

# Effectiveness of household lockable pesticide storage to reduce pesticide self-poisoning in rural Asia: a community-based, cluster-randomised controlled trial



Melissa Pearson, Chris Metcalfe, Shaluka Jayamanne, David Gunnell, Manjula Weerasinghe, Ravi Pieris, Chamil Priyadarshana, Duleeka W Knipe, Keith Hawton, Andrew H Dawson, Palitha Bandara, Dhammika deSilva, Indika Gawarammana, Michael Eddleston, Flemming Konradsen



## Summary

**Background** Agricultural pesticide self-poisoning is a major public health problem in rural Asia. The use of safer household pesticide storage has been promoted to prevent deaths, but there is no evidence of effectiveness. We aimed to test the effectiveness of lockable household containers for prevention of pesticide self-poisoning.

**Methods** We did a community-based, cluster-randomised controlled trial in a rural area of North Central Province, Sri Lanka. Clusters of households were randomly assigned (1:1), with a sequence computer-generated by a minimisation process, to intervention or usual practice (control) groups. Intervention households that had farmed or had used or stored pesticide in the preceding agricultural season were given a lockable storage container. Further promotion of use of the containers was restricted to community posters and 6-monthly reminders during routine community meetings. The primary outcome was incidence of pesticide self-poisoning in people aged 14 years or older during 3 years of follow-up. Identification of outcome events was done by staff who were unaware of group allocation. Analysis was by intention to treat. This trial is registered with ClinicalTrials.gov, number NCT1146496.

**Findings** Between Dec 31, 2010, and Feb 2, 2013, we randomly assigned 90 rural villages to the intervention group and 90 to the control group. 27 091 households (114 168 individuals) in the intervention group and 26 291 households (109 693 individuals) in the control group consented to participate. 20 457 household pesticide storage containers were distributed. In individuals aged 14 years or older, 611 cases of pesticide self-poisoning had occurred by 3 years in the intervention group compared with 641 cases in the control group; incidence of pesticide self-poisoning did not differ between groups (293·3 per 100 000 person-years of follow-up in the intervention group vs 318·0 per 100 000 in the control group; rate ratio [RR] 0·93, 95% CI 0·80–1·08;  $p=0\cdot33$ ). We found no evidence of switching from pesticide self-poisoning to other forms of self-harm, with no significant difference in the number of fatal (82 in the intervention group vs 67 in the control group; RR 1·22, 0·88–1·68) or non-fatal (1135 vs 1153; RR 0·97, 0·86–1·08) self-harm events involving all methods.

**Interpretation** We found no evidence that means reduction through improved household pesticide storage reduces pesticide self-poisoning. Other approaches, particularly removal of highly hazardous pesticides from agricultural practice, are likely to be more effective for suicide prevention in rural Asia.

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## Introduction

Pesticide self-poisoning is a major public health problem in rural Asia<sup>1,2</sup> and a substantial burden on health services.<sup>3</sup> A systematic review<sup>4</sup> of data from 2006–15 showed that an estimated 89% of all global suicides from pesticide self-poisoning occurred in the Asian and Western Pacific regions. WHO recognises pesticide ingestion to be one of the three most important means of suicide worldwide.<sup>2,4</sup> In Sri Lanka, self-poisoning with pesticides is the most common method of self-harm in many rural districts,<sup>5</sup> highly lethal,<sup>6</sup> associated with impulsivity,<sup>7–9</sup> and the fifth leading cause of death in 2012.<sup>10</sup>

Means restriction is a key element of suicide prevention strategies.<sup>11–13</sup> Restricting access to common and highly lethal methods of suicide can reduce both method-specific and all-cause suicide rates.<sup>14–16</sup> Such approaches for pesticide self-poisoning include administrative interventions altering behaviour (particularly the purchase, use, and storage of pesticides) and interventions altering the availability of highly hazardous pesticides in the community (through regulatory action to remove such pesticides from agricultural practice).<sup>17</sup> Interventions working at the patient level, to improve provision of medical care in resource-poor hospitals, are difficult for the most common pesticides used for suicide

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Pharmacology, Toxicology and Therapeutics, University/BHF Centre for Cardiovascular Science, and Centre for Pesticide Suicide Prevention, University of Edinburgh, Edinburgh, UK (M Pearson PhD, Prof M Eddleston ScD); South Asian Clinical Toxicology Research Collaboration (SACTRC), Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka (M Pearson, S Jayamanne MD, Prof D Gunnell DSc, M Weerasinghe MSc, R Pieris MSc, C Priyadarshana BA, D W Knipe PhD, Prof A H Dawson FRCP, Prof I Gawarammana PhD, Prof M Eddleston, Prof F Konradsen PhD); School of Social and Community Medicine, University of Bristol, Bristol, UK (Prof C Metcalfe PhD, Prof D Gunnell, D W Knipe); Faculty of Medicine, University of Kelaniya, Kelaniya, Sri Lanka (S Jayamanne); Department of Community Medicine, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka (M Weerasinghe); Centre for Suicide Research, Department of Psychiatry, University of Oxford, Oxford, UK (Prof K Hawton FMedSci); Sydney Medical School, University of Sydney, Sydney, Australia (Prof A H Dawson); Provincial Department of Health Services, Anuradhapura, North Central Province, Sri Lanka (P Bandara MSc, D deSilva MBBS); Department of Medicine, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka (Prof I Gawarammana);

and Department of Public Health, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark (Prof F Konradsen)

Correspondence to: Prof M Eddleston, Pharmacology, Toxicology and Therapeutics, University/BHF Centre for Cardiovascular Science, University of Edinburgh, Edinburgh EH16 4TJ, UK [m.eddleston@ed.ac.uk](mailto:m.eddleston@ed.ac.uk)

## Research in context

### Evidence before this study

We searched PubMed for articles published between Jan 1, 1990, and May 1, 2017, with the search terms (((“pesticide”) AND “storage”) AND “intervention”). 12 references were retrieved but none reported randomised controlled trials or systematic reviews. A further search of the internet using general search engines with keywords “safe storage” AND “intervention” identified pilot studies of pesticide storage in Sri Lanka, China, and India, as well as the WHO report on safer access to pesticides for suicide prevention. These studies highlighted the potential for improved storage on the basis of the acceptability of such devices in the community. Additional searches of “pesticide” AND “poisoning” identified four randomised controlled studies that focused on clinical management of poisoning. To our knowledge, no effectiveness studies of pesticide storage to prevent pesticide poisoning have been done.

### Added value of this study

This study is the first effectiveness trial of improved pesticide storage to prevent pesticide poisoning. The provision of a

lockable storage container to householders was designed through discussion and pilot studies to be robust and acceptable to farming communities. Our study tested the effectiveness of pesticide storage at a population level to determine if this intervention could make a significant contribution to reducing pesticide poisoning in rural Asian communities.

### Implications of all the available evidence

The results of our study show that improved pesticide storage in households is not an effective intervention to prevent pesticide self-poisoning, despite its community acceptability. Our research counters the current policy approaches advocating improved storage of pesticides to reduce intentional pesticide poisoning. Only withdrawal of the most highly hazardous pesticides from agricultural practice has been shown to reduce deaths from pesticide poisoning. Global public health efforts should focus on this approach to rapidly reduce pesticide suicides worldwide.

(organophosphorus and carbamate insecticides, and paraquat);<sup>18,19</sup> it is unlikely that improved care will be a highly effective approach to suicide prevention.

WHO, the pesticide industry, and the International Association for Suicide Prevention (IASP) have advocated the use of improved household and community storage, with locked boxes or lockers, to prevent pesticide self-poisoning as part of an overall suicide prevention strategy, termed “safer storage”.<sup>20</sup> Findings from pilot studies of improved household storage in Sri Lanka<sup>21,22</sup> and China<sup>20</sup> and studies of community lockers in India<sup>23</sup> suggest that the approach is appreciated by farming communities. However, the trials were pilot in nature and not designed to assess effectiveness; additionally, repeated interaction with the communities to assess use of the storage devices might have affected their utilisation.

Domestic locked boxes can result in pesticides being brought into the home from the field where they are often stored, potentially increasing the risk of self-poisoning. This problem is exacerbated because locking of boxes reduces over time; households might also find it difficult to keep the key hidden from vulnerable household members.<sup>21,24</sup> Real world use of community lockers is uncertain because they often require farmers to walk away from their fields towards the store in the centre of the village, and a second person to be present for the locker to be opened.<sup>23</sup>

In view of the paucity of evidence for effectiveness of safer storage of pesticides and the potential for increased risk of harm, we aimed to test the effectiveness of household pesticide storage containers in a large community-based, cluster-randomised controlled trial.

## Methods

### Study design and participants

We did a community-based, cluster-randomised controlled trial of a lockable pesticide storage container in a rural area of Sri Lanka. A description of the study design and methods has been published elsewhere.<sup>25</sup> The study was done in the Anuradhapura District (population 855 562, census 2011) of Sri Lanka’s North Central Province (figure 1). We recruited geographical clusters of households primarily from the Mahaweli H irrigation region, including the divisional secretariats of Thambuttegama, Thalawa, Galnewa, Rajanganaya, Ipolagama, and Nochchiyagama, because of the high use of pesticides in agriculture and high incidence of pesticide self-poisoning in this region. All communities within the study area were eligible for participation apart from those recruited to our previous pilot studies (1026 households).<sup>22,24</sup> The chief village official (*Grama Niladhari*) was approached to seek consent for community enrolment; individual household verbal consent was then sought at the start of each household survey.

At enrolment, adult householders present in the home were interviewed about household sociodemographic information, current pesticide use and storage practices, and previous history of self-harm and alcohol consumption. Household global positioning system (GPS) coordinates were recorded with a Juno device (Trimble Inc, USA).<sup>26</sup> The questionnaire was administered by young adults, mostly from and familiar with the local area, in the local language, after training and with regular audit. Additional details of this interview process and quality control have been published elsewhere.<sup>25,27</sup>

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