Enhanced surveillance for pesticide poisoning in the Western Cape — an elusive target

R Bailie, L London

Aim. The poor state of reporting of pesticide poisoning is widely recognised as a hindrance to the development of preventive programmes that aim to address this important cause of mortality and morbidity in farm workers. This study aimed to assess the extent to which notification could be improved by enhancing passive surveillance procedures.

Methods. An awareness campaign targeting a range of health care providers was conducted in a rural farming area. This included improving the availability of cholinesterase testing and encouraging all providers to notify on suspicion. Existing reporting forms were supplemented with additional questions, and notification took place through existing channels. The rate of notification in the study area was compared with that in surrounding areas and previous years.

Results. Fourteen poisoning events involving 56 people were reported, with 2 events together accounting for 44 cases. All patients were hospitalised. Over 90% of cases occurred on farms, with the farm store being the most common source of pesticide. Only one case was notified by a general practitioner. The rate of notification in the study area was approximately tenfold that of previous years and of the surrounding area for the same year ($P < 0.0001$).

Conclusion. Although the enhanced surveillance programme resulted in an increase in notifications, the programme appears to have been ineffective in detecting mild cases of poisoning or in improving notification on suspicion by general practitioners.

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National Centre for Epidemiology and Population Health, Australian National University, Canberra, Australia

R Bailie, MB ChB, MPhil (MCH), MRCGP (NZ), FFCH (SA), FAFPHM, MD

Department of Community Health, University of Cape Town

L London, MB ChB, DOH, BSc Hons (Epidemiol), MD, MMed (Comm Health)

SAMJ

Pesticide poisoning is the reason for approximately 10% of poison centre consultations around South Africa[1,2] and is an important reason for admission to respiratory intensive care units.[3] The approximately 240 cases notified nationally during 1991 and 1992 experienced a case fatality rate of about 7%.[4] Although these figures give some indication of the magnitude of the problem, there is substantial evidence of widespread undernotification of incidents of pesticide poisoning.[5-9] The problem of under-reporting and the absence of data on poisonings in many rural settings prevent accurate description of the extent and nature of the problem[10-12] and obstruct the development of preventive programmes.

In South Africa surveillance for pesticide poisoning relies on notifications to the Department of Health in terms of the Health Act, usually by general practitioners or hospital doctors. Notifications are passed on to environmental health officers (EHOs) working for local authorities for investigation and appropriate action. With good coverage, the investigation of incidents of poisoning presents an opportunity to take appropriate action at a local level and could provide valuable information for the development of control programmes. This paper reports on an intervention to enhance existing passive surveillance mechanisms in order to gain a more complete picture of the extent and circumstances of pesticide poisoning and to assess the degree of undernotification.

METHODS

The study was conducted from August 1994 to July 1995 in the rural farming area surrounding Worcester in the Western Cape, where the highly labour-intensive grape farming industry is predominant. Pesticide usage in this region is high,[13] and a previous review of pesticide poisoning identified this region as an important source of cases in the Western Cape.[9]

The passive notification system, which relies on local authority health inspectors, was enhanced by an awareness programme to encourage the reporting of pesticide poisoning. All local health care providers, including general practitioners, medical and nursing staff of the local hospital, nurses working in the local primary care services, pharmacists and ambulance personnel were contacted, the project and the role they could play were explained, and all were provided with information pamphlets and brochures.

To encourage investigation of suspected cases biochemical confirmation of organophosphate intoxication using plasma and erythrocyte cholinesterase testing was made available to all medical practitioners at no cost to themselves or the patient. Workshops were conducted with the local authority health inspectorate to explain the project and to update their knowledge of pesticide poisoning, and its prevention, detection and reporting. The standard reporting forms of pesticide poisonings[14] were supplemented with several questions about the circumstances of the event.

Data on all notifications were forwarded by the local authority health services to the researchers for collation and analysis with Epi Info version 6.03. In addition, private laboratories forwarded results of cholinesterase tests performed outside the public sector for follow-up by environmental health officers. Cases included diagnosis based on clinical evidence and/or laboratory confirmation of lowered cholinesterase levels.

Regional databases at the Department of Health were checked for cases that had bypassed the research project, and to compare completeness of the two databases. Rates of notification (per 100 000 population) in the study area for the period of study were compared with a previous 5-year period and with surrounding areas where fruit farming is an important agricultural industry.

RESULTS

Fourteen poisoning events were reported, affecting a total of 56 people (21 (37.5%) men and 35 (62.5%) women). Twelve events affected 1 person only, 1 affected 20 people, and 1 affected 24 people.

Five events (48 cases) were notified by hospital staff, 3 by ambulance staff (3 cases), 2 by EHOs (2 cases) and 1 by each of the following: a GP, the patient's family and a pharmacist. Information for investigation of the case was provided by the farmer for 4 events (23 cases), the farmer and a doctor for 1 event (24 cases), the patient for 3 events (3 cases), the patient's family for 3 events (3 cases) and another worker for 1 event (1 case). Seven of the events were notified within 10 days, and 3 were notified after 20 days or more had elapsed since the poisoning.

The age of victims ranged from 13 to 59 years, with a median of 29 (age not reported in 18 cases). Missing values further limit analysis by age. Coloured people were most commonly affected (43 cases, 77%) and there were 5 blacks (9%) and 2 whites (4%); the race of 11 patients (10%) was not reported.

All cases were admitted to hospital: in 54 cases (95%) the local hospital, with 1 patient subsequently being transferred to a tertiary hospital and 1 being admitted directly to the tertiary hospital. Three cases (5%) were admitted to intensive care. One death was reported: a farm manager accidentally ingested a carbamate nematicide stored in an unlabelled container, mistaking it for medicine used for dyspepsia. In 2 other cases, poison was accidentally ingested from an incorrectly marked bottle. The large majority of incidents occurred on farms (Table I).

One event affected 20 people (19 women, 1 man) and occurred when spray from a tractor-driven unit drifted to an adjacent field where a team of workers was weeding. This event occurred 6 weeks after another worker (male) on the same farm had been notified because of an occupational poisoning. The other 5 events that occurred during the course

Table I. Circumstances of poisoning

Circumstances	Events (%)*	Cases (%)*
On farms	9 (64)	51 (91)
During course of work	6 (43)	25 (45)
Not during course of work	2 (14)	25 (45)
Deliberate ingestion	1 (7)	1 (2)
Not on farms	5 (36)	5 (9)
Deliberate ingestion	3 (21)	3 (5)
Accidental	2 (14)	2 (4)

* Percentages do not add up to 100% in all cases because of rounding.

of work involved 1 worker each (all men). In 4 events the victim was working with pesticides himself, and in 1 the poison was accidentally ingested from an unmarked bottle which a fellow worker had filled from a spray unit for his own use. Among those working with pesticides, protective equipment was not being worn in at least 1 case, with no reference on the investigation reports as to its use/non-use in the other 3 cases. In addition to the spray drift incident, at least one other incident occurred on a farm where there had previously been a poisoning incident. In 4 events, there was uncertainty about whether a previous event had occurred on the farm.

Of the 2 events that occurred on farms, but not during the course of work, 1 was a deliberate ingestion and 1 was a suspected homicide affecting 24 people. In the latter case, workers had ingested alcohol contaminated with the nematicide, aldicarb, as part of the operation of the 'dop' system, a practice whereby workers are paid in kind or receive wine as a supplement. They had received their wine at the end of the working day decanted from one of two 50-litre containers in which the wine had been stored. The containers were not known to have contained pesticides, and the presumption was that the aldicarb had been deliberately placed in the containers, although this was not proven during police investigations.

Table II shows events (and numbers of cases affected) that occurred during the course of work to be clustered between October and February. Cases of deliberate ingestion (both on farms and elsewhere) are spread throughout the year.

The farm store was the most common source of the poison. The source of the poison in the 'homicide' incident is uncertain. Excluding this incident, the farm store was the source of the poison in 6 events (46%) or 25 cases (78%). In 5 events (38%) or 5 cases (16%) the poison was from a home supply, and in 2 events (15%) or 2 cases (6%) the poison was bought. In all cases of deliberate ingestion the poison was bought or was from a home supply.

Review of the database of the regional Department of Health found one case that bypassed the study. There were also no records at the department of 9 events (including the suspected homicide) detected by the surveillance project.

The annual mean rate of notification of cases per 100 000 population in the study area for the 5-year period 1987 - 1991 was 4.2 while the rate for the study year was almost tenfold greater at 40.5 per 100 000 (Table III) (χ^2: $P < 0.0001$). By comparison, the rate in all surrounding areas together increased from 3.1 per 100 000 per year in the period 1987 - 1991 to 3.9 per 100 000 in the study year. More than half of the cases occurring in the study year in the Western Cape occurred in the study area, despite the study area's being only one of 30 districts in the Western Cape. Even if all notifications that occurred outside the study area and in the 5-year period preceding the study are treated as discrete events and are compared with the number of events in the study area during the study year, there was a significant increase in the number of events (χ^2: $P < 0.05$).

Table II. Timing and circumstances of poisoning — number of events (cases)

	Farm			Not farm	
	Work	Not work	Deliberate ingestion	Not work	Deliberate ingestion
August 1994				1 (1)	1 (1)
September 1994				1 (1)	
October 1994	1 (1)	1 (24)			
November 1994	2 (21)	1 (1)			
December 1994					
January 1995	1 (1)				1 (1)
February 1995	2 (2)				
March 1995					
April 1995					1 (1)
May 1995					
June 1995			1 (1)		
July 1995					
Total	6 (25)	2 (25)	1 (1)	2 (2)	3 (3)

Table III. Numbers of notifications and notification rates in study area and surrounding area prior to and during study period

	1987 - 1991		Study year	
	Cases	Rate/ 100 000	Cases	Rate/ 100 000
District				
Worcester	24	4.2	56	40.5
Tulbagh and Ceres	4	1.1	0	–
Robertson	12	7.4	3	8.1
Montagu	1	0.9	1	4.6
Paarl	23	3.4	0	–
Stellenbosch	21	5.7	5	6.8
Bredasdorp	4	3.5	4*	17.3
Caledon	4	1.0	4*	5.1

* These figures are summed for the calendar years 1994 and 1995, as figures relating to the precise study period of August 1994 to July 1995 were not available.

DISCUSSION

Notifications during the study period were dominated by two incidents of mass poisoning which together involved 44 people, or 79% of all notifications. In terms of the number of people involved, these events clearly affected the profile of circumstances of poisoning and the sex of people involved. Given that existing knowledge of the epidemiology of pesticide poisoning in South Africa is limited by the high degree of undernotification, it is not known to what extent the mass poisonings reported here are uncharacteristic. The small number of events and cases reported here may limit the extent to which these findings are generalisable to other settings and other years.

The seasonal pattern of events is consistent with national figures for the whole of South Africa.[14] However, the sex distribution contrasts with national figures (33% women v. 66% men), with women being relatively more commonly affected than men in this study (62.5% v. 37.5%). This pattern was markedly influenced by the spray drift incident where 19 of the 20 victims were female. However, excluding this incident, the proportion of women involved (44%) is still higher than reflected in national figures. Women are often involved in piece work (payment by unit of output, which encourages speed at the expense of safety), and are usually employed as seasonal labourers, and they may be more at risk because of particularly unfavourable conditions of employment associated with seasonal work. For example, they may be less likely to receive adequate training or protective clothing, they may be unfamiliar with poisons and they may be more likely to be involved in mass poisonings, as happened in this study. Women may also be less likely to be notified, and it is conceivable that the pattern reflected in this study is closer to the true picture. If seasonal workers are more at risk, there is a need to tailor preventive programmes to reduce this risk. The high proportion of women involved is disturbing because of increasing concern about an association between pesticide exposure and birth defects.[15,16]

National figures suggest that 72% of cases where a cause is identified are due to 'negligence', 'accident' or 'ignorance',[14] and the corresponding figure in our study was 43%. However, the distinction between these categories is unclear, and the failure to identify a cause in over 50% of cases notified nationally[14] suggests that the categorisation is inadequate. It is likely that negligence and ignorance contribute to some extent to all 'accidents', and the terms themselves appear to reflect more the health system's attitude to patients (often victim-blaming) rather than provide any helpful pointers to preventive strategies needed.

Understanding the circumstances surrounding events of poisoning may be more pertinent to developing preventing programmes. For example, the findings that: (*i*) 3 events were due to pesticide being stored in an unmarked or incorrectly marked bottle; (*ii*) 2 out of 9 farm-related incidents occurred on farms where incidents had occurred before; (*iii*) there was poor reporting (and probably use) of personal protective equipment; (*iv*) most events are associated with poison that comes from the farm store; (*v*) farm-related events tend to occur during the peak spraying season while deliberate ingestions occur throughout the year; (*vi*) deliberate ingestion is most commonly associated with poison from a home store or which is bought; (*vii*) farm-related events are largely accidental and may involve individuals or groups, while non-farm-related events are more likely to be individual and deliberately self-inflicted; and (*viii*) there was at least a 10-day delay in notification for 11% of cases (which might hamper investigation of the incident), contribute to the quality of data gathered through surveillance and may be useful in tailoring and targeting preventive programmes.

The event in which 20 people were poisoned by spray drift illustrates a relatively unrecognised pesticide-associated hazard in South Africa. Whereas recent occupational health and safety regulations have extended to farming workplaces the requirements to monitor workers and control direct exposures,[17] no attention has been paid to issues of indirect exposure experienced by incidental workers, such as those poisoned by the passing tractor. In addition, time of re-entry of workers into fields that have been sprayed is not regulated in South Africa, unlike in other countries, where such measures play an important role in preventing human poisoning.[18] This study provides additional evidence that Department of Labour legislation should take a comprehensive approach to workplace health and safety in agriculture and learn from approaches practised in other countries.[19,20] Moreover, the fact that this poisoning took place on a farm where a pesticide poisoning had been notified 6 weeks previously and where preventive measures had been recommended by the environmental health officer indicates some breakdown in the public health measures required for pesticide safety. It also illustrates the difficulties of dealing with occupational health problems through the current public health infrastructure, when the Department of Labour has primary responsibility for workplace health and safety.

The poisoning of 24 workers as a result of consumption of contaminated alcohol illustrates some of the complexities of public health surveillance activities in developing countries. Despite the recent extension of collective bargaining and other labour rights[21] to farm workers, many South African farm workers are still subject to coercive labour relations, resulting in poor living and working conditions. The 'dop' system, as one example of these conditions, may place workers at increased vulnerability to homicidal or accidental poisoning on a substantial scale. Additionally, the alcohol abuse associated with a 'dop' culture on farms in the region may contribute both directly and indirectly to pesticide-related morbidity and mortality. For example, alcohol-related liver toxicity may affect hepatic capacity to biotransform hazardous pesticides while, on the other hand, the social disruption associated with alcohol

abuse may lead to increased overall vulnerability to workplace hazards.[22] Such complex multifactorial social problems clearly need comprehensive and innovative public health responses.

Given that GPs were among the prime targets for the intervention, and that the availability of cholinesterase testing was specifically designed to encourage GPs to investigate and notify on suspicion, it is disturbing that only one notification was made by a GP. It may be that these 'serious' cases (all were admitted) bypass the GP, and that the GP therefore cannot be expected to notify them. Similarly, GPs may not be notifying people with mild poisoning and minor symptoms because such cases may not present to GPs. However, the absence of testing of non-admitted suspects by GPs suggests that GPs have a high threshold of suspicion, are therefore not testing people with 'minor' symptoms (many of which are common in general practice) and are not notifying on suspicion.

Passive surveillance through the current system, even when intensified as in this study, appears to be ineffective in detecting mild cases of poisoning, and it may only be possible to determine the incidence of mild poisoning with an intensive active surveillance programme. The encouragement of other health workers (e.g. pharmacists and community nurses) to notify on suspicion may lead to improvements in overall notification rates as well as induce greater compliance on the part of GPs, who may seek to avoid the embarrassment of missing cases.

When compared with surrounding rural farming areas, rates of pesticide poisoning notified in the study area were comparable at baseline but were markedly increased (almost tenfold) during the study period. Even if the 2 cases of multiple poisoning were treated as single cases, the rates of poisoning reported in the study area more than doubled during the intervention, confirming evidence that routine surveillance substantially underestimates the extent of acute poisoning. The study also improved understanding of the settings in which poisoning with pesticides may occur, alerting public health authorities to the full extent of the need for pesticide safety and health promotion.

With comparatively little effort and expenditure, it appears that public health providers can improve notification of pesticide poisoning, primarily by tapping into non-doctor referral sources. However, successful surveillance for milder cases and those that fail to reach public sector health services appears to remain elusive, and further strategies, perhaps in collaboration with other government departments, such as that of Labour and Agriculture, may be needed to capture best the full extent of adverse effects of pesticides on the health of farm residents.

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