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## Assessment of Health Care and Economic Costs Due to Episodes of Acute Pesticide Intoxication in Workers of Rural Areas of the Coquimbo Region, Chile

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### ABSTRACT

**Background:** The increase in agricultural activity that Chile experienced in the past 20 years resulted in a boost in the use of pesticides. Despite pesticides' productivity benefits, they caused health problems such as the increased frequency of episodes of acute poisoning, which constitutes a relevant problem in terms of occupational health. The Chilean authorities require several preventive measures at workplaces, which are not always implemented, increasing the risk of intoxications in farmers. So far in Chile, there are no studies concerning the public health care expenses associated with acute work-related pesticide intoxications. From the societal perspective, there are costs involved if the worker needs to take sick leave and families incur costs to take care of their sick members. **Objectives:** This study aimed to determine the costs associated with health care services used by people who suffered from work-related acute pesticide poisoning, as well as the economic costs for the families of the workers involved, and finally the costs of these episodes for the employer/industrial sector. **Methods:** This study considered a 3-year period (January 2009 to December 2011). Three sources of data were reviewed: reported cases at the Regional Health Authority, for the profile of the intoxications; registers of patients attended in public hospitals, for data on costs of health care services; and public

information of living conditions nationwide. **Results:** The overall costs of a single case depend on the severity of intoxication, days of sick leave, and type of health care needed. Most cases (77%) would be ambulatory and would be assisted at an emergency room, with an average cost of US \$330 per case. Those cases that might need hospitalization (23%) and, therefore, more days off work have an average cost of US \$1158 per case. Taking into account the number of patients reported each year in the country, the cost per annum would be about US \$185,000, but considering the underreporting of intoxications and underestimation of costs at the public insurance system fees, this amount could be six to eight times higher (US \$1.1 million to US \$1.4 million a year). **Conclusions:** This study is the first attempt to estimate costs related to this occupational and public health problem. There is an opportunity to further improve the cost-benefit balance of preventive measures that relate not only to acute poisonings but also to health problems originating from chronic and low-dose exposure to pesticides (e.g., neuropsychological impairment). **Keywords:** cost analysis, occupational health, pesticide poisoning.

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### Introduction

According to the ODEPA Employment Bulletin, the workforce in Chile for the period March to May 2012 amounted to 7,613,709 persons, 694,047 of whom were linked to agriculture [1]. Data from the International Labour Organization indicate that Chile exported agricultural products worth US \$5.411 million in 2007, primarily fruits (US \$3.351 million), wines (US \$1.241 million), and seeds (US \$230 million) [2–4]. Over the past 20 years, the import of pesticides increased by 469%. The imports of insecticides for agricultural use increased by approximately 20% between 2001 and 2005 [5]. The use of pesticides contribute to the enhancement of agricultural

productivity, but the harmful effects that such applications have on the health of human populations are also well known and have been demonstrated. The Coquimbo region is located in the central/north of Chile, with a total of 720,000 inhabitants. Agriculture is the primary economic activity in this region, with about 45,000 workers [6].

The Regulation on Basic Sanitary and Environmental Conditions in the Workplace in Chile [7] requires safety and preventive measures that should be adopted by the employers at workplaces. These measures focus on providing personal protection equipment, safe storage, restrictions when using hazardous products (pesticides among others), as well as specific reentry times after the use of pesticides. This regulation also establishes

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the permissible limits for biological tolerance values in the case of exposed workers and limits for the environmental exposure to physical and chemical agents.

Supreme Decree N° 594 establishes the limit of biological tolerance at 70% of the baseline levels of cholinesterase activity in an individual. This implies that measurements of enzymatic activity must be repeated, a baseline one before exposure and a second one after exposure, thus duplicating the cost of diagnosis. The cost of a single cholinesterase evaluation at the National Institute of Public Health is US \$72.98 [8]. The compliance assessment is the task of the Regional Ministerial Secretariats of Health (Sanitary Authorities—Ministry of Health).

There is also a national network on acute poisoning surveillance (red de vigilancia epidemiologica de intoxicaciones por Pesticidas [Pesticides Intoxications Network]), created by Supreme Decree N° 88, dated October 2004 [9]. In the period 2009 to 2011, the total number of poisoning cases notified to the red de vigilancia epidemiologica de intoxicaciones por Pesticidas was 1514. Of these, 932 were work-related (61.6%) and 39% of the intoxications were caused by organophosphate pesticides [10-13]. The real number of poisonings is estimated to be much higher because, in general, the affected workers do not report the incidents (they fear consequences in terms of their employment status) or there are no health care records due to lack of information about the effects of the pesticides and due to underdiagnosis. The total number of poisonings is estimated to be three to four times higher than the official registrations, thus corresponding to around 3000 annual poisoning cases.

Acute poisonings among agricultural workers generate a cost to the country (considering the demand for health care services), loss of workforce (and a need for its replacement), and sick leave due to the poisoning, with an average of 6 days for each sick leave [14,15]. Up to date, there is no previously published study regarding the overall costs associated with poisonings due to exposure to pesticides at work.

This study aimed to determine the costs associated with health care services used by people who suffered from work-

related acute pesticide poisoning, as well as the economic costs for the families of the workers involved, and finally the costs of these episodes for the employer/industrial sector.

### Methods

This cost analysis was conducted from the societal perspective, and it includes health care costs, costs of productivity losses from poisoning episodes, and the costs of seeking and/or undergoing care as they fall on patients. During the investigation, it became clear that not all cases admitted in hospitals were reported to the Epidemiology Unit (Regional Health Authority, Ministry of Health) and vice versa; not all reported cases were attended at the public hospitals; probably many had gone to a primary health care facility in rural areas and/or to the private system when near to a city.

Therefore, three sources of data were assessed for the study period January 2009 to December 2011: (1) Information regarding pesticide intoxications reported at the Epidemiology Unit (Ministry of Health), which corresponds to 57 work-related poisonings. From this source, the profile of the poisonings, average days off work, and days of sick leave were known. (2) Information about health care services from the three main public hospitals in the region was reviewed, taking into account people who suffered acute intoxication due to pesticides and who required hospitalization, corresponding to 26 patients. (3) Finally, information from public Web sites and publications related to national living costs and conditions was searched. For more detail, refer to Figure 1.

From the hospitals, data to assess the health care costs were taken from the 26 patients' files, discharges registers, and hospital administration registers. Access to medical files was approved by the directors of the health facilities. For the analysis of health care costs, the study considered only people of working age (women aged 18-60 years and men aged 18-65

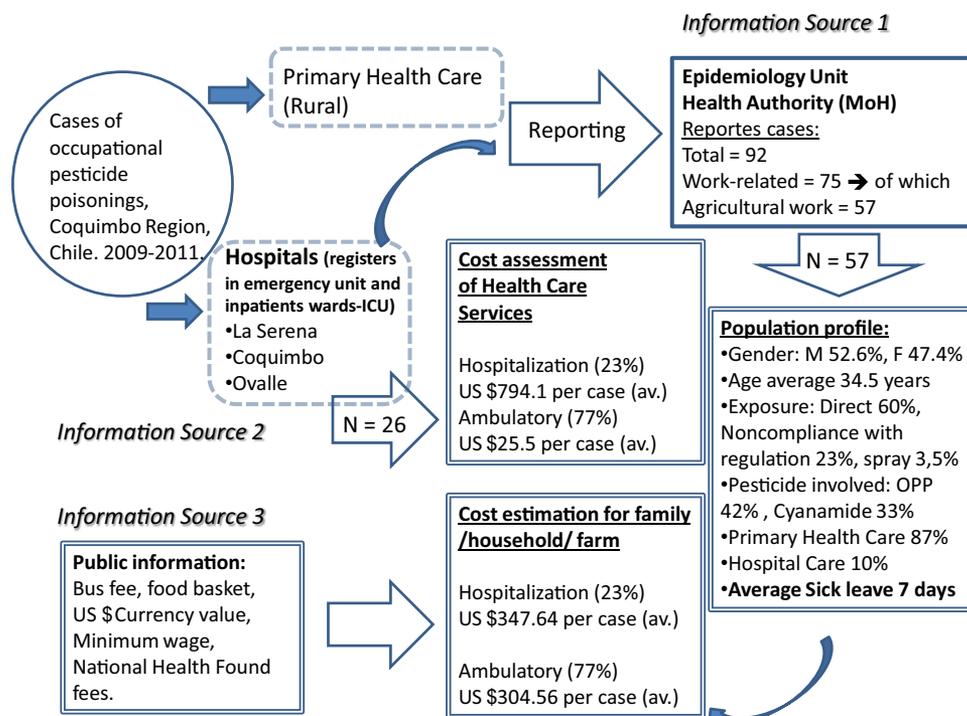


Fig. 1 – Chart of methods, sources of information, sampling strategies, and main results. av., average; F, female; ICU, intensive care unit; M, male; MoH, Ministry of Health; OPP, organophosphate pesticide.

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