

Safer access to pesticides for suicide prevention

Experiences from community interventions



**World Health
Organization**

Safer access to pesticides for suicide prevention

Experiences from community interventions



WHO/MSD/MER/16.3

© **World Health Organization 2016**

All rights reserved. Publications of the World Health Organization are available on the WHO website (<http://www.who.int>) or can be purchased from WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel.: +41 22 791 3264; fax: +41 22 791 4857; email: bookorders@who.int).

Requests for permission to reproduce or translate WHO publications – whether for sale or for non-commercial distribution – should be addressed to WHO Press through the WHO website (http://www.who.int/about/licensing/copyright_form/en/index.html).

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use.

Printed by the WHO Document Production Services, Geneva, Switzerland

Contents

03 **Foreword**

04 **Acknowledgements**

05 **Part 1**

Tackling pesticide suicides through community engagement

Introduction and background

Focusing on community interventions – creating safer access to pesticides

08 **Part 2**

Strengthening community prevention – three case studies

Case study 1: China – combining household lockboxes with community education about suicide prevention

Case study 2: India – central communal storage of pesticides

Case study 3: Sri Lanka – safely securing pesticides within households

24 **Part 3**

Lessons learnt and conclusions

Lessons learnt

Conclusions

27 **References**

Foreword

Self-ingestion of pesticides remains among the most important means of suicide in the world, accounting for an estimated one third of all suicides globally. Pesticide suicides are of particular concern in rural areas of Asia, Africa, Central and South America, and on Pacific islands, where they can account for up to 60% of suicides. Many efforts have been made to better understand pesticide suicides and find ways to prevent them; in this regard, the importance of means restriction as part of an overall suicide prevention strategy has been highlighted. This report consolidates such efforts by summarizing three case studies that explore the feasibility and acceptability of one category of intervention, which is the secure storage of pesticides in rural communities.

Most people who engage in suicidal behaviour are ambivalent about wanting to die at the time of the act, and some suicidal acts are impulsive responses to acute psychosocial stressors. Restricting access to means of suicide is a key component of suicide prevention efforts, because it provides an opportunity for these individuals to reflect on what they are about to do and, hopefully, for the crisis to pass.

Devising appropriate means restriction interventions, however, requires a detailed understanding of the methods of suicide used in the affected communities. Engaging communities is a key approach to ensuring that suicide prevention efforts are tailored to the context of each community, focus on local ownership and respond to local people's needs. It is important to identify interventions that are feasible and acceptable, and to specify why and how they work.

The three case studies explore safer access to pesticides, alongside community education and awareness programmes. The studies provide important knowledge that can be applied in the future. This knowledge, alongside findings from other studies in pesticide education, regulation and management of acute intoxication, are important aspects of efforts to reduce pesticide suicides. Ultimately, such efforts should contribute to reaching the global target of reducing the suicide rate in countries by 10% by 2020. WHO Member States have committed themselves to work towards this target in the WHO Mental Health Action Plan 2013-2020.

Dr Shekhar Saxena
Director
Department of Mental Health and Substance Abuse
World Health Organization

Acknowledgements

Conceptualization and guidance

Shekhar Saxena (WHO)

Project coordination and technical contributions

Alexandra Fleischmann (WHO), Sutapa Howlader (Australia), Michael R Phillips (China), Lakshmi Ratnayeke (Sri Lanka), Lakshmi Vijayakumar (India)

Expert reviewers

Michael Eddleston (United Kingdom), David Gunnell (United Kingdom), Flemming Konradsen (Denmark), Kairi Kolves (Australia)

Reviewers from WHO headquarters and regional offices

Richard Brown, Dévora Kestel, Joanna Tempowski

Administrative support

Adeline Loo

Editing

Leo Vita-Finzi, France

Graphic design and layout

Yusuke Nakazawa, Japan

WHO would like to thank Syngenta, Switzerland, for its financial contribution through an unrestricted grant.

Part 1

Tackling pesticide suicides through community engagement

Introduction and background

Self-poisoning by pesticide is a widely used method of suicide and one of the most common methods of suicide globally, particularly in low- and middle-income countries (WHO, 2014). It accounts for about one third of all suicides worldwide, particularly in countries with a high proportion of rural residents engaged in small-scale agriculture (WHO, 2006; WHO, 2014). In rural areas of China and South-East Asia, pesticide ingestion is responsible for up to 60% of suicides (Gunnell and Eddleston, 2003). In 2007, there were an estimated 258 000 (plausible range 234 000–326 000) deaths from pesticide self-poisoning globally (Gunnell et al., 2007a). In addition, for each person who dies from pesticide self-poisoning there are likely to be more than 20 others who make a suicide attempt (WHO, 2014). These figures demonstrate the magnitude of the problem of access to pesticides. Some suicidal acts are impulsive responses to acute stressors. Restricting access to pesticides can provide an opportunity for the individuals concerned to reflect on what they are about to do and, hopefully, for the crisis to pass (WHO, 2014; Gunnell and Eddleston, 2003).

While suicidal behaviours have been recognized as a major public health problem, there is still a lack of attention paid to the significant role of pesticides in contributing to the problem. In many countries, self-poisoning is an important method of self-harm. In high-income countries, such as the United Kingdom, the vast majority of people who self-poison use medicines and the associated case fatality is low, at less than 1% (Eddleston and Phillips, 2004). In contrast, the case fatality for self-poisoning in rural Asia is 10–20% (Eddleston and Phillips, 2004), where toxic pesticides are readily accessible in farming households. A study in rural Sri Lanka found a variation from 0% to 42% in case fatality between different pesticides (Dawson et al., 2010). The toxicity of different pesticides varies, but the case fatality for self-poisoning with the most commonly used varieties has been estimated to be at least 10 times higher than that for self-poisoning with medicines (WHO, 2006).

Intentional and unintentional pesticide poisoning is a serious problem in the agricultural communities of low- and middle-income countries such as in China, India and Sri Lanka (WHO, 2006). In China, a study found that 175 000 deaths a year occurred from pesticide poisoning, 89% of which occurred in rural farming villages. In Sri Lanka, for a period of time suicide rates increased by over 700%, almost entirely due to an increase in the incidence of fatal self-poisoning with pesticides (Eddleston and Phillips, 2004). With tens of thousands more rural deaths from self-poisoning with pesticides in other countries in Asia and the Pacific (Eddleston and Phillips, 2004), it is critical for effective interventions to be found to combat this problem. Among

countries in the WHO Region of the Americas reporting causes of death, including suicide, to the WHO Mortality Database (http://www.who.int/healthinfo/mortality_data/en/), the proportion of pesticide suicides among all suicides is over 60% in some countries (e.g. Dominica, El Salvador, Guyana, Honduras and Suriname). According to a systematic review, fatal pesticide self-poisoning is also an issue in some African countries (Gunnell et al., 2007a).

Reducing people's access to pesticides in contexts where many suicides are impulsive, alongside community education and awareness programmes, makes sense. Epidemiological and toxicological data have suggested that many of these deaths could be prevented through three types of interventions: restricting the availability of the pesticides that are most toxic to humans, storing pesticides safely and securely in rural communities, and improving the accessibility and quality of care for poisoning (Gunnell et al., 2007a).

This report explores three case studies that test the feasibility and acceptability of one type of intervention: the secure storage of pesticides in rural communities. The case studies are limited in scope, so it is not possible to draw conclusions about their success in reducing suicidal behaviours; however, they do provide a number of important qualitative results for further consideration.

Focusing on community interventions – creating safer access to pesticides

Several years ago, as part of the WHO worldwide initiative for suicide prevention (SUPRE), an intersectoral global public health initiative was launched on the impact of pesticides on health, Preventing intentional and unintentional deaths from pesticide poisoning. The aim was to reduce morbidity and mortality related to pesticide poisoning (WHO, 2006).

In WHO, the Department of Mental Health and Substance Abuse, the Department of Violence and Injury Prevention and Disability, and the Programme on the Promotion of Chemical Safety (now the Unit for Evidence and Policy on Environmental Health) all shared a common interest and concern in working together with other partners, both within and outside WHO, to advance this intersectoral global public health initiative. The initiative had five key components for its implementation:

1. Review and recommend improved pesticide policies.
2. Implement sustainable surveillance of pesticide data.
3. Improve the medical management and mental health care of people with pesticide poisoning.
4. Provide training at various levels.
5. Develop or strengthen community programmes that minimize the risks of intentional and unintentional pesticide poisoning.

Recognizing the need for urgent action, two sets of meetings took place, the first in May 2006, which identified the knowledge on acceptable and effective community interventions with the potential to prevent self-harm by pesticide poisoning (WHO, 2006). This was then expanded upon in a subsequent meeting, held in December 2007. At this second meeting, experts discussed feasibility demonstration projects on community interventions for safer access to pesticides. They selected the three interventions that were then conducted and that are presented below (WHO, 2008).

The expected outcomes of the meetings were to put in place protocols for the demonstration projects as well as to identify sites where the projects could be conducted and to identify the principal investigators (WHO, 2008).

Three projects were selected, presented and finalized:

1. China: combining household lockboxes with community education about suicide prevention.
2. India: central communal storage of pesticides.
3. Sri Lanka: safely securing pesticides within households.

The three interventions were accompanied by psychosocial interventions (WHO, 2008). Further details of the projects, provided during the selection stage, can be found in the publications produced at that time (WHO, 2006; WHO, 2008).

The projects took place over more than three years in total. The case studies presented below investigate the three very different project styles and contexts, which provide this area of suicide prevention with much-needed insights into how to establish community-based suicide prevention strategies for pesticide poisoning.

Given the crucial role that pesticide ingestion plays in the overall incidence of suicide globally, the findings of these community interventions, alongside the findings of other studies of pesticide education and regulation (Cha et al., 2015; Gunnell et al., 2007b; Ito and Nakamura, 2008; Knipe et al., 2014; Myung et al., 2015; Mann et al., 2005; Pearson et al., 2013), have made important progress towards any future recommendations on the reduction of pesticide suicides. Community interventions concerning the safe storage of pesticides in rural areas need to be constructed with due consideration given to the context of each community and focus on local ownership. When implemented appropriately, the safe storage of pesticides is one important component of a multisectoral approach to preventing suicides by pesticide ingestion. A comprehensive approach to addressing pesticide poisoning must also consider community engagement and education, pesticide regulation, implementation and enforcement of regulations, improving access to clinical treatment of pesticide poisoning, training and surveillance.

Part 2

Strengthening community prevention – three case studies

Part 2 of this report presents the three feasibility demonstration projects that sought to support rural farming communities in China, India and Sri Lanka in minimizing their risk of intentional or unintentional pesticide poisoning through the safe storage of pesticides. The three projects explored the feasibility and acceptability of safer storage of pesticides, alongside community-wide education about the risks associated with pesticides and suicide. Each is unique and explores different contexts. Each delves into the importance of adapting pesticide storage and safety and awareness campaigns to the needs of the community. The case studies provide lessons learnt and thoughts on more sustainable pesticide storage. Even though power calculations and sufficient sample sizes were lacking, the value of the case studies is in their qualitative nature. They make an important start to exploring this type of community intervention and show promise, although the results call for further studies with wider scope.

Each case study consists of the following format, highlighting the key findings and lessons to take forward:

- Summary
- Background and context
- Study progress and findings
- Acceptability and feasibility
- Overcoming ongoing challenges
- Lessons learnt

Case study 1: China - combining household lockboxes with community education about suicide prevention

“We no longer casually place them [bottles of pesticides] in the yard, or anywhere else easily accessible. Previously, when pesticides were placed where anyone could easily get them, some people could take and drink them during a fight” – (Participant quote from pesticide lockbox project in China)

Summary

Pesticide ingestion accounts for more than half of all suicides in rural parts of China. Hence, developing strategies to limit access to pesticides is an important component of suicide prevention efforts, particularly in rural communities where many households routinely store pesticides in the home.

This demonstration project developed and assessed an intervention aimed at reducing access to pesticides in one rural county in Shaanxi Province, where suicide rates are relatively high and the use of pesticides as a means of suicide is common. Initially, a monitoring system was established for identifying all suicides and medically treated suicide attempts in the county. Then over 10 000 pesticide lockboxes (and locks) were distributed to all households in two of the 10 townships in the county (the intervention townships), and a variety of activities were undertaken to promote the use of the lockboxes for two years after their distribution. To monitor the use of the lockboxes in the intervention townships, six interviews were conducted over the next three years. Focus group discussions were employed to ascertain the best methods to carry out education in the communities. Finally, the changes (before versus after) in the rates of suicide and medically treated suicide attempts in the two intervention townships were compared with the corresponding changes in rates in the eight control townships.

Both the intervention and control townships showed substantial drops in the rate of suicidal behaviour (combining suicides and medically treated suicide attempts) over the six years of the study (from 2009 to 2014). The drop in the intervention townships was greater than that in the control townships (22% versus 12%), but this difference may have been due to the higher rate of suicidal behaviour in the intervention group at baseline (i.e. reversion to the mean). There are two main messages that can be drawn from the study:

- (1) Means restriction strategies that are based on individual behaviour need to be simple to implement (for the individual or household) and be supported by ongoing promotional and educational efforts that provide effective incentives to sustain behavioural compliance.
- (2) Scientifically demonstrating the effectiveness of community-based means restriction strategies requires large samples, control communities that are matched at baseline in rates of suicidal behaviour and other potential confounding variables, regular assessment of community members' compliance with the intervention, accurate monitoring of fatal and non-fatal suicidal behaviour in the target communities, and a minimum of three to five years of follow-up.

1. Background and context

Communities selected for participation in studies that aim to assess community-based interventions for preventing suicides need to be large enough and have enough individuals who engage in suicidal behaviour to demonstrate statistically significant differences between the intervention and control communities. Moreover, as this intervention was focused on restricting access to pesticides, it was important to select communities where pesticide ingestion is a common method of suicide. Based on these understandings, Mei County was selected. It is a largely agricultural county in Shaanxi Province that has a relatively high rate of suicide and where a high proportion of suicides are by ingestion of pesticides (as well as herbicides and rodenticides).

Mei County has two county-level and 10 township-level general hospitals that treat virtually all medically treated suicide attempts in the county. In 2008 and 2009, by working with the local Centers for Disease Control and these 12 hospitals, a monitoring system for all suicides and medically treated suicide attempts that occur in the county was established. After the development of the reporting system, all suicides and attempted suicides were reported every three months, including information on the location of the residence of the individual involved, the method and other characteristics of the suicide or suicide attempt.

Mei County has 10 townships. Two adjacent townships, where the main source of income was from agricultural production, were selected as the intervention townships: Firstly, Henqu Township with 14 administrative villages and 7068 households, 94% of which were farming households; and secondly, Huaiya Township with 10 administrative villages and 4663 households, 94% of which were farming households. The remaining eight townships in Mei County were used as the control townships with no intervention.

A local manufacturer produced 10 200 wooden lockboxes at a cost of US\$ 8 each. The lockboxes were yellow, waterproof and painted with Chinese characters reading “pesticide box” and with the free national suicide hotline number. Two locks were provided with each box. Materials were developed to distribute with the boxes that highlighted: (1) the importance of employing the lockboxes to safely store pesticides; (2) methods of recognizing suicidal signs and intervening when people display them; and (3) the use of the national 24-hour suicide intervention hotline number.

A pilot project was conducted in January 2010 to ensure that the procedures planned for distributing the boxes were feasible. In April 2010, students from a local college distributed the lockboxes and the educational materials to 10 134 households that reported using pesticides in the two selected townships (85% of all households in the townships). The boxes were installed (i.e. attached to a wall in the household compound) by the students in about 50% of households; in other cases, the householders themselves installed the lockboxes.

After installation of the lockboxes, community groups, community leaders, local agricultural experts and local schools were engaged to participate in the promotional efforts to encourage householders to use the lockboxes. This involved contests, social activities and the distribution of different types of educational materials. Fifty-two presentations were made to local farmers on the safe use and storage of pesticides and other poisons in the home. An educational video was broadcast throughout the two townships. This effort, with specific activities every six months coordinated by the research group, continued for two years after installation of the lockboxes. At intervals of five to seven months (i.e. at 7, 12, 19, 25, and 31 months) after the start of the project, a 10% random selection of all households in the target townships were visited to determine whether and how the households were using the

lockboxes. Reasons for compliance or non-compliance in the use of the lockboxes were recorded. At 36 months after distribution of the lockboxes, 100% of households were visited. The overall rates of suicide and medically treated attempted suicide and the rates of pesticide ingestion suicide and attempted suicide in both the intervention townships and the control townships were assessed at baseline in 2009, and annually through to 2014.

2. Study progress and findings

The results of the follow-up community assessment of the use of the lockboxes at the six time periods after distribution of the lockboxes found that almost all households that stored pesticides in the home used the lockboxes to do so. However, only a minority of households actually locked the lockboxes. Over the first year after distribution of the boxes, about 30% of households locked the lockboxes, in the second year 20–25% locked the lockboxes, and in the third year, after the educational interventions had stopped, only 4–13% of households locked the lockboxes. Very few of the households used both locks provided at the time the lockboxes were distributed.

Suicides and medically treated suicide attempts were monitored in the intervention and control townships from 2009 (the year before the intervention) to 2014 (four years after the start of the intervention). At baseline, the suicide rate in the intervention and control communities was similar (11.8 versus 12.6 per 100 000, respectively), but, unexpectedly, the rate of medically treated suicide attempts was much higher in the intervention townships than in the control townships (92.7 versus 54.9 per 100 000, respectively). Thus, when comparing the intervention and control townships, the change in rates, rather than the absolute rates of suicide and attempted suicide, was compared. Comparison of the baseline rates (in 2009) to those in the four years after the intervention began (2011 to 2014), found that the combined rate of suicides and medically treated suicide attempts dropped by 12% in the eight control townships (from 67.9 to 59.6 per 100 000) and by 22% in the two intervention townships (from 104.5 to 81.4 per 100 000); the more rapid drop in rates in the intervention group may have been influenced by the much higher rate of attempted suicide in the intervention communities than in the control communities at baseline (something that was discovered after starting the study). The proportion of suicides and medically treated suicide attempts that used pesticides stayed relatively constant in both the intervention townships (81% in 2009 and 81% in 2011–2014) and control townships (69% in 2009 and 73% in 2011–2014).

Interviews conducted at baseline and at six months and 18 months after installation of the lockboxes in the intervention townships found the following: (a) villagers were happy to accept lockboxes for storing their pesticides; (b) most respondents felt that the lockboxes provided a convenient location for storage that limited loss, damage, theft and possible ingestion by children or animals; (c) most respondents approved of the community education efforts to promote the boxes and raise awareness of the issue of suicides in the community.

3. Acceptability and feasibility

Householders in the intervention communities were eager to obtain the “free” lockboxes at the beginning of the project (some tried to get two or three). The various educational components of the intervention were generally well received, though only a minority of community members attended these activities. Most households used the lockboxes to store their pesticides, but the proportion that actually locked the boxes dropped quite rapidly, particularly after the community education

component of the programme had stopped. The original plan for using two locks on the lockboxes, with one key supervised by the husband and the other by the wife, though theoretically appealing, was never really accepted; it was simply too inconvenient for households.

4. Overcoming ongoing challenges

There were two specific problems with the use of the lockboxes provided to the more than 10 000 households. First, they were not big enough to store the amount of pesticides that some households purchased. Second, after five years many of the wooden lockboxes (which were usually attached to an exterior wall and, thus, exposed to the elements) had deteriorated. This was the result of a financial consideration at the beginning of the study: larger metal boxes would have cost at least twice as much and, thus, limited the number of households that could have had boxes distributed to them. But this was only a part of the cost of the project. In retrospect, it may have been better to build sturdier boxes and conduct fewer community follow-ups.

5. Lessons learnt

This demonstration project identified a number of methodological issues that need to be considered in subsequent work on the value of pesticide lockboxes as a suicide prevention strategy:

- Cluster randomization should be used to assign a sample of communities (10 or more communities) to the intervention or control conditions (i.e. to install or not install the lockboxes). However, such large, complicated studies are extremely expensive to mount, so they are not practical in most settings. In the absence of cluster randomized studies, comparison of changes in rates of suicidal behaviour before and after the intervention in one or more intervention and matched (e.g. by suicide and attempted suicide rates, economic level, proportion of households that employ pesticides) control communities seems the best available option to assess the potential value of installing lockboxes.
- Monitoring of the rates and methods of both attempted suicide and suicide in the intervention and control communities is essential to determine whether or not the intervention actually affects suicidal behaviour. Given the low base rates of suicide and attempted suicide, the selected communities need to be big enough and followed long enough to provide sufficient numbers of suicides and suicide attempts. The monitoring should continue for at least three to five years to help determine whether or not substitution of suicide methods occurs when access to one method (i.e. pesticides) is limited.
- Placement of pesticide lockboxes in households can only be effective as a suicide prevention measure if household members actually use the boxes to store pesticides. This requires individual-level behavioural change that is sustained over time; to achieve this, an ongoing public promotion campaign that generates public and government support for the intervention is essential to promote continuing compliance with the intervention.
- An assessment of the fidelity with which the promotion campaign and the intervention itself are implemented in the target communities provides essential information about why the intervention did or did not work. For example, providing lockboxes does not guarantee that households will use them and, even if they do use them, usage is likely to decrease over time, so the level of use of the lockboxes needs to be monitored over time. Regular assessments of compliance may provide additional incentives to community members and, thus, be considered part of the intervention.

In conclusion, the key messages that the project highlighted include the importance of ensuring that means restriction is part of an overall suicide prevention strategy, not a stand-alone programme. The distribution of methods of fatal and non-fatal suicidal behaviour in a community need to be understood in order to determine the relative importance of means restriction in the overall suicide prevention strategy for that community and to develop community-specific plans for means restriction.

The focus of subsequent research on community-based suicide method restriction strategies needs to be on the factors that enhance sustained compliance with the required change in behaviour at the household level. This means further exploration of the characteristics of the intervention that make it easier to comply with and the types of ongoing community education and incentives that promote sustained compliance.

Case study 2: India - central communal storage of pesticides

“Two months back, I had consumed some alcohol, went home and fought with my wife. I became upset and wanted to consume pesticide and die... [but] all our pesticides are kept in the central storage facility. I am alive today because of that facility” – (Participant quote from central communal pesticide storage project in India)

Summary

The idea behind the communal pesticide storage demonstration project in rural southern India was a simple one. Keeping pesticides out of sight and beyond the easy access of households might reduce the occurrence of suicides and suicide attempts by means of pesticide ingestion. The project was the first of its kind in India. The aim was to investigate whether the safe storage of pesticides away from people's homes, in a communal unit, could indeed contribute to reducing the risk of suicides and suicide attempts.

Though limited in scope and therefore making it impossible to draw any conclusions on the correlation between the introduction of the central communal storage facilities and a reduction in the numbers of suicide attempts and suicides in the intervention villages, the study did obtain information about other important aspects of the feasibility and acceptability of this type of community intervention in rural India (Vijayakumar et al., 2013). Importantly, the study highlighted the integral nature of community involvement in suicide prevention, particularly through the acceptance of the community storage centres by the community at large, and through the involvement of the *panchayat* (local self-government) leaders.

The project revealed that most participants found the storage facility to be both useful and acceptable. Moreover, the associated community education and awareness raising efforts resulted in greater awareness in the community about the risks of storing pesticides at home, and pesticide storage at home dropped from 44% at baseline to 7% at follow-up in the two intervention villages.

Due to the differences in the sites at baseline and the small nature of the study, the reduction in pesticide suicides and suicide attempts must be interpreted with caution. The success of this initial study was rather in finding that such an initiative could be effective in drawing attention to the issue of pesticide suicides in villages through the creation of spaces for safe dialogue. It also found that acceptability of this intervention was higher when there was a dual benefit in the form of time and cost savings and through safe storage from children, theft, loss and damage.

1. Background and context

The demonstration project commenced against a backdrop of reportedly 22 000 pesticide suicides in India in 2006 (Ministry of Home Affairs, 2006). It is widely accepted that these figures grossly underestimate the actual numbers of pesticide suicides due to the lack of surveillance and registrations. Actual figures may be six to nine times more (Gajalakshmi and Peto, 2007). Other studies have estimated far higher numbers, and one study stated that there could be up to 420 000 suicides annually in India overall, of which 126 000 could be attributed to pesticide ingestion (Gunnell et al., 2007a). Another study estimated that 49% of male suicides and 44% of female suicides in India are through pesticide ingestion (Patel et al., 2012).

Given the magnitude of the problem, Sneha suicide prevention centre in Chennai and the University of Oxford Centre for Suicide Research in the United Kingdom organized a national review. The review found that the rate of farmers' suicides is particularly high in the southern states, and due to the availability of pesticides there, pesticide ingestion was a common method used for suicide. After the review, the idea of storing pesticides centrally within the community was explored, resulting in the demonstration project (WHO, 2006).

The location of the demonstration project was Kattumannarkoil Taluk in Tamil Nadu, southern India. The two intervention villages and two control villages (with no intervention) engaged in floriculture, which requires a high amount of pesticide use. Both intervention villages, Kandamangalam and Kurungudi, were primarily engaged in producing jasmine, with crops being sprayed twice a month. A centralized storage locker facility was constructed in each of the two intervention villages. To gauge impact, interviews were conducted at baseline, and again 18 months later. Information on the use of the facilities and attitudes towards both the central storage facility and pesticide suicides was collected. A surveillance system was initiated and then maintained throughout the project in the villages. Every household was visited to ask about deaths and suicide attempts and verbal autopsy of any death was carried out. Doctors, teachers, hospital staff and police officers were interviewed monthly during the study to document deaths and suicide attempts.

2. Study progress and findings

A comparison of the baseline and follow-up data in the intervention and control sites revealed 10 suicides and 16 suicide attempts in the intervention sites versus zero suicides and five suicide attempts in the control sites at baseline (over a period of 18 months). In the period leading up to the follow-up, 18 months after the start of the intervention, there were two suicides and three suicide attempts (intervention sites) versus two suicides and two suicide attempts (control sites).

On initial inspection, the results look promising, but they need to be interpreted with caution. This study, the first of its kind, was a qualitative study aiming to address the issue by setting up central storage facilities, but it was limited to only two villages, which varied in both baseline data and characteristics. A power calculation was not done during the study development nor was a sufficient sample size available to permit analysis of quantitative results. The reduction in suicides and suicide attempts in the intervention sites must be contextualized and cannot be directly or indirectly attributed to the central storage facilities.

Rather than focusing on the reduction in suicides and suicide attempts, the focus should be on the other important qualitative findings from this demonstration project. Firstly, and significantly, none of

the people who used the community storage facility either attempted or died by suicide. In fact, one farmer reported feeling suicidal and referenced the centralized storage facility as being instrumental in stopping his ability to act on the impulse, by limiting his access to pesticides. This is a significant initial finding that requires further exploration from a larger study size.

The centralized storage of pesticides reduced the amount of pesticides that were stored in homes and fields and thereby access to them; the project also enabled the involvement of the entire community in its implementation. This involvement is imperative, as it increases awareness of the issue. As a result of focus group discussions, more people were talking about suicide and risk factors, which is a positive result as it has the potential to highlight the fact that people are not alone, and therefore they may feel less isolated. An increase in community engagement is perhaps the most important by-product of the central storage initiative.

3. Acceptability and feasibility

This study examined the feasibility and acceptability of the centralized storage of pesticides as a preventive intervention strategy in reducing pesticide suicides. All pesticides were stored at one central location in each intervention village. This can have a number of benefits in terms of safe storage as well as challenges in terms of timely access to pesticides. Overall, most people found the storage to be both useful and acceptable.

167 and 132 bank locker storage style boxes, respectively, were set up in the intervention villages, at a total cost of US\$ 1500. Maintenance of the central storage facilities, in terms of staffing costs and general upkeep, then cost a further US\$ 115 a month.

Focus group discussions were conducted with men and women separately, to understand their views on the concept of central storage, as well as their attitudes towards pesticide suicides. A total of eight focus group discussions were conducted at baseline in both sites, and then four at the 18-month follow-up. A register was also kept to record use and frequency of use.

In total, 248 households, or 23.3% of overall households, used the storage facility. Of those, 134 reported using it all the time; the two main motivations for doing so were that the storage facility was safe and that it was conveniently located. There were 815 households that did not use the facility; however, 42% of these did not own land, so the use of the storage locker was not relevant to them.

In terms of the capacity of the central storage unit, 74% of one central storage unit was used, which was reduced to 29% during the monsoon season. The second intervention village reported 94% usage, with a reduction to 43% during the monsoon.

The high levels of usage and the large numbers of households that used the facilities indicated that they were seen as both useful and acceptable in the two villages. However, the small scale of the studies means there is a need for larger studies, of a longer duration, before more conclusions can be drawn. Importantly, the central storage units ensured that farmers had easy access to the pesticides when these were required for use in the fields, as they could access the storage boxes any time between 7 a.m. and 7 p.m. Each farmer had his or her own personal key and spare keys were also kept by each of the four managers. The managers were given training on the importance of the communal storage option, including the importance of their availability to ensure that farmers were not inconvenienced. In addition, they were given training on the safe disposal of pesticides.

There were three key reasons cited for the usefulness of the central storage facilities: 85% of focus group participants indicated that they reduced theft and damage, 62% believed that they improved safety in terms of pesticide ingestion by children and other accidents, and 60% believed that they saved travel time and cost. The majority of the farmers travelled to the nearest town regularly to purchase pesticides; as they were able to reduce the number of trips they made, thanks to the safe storage facility, they found the system to be cost effective. The usefulness of the central storage system was more clearly communicated because *panchayat* (local self-government) leaders were invited to take an active part in meetings that espoused the benefits of the central locker system. As a result, people were aware of why the system was being tested.

Despite mostly positive attitudes, the location of the storage facilities was seen as being key, and suggestions included establishing storage units for farmers who are based further afield. Focus group participants also suggested that the government should take over the scheme and make it compulsory.

4. Overcoming ongoing challenges

Some important issues and challenges concerning the central storage units were raised:

- Farmers should live within two kilometres of central storage units – 35% of people did not use the units because they were located too far from their homes or their fields.
- Supervisors were not always present, making it inconvenient at times for the farmers to access the facilities.
- There is potential for misuse of the pesticides stored in the facility if there are not sufficient supervisory checks.

The demonstration project itself was also limited due to the following factors, which made it more difficult to draw conclusions:

- More people in the intervention sites were in debt (75%) than those in the control sites (55.8%).
- Pesticide use in the intervention sites was higher (50.6%) than in the control sites (38.9%).
- In a study such as this, it is difficult to determine what portion of any reduction in suicide rates in the region could be attributed to the intervention itself.

5. Lessons learnt

The key lessons learnt from the demonstration project were as follows:

- The location of the central storage units needs to be well thought through, as farmers living too far afield may lack access.
- The usefulness and usage of the central storage units increase when there is perceived to be a “dual benefit”, rather than if only suicide risk is addressed. Such additional benefits, in this case, included enabling people to save money by buying in bulk, reducing the risk of theft, and reducing the risk of children ingesting pesticides by accident. Farmers also reported that the quality of the pesticides used was better and that the wastage that occurred previously when farmers forgot where they had buried their pesticides was avoided.
- The emphasis needs to be on convenience for the farmers. If the storage unit is not well serviced by managers, or poorly monitored, then it is unlikely to be used as frequently. This means that monitors/managers of the storage units need to be well trained.

Finally, while some people in the community remained sceptical, storage at homes still dropped from 44% to 7% from baseline to follow-up. This drop indicates that there were many direct and indirect benefits of the demonstration project for those in intervention villages, poignantly illustrated by one farmer who attributes the fact that he is still alive to the storage facility.

Case study 3: Sri Lanka - safely securing pesticides within households

“The children are safe, there is security for all. No one can access the poisons in a hurry” – (Participant quote from pesticide lockbox project in Sri Lanka)

Summary

Pesticide ingestion being the most common method of suicide used in Sri Lanka, it made sense to target farming families in rural Sri Lanka who were the most vulnerable to this phenomenon. Boxes were provided to securely store pesticides around the homes of farming families. The hope was that if pesticides were harder to access, the incidence of pesticide suicides might be reduced, particularly among individuals acting on impulse, as the time taken to access the agricultural poisons would be increased.

This demonstration project was limited in scope and did not enable any conclusions to be drawn on the association between the introduction of the secure lockboxes in farming families and a reduction in the incidence of suicide. Deliberate self-harm by pesticide ingestion was slightly higher in the intervention villages than the control villages. However, these numbers were too small to enable wider conclusions to be drawn and there was a lack of power calculations.

After 18 months, 93.6% of the families who had been issued with a lockbox reported using it to store their pesticides, although the number of boxes that were actually locked on inspection was down to 63.5% at the same point in time. This illustrates the widespread acceptance of the lockboxes, but perhaps a lack of understanding of the importance of using them properly.

The demonstration project also aimed to explore the acceptability of safe disposal of empty pesticide containers. In this respect, the study showed positive outcomes, with 81.9% of families reporting that they had changed the way they disposed of their empty containers. The effectiveness of mobilizing voluntary monitors from within the community was also explored for the first time, with mixed results reported by families and monitors. While farming families saw the monitoring visits as valuable, the monitors themselves reported being unable to influence or change storage behaviour, as they found many of the lockboxes unlocked during inspections.

The demonstration project revealed that most participants found the lockboxes to be both useful and acceptable as they kept families, particularly children, safe and reduced pesticide wastage and loss due to theft. This shows that the intervention had multiple benefits in addition to possible suicide prevention.

1. Background and context

Pesticides have been a significant problem in Sri Lanka for many years. Combined with the impulsive nature of suicides in the country, they have contributed towards the high rates of suicide overall. In response to the problem, Sri Lanka Sumithrayo and the University of Oxford Centre for Suicide Research in the United Kingdom initiated a pilot study in 2004 that explored the safe storage of pesticides in lockboxes within households. They found that 96% of farmers in the study were successfully using their lockboxes at 18 months after the introduction of the boxes. However, just one year later, the number went down to 60%. A longer-term sustained effort was obviously required to keep correct usage high and entice behavioural change. This demonstration project was designed to do just that, and build on the initial pilot, with regular inspection through village monitors (WHO, 2006).

The secure storage demonstration project had two intervention villages: Allegala and Mahensenpura. Two similar villages, Gothabayapura and Polgahawelana, were selected as control villages. The main crops cultivated in the villages were rice, bananas, chillies and sesame. In the intervention villages, 570 families were given lockboxes, providing blanket coverage of all farming families that were handling agricultural poisons within the two villages. Families were issued with lockboxes alongside information on where the lockboxes could be affixed and the importance of keeping them locked and the keys hidden.

To better understand attitudes towards using the lockboxes, several interviews were conducted during the project period, 2008–2012. Community monitors were also asked to record whether the lockboxes were being used correctly. In addition, suicide statistics for the villages were collected regularly from the district hospital and police station in the area.

2. Study progress and findings

Over the course of the project, from June 2008, when the lockboxes were distributed, until May 2012, there were eight suicides (three by pesticide, all from box houses) and 47 suicide attempts (24 by pesticide, 21 of which were from box houses) in the intervention sites, versus three suicides (two by pesticide) and 44 suicide attempts (19 by pesticide) in the control sites. The larger number of suicides and suicide attempts in the intervention villages appears disconcerting, particularly as 24 of the incidents occurred in houses that had lockboxes. It is important to contextualize the study as a limited one involving only two villages. Looking at the suicide and suicide attempt numbers alone does not reveal the qualitative findings of the study or, importantly, how such an intervention could be improved in future efforts.

Interviews were carried out at the beginning, and within 10 days, six months and 18 months of the project's start. These interviews revealed some of the benefits of the intervention. Firstly, there were positive reactions to the message displayed on the box, which read as follows:

“Poison is not the answer for your anger, pain of mind and despair. Talk to a trusted friend about your feelings of anger and sadness. Remember to keep all pesticides and other poisons out of reach, safely locked in the box.”

Many interviewees commented on the value of seeing this message and the deterrent quality of the message. As one person remarked:

“Even when you are very upset and sad the message gives you hope for living” – (Participant quote from pesticide lockbox project in Sri Lanka)

These comments display the value that the farming families saw in the initiative, and the difference that simple messaging could make. In addition, 93.6% of the families to whom a lockbox was distributed reported using it to store their pesticides. By the time of the final interviews, in January 2012, 68.9% of families reported using the lockbox all the time, and 15.5% used it most of the time. In fact, the frequency of use of the lockboxes over the course of the study actually increased, with 20% more families using the box all of the time at the end of the study as compared with the beginning of the study. This illustrates the perceived usefulness of the lockboxes by families that had them installed around their homes, preferably on the outside wall.

Significantly though, most of the monitoring volunteers admitted to becoming disillusioned with the visits (to check whether the lockboxes were being used properly), and had reduced or completely stopped their visits by time of the final interviews. They claimed that the families were not locking the boxes and, in spite their visits, that they could not encourage behavioural change. The data also show that out of the 93.6% of families using the lockboxes, only 63.5% were actually locking them. This is a significant finding and demonstrates a wide gap between perceptions of the usefulness of the lockboxes and the lack of internalization of the importance of using them properly (including the impact that proper use could have on both children’s safety and suicide prevention). Behavioural change takes time. Despite villagers seeing the benefits of locking the boxes, they had difficulties putting this into practice.

While the installation of the lockboxes may have raised community awareness of pesticide suicide issues initially and some community education was provided through school and community meetings, there was a lack of follow-through on increasing community dialogue and understanding of the correct use of lockboxes and on suicide prevention strategies more generally. A more sustained and concerted effort may have been required to sustain behaviour change.

Further efforts to provide larger-scale community dialogue through suicide prevention education for the whole community seems a key gap in the project. Paying community volunteers to increase their commitment to their monitoring roles could also have beneficial outcomes and should be explored in future studies. Using focus group discussions could also highlight pesticide suicides as a community issue and encourage further dialogue. The study revealed an initial and then sustained interest in using the lockboxes, but a gap in comprehending the importance of keeping the boxes locked, and the need for a more comprehensive strategy towards suicide prevention in addition to lockboxes.

3. Acceptability and feasibility

This demonstration project examined the feasibility and acceptability of providing lockboxes to households that engaged in farming in order to make their pesticides less accessible and thereby reduce pesticide suicides. The locker-style storage boxes were distributed to all farming households in the two intervention villages, and they were found to be acceptable as a safe and convenient storage facility for pesticides, as demonstrated by their high usage.

The project sought to build on a previous pilot study by introducing a community intervention aspect, in the form of monitoring volunteers from within the villages who were tasked with checking that the lockboxes were being kept locked, providing information to the families on the safe usage of the

lockboxes, and providing emotional support for individuals or families if they noticed people in distress and therefore at heightened risk of suicide. While the incorporation of community monitors elected by the community was acceptable from the perspective of the families, there was a major feasibility gap. All monitors were voluntary and unpaid, so while initially they were happy to donate their time for the greater good, once they saw evidence of families failing to lock the boxes, they became demotivated and reduced or stopped their visits. This limited the long-term impacts of the community engagement aspect of the study.

In terms of access to the lockboxes, the preferred location of the boxes was close to the home, either inside the home itself (16%) or on a wall outside the home (75%). The families reported these being convenient places to store their pesticides. By the final interview, the use of the lockboxes to store pesticides remained high, but those who were keeping their boxes unlocked were not prevented from doing so, as most monitors had stopped visiting by this point. The reasons given for the failure to lock up the boxes included the fact that farmers had nothing to lock up, that they were in the process of spraying close to home, that fields were being leased and not used, that padlocks were lost or broken, and that farmers did not use pesticides anymore. Alarming, monitors also reported that keys were not kept hidden from children in about a third of cases.

Despite mostly positive attitudes towards the lockboxes, with people appreciating that pesticides should be under lock and key, keeping children, families and animals safe, in reality the locking of the lockboxes was not put into practice due to a lack of follow-through with community engagement.

4. Overcoming ongoing challenges

As highlighted by some of the feasibility factors for farmers, some challenges in the project were identified. They included:

- Lack of sustained efforts to keep the lockboxes locked.
- Lack of interest from community volunteers in checking on progress.
- Mismatch between the perception of the farming households concerning the safety the lockboxes were providing and actual safety, due to the failure to keep the boxes locked and a lack of overall understanding of the issues related to suicide.

In addition, some common complaints were that the boxes were not big enough, too heavy to be fixed to mud walls, and not sturdy enough (one woman claimed that her husband was able to break one in anger). The desirability of placing a second lock on the boxes significantly decreased as the first lock was not being used.

5. Lessons learnt

The key lessons learnt from the demonstration project were as follows:

- While community monitors started off enthusiastically and had the overall attitude that they were making a contribution, there was a lack of sustainability when they felt behaviour change was not taking place and boxes remained unlocked. In future, to ensure their ongoing participation, it might be worth paying the monitors or finding other ways of compensating them.
- While 548 of the interviewees stated there was a change in the way they stored their pesticides after they received their boxes, there was still a large number of farmers who did not keep the boxes locked despite keeping the pesticides in them. A larger amount of community education and

awareness is required about the importance of keeping the lockboxes locked, and around suicide prevention more generally.

- A key success of the study was that 81.9% of the families reported that they changed the way they disposed of empty pesticide bottles. Instead of selling them for empty glass, 422 interviewees now reported burning them.
- The provision of secure storage boxes for agricultural poisons alone may be insufficient to make any lasting difference to the suicide rates in rural communities of Sri Lanka. It needs to be part of a larger, more comprehensive, strategy that includes community education and awareness raising, in order to promote longer-term behaviour change.

Finally, while the study did not diminish access to pesticides for the key holder (the majority of key holders were the farmers themselves), it began to show benefits for the safety of other household members. The quote below is an example of the benefits:

“My son threatened to drink poison but I made sure all pesticides were locked in the box. That alone shows how much this box has meant to us” – (Participant quote from pesticide lockbox project in Sri Lanka)

Part 3

Lessons learnt and conclusions

Lessons learnt

Any reduction or increase in the number of suicides and suicide attempts through the ingestion of pesticides in these case studies must be interpreted cautiously. All three projects took place in relatively small rural villages. In addition, control villages in some cases varied significantly from intervention villages, making comparisons difficult. However, when looking at the qualitative information on feasibility and acceptability from the community focus group discussions, it is clear the case studies have a significant value to add to efforts to develop better interventions for the prevention of pesticide suicide. The lessons learnt from the case studies, when combined with other studies taking place to reduce pesticide ingestion globally, provide solid foundations on which to build for future interventions and testing in this area, e.g. in large randomized controlled trials with power calculations and sufficient sample sizes.

- 1. Involving the community and community leaders during the planning stages is vital to ensuring community ownership of the intervention.** Community ownership through the active participation of community leaders and members can help guide an intervention to success in a couple of key areas. Firstly, the input from community members can result in an intervention that is tailored to the context and therefore more effective, e.g. centralized storage of pesticides may be proposed by the community as preferable to the storage of pesticides in the home. Secondly, by involving the community in the implementation of the intervention, e.g. by using community leaders to spread the word about the intervention and its objectives, the community is more likely to internalize and take ownership of the intervention, leading to better participation and also giving the intervention further credibility and acceptability.
- 2. Interventions are valued more if they have multiple benefits, in addition to reducing suicide risk. Lockbox interventions should also consider overall safety for the community through appropriate storage.** When individuals were asked about the key benefits of having a lockbox either centrally or within households to safely store pesticides, the perceived benefits ranged from preventing suicides, increasing the safety of children who may accidentally ingest pesticides, safety from loss of pesticides through misplacement or theft, and finally, better use of pesticides as they remain undamaged. When there are multiple benefits of lockbox pesticide storage that go beyond suicide prevention alone, there seems to be more enthusiasm for the intervention and its upkeep by individuals and families.

- 3. All lockbox interventions must be convenient for farmers and households. If the intervention adds too much difficulty or deviates too much from people's current behaviour, it is unlikely to be implemented.** Behaviour change takes time and effort. If the intervention asks farmers to change their usual habits too much, it is unlikely to be successful, unless there are immediate tangible benefits. Regardless of whether the intervention is to install central storage facilities for pesticides or to lock up pesticides within or outside the home, it should not unduly inconvenience farmers: central storage locations should be within a short distance of the farmers' homes and lockboxes should be easy and not time-consuming to access. Access to the pesticides, while restricting impulsive ingestion, must not be too restrictive in terms of easy access for agricultural purposes. This has to be a balancing act.
- 4. Sufficient resources must be allocated to the initiative to ensure that it functions effectively within the community and is sustainable.** In cases where there were paid monitors of the central storage units, farmers had better access to their pesticides when they needed them for agricultural purposes. This was possible due to the motivation of the monitors through adequate compensation. In comparison, community monitors who were given initial training but no ongoing compensation for their efforts quickly became dejected. When there was difficulty in changing the behaviour of farmers in regard to locking the storage boxes, it was easy for unpaid community monitors to lose motivation. Beyond payment for monitors, thought should also be given to allocating other resources that may ensure sustainability of the interventions.
- 5. Community education is important in providing better understanding about the role of the intervention in reducing suicide. It can also increase community discussions about topics that were previously taboo.** While suicide in many places still retains a great deal of stigma, an intervention that includes community education allows the opportunity to start a dialogue on topics that may be taboo. In the case of pesticide suicides it can create a safe space for farmers and their families, who may quietly be dealing with this issue, to know they are not alone and that it is something the community can deal with as a whole. This reduces the isolation that individuals and families may face, particularly in rural villages. In addition, it allows for a deeper understanding of how specific interventions are designed to reduce pesticide suicides, so the community can also monitor the effectiveness and invest in the success of the intervention.

Conclusions

The case studies in China, India and Sri Lanka add to a growing body of evidence on pesticide means restrictions. Community interventions in the form of lockboxes, either centrally located or around households, need to be tailored to the context and combined with a more comprehensive suicide prevention strategy. While the studies were limited in scope, thus not providing sufficient evidence in terms of numbers, they added a great deal of insight into community engagement in the issue of pesticides.

When conducting future studies, the potential danger of having the pesticides in a visible and accessible location if in an unlocked lockbox within the household would need to be measured as part of the evaluation. Future studies should also include a component that explores means

substitution (i.e. the use of other means of suicide) when pesticides are successfully made less accessible.

Evaluating a means restriction strategy requires a reliable monitoring system, which is ideally pre-existing and which identifies all fatal and non-fatal suicidal behaviour that occurs in the target communities by method, including self-poisoning by pesticides. In the absence of such data or surveillance, it is not possible to determine whether or not the intervention resulted in a change in the rates of suicidal behaviour.

It is unrealistic to think that there will be complete compliance with a means restriction intervention that depends on individual behaviour. Restriction based on securing common methods of self-harm (such as pesticides, other poisons, potent medications, guns and knives) in the home, inevitably depends on the willingness of householders to comply with the intervention. Nevertheless, increasing safe household storage of pesticides or other means of self-harm, even if from 0% to 20% for instance, is still a positive outcome that should, if all other factors are constant, result in reduced suicidal behaviour.

The case studies highlight the challenges around behavioural change and limited resources. They also draw attention to the importance of ensuring that future interventions do not inadvertently increase or displace suicide risks. Finally, and most importantly, they demonstrate the importance of community engagement and ownership. In particular, the benefits of incorporating local individuals and leaders in both the initial design and implementation of suicide prevention interventions are clearly shown. All pesticide suicide prevention efforts must acknowledge the context of the country. It is only when community interventions consider these factors and play a role within larger pesticide suicide prevention programmes that they can be most influential.

References

Cha ES, Chang SS, Gunnell D, Eddleston M, Khang YH, Lee WJ (2015). Impact of paraquat regulation on suicide in South Korea. *Int J Epidemiol*. Nov 18. doi:10.1093/ije/dyv304.

Dawson AH, Eddleston M, Senarathna L, Mohamed F, Gawarammana I, Bowe SJ et al (2010). Acute human lethal toxicity of agricultural pesticides: a prospective cohort study. *PLoS Med*.7 (10):e1000357. doi:10.1371/journal.pmed.1000357.

Eddleston M, Phillips MR (2004). Self-poisoning with pesticides. *BMJ*.28:42. doi:http://dx.doi.org/10.1136/bmj.328.7430.42.

Gajalakshmi V, Peto R (2007). Suicide rates in rural Tamil Nadu, South India: verbal autopsy of 39 000 deaths in 1997-98. *Int J Epidemiol*.36(1):203-7.

Gunnell D, Eddleston M (2003). Suicide by intentional ingestion of pesticides: a continuing tragedy in developing countries. *Int J Epidemiol*.32(6):902-9.

Gunnell D, Eddleston M, Phillips MR, Konradsen F (2007a). The global distribution of fatal pesticide self-poisoning: a systematic review. *BMC Public Health*.7:357. doi:10.1186/1471-2458-7-357.

Gunnell D, Fernando R, Hewagama M, Priyangika WDD, Konradsen F, Eddleston D (2007b). The impact of pesticide regulations on suicide in Sri Lanka. *Int J Epidemiol*.36(6):1235-42. doi:10.1093/ije/dym164.

Ito T, Nakamura Y (2008). Deaths from pesticide poisoning in Japan, 1968-2005: data from vital statistics. *J Rural Med*.3(1):5-9.

Knipe DW, Matcalfe C, Fernando R, Pearson M, Konradsen F, Eddleston M, Gunnell D (2014). Suicide in Sri Lanka 1975-2012: age, period and cohort analysis of police and hospital data. *BMC Public Health*.14:839. doi:10.1186/1471-2458-14-839.

Ministry of Home Affairs (2006). Accidental deaths and suicides in India, 2006. New Delhi: Ministry of Home Affairs of the Government of India (National Crime Records Bureau); 2006.

Mann JJ, Apter A, Bertolote J, Beautrais A, Currier D, Haas A et al. (2005). Suicide prevention strategies: a systematic review. *JAMA*.294(16):2064-74.

Myung W, Lee GH, Won HH, Fava M, Mischoulon D, Nyer M et al. (2015). Paraquat prohibition and change in the suicide rate and methods in South Korea. *PLoS ONE*.10(6):e0128980. doi:10.1371/journal.pone.0128980.

Patel V, Ramasundarahettige C, Vijaykumar L, Thakur J, Gajalakshmi V, Gururaj G et al. (2012). Suicide mortality in India: a nationally representative study. *Lancet*.379:2343–51. doi:10.1016/S0140-6736(12)60606-0.

Pearson M, Zwi AB, Buckley NA, Manuweera G, Fernando R, Dawson AH et al. (2015). Policymaking ‘under the radar’: a case study of pesticide regulation to prevent intentional poisoning in Sri Lanka. *Health Policy Plan*.30:56–67. doi:10.1093/heapol/czt096.

Vijayakumar L, Lakshmanan J, Kumar S, Mohanaj R, Shanmugasundaram D, Manikandan S (2013). A central storage facility to reduce pesticide suicides – a feasibility study from India. *BMC Public Health*.13:850. doi:10.1186/1471-2458-13-850.

WHO (2006). *Safer access to pesticides: community interventions*. Geneva: World Health Organization.

WHO (2008). *Prevention of suicidal behaviours: feasibility demonstration projects on community interventions for safer access to pesticides*. Geneva: World Health Organization.

WHO (2014). *Preventing suicide: a global imperative*. Geneva: World Health Organization.