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International Code of Conduct on Pesticide Management

Guidance on use of pesticide regulation to prevent suicide



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World Health Organization
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International Code of Conduct on Pesticide Management: guidance on use of pesticide regulation to prevent suicide

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Contents

Foreword	vi
Acknowledgements	vii
Acronyms	viii
Glossary	ix
1. Introduction	1
2. Methodology	1
3. Background	2
3.1. Suicide and its risk factors	2
3.2. Suicide by pesticide poisoning	3
3.3. Roles of national authorities in preventing pesticide suicide	5
4. Monitoring and evaluation of pesticide-related suicide	7
4.1. Monitoring	7
4.2. Evaluation	9
5. Using regulation to prevent pesticide-related suicides	9
5.1. Improving the pesticide regulatory framework for prevention of suicides	10
5.2. Preventing registration and re-registration of pesticides strongly associated with suicide	10
5.3. Phasing out acutely toxic highly hazardous pesticides	11
5.4. Restricting and reformulating pesticide formulations	12
5.5. Restricting use of highly hazardous pesticides to professional sprayers or to particular crops	14
5.6. Improving storage and reducing “left-over” pesticides	14
5.7. Engineering controls and personal protective equipment	15
5.8. Collaboration and awareness-raising	15
6. Alternative approaches to crop protection	15
7. Conclusion	15
References	17

Foreword

This document provides guidance, particularly for low- and middle-income countries, in cooperating with relevant stakeholders on best practices in using regulation to prevent suicides with agricultural pesticides.

The guidance was prepared with the support of the FAO/WHO Joint Meeting on Pesticide Management (JMPM), which advises FAO and WHO on guidance to promote compliance with the International Code of Conduct on Pesticide Management. The internationally recognized “Code of Conduct” provides a framework and voluntary standards of conduct for those responsible for pesticide management, in particular governments and the pesticide industry. The Code, endorsed by FAO, WHO, governments, pesticide producers, nongovernmental organizations and other stakeholders, emphasizes stakeholders’ shared responsibility in promoting best practices and risk reduction throughout the life cycle of a pesticide. The Code thereby establishes the commitment and moral obligation of stakeholders to comply with the agreed standards of conduct and to assume their respective responsibilities. These include governments’ responsibility to promote reduction of the risks associated with pesticides and industry’s responsibility to produce products that are adapted to the context of their use and to provide stewardship of those products throughout their life cycle.

FAO and WHO welcome readers’ feedback

FAO and WHO consider this guidance to be a living document that could be improved. They therefore welcome any feedback and comments from readers, including examples of how the guidance is used.

Please send your suggestions, comments and examples to pesticide-management@fao.org or VVE@who.int, indicating the title of the guidance and the relevant section and page.

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Declaration of interest

FAO and WHO reported that they had received and reviewed declarations of interest from all FAO and WHO expert panel members who participated in the 15th JMPM and had concluded that none could give rise to a potential or reasonably perceived conflict of interest related to the subjects discussed at the meeting.

Acronyms

FAO	Food and Agriculture Organization of the United Nations
HHP	highly hazardous pesticide
HIC	high-income country
IOMC	Inter-Organisation Programme for the Sound Management of Chemicals
JMPM	FAO/WHO Joint Meeting on Pesticide Management
LMIC	low- and middle-income country
WHO	World Health Organization

Glossary

Means restriction: limitation of access to lethal methods used for self-harm and suicide; an important population strategy for suicide prevention

Self-harm: an act of non-fatal self-poisoning or self-injury, irrespective of motivation. This definition excludes accidental harm to oneself. The motivation or suicidal intent associated with an act of self-harm varies, and not all acts of self-harm are undertaken with the intent to die. Self-harm may be a means of communicating deep emotional distress or a way of coping with traumatic events or situational stressors, such as the death of a loved one or interpersonal conflict. Other terms commonly used to describe self-harm are “suicide attempt” and “parasuicide”. These terms imply suicidal intent; however, it is often difficult to determine whether an individual intended to kill her or himself in a moment of crisis. The more inclusive term “self-harm” is used throughout this document.

Self-poisoning: a specific act of self-harm involving the intentional (i.e. non-accidental) consumption of one or more harmful compound (e.g. medicines, illicit substances, pesticides, household chemicals, plant poisons), irrespective of suicidal intent

Suicide: an act of intentional self-harm with a fatal outcome. The act was carried out with the purpose of harming oneself, but may or may not have included the intent to die; alternatively, the intent to die may have been transient, or the individual may have been ambivalent about dying or living. Although acts of self-harm may be carried out without any intent to die, impulsive acts of self-harm result in many unintentional deaths due to the use of highly lethal means such as firearms and highly toxic pesticides. The term “pesticide suicides” is used in this document to include all people who die after intentionally ingesting pesticides, irrespective of their intent.

The definitions below are from Article 2 of the International Code of Conduct on Pesticide Management¹¹, unless otherwise indicated. They represent the international consensus on terminology for pesticide management.

Active ingredient means the part of the product that provides the pesticidal action.

Banned pesticide means a pesticide all uses of which have been prohibited by final regulatory action, in order to protect human health or the environment. It includes a pesticide that has been refused approval for first-time use, or has been withdrawn by industry either from the domestic market or from further consideration in the domestic approval process, and where there is clear evidence that such action has been taken in order to protect human health or the environment.

Co-formulant means a non-active ingredient component of a formulated product.

Exposure to pesticides means any contact between a living organism and one or more pesticides (2).

Formulation means the combination of various ingredients designed to render a product useful and effective for the purpose claimed and for the envisaged mode of application.

Hazard means the inherent property of a substance, agent or situation use of which could have undesirable consequences (e.g. properties that can cause adverse effects or damage health, the environment or property).

Highly hazardous pesticides (HHPs) means pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems such as WHO or the Globally Harmonized System of Classification and Labelling of Chemicals, or

their listing in relevant binding international agreements or conventions. In addition, pesticides that appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered to be and treated as highly hazardous.

Integrated pest management means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human and animal health and/or the environment. It emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

Integrated vector management means the rational decision-making process for the optimal use of resources for disease vector control. It aims to improve efficacy, cost-effectiveness, ecological soundness and sustainability of disease vector control interventions for control of vector-borne diseases.

Pesticide means any substance, or mixture of substances of chemical or biological ingredients, intended for repelling, destroying or controlling any pest, or regulating plant growth.

Pesticide management means the regulatory and technical control of all aspects of the pesticide life cycle, including production (manufacture and formulation), authorization, import, distribution, sale, supply, transport, storage, handling, application and disposal of pesticides and their containers to ensure safety and efficacy and to minimize adverse health and environmental effects and human and animal exposure.

Risk is the probability and severity of an adverse health or environmental effect occurring as a function of a hazard and the likelihood and the extent of exposure to a pesticide.

Severely restricted pesticide means a pesticide virtually all use of which has been prohibited by final regulatory action in order to protect human health or the environment, but for which certain specific uses remain allowed. It includes a pesticide that has, for virtually all use, been refused for approval or been withdrawn by industry either from the market or from further consideration in the domestic approval process, and where there is clear evidence that such action has been taken in order to protect human health or the environment.

1. Introduction

The revised International Code of Conduct on Pesticide Management (1, 2), further referred to as the ‘Code of Conduct’, is a regularly updated, globally accepted standard of conduct relating to all aspects of the management of pesticides. The Code of Conduct, now jointly published by FAO and WHO, has been strengthened to reduce the adverse effects of pesticides on health and the environment and to support sustainable agricultural practices. In addition, new topics have been included to better address pesticide management and the pesticide life-cycle approach, to cover both agricultural and public health uses of pesticides, including both integrated pest management and integrated vector management, as well as new definitions, such as for highly hazardous pesticides (HHPs). Although adherence to the Code of Conduct is voluntary, the document provides general, authoritative guidance on pesticide management, and many countries have adopted its principles in their national legislation.

During the past 30 years, it has become clear that intentional self-poisoning and suicide (see definitions) with pesticides is a public health problem in many regions in which small-scale farmers use agricultural pesticides. It is estimated that as many as 20 percent of all suicides globally are due to self-poisoning with pesticides, equivalent to 165 000 suicides each year (3, 4). International guidance to countries on pesticide management has not, however, recognized suicide as a priority (1, 5), and pesticide suicides are not mentioned in the Code of Conduct (1). As a result, although some countries have taken action to ban or severely restrict pesticides associated with suicide, national legislation in many countries does not consider suicide as a risk that should be evaluated, accounted for or mitigated in pesticide registration, training, distribution or labelling.

The aim of this document is to inform governments, particularly agricultural and health authorities, about the issue and to provide best practices for using regulation to prevent pesticide suicides, consistent with WHO’s recommendations and guidelines for suicide prevention (4, 6).

The document provides guidance, particularly for low- and middle-income countries (LMICs), in cooperating with relevant stakeholders on best practices in using regulation to prevent suicides with agricultural pesticides. It builds on the 2016 FAO/WHO guidelines on highly hazardous pesticides (2) and serves as a technical complement to the 2019 WHO/FAO publication, Preventing suicide: a resource for pesticide registrars and regulators (7). It is consistent with WHO’s strategy for suicide prevention (4, 6), WHO’s recommendations on cost-effective interventions for mental health (8, 9) and the supporting evidence for those recommendations (9).

2. Methodology

The 12th JMPM (2019) recommended that guidance on use of pesticide regulation to prevent suicides be developed as a priority document. A JMPM working group was formed to draft an outline of the document for discussion in the intersessional meeting in 2020. Thereafter, the 13th JMPM (2020) reviewed the initial draft prepared by the JMPM working group and made various suggestions to revise the document, in particular to introduce suicide into the scope of pesticide registration and regulation; provide case studies of how regulations can reduce suicides; link the subject to relevant sections of the current Code of Conduct; and describe how it could complement the WHO–FAO Resource Guide on Preventing suicide (7).

The 14th JMPM (2021) reviewed the progress in preparing the guidance and suggested ensuring its consistency with WHO’s ongoing work on suicide prevention (6). The revised document was reviewed by the JMPM intersessional meeting (July 2022), which suggested some minor changes. The document was presented to the 15th JMPM (2022), which endorsed the guidance with agreed minor changes. The revised document was shared with JMPM electronically and finalized.

3. Background

3.1. Suicide and its risk factors

Regulators should be concerned about suicides and include prevention measures in their regulatory activity, because suicides are preventable (4, 6). In 2019, however, over 700 000 people in the world lost their lives to suicide; 77percent of the deaths occurred in LMICs. Suicide is the fourth leading cause of death among 15–29-year-olds and the third leading cause of death among 15–19-year-old girls. Every suicide is a tragedy, with far-reaching impacts on families, friends and communities. Reducing the number of deaths by suicide around the world is a global imperative, led by WHO. Reduction of the global suicide mortality rate by one third by 2030 is both an indicator and a target (the only one for mental health) in the United Nations Sustainable Development Goals and in WHO's *Comprehensive mental health action plan 2013–2030* (10).

Suicide is complex, driven by a range of sociocultural, economic, psychological and biological factors. No one risk factor causes suicide, and certain risk factors are likely to have differential effects according to age, gender, sexuality and ethnicity, within and among countries. Frequently cited risk factors for suicide at the individual level include mental disorders (e.g. depression and alcohol misuse), individual and family history of suicidal behaviour, chronic illness and psychosocial risk factors such as financial stress, interpersonal conflict (including household violence), adverse childhood experiences, loneliness and discrimination. Contributors at population level include difficulties in accessing and in receiving health care, inappropriate media reporting that sensationalizes suicide (increasing the risk of imitative suicides), systemic racism, stigmatization of people who seek help for suicidal behaviour or for mental health and problems substance abuse (e.g. alcohol and drugs) and ready availability of the means for suicide.

Although suicide is complex and multifactorial (as are many chronic diseases), the final common path linking an act of self-harm to a fatal or non-fatal outcome is simple. The factors that determine whether a person survives or dies (becoming a “suicide”) are (i) the means used (determined by availability and acceptability), (ii) the availability of timely, effective treatment, and (iii) whether the person seeks treatment or is found early enough to receive treatment (11). Easy access, including through online sales, to a lethal means of suicide such as a very toxic chemical or a firearm can determine whether a person survives or dies. About 5–8 percent of all people attempt suicide in their lifetimes (4). Most survive after receiving effective treatments and go on to lead productive lives; however, if they use a highly lethal method, there is often no second chance.

Suicide prevention requires coordination and collaboration among many sectors of society, including both health and non-health sectors, such as education, labour, agriculture, business, justice, law, defence, politics and the media (4). The efforts should be comprehensive, integrated and synergistic. At population level, the recommended interventions include restricting access to the means of suicide, school-based interventions and encouraging the media to report responsibly on suicide (4, 8). Restricting access to the means for suicide has been shown to work (6).

Increasing evidence shows the importance of understanding the context to better understand the risk of suicide. As many suicides are impulsive, occurring at moments of crisis, the availability of lethal means can determine whether the person lives or dies. Removing such access – **means restriction** – saves lives as people leave the acute crisis behind or use less lethal methods and survive. Means restriction is a key component of suicide prevention because it gives individuals an opportunity to reflect on what they are about to do and, if possible, for the crisis to pass. The vast majority of people do not then seek alternative means with which to die (4).

In Sri Lanka, removal of just a few acutely toxic HHPs resulted in a > 70 percent reduction in all deaths from suicide, as self-harm became safer (12). A single preventive approach thus resulted in a major reduction in suicides. The availability of acutely toxic pesticides in the house or in nearby fields markedly increases the risk that an act of self-harm becomes a suicide. It is easier to remove highly lethal methods of self-harm than to prevent suicidal acts taking place.

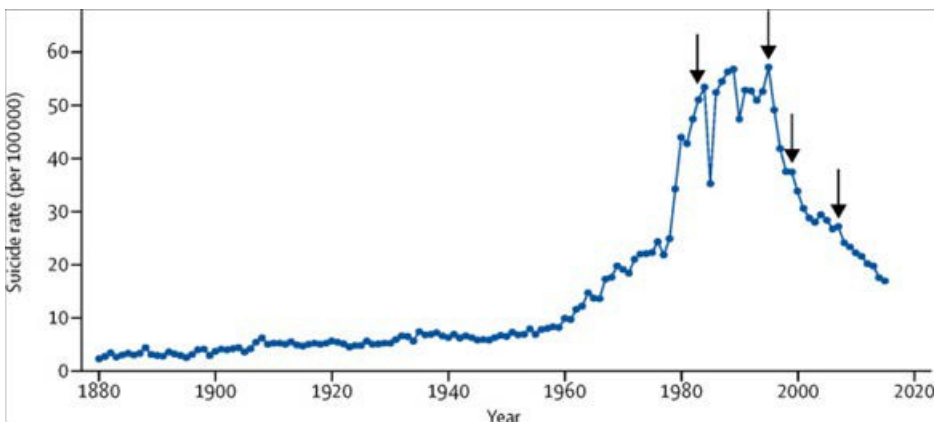
3.2. Suicide by pesticide poisoning

Pesticide poisoning is a major clinical and public health problem where acutely toxic agricultural HHPs are used in small-scale farming communities (13) or illegally repackaged for sale to poor urban communities (termed “street pesticides” by public health workers) (14). The introduction of high-concentration agricultural formulations of organochlorine and organo-phosphorus insecticides into rural LMIC communities in the 1950s and 1960s (15, 16) resulted in an epidemic of accidental, occupational and suicidal deaths due to poisoning (3, 17, 18). Published estimates suggest that 14 million people died worldwide after intentionally ingesting pesticides up to 2018 (19), and hundreds of thousands have died from occupational or accidental poisoning (3, 18). Inadequate regulation and enforcement of regulations on use of agricultural pesticides in some countries has allowed decantation of HHPs into small, unlabelled containers for sale in low-income urban communities for domestic pest control, particularly in Africa (14). These highly hazardous “street pesticides” have resulted in deaths of adolescents and adults from self-poisoning (20).

The impact on national suicide rates of the ready availability of HHPs is well recognized by WHO as one of the three most common means of suicide globally (4), and pesticide suicides have been categorized as a Schilling Category 4 occupational health condition, in that “work provides easy access to potential dangers” (21). Depending on the existence of and possibility of enforcing appropriate pesticide regulations, products used in attempts at self-harm are available not only for agricultural workers but also others in the community, including adolescents.

There is increasing evidence that removal of HHPs can reduce suicide rates. As noted above, in Sri Lanka, removal of just a few acutely toxic HHPs contributed to one of the steepest decreases in suicide rates ever seen (22), with a > 70 percent reduction in all suicides since 1995 (Figure 1). The decrease was due mainly to reduced access to acutely toxic HHPs, with general improvements in medical management of poisoning and intensive care (22–24).

Figure 1. Incidence of suicide in Sri Lanka, 1880–2015, with introduction of pesticide bans indicated by arrows



Source: reference 12, data obtained from police records

WHO used a standardized method for establishing cost-effectiveness and found that pesticide regulation to prevent suicides is highly cost-effective when pesticide suicides account for at least 2 percent of national suicides (9). It was found that regulation is more cost-effective in countries where a high proportion of suicides are attributable to pesticide self-poisoning, reaching a ratio of USD 75 (95 percent uncertainty interval, 58 ; 99) per healthy life-year gained in countries where pesticide suicides account for > 30 percent of all deaths from suicide. In the example in Sri Lanka (Figure 1), the interventions were cost-saving and, in addition, did not adversely impact agricultural output (25, 26).

3.2.1. Pesticide self-poisoning in high-income countries

Pesticide self-poisoning causes fewer deaths in high-income countries (HIC) than LMIC because pesticides are subject to stronger regulation and enforcement and are therefore generally less readily available in rural and urban communities. Farms are often large and mechanized, with few people to access or use pesticides, and high-concentration agricultural pesticides are usually stored in central, locked storage areas, particularly out of working hours. Pesticides that can be purchased by non-professionals are usually of low concentration and not lethal if ingested. Few people are at high risk of death due to access to HHPs (27–29). In HICs, overdosing with medicines is the most common means of self-poisoning; however, due to their relatively low toxicity, > 95 percent of people survive their self-poisoning act (30).

Pesticide self-poisoning was, however, a major problem in two Asian HIC, Japan (31–33) and the Republic of Korea (34, 35), in which thousands of cases occurred each year before effective regulation was implemented. In both countries, paraquat ingestion became a major method of suicide nationally, with a very high case fatality of > 40 percent, far higher than that associated with almost any other pesticide (36). In other HICs, although pesticide self-poisoning is uncommon, patients who present to hospital nevertheless account for substantial intensive care resources (37).

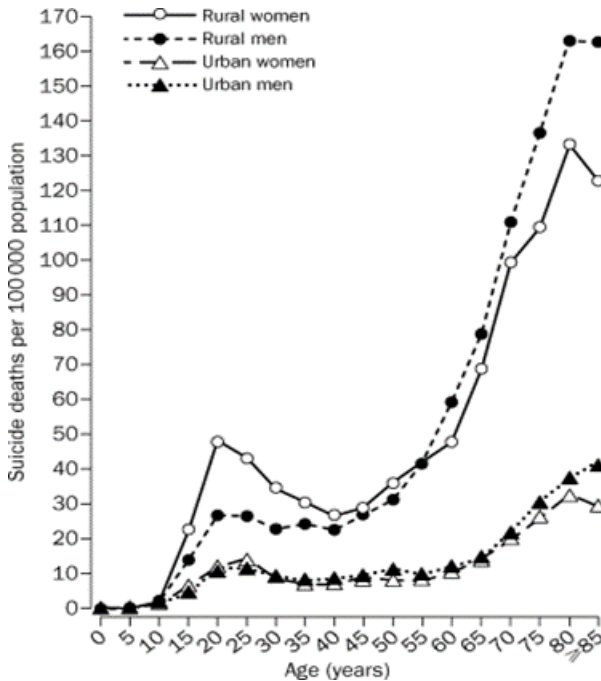
3.2.2. Pesticide self-poisoning in LMIC

Pesticide self-poisoning is a major problem in small-scale LMIC farming communities where agricultural pesticides are stored in and around households. In these communities, the hazards of occupational pesticide use (when pesticides are used for crop protection during working hours) cannot easily be separated from the hazards out of working hours, as the pesticides are stored in households and easily accessible from local shops, not only to agricultural workers but to anyone in the community, regardless of age or occupation. Similarly, many low-income urban communities easily access agricultural HHPs as illegally decanted products used to control common household pests such as rodents and cockroaches.

Self-poisoning in LMIC urban households rarely results in death (except from “street pesticides” (14)), because the case fatality with most commonly used poisons (usually medicines) is low (e.g. < 0.5 percent for paracetamol (30)). In contrast, self-poisoning in rural LMIC communities often results in death because of the toxicity of the pesticides kept in or near a house (e.g. 6.6 percent for pesticides overall, > 40 percent for paraquat soluble liquid concentrate formulations (36)). People in rural communities die from suicide not because of greater intent but because the means at hand – such as high-toxicity pesticides in their households – are much more lethal.

Differences in the rates of death from self-poisoning between rural and urban communities are clearly seen in suicide data from China, where 62 percent of deaths in the late 1990s were due to pesticides (38, 39) (Figure 2), with high rates among young women aged about 20 years due to high rates of impulsive, low-intent self-poisoning with pesticides in this group (4).

Figure 2. Rates of suicide in China, 1995–1999, according to rural vs urban location



Source: reference 12, data obtained from police records

3.3. Roles of national authorities in preventing pesticide suicide

National agricultural and health authorities play the main roles in preventing pesticide suicides.

3.3.1. National pesticide regulatory authorities

Potential roles for national agriculture authorities in preventing suicide are stated in relevant articles of the Code of Conduct. The roles involve ensuring sound life cycle management of pesticides under the conditions prevailing in the country. The following articles should be represented in national policy, legislation and/or regulations.

Pesticide management (Code of Conduct chapter 3)

Article 3.1 states: “Governments have the overall responsibility for regulating the availability, distribution and use of pesticides in their countries and should ensure the allocation of adequate resources for this mandate.”

Reducing health and environmental risks (Code of Conduct chapter 5)

Article 5.1.8 states: “[Governments should] with the cooperation of the pesticides industry limit the availability of pesticides that are sold to the general public through non-specialized outlets to low hazard products (WHO Class U) or low risk and ready to use products that require no dilution or other preparation and can be applied with limited need for personal protective equipment.”

Regulatory and technical requirements (Code of Conduct chapter 6)

Article 6.1.5 states: “[Governments should] conduct risk evaluations and make risk management decisions based on all relevant available data and information, as part of the pesticide registration process.”

Article 6.1.9 states: “[Governments should] allow for re-evaluation and establish a re-registration procedure to ensure the regular review of pesticides, thus ensuring that prompt and effective measures can be taken if new information or data on the performance or risks indicate that regulatory action is needed.”

Availability and use (Code chapter 7)

Article 7.2 states: “When determining the risk and degree of restriction appropriate to the product, the responsible authority should take into account the type of formulation, method of application and its uses ...”

Article 7.3 states: “Availability of pesticides may be restricted by the responsible authority in different ways, such as not registering a product or, as a condition of registration, restricting the availability to certain groups of users or certain uses in accordance with a national assessment of the hazards involved in the use of the product.”

Article 7.4 states: “Governments and industry should ensure that all pesticides made available to the general public are packaged and labelled in a manner which is consistent with FAO/WHO or other relevant guidelines on packaging and labelling and with appropriate national or regional regulations.”

Article 7.5 states: “Prohibition of the importation, distribution, sale and purchase of highly hazardous pesticides may be considered if, based on risk assessment, risk mitigation measures or good marketing practices are insufficient to ensure that the product can be handled without unacceptable risk to humans and the environment.”

Information exchange (Code of Conduct chapter 9)

Article 9.1.2 states: “facilitate the exchange of information between regulatory and implementing authorities to strengthen cooperation. The information to be exchanged should include:

- 9.1.2.1 actions taken to ban or severely restrict a pesticide in order to protect human health or the environment ... and
- 9.1.2.5 poisoning and environmental contamination incidents data.”

After assessing the risks, national authorities should decide upon the appropriate measures to mitigate the risks (i.e. restricting, changing formulations/uses or implementing policy/administrative measures). The most appropriate approach will depend on risk levels and needs and also on policies and the adequacy of institutional infrastructure for pesticide management.

These options are discussed further in section 4.

3.3.1. National health authorities

Potential roles for national health authorities can also be found in the Code of Conduct, especially in **Article 5.1**. The roles involve identifying and reporting the health effects, including poisoning, of pesticides and improving the clinical care of pesticide-poisoned individuals. The following articles from the Code of Conduct should be represented in national policy, legislation and/or regulations.

Article 5.1.3 states: “[Governments should] carry out health surveillance programmes of those who are occupationally exposed to pesticides and investigate, as well as document, poisoning cases.”

Article 5.1.4 states: “[Governments should] provide guidance and instructions to health workers, physicians and hospital staff on the diagnosis and treatment of suspected pesticide poisoning as well as on the prevention of exposure and poisoning, and the reporting and recording of incidences.”

Article 5.1.5 states: “[Governments should] establish national or regional poisoning information and control centres at strategic locations to provide immediate guidance on first aid and medical treatment, accessible at all times.”

Article 5.1.6 states: “[Governments should] utilize all possible means for collecting reliable data and maintaining statistics on health effects of pesticides and pesticide poisoning incidents, ...”

Collection of reliable data on health effects of pesticides is discussed in Section 3.

Guidance on establishment of poison information centres for the diagnosis, treatment and reporting of pesticide poisoning cases has been published by WHO (40). Such centres can provide accurate guidance on the management of pesticide-poisoned patients to hospitals and health workers (41).

4. Monitoring and evaluation of pesticide-related suicide

This section provides information on ways that national agricultural and health authorities can monitor and evaluate suicide as a national issue and engage to reduce pesticide-related suicides. A country that is considering establishment of a national policy on preventing suicides, including those related to pesticides, should involve both agricultural and health authorities for collaboration and action. Involvement of individuals with a public health or medical interest in pesticide poisoning will encourage recording and reporting of case data.

4.1. Monitoring

4.1.1. Recording and reporting data on pesticide suicides

Deaths occurring in a country are registered at a local civil registry, with information on the cause of death. Some countries submit cause-of-death statistics from country civil registration systems according to International Classification of Diseases nomenclature (<https://icd.who.int/en/>) to the WHO Mortality Database (<https://www.who.int/data/data-collection-tools/who-mortality-database>) every year. Only about 60 countries, however, have high-quality vital statistics (42), while others lack high-quality data or a system for recording causes of death. As decisions in public health depend on reliable, timely data on births and deaths, including causes of death best collected through a well-functioning civil registration and vital statistics system, WHO assists countries in establishing and improving registration of vital events (43).

Health authorities should ensure that systems are in place to ensure proper recording and reporting of information related to death due to suicides, pesticide poisoning cases admitted to hospital and people who die from pesticide poisoning, both in and out of hospital. Health authorities could review whether pesticide poisoning is a locally notifiable condition and that health authorities receive reports on all patients attending hospital. This will provide comprehensive data on which to base decisions. A review of data held by health authorities will show which data are available and their quality. Health authorities should nevertheless keep in mind that suicide may be misreported as an accidental or natural death, particularly in countries where suicide is criminalized and/or stigmatized or not reported at all. Families may be unwilling to report suicide for fear of police involvement and the stigma of mental illness. If this is suspected to be the case, health authorities should encourage accurate reporting and train its staff to reduce stigmatization. In countries where suicides are not comprehensively reported, records of all deaths associated with pesticides could be recorded, irrespective of the intention.

4.1.2. Recording and reporting data on the identity of pesticides responsible for deaths

It is important to identify the specific pesticides involved in large numbers of deaths in order to set priorities for regulation. In addition, consistent with national legislation, pesticides that harm to health or to the environment but do not cause acute deaths, should also be considered for regulation (2, 44). For the purposes of this guidance, only acutely toxic HHPs likely to cause death when ingested intentionally are considered.

Although health authorities may hold data on the incidence of pesticide suicides or hospital admissions for pesticide poisoning, the specific pesticides involved in deaths or serious poisoning are rarely routinely recorded, even when they are known to the clinician treating a patient or the coroner reporting a death. At best, the pesticide chemical class may be given, such as “organophosphorus insecticides” (ICD-11: XM7154 organophosphate insecticide) (45). Such pesticide class-based identification is usually insufficient for regulatory guidance, as individual active ingredients and/or formulations are regulated. Health authorities should ensure that systems are in place for proper identification, reporting and recording of the specific pesticides involved, nationally or regionally. In large countries, this may be done most efficiently by a small number of representative “sentinel” sites rather than national coverage.

National poison information centres may have data on the specific pesticides responsible for occupational, intentional or accidental poisoning cases. Most of the data will be from hospitals; however, hospitals will not have data on pesticides that kill rapidly, before patients arrive at hospital. An established hospital-based surveillance system for self-harm (46), a community surveillance system for suicide and self-harm, hospital clinicians who care for poisoned patients, and judicial officers who investigate deaths from pesticide poisoning may indicate pesticides that are particularly problematic and should be considered for regulation. Similarly, researchers studying pesticide poisoning may be able to identify pesticides that are locally problematic and/or illegal (36).

The specific pesticide involved in most cases can be identified accurately by questioning patients and relatives, referring to the brand names and/or photographs of locally common pesticide bottles (47, 48). Conversations with clinicians, judicial officers and patients might indicate pesticides to be considered for regulation. The illegality of attempted suicide, however, and the resulting stigmatization in some countries may make such conversations more difficult (49).

Sudden deaths are commonly subjected to judicial review and medicolegal post-mortem examination to determine the cause of death. The stomach contents of poisoned patients may be sent to a forensic toxicology laboratory for identification of poisons. Identification of the individual pesticide involved in each death will indicate the most important pesticides over time and by area, and these data are the most scientifically valid for identifying pesticides for regulation. Health authorities can work with forensic toxicology laboratories to

collect such data systematically for use in deciding on pesticide regulations, as has been done in Nepal (50). Governments are encouraged to use and, if appropriate, consider financing the collection and use of mortuary data as part of an effective surveillance system for pesticide poisoning. Experience from nearby countries may be helpful in identifying pesticides that commonly cause death when ingested. Such regional cooperation is encouraged by both WHO and FAO.

Identification and withdrawal of pesticides that cause suicidal deaths can be monitored and reported to FAO and WHO (Code Article 12).

4.2. Evaluation

Health and regulatory authorities can jointly review information on the proportion of suicides that are due to pesticides. As mentioned in section 2.2, a plan for regulatory review and action can be drawn up when pesticide suicides account for > 2 percent of suicides (8, 9).

5. Using regulation to prevent pesticide-related suicides

The Code of Conduct encourages governments to take full account of factors relevant to preventing suicide, such as local needs, social and economic conditions, levels of literacy, climatic conditions, the availability and affordability of appropriate pesticide application and personal protective equipment when considering any regulatory action (1). After evaluation of the available monitoring data on pesticide-related self-harm attempts and assessment of pesticide risks, countries should decide on appropriate measures to mitigate those risks (i.e. restricting, changing formulations or uses, policy or administrative measures). The most appropriate approach will depend on risk levels and needs and also on national policies and the adequacy of institutional infrastructure for pesticide management (2).

National registration authorities use various approaches to evaluate and authorize pesticides according to national legislation and policy, the available human resources for pesticide evaluation (e.g. technical expertise, experience) and financial resources (e.g. level of operational funding). A pesticide registration and evaluation strategy may range from basic to comprehensive. While a basic strategy may be appropriate when few resources (e.g. monitoring data, regulatory staff) are available, more data and resources will generally permit a more comprehensive evaluation of a pesticide. It is recognized that regulatory authorities in a resource-limited countries can lack basic resources for pesticides evaluation and would opt for a simple evaluation. That process can be based on a limited comparison of a pesticide product submitted for authorization and a similar product in one or more reference countries.

Countries can use both hazard- and risk-based approaches to evaluate pesticides. An initial hazard assessment of the intrinsic properties of a pesticide, irrespective of exposure (dose), is a first step in a more elaborate risk assessment. If a human health risk assessment cannot be conducted, the registration authority may decide on the acceptability of the pesticide on the basis of a hazard assessment alone. A risk assessment is based on both the properties of the pesticide and the level and probability of exposure. Depending on the resources available, a country can choose a more or less complex evaluation procedure. Countries with limited resources may initially choose a basic evaluation of the properties of the pesticide, use patterns under local conditions and the level of production and/or import to determine the priority or importance of the pesticide to its food security and economy. With experience over time, expertise and infrastructure will be built up and the evaluation system can progressively be strengthened and made more comprehensive.

For a domestic regulatory approach to pesticide-related self-harm, pesticide regulators should, with the ministry of health, consider the adequacy of monitoring data on self-harm attempt as a basis for regulatory action; the legislative authority for using data on self-harm for regulatory action; the properties and availability of the products associated with self-harm attempts; the viability and availability of alternatives in relation to known pest pressures; the regulatory options available; the expected impacts of the regulatory action (both for and beyond self-harm attempts); and capacity to enforce the regulatory action. Consideration of these and other factors will allow pesticide regulators to take informed regulatory action to address the issue of self-harm that is consistent with national legislation. The actions may include improving the pesticide regulatory framework for the prevention of suicides; not registering or re-registering pesticides associated with a high risk of fatal self-harm; phasing out acutely toxic pesticides; restricting and reformulating pesticide formulations; restricting use to professional sprayers or to particular crops; improving storage and reducing “left-over” pesticides; using engineering controls; and collaboration and awareness-raising.

In industrial hygiene, the hierarchy of control is used approach (52). The hierarchy starts with the controls perceived to be most effective and moves down to those considered least effective. It flows as follows: elimination (physically remove the hazard), substitution (replace the hazard), engineering controls (isolate people from the hazard), administrative controls (change the way people work) and, last, personal protective equipment (protect the worker) (52). The FAO/WHO guidance on HHPs, for example, applies the principles of the hierarchy of control and outlines the options for mitigating the risks, including, where appropriate, removal or restriction (2). Some stages of the hierarchy of control are relevant for pesticide regulation with respect to suicide (53, 54). As discussed above, the social, economic and other factors that contribute to intentional self-harm require a considered, country-specific approach to the problem. Nevertheless, the main determinant of whether an act of self-harm results in death (becomes a “suicide”) is the means selected (e.g. gun vs medicine), which is influenced by the means available at the moment of self-harm. Removal of easy access to lethal means, such as acutely toxic HHPs, can prevent acts of self-harm resulting in death.

5.1. Improving the pesticide regulatory framework for prevention of suicides

Suicide prevention can be integrated into relevant national legislation on pesticide management, including regulations on registration, online sales, distribution, applications/storage, licensing of applicators of HHPs, monitoring and awareness. This can institutionalize suicide prevention in national legislation and regulations. For example, countries can develop national policies on preventing suicides by pesticides, including those that meet the definition of a WHO hazard class I pesticide, or pesticide active ingredients and formulations that have been shown to have severe or irreversible adverse effects on human health or the environment (HHP criteria 8 (2)), even if in a different WHO hazard class.

Governments may also consider adopting WHO suicide prevention (6) and mental health strategies (55) coordinated with suicide prevention provisions in pesticide management legislation.

Pesticide regulatory authorities should be empowered to consider use of a pesticide in suicide as a legitimate purpose for regulation, as per the FAO/WHO resource document (7).

5.2. Preventing registration and re-registration of pesticides strongly associated with suicide

Article 6.1.9 of the Code of Conduct states: “Allow for re-evaluation and establish a re-registration procedure to ensure the regular review of pesticides, thus ensuring that prompt and effective measures can be taken if new information or data on the performance or risks indicate that regulatory action is needed.”

The extent to which pesticides could readily be used or are recorded as being used in lethal self-harm should be considered in decisions on national registration and re-registration. Registration of a novel pesticide that is highly toxic and therefore highly lethal after ingestion should be avoided.

5.3. Phasing out acutely toxic highly hazardous pesticides

Article 7.5 of the Code of Conduct states: “Prohibition of the importation, distribution, sale and purchase of highly hazardous pesticides may be considered if, based on risk assessment, risk mitigation measures or good marketing practices are insufficient to ensure that the product can be handled without unacceptable risk to humans and the environment”.

Governments should regularly review currently registered pesticides and eliminate products associated with high risks of suicide. Obtaining the information necessary to evaluate risk and to take appropriate regulatory action is discussed above. Pesticides that are lethal after ingestion and have been shown to cause death in a national jurisdiction should be considered for regulatory action after a national needs assessment.

When appropriate, regulatory action can remove a whole classes of pesticides, such as WHO hazard class I or II pesticides, associated with a case fatality of > 5 percent after self-poisoning (36, 56). Alternatively, individual compounds identified as being responsible for most suicide deaths can be phased out (57). While such national action has been shown to be highly effective, national bans and phase-outs should be considered in context, such as the availability of suitable cost-effective alternatives and national capacity to enforce a ban. For example, a national decision to eliminate a pesticide may not reduce suicide incidence if the national authority cannot prevent illegal importation of the banned pesticide, indicating the importance of education. The availability of viable, cost-effective crop protection alternatives for farmers is important, as is effective regional implementation and enforcement of both border and regulatory controls. Examples are available in which selective regulatory elimination of acutely toxic HHP (withdrawal or substitutions) has been effective in reducing the pesticide suicide rate and in some cases the total suicide rate (57).

The following examples show that certain pesticides can be successfully removed from agriculture, with replacement by effective alternative chemical and non-chemical forms of crop protection identified by the national agricultural authorities.

Sri Lanka recorded increased rates of both pesticide suicides and all suicides between 1960 and the early 1970s, and a more rapid increase between 1979 and 1984. The Government asked the Office of the Registrar of Pesticides to improve incidence reporting, identify the pesticides responsible for most deaths and to lead the Government response in a multi-sectoral approach (58). Methyl-parathion and parathion were first removed in 1983, followed by all WHO hazard class I insecticides in 1995 and the WHO hazard class II organochlorine insecticide endosulfan in 1998. These phase-outs resulted in a dramatic fall in the total number of suicides (not just from pesticides), indicating that people were not switching to other lethal means (12, 59). This also indicated that many of the pesticide suicides that had occurred during the previous 20 years had not been intentionally fatal – that people had not strongly intended to die and had tried another means if they survived. The regulatory action reduced the national suicide rate by more than 70 percent over 20 years, saving an estimated 93 000 lives at a direct Government cost of < USD 50 per life saved (12). Studies of agricultural costs and outputs in Sri Lanka demonstrated that the action focused on the most hazardous compounds did not affect agricultural productivity (25, 26).

Bangladesh phased out all WHO class I pesticides in 2000, resulting in a marked reduction in both pesticide suicides (by 65.1 percent) and total suicides (25.0 percent) by 2014 and saving an estimated 35 000 lives (60). No effect of the major reductions in HHP use was detected on Bangladeshi agricultural productivity (60).

Since 2000, China has regulated the removal several acutely toxic HHPs from agricultural use

because of their impacts on health and the environment. Previously, 46 WHO hazard class Ia and Ib agricultural pesticides were allowed in China. Of these, 14, including five organophosphorus HHPs, were withdrawn in 2002, and a further 22 were withdrawn between 2008 and 2022; the final six will be banned for production and registration by 2024 and for use in 2026. The regulatory decisions made in 2007 and 2014–2016 recognized the issue of pesticide suicides. Since 2000, the suicide rate has fallen dramatically in China, the greatest reduction being in pesticide suicides (61). The relative contributions of migration from rural areas to cities, mechanization of agriculture (both of which would reduce the number of people with access to pesticides) and pesticide regulation to these reductions are uncertain.

The Indian state of Kerala ended registration of endosulfan in 2005 and of all WHO hazard class I and II pesticides in 2011 because of their high toxicity and harm to humans; India phased out endosulfan nationally in 2011 as a result of a Supreme Court decision (62). The regulation was associated with a reduced rate of pesticide suicides in Kerala and reductions in both pesticide suicides and total suicides nationally, with no evidence of decreased agricultural outputs (62, 63). In 2018, India withdrew a number of HHPs, including WHO hazard class I (extremely and highly hazardous) organophosphorus insecticides responsible for many pesticide suicides in India (methyl parathion, phorate, phosphamidon and dichlorvos) (62, 64). A proposal for regulatory action in 2020 included the key pesticides monocrotophos (WHO hazard class Ib) and dimethoate (WHO hazard class II) (65).

The Republic of Korea cancelled registration of the herbicide paraquat in 2012 because of large numbers of self-poisoning deaths. The resulting reduction in paraquat self-poisoning (10) led to a 37–48 percent decrease in pesticide suicides over the next 2 years, with no effect on agricultural yield (11, 12).

Nepal identified dichlorvos and high-concentration aluminium phosphide tablets as the pesticides responsible for most pesticide suicides nationally (50) and withdrew the registration of dichlorvos and other WHO hazard class I pesticides in 2019 (66). The effects of these regulatory actions on agriculture and health are being studied.

5.4. Restricting and reformulating pesticide formulations

Restricting or removing particular pesticide formulations can be effective approach in preventing suicide in some situations.

Removal of 3-g 56 percent aluminium phosphide tablets from the market in India in 1999, while permitting 12-g 15 percent tablets and 6 percent tablets resulted in a marked reduction in case fatality and suicides from this poison (62, 67).

Carbofuran is permitted only as a 3 percent wettable powder in Sri Lanka, resulting in a lower case fatality after ingestion than with the less hazardous carbosulfan, which is permitted as a 25 percent emulsifiable concentrate (36, 68).

Global changes in the formulation of paraquat to make it less easy to ingest and less toxic after ingestion (by adding a stenching agent, colourant and emetic (69, 70) or by adding higher concentrations of an emetic, a purgative and an alginate (71)) have not markedly reduced the high case fatality after ingestion (43–68 percent) (72–74).

China banned paraquat SL20 formulations in 2012 and then introduced a gel formulation in 2013,

which was withdrawn in 2020. Unpublished data suggest a lower case fatality with the gel formulation.

Paraquat was registered in Japan in 1962 as a soluble liquid SL20 formulation. In 1986, the Ministry of Agriculture, Forestry and Fisheries imposed restrictions on its sale and use because of a major increase in fatal poisoning cases, and a lower-concentration combination product (4.3 percent paraquat ion/4.1 percent diquat ion) was introduced into agricultural practice. This was associated with reduced use of the product and a reduced rate of pesticide suicides, from 2013 in 1985 to 146 in 2019 (33).

5.5. Restricting use of highly hazardous pesticides to professional sprayers or to particular crops

When use or continued use of a pesticide presents risk but is considered essential in a needs assessment (2), it may be registered or re-registered while reducing its general availability by restricting its use to professional spray service providers or limiting its use only to necessary crops. This approach, however, requires effective enforcement, so that regulators should consider national enforcement capacity before adopting it. The approach does not always work. For example, studies in hospitals in Sri Lanka indicate that pesticides that are restricted to spray service providers can still find their way into homes and be used for self-poisoning (e.g. malathion (75)). Similarly, in Maharashtra State, India, monocrotophos is restricted for use in cotton farming; however, the restriction is not enforced, and monocrotophos is widely used in home vegetable gardens (76). As a result, it is commonly used in fatal pesticide self-poisoning (56, 77) and found in cases of poisoning (particularly of children) by contaminated food (78, 79).

National authorities should consider whether the necessary capacity for enforcement is available, which may be difficult when regulatory resources are limited. Effective enforcement of pesticide legislation can be supported by FAO/WHO guidance (80).

5.6. Improving storage and reducing "left-over" pesticides

Careful storage of pesticides to limit their availability to non-authorized users is routinely recommended to reduce unintentional exposure; however, the effectiveness of the measure remains to be demonstrated.

Improved or "safe" storage of pesticides has been tested for reducing pesticide self-poisoning. The results of a series of small pilot studies were promising (81–83); however, a large, pragmatic, cluster randomised controlled trial of the effectiveness of providing a lockable in-field or household–garden storage container to over 53 000 households in the North Central Province of Sri Lanka found no difference in the incidence of pesticide self-poisoning over 3 years of follow-up (84). Once the containers were installed, promotion of its use was limited to community posters and 6-monthly reminders at routine community meetings. This approach is unlikely to be effective for reducing pesticide suicides.

A community model has been tested in both China and India (82, 85). Feasibility studies showed community enthusiasm but only modest use, probably due in part to the central location of the facility, away from the fields (86). There was no evidence of effectiveness.

Agricultural extension services can work with farmers to guide their purchases in order to reduce the amount of left-over pesticide, minimizing the amount that must be stored and reducing the risk that a pesticide is available for ingestion.

5.7. Engineering controls and personal protective equipment

The hierarchy of control (51) includes both engineering controls and use of personal protective equipment. The former may offer some benefit in HICs or commercial plantations if closed systems for pesticide use prevent anyone from open a bottle without special equipment. The latter approach is not relevant for pesticide self-poisoning, as it is designed to prevent occupational poisoning of pesticide sprayers rather than self-poisoning.

5.8. Collaboration and awareness-raising

The health and agricultural sectors should work together to address the problem of pesticide suicides, with awareness-raising and engagement of a variety of stakeholders, including local communities, civil society, clinicians in rural hospitals, forensic medicine departments and the private sector, including the pesticide industry (6).

6. Alternative approaches to crop protection

The Code of Conduct (section 3.8) recommends that governments make a concerted effort to develop and promote use of integrated pest management. More recently, agroecological practices were recommended by the 4th International Conference on Chemicals Management and by FAO (87). These methods will reduce or substitute the use of acutely toxic HHPs in agriculture, thus reducing their availability in rural communities. Reduced availability will avoid the use of acutely toxic HHPs in acts of self-harm, reducing the lethality of self-harm and preventing deaths (7).

Agricultural extension services should be empowered to promote substitution of acutely toxic pesticides with less hazardous crop protection methods.

7. Conclusion

While suicide is complex, driven by a range of sociocultural, economic, psychological and biological factors, pesticide suicides can be prevented (6, 7). The appropriate approach to pesticide suicides will be decided by countries according to their circumstances, national policies and the adequacy of their institutional infrastructure for proper pesticide management. Nevertheless, countries can learn from successful actions in other countries.

Means restriction (limiting access to highly lethal methods of suicide) is the intervention for which there is the strongest evidence for reducing suicide deaths (4). Countries should monitor and analyse the number of pesticide suicides and the agents involved in most deaths to inform action. Countries are encouraged to strengthen national policy and regulatory regimens to take suicide prevention into account. Regulatory actions may include not registering or re-registering pesticides with high potential risk for suicide, eliminating or banning pesticides that are locally responsible for most pesticide suicides, removing or reformulating particular formulations, substituting certain pesticides for less hazardous alternatives and restricting access (e.g. allowing certain pesticides to be sold only to certified applicators).

To ensure that pesticide suicides are recognized as a consequence of pesticide use and therefore availability, the more than 100 000 deaths that occur annually worldwide could be addressed formally and be the subject of a concerted joint public health and agriculture programme. With increased monitoring and evaluation of

the issue of pesticide suicide, national authorities in the agriculture and public health sectors can evaluate the appropriateness of addressing pesticide suicides through regulation, as for medicines in HIC, where they are regulated directly to prevent suicidal poisoning deaths (88–90). Use of regulation to prevent suicides from pesticides can meaningfully improve human health and also probably benefit the environment by less use of certain pesticides and greater reliance on integrated pest management and agroecology.

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