation of the relief of poverty would

be electrification of all dwellings. Before this laudable but formidable goal of poverty relief can be achieved, however, other steps can be taken, such as legislation to prevent unsafe designs from being imported to the market. Pictorial instructions can be attached to newly purchased appliances to help users with low literacy levels. Teams of volunteers can be formed in informal settlements to observe risky behaviors and educate communities on safe practices.

Event

Human factors — Several techniques can be taught to appliance users, all of which can reduce the extent of injury or damage. These include the “stop, drop and roll” maneuver to stop the burning process, and to smother the burning clothing or person with blankets or by dousing them with water. A paraffin fire is best smothered by a bucket of dry sand. Populations that customarily wear loose-fitting garments can be taught not to wear them or to modify them somehow while working with open flames.

Object/substance — If kerosene and other flammable or combustible fuels and materials are kept away from lit lamps and stoves, there is less likelihood that when a fire does occur, it will spread by the ignition of nearby fuels. Consumers can also be taught to carefully separate containers for milk, water, and fuels and label these clearly so no mistaken identifications can result. Ideally consumers should avoid using any beverage container for the storage of fuels, and, these fuels should be pre-packed with their own iconic packaging, hazard labels, and child-proof closures.

Physical environment —Water and dry sand can be kept in easily identified containers, such as buckets near the cooking area, so that they can be rapidly accessed and used without endangering lives. However, in South Africa, the results of shack-fire simulations conducted by the Paraffin Safety Association have suggested that this may be impractical as a first-line intervention. There is often no time to effectively douse a fire with sand; escaping the premises is more important. Formal housing dwellers may have more time to evacuate than shack dwellers. Other strategies to reduce the need for space heating and therefore exposure to hazards includes using less combustible building materials, positioning dwellings at a fair distance apart, designing for escape alternatives, engineering the building for optimal thermal efficiencies, and using insulation in the home.

Sociocultural environment — Neighborhood-watch groups can be formed to respond to fires and burn victims in a timely manner, limiting the spread of the fire and the damage to the victim. Community cohesion would facilitate the risk assessment, response planning, training, and cooperation that would be required to limit the danger. Also important are the public display of emergency numbers (fire brigade and police) on walls and the education of the community members to immediately alert these stations once they notice a fire.

Post-event

Human factors — Teach adults and children alike how to apply appropriate first aid by cooling burns with water. After cooling, they should cover wounds and continue to keep them dry and clean. Facilitate better re-building designs and storage or appliance choices. Once again, education in schools or directly in the affected communities and posting in public places easily accessible displays of emergency numbers can facilitate the early evacuation of burn victims.

Object/Substance ? Provide education of all pre-event factors. Encourage the adoption of safe practices and products.

Physical Environment — Clean the environment thoroughly. Correct all variables in the environment that led to the injury.

Sociocultural environment — First-response teams can be formed to provide control of fires and transport of injured victims to appropriate medical care.

THIRD DIMENSION OF HADDON'S MATRIX

The criteria used to evaluate potential interventional strategies will be based on values that are suited to the problem and the setting, are culturally appropriate, and can be implemented in a reasonable and for a sustained period of time. By viewing options for alternative interventions with this dimension, decision makers can more clearly evaluate the intervention's relative merits by considering what is important in the decision process, facilitating participation in decision-making by means of a structured process, and facilitating the ease with which choices are made. This will potentially result in more effective advocacy. These evaluative criteria include effectiveness, cost, freedom, equity, stigmatization, preferences, and feasibility.(1, 2)

Effectiveness — This criterion addresses whether or not there is evidence that, if applied, the proposed intervention will work. Are there data from established studies demonstrating that experience with this proposed intervention has worked in the past in a similar setting? Or are there suggestions that this intervention should work based on theory, judgment or experience? As we review the proposals detailed above, it is clear that some strategies lack effectiveness (e.g. providing written instructions with appliances; legislation to prohibit the manufacture of kerosene stoves), but others have a high likelihood of succeeding (e.g. reduction of poverty; cooling the burn with water). In particular, where possible, the use of alternate energy sources may drastically cut the incidence of injuries. In India, the introduction of liquid petroleum gas (LPG) stoves alone has led to a dramatic reduction in the incidence of burns from kerosene stoves. (Personal communication, RBA)

Cost — The cost of the proposed interventions is best examined in relation to the financial or human cost of implementing the intervention compared to not implementing the intervention. Regarding the latter, there are many reports in the literature that include the financial cost of caring for patients burned as a result of incidents involving non-electric domestic appliances.(3) The human cost is measured in terms of disability, scar formation, pain and suffering, and death. In a developing economy that relies on small entrepreneurial activities, the loss of the home which doubles as a place of business not only results in loss of productivity, but also results in a much slower financial recovery because shack dwellers are typically not insured for loss.

Nonetheless, because these proposed interventions depend upon implementation by government or non-government organizations, the cost of the intervention must also be measured in terms of the likelihood of success. The reality is that these agencies are most likely to approve the least costly interventions. With that in mind, some of the proposed interventions (e.g. electrification of all dwellings) are less likely to be successful because of the high financial cost attached to them. However, there may be other factors that make universal use of electricity too costly. In South Africa it is too expensive to roll-out to remote areas and even where users have received the free electricity grant from the government, they may still not be able to afford using electricity for cooking and heating and will therefore still use paraffin for these purposes. Also in South Africa, an increase in electricity use has been correlated with an increase in the incidence of liquid burns; consequently, attempts to conserve on cost by switching to

alternative sources of fuel may carry their own and different risks. This must all be taken into account in planning.

Other strategies, such as establishment of professional first-response teams in neighborhoods, will also require a significant commitment of resources; but they should remain on the agenda at a high priority because of their wide-ranging implications for improving health care.

Freedom ? Infringement of freedom is a concern that has different weights in different societies. In Western cultures, particularly among the more affluent nations, infringement upon personal freedom is carefully avoided. In developing nations, particularly those under non-democratic rule, this may be less of a prohibition. Still, in evaluating a proposed intervention, it is useful to look at the types of freedom that may be restricted by the intervention and the degree to which those freedoms will be limited. On the other hand, this should be balanced against the loss of freedom associated with not performing the intervention; that is, the loss of one's life, the loss of freedom to otherwise exist without painful and restricting scar tissue, and the loss of freedom to exist unimpaired by severe burn injury. In this regard, certain interventions that are proposed above are associated with greater restriction of personal freedom, such as removal of kerosene stoves from the market altogether. This restriction of personal freedom can only be effective if an alternate source of energy is available at a similar cost. The success of other interventions, however, depends on the autonomous and self-motivated behavior of the individual. This includes all strategies focused on educating the users.

Equity ? When evaluating proposed interventions, it is valuable to pursue equity among the interventions being reviewed. Horizontal equity means that all persons in a community are treated equally. Again, in some societies there is a stronger sociocultural drive to ensure that this occurs, particularly in developing nations that are striving to protect and nurture the less advantaged segment of their community. However, in regard to addressing the challenges associated with reducing the burden of injury from non-electric appliances, it is clear that vertical equity is more important.

Vertical equity means that people in different segments or classes of the community are treated differently in order to restore all members of that community to an equal state of protection. In regard to the present set of challenges, it is clear that it is the most disadvantaged segment of the population that is at the highest risk. Women and children in more affluent homes, even in developing nations, are at much less risk for a number of reasons. In many countries electrification has progressed such that affluent homes no longer need to use flammable fuels in their kitchen appliances. Universally, however, women and children in affluent homes simply do not become involved in the cooking or lighting chores because those chores are delegated to domestic helpers. Thus, in order to make the risk equitable to all segments of the community, more emphasis must be placed on strategies that target the poor.

Stigmatization ? Stigmatization is likely to occur if the principle of vertical equity is followed. The segment of the population in the lowest socioeconomic stratum will be targeted, either for education, for legislative reform, or for improvement in standards pertaining to devices or the environment. The question is, is this stigmatization going to

be perceived as undesirable? This question is best answered on a region-to-region, culture-to-culture basis.

Feasibility ? Feasibility of the strategies can be analyzed on a number of different levels. Technological feasibility is a priority when assessing new designs for small non-electric stoves, such as the competitions for stove design held in May 2004 by the Paraffin Safety Association of South Africa.(4) Economic feasibility is also somewhat easier to identify, particularly when changes in stove design or the introduction of new stove models is being examined because these changes can be attached to cost differences.

Table 1.? Haddon Matrix applied to the problem of residential fires in developing countries using non-electric domestic appliances.

	<u>Host/Human factors</u> (People living in home)	<u>Object/Substance</u> (stoves, lamps, fuels, matches/lighters)	<u>Physical environment</u> (home)	<u>Sociocultural environment</u> (community norms, policies, regulations)
<u>Pre-event</u> (before fire starts)	<ul style="list-style-type: none"> • Teach fire safety techniques: wear tight clothing; keep water and dry sand accessible • Teach consumers appliance safe design 	<ul style="list-style-type: none"> • Identify safer fuel • Change appliance design • Use thick tubing for LPG containers • Inspect regulator and tubing bimonthly of LPG stoves • Provide pictograms with appliance instructions • Design kerosene containerization to eliminate human contact • Promote LPG & electricity • Teach users safe fuel-use techniques 	<ul style="list-style-type: none"> • Store fuels in safe, easily marked, separate, red containers • Open windows prior to lighting fuel source • Teach consumers how to smell kerosene for quality • Place appliances on stable surfaces, out of reach of children and away from flammable substances 	<ul style="list-style-type: none"> • Prevent kerosene contamination • Create political/economic leverage for adoption of design improvement • Legislate for design regulations & enforcement • Use evidence-based research to support advocacy & programs • Take holistic approach with inter-governmental collaboration • Discourage corruption in industry & government • Implement building codes • Develop school-safety curricula • Train caregivers, and health workers • Train volunteers to observe risky behaviors and unsafe practices
<u>Event</u> (during fire)	<ul style="list-style-type: none"> • Use “stop, drop, and roll” • Use blankets to smother or water to douse flames 	<ul style="list-style-type: none"> • Turn off device 	<ul style="list-style-type: none"> • Emergency numbers handy 	<ul style="list-style-type: none"> • Prepare neighbors to intervene in putting out fire and assisting victims
<u>Post-event</u> (injury has occurred)	<ul style="list-style-type: none"> • Acute care/rehabilitation • Education at place of care, shared by providers • Teach consumers to evacuate premises 	<ul style="list-style-type: none"> • Discard faulty equipments and fuels 	<ul style="list-style-type: none"> • Clean environment with regard to future prevention 	<ul style="list-style-type: none"> • Educate community using event as example

DISCUSSION

The overall solution for reducing domestic-appliance fires involves embracing all three traditional approaches to injury prevention: engineering, enforcement and education. A number of organizations have already proposed solutions.

One solution is to identify a safer fuel. Coconut oil is safe but it is not satisfactory for lamp fuel because it does not ascend the wick.(5) Diesel fuel has the same flammability as kerosene but is unsatisfactory for lamps because it creates soot and is costlier than kerosene. Ethanol gel fuels are being investigated by the South African government.

The South African Department of Minerals and Energy is also promoting an LPG stove, with a long life expectancy, which is much less expensive to use and maintain. However, start-up costs are much higher than with wick or pressure stoves. Decades ago, kerosene flame stoves were used extensively in Sri Lanka, but they now are used only in rural homes. Because they are more economical, LPG stoves have become very popular there, even in houses with electricity. Whether or not LPG reduces the injury burden on the community is still unclear. Although the incidence of LPG incidents may be lower than those caused by kerosene, the effects of LPG tend to be more devastating to persons and property.(6)

In 2006, South African scientists made a breakthrough discovery: a revolutionary new, highly efficient, inexpensive solar power technology that will enable homes to draw all their electricity from the sun. The alloy solar panel is much more cost-efficient than the old silicone panels. Energy can be fed directly into the wiring of existing houses.(7) The technology is still in its infancy so at this time there are still many drawbacks to its

use. Nonetheless this is an area that should be regularly monitored for progress and its benefits included for consideration.

It is possible to prevent contamination of kerosene.⁽⁸⁾ Enforcement of existing safety regulations at petroleum refineries and petrol filling stations, or by informal resellers in the case of South Africa, can be enforced. (In South Africa the industry is highly regulated, but the problems occur after the fuel leaves the gantry gates. The path to the consumer involves many resellers including “village vendors” who sell paraffin from their homes. Regulation enforcement could enable equitable pricing and manufacturers’ consistent incorporation of a device that can track the source and path of the product in the event of a contamination.

Consumers can be taught to use different containers for different substances; or preferably dedicated containers could be pre-packed for kerosene or petrol.

Changing appliance design is among the more obvious and effective remedies to the problem of appliance fires, but there are still barriers to implementing this solution. Manufacturers compete in the high volume, low cost/low income market, and safer products carry a higher price. If the transition to safer design is not undertaken prudently, manufacturers will be forced out of this market niche. Many stoves are manufactured outside the country of purchase, and countries at risk might lack the political or economic leverage to force supplier countries to modify design specifications. Thus the focal point of regulation becomes imported goods.

Because manufacturers are reluctant to risk any market loss, changes in design may require legislation by which to regulate design specifications. Several years ago the Indian Standards Institute (ISI) established design specifications for Primus stoves

manufactured in India.(9) However, it is not mandatory for all stoves sold to have the ISI stamp of approval. As expected, ISI-approved stoves are more expensive, and legislation has been difficult to enforce.

In South Africa, however, the Department of Trade and Industry has effectively banned the unsafe non-pressure paraffin appliances by means of the specification of the South African National Standard (SANS) 1906 (compulsory as of January 1, 2007). All indications show that the revised, complementary standard for pressurized appliances, namely SANS 1243 would also soon be regulated in order that all paraffin-fuelled appliances adhere to the minimum health and safety criteria. The impact of these regulations should be measurable in the near future.

In general, minimum health and safety standards are difficult to implement in developing countries because of the lack of enforcement personnel and their susceptibility to participate in graft.

Education, although generally ineffective at producing sustainable change, is critical at a number of levels. Indeed, there are some focus areas in which education is the only hope for effecting change. Fire safety should be taught, specifically focusing on primary (pre-event), secondary (event), and tertiary (post-event) interventions. For example, primary prevention includes not wearing loose clothing around open flames, placing stoves on an elevated, cloth-free surface away from combustibles, extinguishing the flame and allowing the appliance to cool prior to refilling, and ultimately avoiding residence in high-risk dwellings, such as informal settlement shacks. Examples of secondary prevention include keeping a bucket of dry sand in the kitchen to contain fires once they start, and teaching families how to distinguish between fires that can be

extinguished and those that require immediate escape. Finally, tertiary prevention includes teaching fire safety (“stop, drop and roll”), use of emergency telephone contact numbers, and first aid management (cooling the burn with water). To avoid accidental ingestion, kitchens should be well-ventilated to prevent the accumulation of vapors and inhalation of toxins, and kerosene should be stored in safe containers out of reach of small children. Those who use LPG should be instructed that when they connect the gas cylinder to the stove they should use thick tubing that rats cannot bite. LPG stoves should be lit only after opening the windows for at least five minutes, and stoves should not be lit if the odor of gas is present and definitely not placed on top of an electric stove. Twice each month the LPG regulator and tubing should be inspected for damage or wear.

In other cases, education can be offered in tandem with design changes or legislation, thus improving compliance and effectiveness. For example, consumers should be taught about safe appliance design features so that they do not buy an unsafe appliance.(9) Users should be instructed that flammable-fuel containers should be painted red to indicate danger, clearly labeled, and not used for any other purpose. Consumers should be instructed how to smell kerosene to check its quality and to look for signs of contamination with petrol. Because of low literacy levels especially in low income communities, instructions and warnings written in pictograms are important for comprehension, and consumers should be taught to carefully follow the pictorial messages.

The burden of education can be shared by health care providers, oil companies and government.(8) In South Africa, for example, the Paraffin Safety Association of Southern Africa was established in 1996 by South African oil company representatives of

BP, Caltex, Engen, Shell, and Total (Sasol later became a member) as a non-government organization to promote health and safety practices in the use of domestic paraffin.(4)

This organization initiated the testing of the most commonly sold paraffin stoves in 2003. It promotes safe pre-packaging of all paraffin, advocates for regulation of the industry, advises the national government regarding policy issues, has conducted a Safer Paraffin Stove Design and Safe Paraffin Packaging competition to stimulate interest in the design fraternity, has launched educational and public awareness projects, has stimulated necessary national legislation, and has advised the South African Bureau of Standards, has conducted or collaborated on several research projects, has launched educational and public awareness projects, and is piloting a national energy-related surveillance system. The South African government, which has taken the bold move to regulate** the paraffin industry, estimates that it could save the country a major portion of the estimated R104 billion a year externality cost of paraffin-related incidents.(10)

Other broader approaches can be taken as well. Evidence-based research can be used to support program and advocacy initiatives. Governments can be supported in policy development to ensure safe fuel use. Surveillance programs can be implemented and maintained, and continuing evaluation of programs and interventions can be ensured. This would empower communities to monitor and manage their own risk profiles.

One example of progress being made is the work of the Safe Bottle Lamp Foundation in Sri Lanka, which has improved lamp design over its 14 years of

** As of January 1, 2007, under the Standards Act, 1993 SANS 1906:2006, non-pressure paraffin appliances became compulsory. The estimated date for conclusion and adoption of the further standard SANS 1243 is April 1, 2007. Until that time the SANS 1243 guidelines are voluntary. The text of SANS 1906 is available online at http://search.sabinet.co.za/pdf/ggaz_pdf/2006/jul/gg29338_nn1091.pdf

existence.(5) The safe lamp has two flat sides to prevent rolling, a lid that can be screwed on tightly, and it is short and heavy to decrease the chance of spilling. Each costs only US\$0.35 to produce. The Safe Bottle Lamp Foundation manufactured and distributed 600 000 lamps, either for free or at below cost. They have educated the public about burns, such as refraining from filling lamps while they are burning or allowing children to perform this task, how to extinguish burning clothing, and the need to cool burns with cold water. Although it is primarily concerned with lamp burns, the foundation also advises the public on how to avoid burns when using LPG stoves.

CONCLUSIONS

This analysis using all three dimensions of Haddon's matrix has left us with the following conclusions regarding the most likely action steps that should next be taken to address this problem.

- Promote the safe use of kerosene and its appliances, or, where possible, the use of alternative energy sources, such as LPG and electricity (despite the paraffin market's firmly establishment in most countries).
- Encourage an integrated approach to finding interdisciplinary solutions.
- Devise a system of kerosene containerization to eliminate human contact with the fuel or the possibility of contaminating kerosene with other fuel sources.
- Re-engineer appliance designs to prevent health and safety hazards.
- Legislate for the enforcement of minimum health and safety standards.

- Stimulate technological advancement e.g. development and use of fire retardant building materials and furnishings especially for low income households
- Take a holistic approach to housing, health, education and safety through government's inter-departmental collaboration, discouraging often-rampant dishonesty and corruption.
- Encourage ventilation of cooking and living areas to help prevent respiratory conditions or asphyxiation.
- Implement basic building codes for the placement of appliances and materials used (including security gates that inhibit emergency evacuation from homes).
- Educate consumers in optimal kerosene use practices and safe evacuation procedures. Incorporate curricula into schools and tertiary education.
- Train caregivers, and community health and emergency workers.

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