

# Surveillance of Pesticide-related Illness in the Developing World:

## Putting the Data to Work

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With PLAGSALUD support, pesticide illness surveillance has extended to all seven Central American countries, producing 7,000 poisoning reports in 2000, but governments' use of the surveillance data has been limited by inadequacies of data management, interpretation, and reporting and an influential pesticide industry in weak economies. Overrepresented reports of suicides minimize occupational hazards. In six countries, 32,245 questionnaire responses indicated 98% underreporting of pesticide poisonings and a regional estimate of 400,000 poisonings per year (1.9% of the population), 76% work-related. A potentially far-reaching measure to come out of this surveillance is an agreement of the ministers of health of Central America and the Dominican Republic (RESSCAD 2000) for a harmonized list of banned and restricted pesticides, including the 12 most frequently reported. The RESSCAD agreement has met considerable resistance from industry. Its achievement versus failure will disclose the ability of Central American governments to prioritize protection of human health against commercial corporate interests. Surveillance data have potential for policy reform, but a more aggressive health sector is needed, linked with the environmental sector, grass-roots organizations, and universities. *Key words:* pesticide poisoning; pesticide illness; surveillance; developing countries; Central America; pesticide policy.

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**I**llness surveillance is essential to the efficient and timely delivery of health services. It can also provide valuable guidance for health policy reform. Traditionally, surveillance has focused primarily on potentially epidemic acute and chronic infectious diseases such as measles, malaria, hepatitis, venereal dis-

eases, and tuberculosis. The information provided by such systems allows rapid mobilization of public health response in the control of potentially disastrous contagious conditions. The surveillance of acute and chronic non-infectious diseases leads to the control of exposures, primarily through public education or policy change. The control of environmental and occupational exposures is achieved through the demonstration of harm to the public health, and the impetus for change is generally proportional to the size of the public health threat. In the developing world, one of the non-infectious health problems that has received significant attention in recent years is acute pesticide intoxication. Pesticide intoxications occur in some regions of the world at rates that rival or surpass those of many of the acute infectious health problems traditionally considered to be among the most frequent and severe in developing countries.<sup>1</sup>

Surveillance of pesticide-related illness has increased over the past two decades.<sup>2-5</sup> However, the use of surveillance derived data for problem solving in the developing world remains quite limited. Some such data have been used to identify specific hazards, which have then been addressed in education, training activities, or regulations,<sup>6,7</sup> but for the most part pesticide-related illness surveillance data have not brought about broader and more ambitious hazard reduction efforts, particularly in the form of policy reforms.

Central America is one of the regions of the developing world where considerable attention has been paid to pesticide-related problems. This is due in part to the fact that this region has been a world leader in pesticide use and pesticide-related problems.<sup>8-12</sup> In the year 2000, pesticide use was approximately 45,000 tons in the seven Central American countries.<sup>13</sup> There have been a number of efforts to accurately portray the nature and scope of pesticide illness in Central America, with the intention of generating pesticide problem-solving measures,<sup>9,10,14-20</sup> but demonstrably effective problem-solving efforts have been few and limited.

The lack of effective responses is a product of numerous factors. Most important are the debilitating effects of a two-decade-long decline in the Central American economies, accompanied by a devolution of the Central American states.<sup>21</sup> Furthermore, a long history of a weak and often repressed civil society (partic-

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ularly unions and peasant groups) and a relatively strong, more influential business sector (in this case most notably the pesticide industry and related agrobusiness interests) has led to inability or unwillingness of political leaders and governments to respond to pesticide-related problems.<sup>10</sup> Recently, however, new impetus has been given to the efforts to address these problems. The role of surveillance of acute pesticide intoxications has become increasingly important. The following discussion explores the efforts to generate a more accurate understanding of pesticide hazards in Central America through pesticide-related illness surveillance, with particular attention to how illness surveillance data have been, and could be, used to generate policy reform and reduce pesticide hazards.

## **HISTORY OF CENTRAL AMERICAN PESTICIDE-RELATED ILLNESS SURVEILLANCE**

During the 1980s, pesticide poisonings started to be monitored in some countries in Central America through the traditional infectious-disease surveillance systems of the ministries of health. These surveillance systems have been almost entirely passive in their data-gathering procedures, recording only those cases reported by physicians and health center personnel. Even where reporting occurred, data were incomplete and frequently not consolidated or analyzed. For example, the Department of León, Nicaragua (the region where pesticide use was most intensive), in 1983 reported fewer than 200 cases,<sup>15</sup> only a small fraction of the pesticide-related illnesses that occurred that year. In Costa Rica, 104 poisonings were reported to the surveillance system of the Ministry of Health in 1986, whereas a comprehensive nationwide survey detected roughly 3,750 cases of pesticide-related illness that had entailed medical attention.<sup>16</sup>

In the mid-1980s, CARE International launched the Pesticide Health and Safety Project in Nicaragua. Among the activities of the project was an increased attention to data gathering for pesticide-related illnesses.<sup>10</sup> A more active data-gathering system involving regular calls and visits to local health centers by officials of the Ministry of Health began to generate increasing data on pesticide-related illness. In response to surveillance reports, outbreak investigations were pursued including site visits and follow up investigations. By 1987 the reported incidence of pesticide poisonings in León, Nicaragua had risen to 1,266, still only a small portion of the actual number of pesticide-related illnesses.<sup>15</sup>

During the same period, the Universidad Nacional in Costa Rica established the Pesticide Program (PPUNA) (today the Central American Institute for Studies on Toxic Substances, IRET), which collected data on pesticide use and health and environmental effects in Central America.<sup>8,9</sup> In the early 1990s, PPUNA initiated, together with the Ministry of Health,

a pilot surveillance system of pesticide poisonings in Cariari, a district in Costa Rica's banana-growing Atlantic Coast.<sup>22,23</sup> As in Nicaragua, reported poisonings rose in a few years, to 1,130 in 1995.<sup>24</sup>

Both programs demonstrated that the incidence of pesticide-related illness was dramatically higher than official sources suggested. One underreporting study done in Nicaragua during this period concluded that despite the already high numbers, only 1 in 8 cases occurring in the cotton growing region was actually being reported.<sup>17</sup> In Costa Rica, it was estimated that 4.5% of the agricultural workers suffered a poisoning yearly.<sup>16</sup>

By the early 1990s, both programs focused on relatively small regions of the individual countries in which they were based. Surveillance was complemented with ad-hoc studies in particularly high-risk groups.<sup>6,19,20,25</sup> But at about the same time, the Pan American Health Organization (PAHO) was developing a new regional project, PLAGSALUD, to address occupational and environmental health problems associated with pesticide use over a seven-country region. The project drew heavily on the experience of the CARE project in Nicaragua,<sup>26</sup> including a strong emphasis on illness surveillance and also on the incipient surveillance system in the Atlantic Region in Costa Rica.<sup>22,23</sup> In 1994 the project began, with funding from the Danish Agency for International Development (DANIDA), in Nicaragua and Costa Rica. In 1997, it expanded into Panama, El Salvador, Honduras, Guatemala, and Belize. The PAHO project strengthened the illness surveillance and response capacities of the ministries of health throughout the region. As a consequence, over the past several years pesticide-related illness reporting has improved dramatically. By the year 2000, the surveillance systems reported approximately 7,000 cases in the region.<sup>13</sup>

## **PROBLEMS IN CENTRAL AMERICAN PESTICIDE-RELATED ILLNESS SURVEILLANCE**

In spite of the advances in the reporting of acute pesticide-related illness, surveillance has continued to fall short of its potential for altering the health problems associated with pesticides. The weakness in pesticide-related illness surveillance has in large part been the product of a continuing inability to organize, interpret, and report the data in a manner useful to policymakers and the public. In some cases this failure to accurately characterize the pesticide problem through illness-data analysis has led to the misinterpretation of the existing data and, thus, has actually worked against the pesticide problem-solving efforts. This paradoxical effect of pesticide-related illness surveillance is most notable in the discussions of the causes of pesticide poisonings. Pesticide-related suicides and attempted suicides are reported in some countries as occurring at rates equal to or greater than occupational and non-occupational

accidental poisonings.<sup>27</sup> These reports have been used by the pesticide industry and policymakers to argue that the problem is not really one of pesticide hazards but one of mental disorders.<sup>28,29</sup> As a pesticide industry spokesperson argued in a recent international congress on pesticide-related problems, if we ban a pesticide because it is frequently used in suicides, will we not then have to ban bridges and tall buildings? The implication of this statement being that an individual bent on suicide will continue to search for lethal means if that individual is denied access to pesticides. However, there is ample evidence that many suicides occur precisely because an individual has easy access to a lethal agent at a moment of emotional crisis, but if that agent is not present, often the moment will pass and the individual will not continue to pursue his or her demise.<sup>30-32</sup>

The problem is that suicides are overrepresented in illness-surveillance data. Attempts at suicides usually involve ingestion of a pesticide, which results in the most severe, and often fatal, results. Consequently, these cases appear more often at hospitals, where the cases are more likely to be reported to the surveillance system, and, when fatal, become part of an additional and separate fatality-reporting process. In comparison, work-related pesticide poisonings are significantly underreported, due to, among other factors, the less severe nature of most cases, the fact that illnesses occurring on farms are often far from health facilities and are thus more frequently self-treated or not treated at all, and the unwillingness of employers to have workers' illnesses reported and thus incur insurance liabilities. In a recent nationwide population survey of pesticide poisonings in Nicaragua, only 3% of the poisonings were suicides, compared with 45% in the country's surveillance system.<sup>33</sup>

A related problem is the gender bias in the data. Women make up only a small percentage of the reported poisoning victims. While some activities involving high risk may indeed rely primarily on male workers, female job categories and employment structures, such as day labor instead of seasonal or career-type employment, result in women's seeking medical attention less often or, if they do, attending primary rather than occupational health care services, where general physicians will not easily establish the link between symptoms and labor risk factors. London et al. discussed evidence that pesticide illness in women is less likely to be diagnosed because women are believed to be more hysterical and they are thought not to be exposed to pesticides.<sup>34</sup> Thus, women are less likely to be counted in illness surveillance systems than are their male counterparts.

## **SOLUTIONS TO PESTICIDE-RELATED ILLNESS REPORTING PROBLEMS**

The PLAGSALUD project undertook a region-wide study of underreporting in 2000 to determine the real

scope of the acute pesticide-poisoning problem. The basic principle of the regional underreporting study's effort was predicated on the capture-recapture methods as used in human surveillance work but originally designed for wildlife population estimation<sup>35</sup> and employed earlier by Keifer et al. for a regional Nicaraguan estimate.<sup>17</sup> With this method, individuals appearing in the surveillance system during a specific time period are considered the captured sample and tagged. Individuals in the source population derived from a community sample are then asked about their experiences with pesticide poisoning during the same time period. Those that experienced a medically treated poisoning and thus were eligible to be reported to the surveillance system represent the recapture sample. The ratio between the marked and the unmarked individuals in the recaptured sample represents the proportion of reporting of pesticide poisoning in the source population. Depending on locally available resources or limitations in the different countries in Central America, a variety of approaches was ultimately employed, such as surveys restricted to smaller regions instead of nationwide surveys or the targeting of high-risk groups. Responses were received to a total of 32,245 questionnaires.

The data analysis is ongoing, but some preliminary results can already be released. The results do not include the data from Honduras, since the study there was restricted to underreporting within the surveillance system. The differing approaches provided insights into various levels of the different countries' reporting systems, with underreporting rates of at least 98% in all countries. The vast majority (76%) were work-related poisonings, followed by accidental poisonings and by suicides in a low proportion for all countries combined. Poisoning rates were 0.3% among children under age 15 and 2% among the population of 15 years and older, 2.1% for women and 7.3% for men. When projecting these figures to the subpopulations sampled in the six Central American countries in the survey (approximately 14.9 million people), we arrived at 200,865 poisonings in a one-year time period (2000–2001). When projecting these figures to the total population of the six Central American countries, we would expect 29,768 cases under age 15 and 368,557 cases in the population of people 15 and older. This means that annually 1.9% of the Central American population and 4.9% of those who use or are otherwise exposed to pesticides may suffer a symptomatic episode of pesticide poisoning.

## **PUTTING THE DATA TO WORK**

Once more accurate data are generated, the task becomes one of putting those data to work to address the pesticide problem. The most important area of problem solving is the policy reform process. In the

case of pesticide-related problems, policy reform is a formidable task due to the powerful alignment of interests opposed to curbing pesticide sales and use. The pesticide industry in Central America has long been staunchly opposed to increasing regulatory control of pesticides.<sup>10</sup> They are closely allied with Ministry of Agriculture officials throughout the region. Together these interests have thus far blocked all but the most minimal changes in the control of pesticide imports and sales.

However, one important advance in the pesticide problem-solving efforts has come from the increased awareness of pesticide-related problems among the public and policymakers alike. In recent years the media have given increased coverage to the reports from the illness-surveillance systems. Unfortunately, this reporting has suffered from the inadequate or incorrect analyses of the data by the health authorities described above. Yet the increased attention has also made pesticide-related illness a more widely recognized problem among the Central American public.

A related benefit of the increased reporting of pesticide-related illness has been the willingness of the ministries of health and social security, and other ministries, to give greater priority to pesticide poisoning and pesticide hazard reduction. Despite the limitations of the statistics and their interpretations, in Nicaragua, pesticide-related health problems were identified as one of a small group of high-priority problems in occupational health.<sup>36</sup> In addition, in Nicaragua and Guatemala pesticide poisonings have been placed among the public health priorities in the National Health Plan.<sup>37</sup> In Belize, where pesticide poisonings were considered minimal (22 cases reported in 2000), the results of the underreporting study carried out by PLAGSALUD<sup>38</sup> have reportedly caused considerable debate among government officials. In Nicaragua, these statistics permitted the health authorities to request the agricultural and environmental authorities not to sign a Central American customs agreement to reduce requirements for human and animal toxicity data for pesticide registration purposes.<sup>39</sup>

Perhaps the most controversial, and most potentially far-reaching, measure to come out of the Central American pesticide illness-surveillance systems is a proposal for a harmonized list of banned and restricted pesticides for the region. PLAGSALUD and the ministries of health created a list of the 12 pesticides most frequently reported by the health surveillance systems as causing acute pesticide poisonings, and combined those with a list of 107 pesticides already banned or deregistered in at least one of seven countries in the region. They presented this list to the annual meeting of the ministers of health of Central America and the Dominican Republic (RESSCAD) in Tegucigalpa, Honduras, on September 12, 2000. The ministers adopted Agreement #9 during the meeting, agreeing to pursue the prohibi-

tion or restriction of all the pesticides on the list in each of their respective countries.<sup>40</sup>

The RESSCAD agreement has been met with considerable resistance in various countries in the region. Of particular concern has been the list of the 12 pesticides causing the majority of acute pesticide illnesses: aldicarb, aluminum phosphide, carbofuran, chlorpyrifos, endosulfan, etoprophos, methamidophos, methomyl, methyl parathion, monocrotophos, paraquat, and terbufos.<sup>40</sup> A number of the pesticides on this list are among the most widely used products, and some are significant sources of profit for pesticide vendors. The pesticide industry and officials in the ministries of agriculture have responded with a variety of objections, including demands for more data or outright rejection of the RESSCAD agreement. It is unclear how this initiative will proceed. If the RESSCAD initiative is successful in achieving the ban of even a few of the most problematic pesticides, it will likely result in a considerable reduction of acute pesticide poisonings in Central America and it will possibly raise the level of public concern and the demands for more effective control of pesticides in the future. If the pesticide proponents are successful in blocking the initiative, probably through debatable claims of the agricultural necessity of the involved pesticides, such blockage would in fact be an unfortunate example of governments' failure to prioritize protection of human health against commercial corporate interests.

In several Central American countries the Central American Pesticide Action Network (RAPAC) has begun an initiative to work with the press to assure that pesticide hazards, and particularly the results of pesticide-related illness monitoring, are brought to the public's attention. A parallel proposal has been drafted by the Center for Environmental Journalism of the University of Colorado to conduct workshops for working journalists on environmental issues in the region (as of going to press, the University of Colorado proposal has not been funded). Because of the level of attention to pesticides, and the existence of a large body of reliable information, the university-based initiative has identified pesticides as one of the three or four initial themes for journalist training.

Another proposed project relies heavily on the illness-surveillance systems in the region. DANIDA is reviewing a region-wide project to promote integrated pest management (IPM) as an alternative to chemical intensive farming. While IPM has been pursued for several decades in the region, it has had only marginal success. The new initiative proposes to build upon the local health structures organized by PLAGSALUD, and seek to link community concerns over pesticide poisonings with efforts to convince farmers, and national authorities, to shift to more non-chemical-based strategies. One of the long-term goals of this initiative is to help policymakers understand the linkages between

shifting to more sustainable farming practices and improved public health.

## CONCLUSION

The increasing quality of pesticide-related illness surveillance data is an important resource for policymakers and the public in Central America. Much of what is transpiring in the region today is only suggestive of the potential that surveillance systems provide for problem solving and policy-reform initiatives. To realize this potential, several related measures still need to be pursued.

First, the health sector must become more active in solving pesticide-related problems. In spite of the examples presented above, there remains considerable reluctance on the part of health officials to engage in the policy debates that are emerging over pesticide imports, sale, and use. Although industry now lines up mainly with the ministries of agriculture, it can be expected that pressure on health officials will increase as surveillance data become more relevant. By way of example; after a use restriction of paraquat was announced in Costa Rica, industry quickly pursued an official agreement with the Ministry of Health, in support of the continuation of paraquat sales under debatable arguments of the potential for safe use.<sup>41</sup> The powerful alignment of pesticide proponents continues to dominate and control the policy dialogue. A more aggressive health sector, along with the environmental sector, is crucial to altering existing public policy.

Second, in spite of the improvements in data quality and analysis, there remains an urgent need to better analyze, interpret, present, and publicize the results of pesticide-related illness surveillance. In many cases, policymakers and others continue to recycle old arguments against greater control of pesticides, based on inaccurate and misleading presentations of surveillance results. Additionally, officials at ministries of health in charge of surveillance systems should be supported by the academic community in improving the quality of data, with proper sampling, analysis, and interpretation. Surveillance data should be employed to justify and monitor intervention studies in reducing pesticide overexposure and should be employed to support research on potentially related illness clusters and etiologic investigations.

Further, there is a need for government health officials and societal organizations to build stronger links. The success of the historical alliance between government officials in the agricultural sector and the pesticide industry demonstrates how effective public and private linkages can be. Unfortunately similar alliances have not developed between farm workers, unions, environmental organizations and universities, and the health and environmental ministries. Strengthening such alliances will not only provide some counterbalance to the powerful interests promoting the proliferation of pesticides,

it may also lead to strengthening the seriously underfunded health sector's capacity to provide better surveillance of and response to pesticide hazards in the future.

The creative use of pesticide-related illness surveillance systems can potentially serve as an important example of how the health sector can utilize and improve existing tools to become more effective in protecting health in the developing world. It remains to be seen whether the health sector can learn to take advantage of emerging opportunities to bring major public health problems, such as those posed by the continued heavy reliance on pesticides, under control.

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