SUMMARY OF RESULTS FROM THE CALIFORNIA PESTICIDE ILLNESS SURVEILLANCE PROGRAM
- 2019 -

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Department of Pesticide Regulation Regional Enforcement Offices
California Poison Control System
California Department of Public Health, Occupational Health Branch
Office of Environmental Health Hazard Assessment

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EXECUTIVE SUMMARY

This report provides a summary of pesticide-related illnesses and injuries reported to the California Department of Pesticide Regulation's Pesticide Illness Surveillance Program (PISP) in 2019. PISP received 2,157 cases, stemming from 1,229 episodes, potentially involving health effects from pesticide exposure. A case is a representation of an individual's exposure to a pesticide(s) that may or may not result in an illness and/or injury. An episode is an event in which a particular source appears to have exposed one or more people (cases) to pesticides. PISP epidemiologists determined that 1,198 (56%) of those reported cases, stemming from 814 (66%) episodes, were at least possibly associated with pesticide exposure. Evidence indicated that pesticide exposure did not cause or contribute to illnesses and injuries in 490 (23%) of the 2,157 cases evaluated. Insufficient information prevented evaluation of 469 (22%) cases.

PISP identified 87 episodes resulting in 409 cases as associated with agricultural use pesticides (34% of the 1,198 cases). Agricultural field workers were impacted by pesticide exposure in 27 separate episodes in 2019, of which 15 were multi-person episodes. The largest number of field workers affected in a single episode was 47. These workers were exposed to an insecticide applied by an air blast sprayer to a neighboring field.

There were 719 episodes resulting in 781 cases identified as associated with non-agricultural use of pesticides (65% of the 1,198 cases). Eight (<1%) of the 1,198 pesticide-associated cases could not be characterized as agricultural or non-agricultural due to insufficient information.

Of the 781 cases associated with non-agricultural use pesticides, 210 (27%) were occupational, meaning the incident occurred while the affected individuals were at work. Antimicrobial products were implicated in 131 of these cases (62% of the 210 cases).

Children (less than 18 years old) accounted for 159 (14%) of the 1,198 associated cases; 146 cases involved non-agricultural use and 13 cases involved agricultural use pesticides. One student was exposed to antimicrobials applied at a school site. There were no reported cases of children exposed to agricultural use pesticides while at school.

BACKGROUND, SOURCES, AND PURPOSE OF ILLNESS SURVEILLANCE

The California Department of Pesticide Regulation (DPR) administers the California Pesticide[1] Safety Regulatory Program. This program includes a thorough review of all pesticide data submitted for

[1] Pursuant to Title 3, California Code of Regulations (3 CCR) section 6000, "pesticide" is used to describe any substance which is intended to prevent, destroy, repel, or mitigate any pest. Pests may be insects, fungi, weeds, rodents, nematodes, algae, viruses, or bacteria that may infest or be detrimental to vegetation, man, animals, or households, or any agricultural or non-agricultural environment. Therefore, pesticides include herbicides, fungicides, insecticides, rodenticides, and disinfectants, as well as insect growth regulators. In California, adjuvants are also subject to the regulations that pertain to pesticides. Adjuvants are substances used to enhance the efficacy of a pesticide, and include emulsifiers, spreaders, water modifiers, and wetting and dispersing agents.

registration in California, often with specific data requirements not required by other states, as well as mandatory pesticide illness and pesticide use reporting requirements. In addition, DPR oversees a unique enforcement system involving the assistance of the County Agricultural Commissioners (CACs) operating in every county in the state. The CACs enforce all federal and state pesticide laws and regulations at the local level and can impose additional permit conditions on the use of restricted material pesticides[2].

Data Definitions

Definitions for all terms used in this report may be found in Appendix B: Glossary (page 24).

Data Sources

In California, reporting of pesticide illnesses is mandatory. Under California Health and Safety Code (HSC) section 105200, physicians are required to report any suspected case of pesticide-related illness or injury to the local health officer (LHO) within 24 hours of examining the patient. LHOs must then inform the local CAC, complete a pesticide illness report (PIR), and send the PIR to the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Industrial Relations (DIR), and the DPR-Pesticide Illness Surveillance Program (PISP). LHOs, physicians and other health care providers are also able to fulfill their reporting requirements via the California Reportable Disease Information Exchange (CalREDIE), a statewide web-based morbidity reporting system. PISP began receiving PIRs from CalREDIE in 2013 but receives only a small portion of reports via this pathway.

In order to ensure that the PISP database captures a wide range of pesticide-related illnesses and injuries, DPR maintains a contract with the California Poison Control System (CPCS) to further assist health care providers in fulfilling their reporting requirements. When a health care provider consults with CPCS about an illness or injury that may involve a pesticide, CPCS offers to submit a PIR on behalf of the provider. Through this contract, PISP has been able to identify hundreds of pesticide-related exposures annually, mostly non-occupational, that may otherwise have been unreported.

A Doctor's First Report of Occupational Illness and Injury (DFROII) is a document associated with a workers' compensation claim that a physician is required to forward to the DIR[3] and is subsequently shared with the California Department of Public Health-Occupational Health Branch (CDPH-OHB). PISP epidemiologists also review copies of these reports submitted to the CDPH-OHB to identify occupational pesticide-related illness cases that may not have been reported to the LHO. The DFROIIs are the primary source of PISP's occupational illness reports and predominantly involve non-agricultural use pesticides. When a DFROII has been identified by PISP epidemiologists as involving a pesticide as a possible cause of injury or involving a situation in which pesticide use is likely, the DFROII is forwarded to the local CAC for investigation as described below. PISP receives pesticide-related incident reports primarily from CPCS, workers' compensation reports, LHOs, and, to a lesser extent, from citizen complaints, Federal

[2] California Food and Agricultural Code (FAC) § 11501.5, 12977, 12982, 14004, and 15201 specifies that the CACs enforce the pesticide use enforcement program under the direction and supervision of the DPR. FAC § 2281 outlines the responsibilities of each party in joint programs. 3 CCR § 6140 and 6141 specify that DPR or the CAC may at any reasonable time, enter and inspect, interview employees and/or sample items in order to determine compliance.
[3] 8 CCR § 9785.

Insecticide, Fungicide, and Rodenticide Act 6(a)(2) adverse effect reports, and referrals from other agencies and news media.

Investigations and Analysis

Through the U.S. Environmental Protection Agency (U.S. EPA), DPR is vested with primary authority to enforce federal and state laws pertaining to the proper and safe use of pesticides[4]. DPR's authority to enforce pesticide laws and regulations throughout the state is largely carried out in California's 58 counties by the CACs[5]. The CAC staff investigate suspected pesticide illnesses that occur in their jurisdictions, whether or not they pertain to agriculture.

When investigations are complete, the CACs send their reports describing their findings to DPR. These reports describe the circumstances that may have led to the pesticide exposure and the consequences to all those known to have been exposed. In their role as enforcement agents, the CACs also determine whether pesticide users complied with safety requirements. In an effort to maintain the quality of the investigation reports received, DPR provides training sessions on investigation procedures to train new CAC staff, and to also serve as a refresher for experienced investigators. DPR also provides technical support for CAC investigators on how, when, and what type of samples to collect and to document unintended exposure or contamination of persons and/or the environment, when possible.

PISP epidemiologists evaluate medical reports and all information gathered by the CACs in the investigative process. Following analysis of all the available information and evidence, PISP epidemiologists assess the likelihood that the pesticide exposure caused or contributed to the illness or injury. Standards for the determination of pesticide exposure are described in the PISP program brochure, "Preventing Pesticide Illness."[6]

Data Limitations

PISP is a passive surveillance system that depends primarily on the reports submitted by health care providers to identify cases of pesticide-related illnesses and injuries. Thus, the quality, quantity, and timeliness of the information received can vary widely. PISP may become aware of a pesticide-related illness episode, and receive illness reports or additional case information for the published year after the release of the Annual Report. Therefore, the numbers contained in this report may differ from DPR's online database query system, California Pesticide Illness Query (CalPIQ), which is updated with the new information.

This report provides a descriptive summary of the number and types of exposures occurring in the given year but does not draw conclusions or make recommendations.

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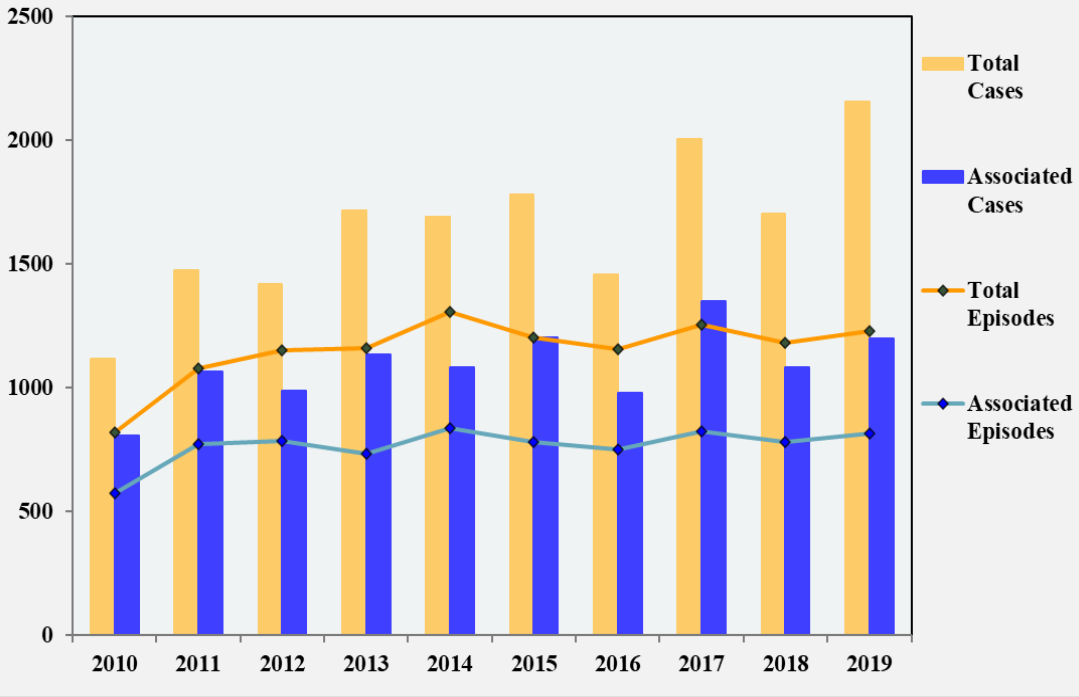
[4] Under Federal Insecticide, Fungicide, and Rodenticide Act section 26, a State shall have primary enforcement responsibilities for pesticide use violations if EPA determines that such State has adopted and is implementing adequate pesticide use laws and regulations, enforcement procedures, and recordkeeping and reporting requirements.
[5] California Food and Agricultural Code section 12977: The director and the commissioners of each county under the direction and supervision of the director, shall enforce the provisions of this article and the regulations adopted pursuant to it.
[6] The PISP program brochure, "Preventing Pesticide Illness" can be viewed or downloaded from DPR's web site at http://www.cdpr.ca.gov/docs/whs/pisp/brochure.pdf.

OVERVIEW OF 2019 CASES

PISP epidemiologists received reports on 1,229 episodes resulting in 2,157 cases that potentially involved health effects from pesticide exposure (Figure 1). Despite the slight annual variations in the total number of episodes and cases, overall, the number of associated episodes has been relatively consistent since 2014.

Figure 1: Number of Cases vs. Number of Episodes Investigated, 2010-2019



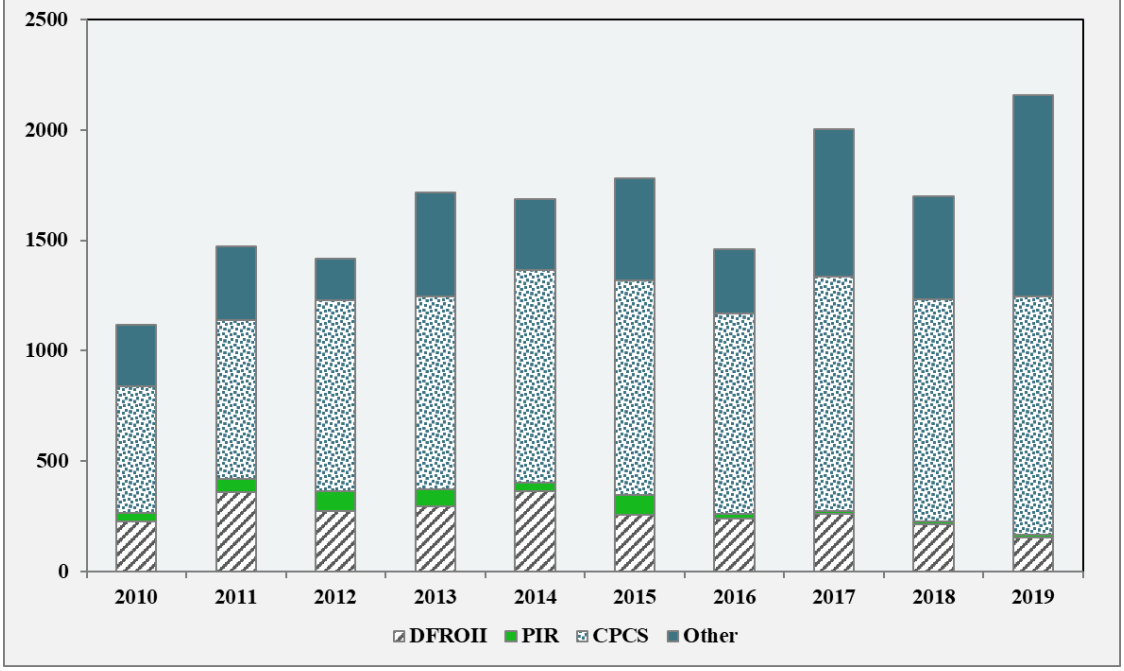
PISP receives reports of pesticide exposure and assigns case numbers to those meeting program criteria[7] for inclusion into the PISP database. These reports are then sent out to the CACs for investigation. The CPCS remained a major source for case identification and initiating investigations (1,076, 50%) (Figure 2). DFROII reports contributed 154 (7%) illness cases. Other reporting sources, such as county complaints, news media, as well as additional cases identified by the CAC during the course of an investigation, accounted for 911 (42%) cases. Direct physician reporting to LHOs, as required by HSC § 105200, accounted for 16 (<1%) of all identified cases, of which nine were transmitted by LHO to PISP via CalREDIE and seven

The California Poison Control System continues to be a major source of case identification and initiating investigations.

[7] Incident reports must meet all of the following criteria for inclusion into the PISP database: a pesticide is suspected to be involved in the exposure, symptoms were reported, evaluation by a health care provider, and exposure occurred in California.

were submitted by LHO to PISP via facsimile. Of the nine CalREDIE PIRs, seven were the source for initiating the investigation and two provided additional information on cases in the PISP database that were initially reported through other sources.

Figure 2: Mechanism that Identified Cases for Investigation, 2010-2019



PISP defines the term "associated" as cases where the reported illnesses or injuries were evaluated as definitely, probably, or possibly related to pesticide exposure (see Appendix B on page 24 for full glossary of terms). PISP epidemiologists determined that of the 2,157 cases identified in 2019, 1,198 (56%), stemming from 814 episodes, were associated cases. Figure 3 shows the outcome of the cases evaluated and the level of certainty (relationship). Sufficient evidence was available to determine that of the 1,198 pesticide-associated cases, 138 (12%) were definitely related, 896 (75%) were probably related, and 164 (14%) were possibly related to a pesticide exposure. There was evidence indicating that pesticide exposure did not cause or contribute to the reported illness or injuries[8] in 490 (23%) of the 2,157 cases evaluated. This grouping includes 333 asymptomatic cases, which constitute 15% of the total cases identified in 2019. There were 469 (22%) cases in which not enough information was provided in the report to determine an association between the pesticide exposure and the resulting illness or injury.

[8] Consist of cases evaluated as Unlikely, Indirect, Unrelated or Asymptomatic.

Figure 3: Outcome of 2019 Illness Investigations, by Cases

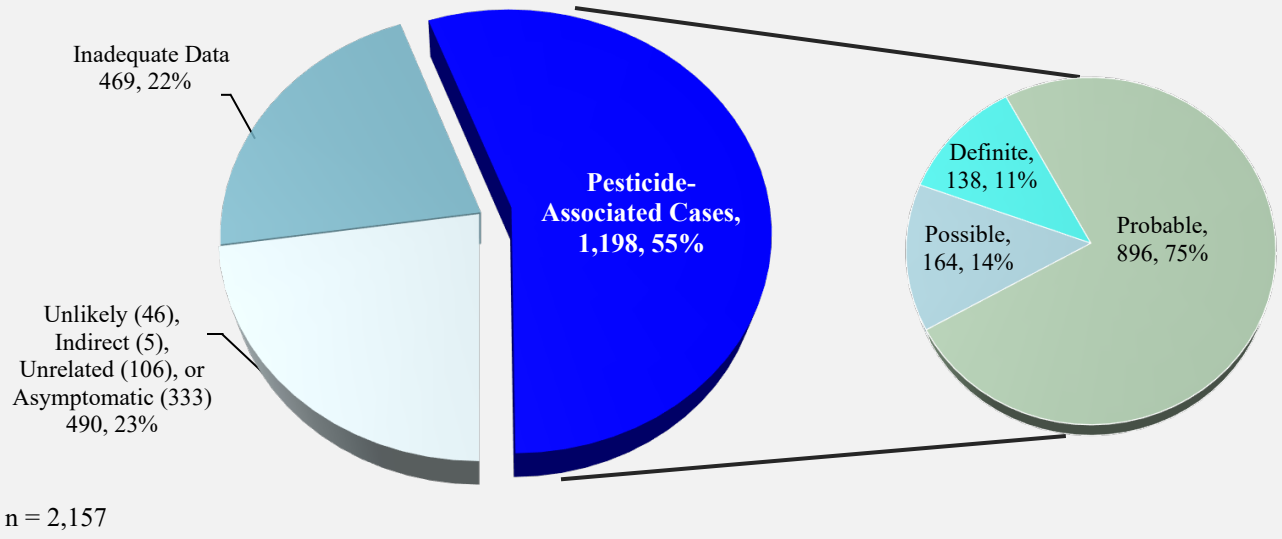
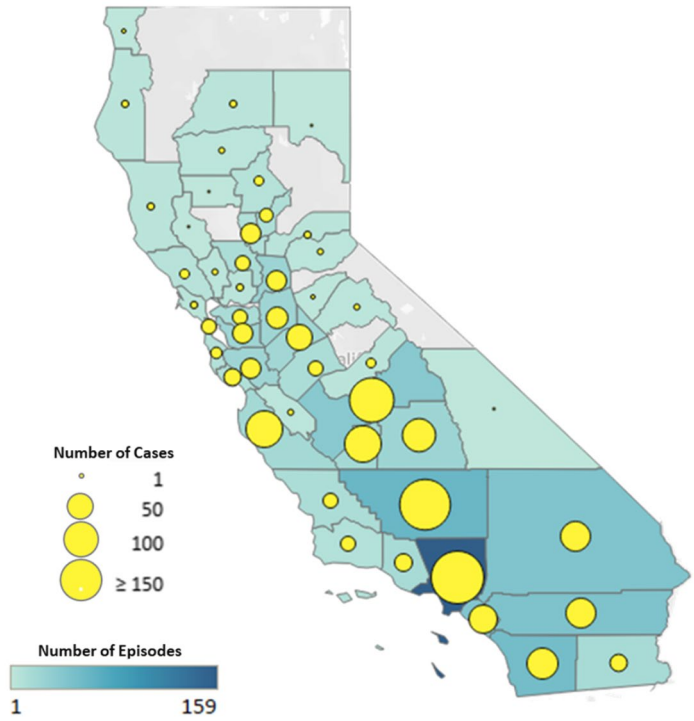


Figure 4 displays the distribution of associated episodes (814) and cases (1,198) across the counties statewide. Los Angeles County accounted for the largest number of associated episodes (159, 20%) and cases (172, 14%), indicating that the majority of the exposures there were single-person incidents. Kern county had the second most associated episodes (60, 7%) and cases (139, 12%). Although 5% (38) of the episodes occurred in Fresno County, it contributed to 9% (107) of the associated cases, reflecting occurrences of multi-person incidents in Kern and Fresno counties. (See Table - Summary of Illness/Injury Incidents Reported in California Related to Pesticide Exposure, Summarized Statewide and by County of Occurrence, for a complete listing of associated episodes and cases by county.)

Figure 4: Distribution of Associated Episodes and Cases, 2019



Overall, the number of associated agricultural episodes has been relatively consistent since 2013 (Figure 5). "Agricultural" is defined as involving pesticides intended to contribute to production of an agricultural commodity, including

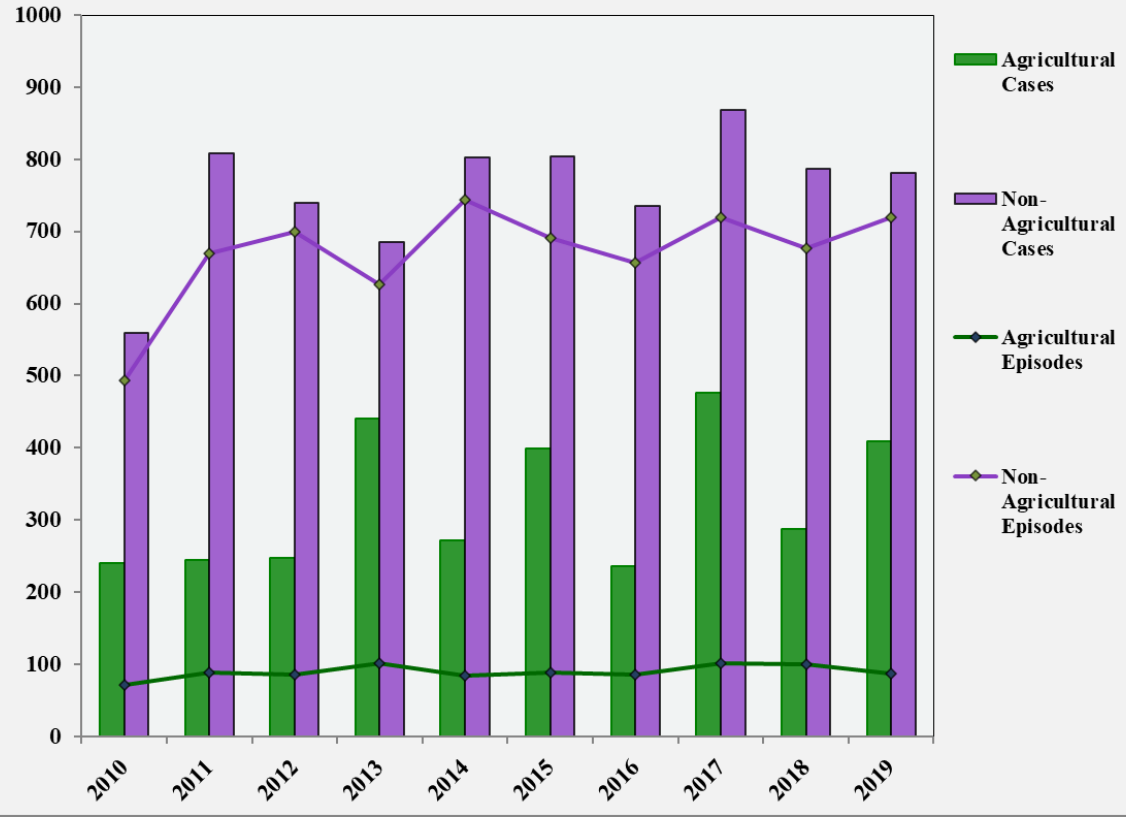
livestock, which corresponds to the regulatory definition[9] of "production agriculture." Of the 814 associated episodes, 87 (11%) episodes resulting in 409 cases, were attributed to pesticides used for agricultural purposes. The number of cases has varied year-to-year based on the number of individuals involved in multi-person episodes. In 2019, there were 24 multi-person agricultural-related episodes involving 346 associated cases.

Most of the associated episodes occurred under non-agricultural circumstances, (719, 88%). These episodes represent 781 cases, most of them involving a single person (accounting for 96% of the non-agricultural episodes). Use or intended use in non-production agriculture is designated as "non-agricultural," and includes structural, sanitation, home garden, most industrial and institutional uses, as well as pesticide manufacturing, transport, storage, and disposal.

Majority of the cases involved non-agricultural use pesticides.

There were eight pesticide-associated episodes, all of which were single-person events, which could not be characterized as agricultural or non-agricultural due to insufficient information. These uncharacterized events constitute less than 1% of the associated episodes and cases and are not included in Figure 5.

Figure 5: Agricultural vs. Non-Agricultural Pesticide-Associated Cases and Episodes, 2010-2019



[9] FAC § 11408: "Agricultural use" means the use of any pesticide or method or device for the control of plant or animal pests, or any other pests, or the use of any pesticide for the regulation of plant growth or defoliation plants.

Occupational exposures, defined as those that occurred while the affected individuals were at work, accounted for 603 (50%) of the 1,198 associated cases, with agricultural workers accounting for two-thirds of these cases (386, 64%). Non-occupational exposures accounted for 589 (49%) of the associated cases, involving mostly non-agricultural use pesticides (567, 96%). Six associated cases could not be characterized as occupational or non-occupational due to insufficient information (Table 1).

Table 1: Agricultural and Occupational Status Evaluation of 2019 Illness Cases

Occupational Status	Agricultural	Non-Agricultural	Unknown	Total
Non-Occupational	22	567	0	589
Occupational	386	210	7	603
Unknown	1	4	1	6
Total	**409**	**781**	**8**	**1,198**

When PISP receives and evaluates illness investigative reports for a given year, which includes determining if any violations of pesticide laws and regulations have occurred, enforcement actions by CACs and DPR are often still ongoing. Thus, violations noted by PISP for the given year may not always reflect enforcement actions ultimately taken by CACs and/or DPR. Based on the information available at the time of evaluation, PISP epidemiologists concluded that 430 (53%) of 814 associated episodes, resulting in 717 cases, contained evidence to indicate that a violation of safety requirements contributed (contributory violation) to the exposure, e.g., not wearing label-required personal protective equipment. Illness and/or injury *may* have been prevented if the people involved had followed the safety procedures required by regulations and/or pesticide labels. Of the 430 episodes with these contributory violations, 48 (11%) were attributed to pesticides intended for agricultural purposes.

In 31 (4%) of the 814 episodes, PISP epidemiologists determined that non-compliance with regulations did not contribute to the pesticide exposure (e.g., record keeping violations). Due to insufficient information, PISP could not determine if a violation occurred in 221 (27%) episodes. There were 132 (16%) episodes involving 163 individuals that had health effects attributed to pesticide exposure despite apparent compliance with all applicable label instructions and safety regulations. Of the 132 episodes, 109 (83%) and 22 (17%) were attributed to pesticides used for non-agricultural and agricultural purposes, respectively, and the agricultural status could not be determined in one episode.

NON-AGRICULTURAL PESTICIDE ILLNESSES

Of the 781 cases involving pesticides not used for agricultural commodities, exposures from direct forms of contact contributed to 364 (47%) cases. The affected individuals came in contact with a pesticide when the pesticide was spilled or directly propelled by the application equipment. Exposures from off-site movement accounted for 177 (23%) of the 781 cases. PISP defines off-site movement as spray, mist, vapors, or odor carried from the target site by air during a pesticide application or the mixing/loading of pesticides. Off-site movement as an exposure mechanism does not necessarily correspond to drift as a violation. Illness and injuries due to inhalation accounted for 290 (37%) cases, followed by ingestion with 134 (17%) of the non-agricultural use cases. Table 2 shows the number of non-agricultural cases according to exposure mechanisms.

Table 2: Mechanisms of Exposure in Non-Agricultural Associated Cases, 2019

Type of Exposure	Cases		Route of Exposure	Cases
Direct Contact	364		Dermal	60
Off-site Movement*	177		Ingestion	134
Multiple Types of Exposures	19		Inhalation	290
Other	53		Multiple Routes of Exposure	149
Residue	108		Ocular	107
Unknown	6		Unknown	41
Total	**781**		**Total**	**781**

* Category was renamed to *Off-site Movement* from *Drift* in 2019.

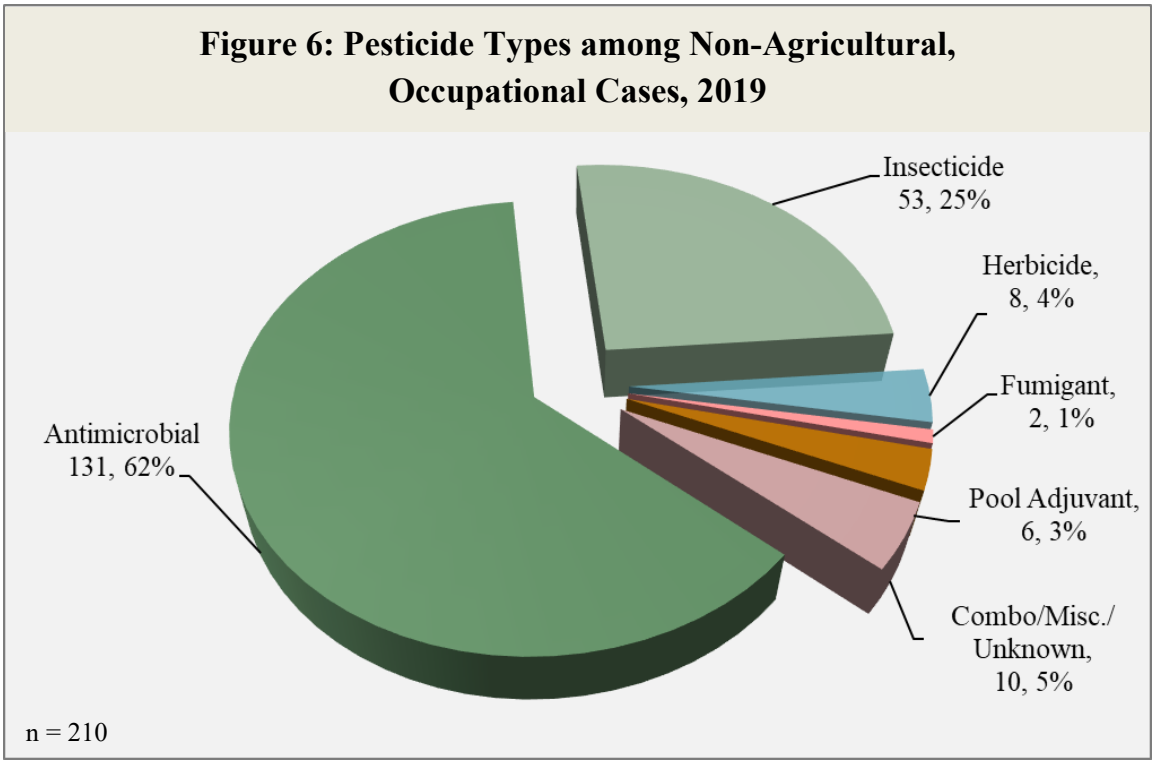
Occupational, Non-Agricultural Exposures

For cases involving non-agricultural, occupational exposures, 210 were evaluated as associated with pesticide use. Workers exposed while handling pesticides accounted for half of these cases [Applicators (82, 39%), Mixer/Loaders (25, 12%)]. Twenty-eight (13%) of the 210 workers were exposed to pesticides as occupational bystanders, meaning they were not handling pesticide products and their normal work activity had minimal expectation for exposure to pesticides (e.g., office workers sitting at a desk). Antimicrobials and disinfectants were implicated in 131 (62%) of the occupational cases. Insecticides were the second most common pesticide class, accounting for 53 (25%) of occupational cases (Figure 6).

Of the antimicrobial cases (131), service establishments, such as restaurants, hotels, or fitness centers were the most represented incident setting (35, 27%). Followed by exposures at hospitals or other medical facilities (19, 15%), and retail establishments (10, 9%). Workers applying or mixing/loading antimicrobials accounted for 70% (92) of the cases. Two-thirds of the workers handling antimicrobials reported eye or skin symptoms, either alone or in combination with other illness types (55, 60%). Twenty workers (22%) reported having at least one disability days due to their injury. A third of the workers (31,

34%) were not wearing the label-required personal protective equipment at time of exposure, and 17 (18%) workers mixed incompatible chemicals or used the product above the label rate. An additional seven (8%) workers did not wear the label-required personal protective equipment as well as used the product that was inconsistent with the label. Most of the antimicrobials involved contained sodium hypochlorite or quaternary ammonium compounds, which can produce a toxic vapor when mixed together. Under Title 3 CCR § 6720(c), employers using antimicrobials as sanitizers or disinfectants are exempt from certain Title 3 CCR regulations, provided they instead comply with corresponding Title 8 CCR regulations. The CAC does not have statutory authority to take enforcement action against Title 8 CCR violations.

Figure 6: Pesticide Types among Non-Agricultural, Occupational Cases, 2019

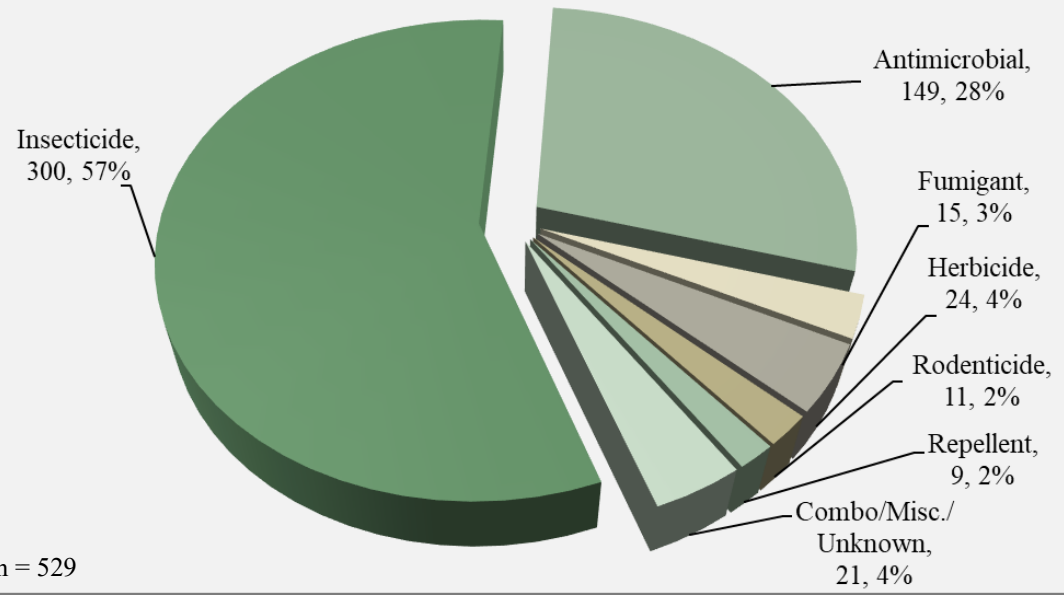


Non-Occupational, Non-Agricultural Exposures

For cases involving non-occupational, non-agricultural exposures, 567 were evaluated as associated with pesticides. Forty-two percent (237) of these individuals were exposed while performing activities with minimal expectation for exposure (e.g., playing in the backyard) to pesticides; followed by individuals who were exposed while handling pesticides (188, 33%). Most of these incidents occurred in residential settings (529, 93%). The remaining associated cases occurred in non-residential locations such as service or retail establishments (e.g., public pools, fitness centers, restaurants, grocery stores) (18, 3%). Contrary to occupational exposures which mostly involved antimicrobials, over half of the products involved in non-occupational residential exposures (529) were insecticides (300, 57%). Exposures to insecticidal total release foggers and aerosol cans accounted for 117 (22%) of these residential cases. The most common causes of exposure were that individuals did not vacate the premises in a timely manner or at all, use of multiple foggers in a small area, or over spraying. Antimicrobial disinfectants and sanitizers (149, 28%) were the second most implicated products. The Combo/Misc./Unknown category consists of pool adjuvants (e.g., muriatic acid), fungicides, multiple types of pesticides used in combination, and unknown types of pesticides (Figure 7).

93% of non-occupational cases occurred at home and the majority of these involved the use of insecticides.

Figure 7: Pesticide Types among Non-Agricultural, Non-Occupational Cases in Residential Settings, 2019



Exposures via direct contact accounted for 242 (46%) of the non-agricultural, non-occupational cases in residential settings. Direct contact includes exposures to pesticides spilled or propelled by the application equipment, and by ingestion route of exposure. Exposures from off-site movement closely followed in frequency, with 131 (25%). Pesticide handlers (Applicators and Mixer/Loaders) were most commonly affected by off-site movement (e.g., a homeowner pouring pool chlorine into their swimming pool and inhaled the vapors carried by air away from the target site) (Table 3). Ingestion of pesticides accounted for 112 (21%) of the 529 non-agricultural, non-occupational cases in residential settings. Seventy-seven (77%) of the ingestion cases were accidental, primarily due to improper storage (e.g., pesticide was stored in a water bottle) or placed in areas easily accessible to children.

Table 3: Exposure and Activity of Non-Agricultural, Non-Occupational Cases in Residential Settings, 2019

Activity	Direct Contact	Off-Site Movement*	Residue	Multiple Exposures	Other/ Unknown	Total
Applicator	64	103	-	2	14	**183**
Mechanical	1	-	-	-	0	**1**
Mixer/Loader	8	5	-	-	2	**15**
Handler, Other or Unspecified	-	5	-	-	-	**5**
Routine Activity	97	14	83	2	22	**218**
Other Activity	54	4	5	4	6	**73**
Transport/Storage/ Disposal	1	-	-	-	2	**3**
Unknown	17	-	-	-	14	**31**
Total	**242**	**131**	**88**	**8**	**60**	**529**

* Category was renamed to *Off-site Movement* from *Drift* in 2019.

AGRICULTURAL PESTICIDE ILLNESSES

Of the 1,198 associated cases, PISP identified 409 (34%), stemming from 87 episodes, as associated with agricultural use pesticides. Exposures from pesticide moving off-site contributed to 256 (63%) of the 409 agricultural cases. Exposures from residual pesticide and direct contact accounted for 85 (21%) and 26 (6%), respectively, of the agricultural cases. One-third of the cases involved exposures to insecticides (140, 34%) used for an agricultural commodity, and fumigants were involved in 50 cases (12%). Exposures to a combination of different types of pesticides, either from a tank mix or concurrent applications contributed to 154 cases (38%). Table 4 shows the number of agricultural cases according to the types of pesticide and exposure mechanisms.

Table 4: Types of Pesticide and Mode of Exposure in Agricultural Cases, 2019						
Pesticide	**Direct Contact**	**Off-Site Movement***	**Residue**	**Multiple Exposures**	**Other/ Unknown**	**Total**
Antimicrobial	5	4	-	-	5	**14**
Fumigant	4	4	9	33	-	**50**
Fungicide	2	6	7	-	1	**16**
Herbicide	8	26	-	-	-	**34**
Insecticide	5	131	3	-	1	**140**
Rodenticide	-	1	-	-	-	**1**
Combo/Misc.	2	84	66	-	2	**154**
Total	**26**	**256**	**85**	**33**	**9**	**409**

* Category was renamed to *Off-site Movement* from *Drift* in 2019.

Two-thirds of the individuals reported inhaling pesticides used for an agricultural commodity (256, 63%), and 107 reported having multiple routes of exposures (26%). Applications made by air blast sprayers accounted for 172 (42%) cases, stemming from 13 episodes. In most of the applications with air blast sprayers, the applicator did not turn off the nozzle before turning at the end of the row (see Program Monitoring of Air Blast Sprayers on page 19). Aerial applications also had the same number of episodes (13), but resulted in fewer cases (92, 22%). Other types of ground applications accounted for 51 (12%) cases, stemming from 17 episodes.

Applicators and Mixer/Loaders

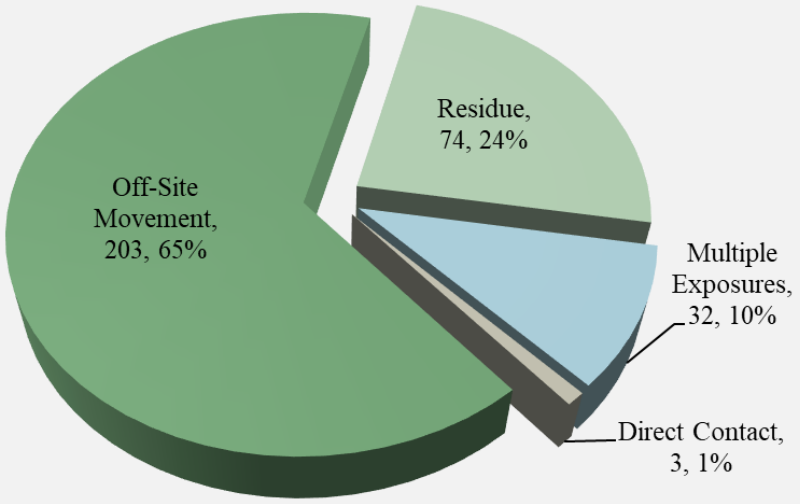
Of the 409 associated cases, 33 (8%) involved applicators or mixer/loaders of agricultural pesticides, and all but four cases were single-person episodes. For these 33 cases, spills or other direct contact from pesticides not propelled by an application or mix/load equipment contributed to 20 (61%) of the cases, followed by off-site movement at eight (24%) cases. The exposure mechanism remained unknown in one (3%) of the cases. Equipment failure and use inconsistent with the label contributed to over half (17, 52%) of the cases. Fourteen (42%) of the handler (Applicator and Mixer/Loader) cases had reports of lost workdays, and none of the handlers were hospitalized due to their exposure.

Field Workers

PISP data show that 312 field workers were injured by pesticide exposure in 27 separate episodes in 2019, constituting 76% of the 409 agricultural illness cases and 31% of the 87 agricultural episodes. Large multi-person episodes can dramatically alter the overall number of cases from year to year. The largest number of field workers injured in a single pesticide drift related episode in 2019 was 47. There were six crews consisting of 487 workers harvesting grapes in a vineyard that day. One crew of 84 workers smelled an odor and 47 reported symptoms as they arrived at their worksite A miticide

application using an air blast sprayer was occurring at a vineyard 0.23 miles away. Gradient samples taken were positive for the pesticides applied, confirming the pesticides had moved off-site. The grower of the treated vineyard was cited for failing to perform pest control in a careful and effective manner. Off-site movement of pesticide(s), as defined by PISP, was associated with 203 (65%) cases, and pesticide residue contributed to 74 (24%) of the 312 cases involving field workers (Figure 8).

Figure 8: Field Worker Mechanism of Exposure to Pesticides, 2019



n = 312

REPORTED ILLNESSES AMONG CHILDREN

There were 159 associated cases of pesticide exposure involving children (less than 18 years old). One (<1%) child was hospitalized due to their pesticide exposure. A 12-year-old girl was exposed to residual acephate powder from an oven that was previously treated by her mother to control roaches a week prior. The two most common types of exposures were direct contact (90, 57%), and residue (32, 20%) (Table 5). Ingestion and inhalation of pesticide(s) were the most reported route of exposure, 50 (31%) and 40 (25%), respectively. The two pesticide types most often ingested were antimicrobials and insecticides, 29 (58%) and 14 (28%), respectively. Thirty-eight (76%) of the 50 children who ingested pesticides were less than six years of age. In most of the ingestions by children under six years of age, improper storage and accessibility of the pesticide contributed to the exposure (33, 87%).

In 2019, there were no reports of children exposed to agricultural use pesticides while at school.

Thirteen children were exposed to agricultural use pesticides in four separate incidents. None of the children were admitted to the hospital. In the first incident, two 17-year-olds were working as field workers

when exposed. In the second incident, eight children were exposed when their bus was drifted on by an air blast sprayer applying insecticides to a nearby field. The third incident involved twin toddlers exposed to pesticides while playing in their yard. A ground application was occurring at a nearby alfalfa field about 30 feet away, and samples taken from the yard were positive for the pesticides applied. Lastly, a 10-year-old girl was exposed when she smelled an odor while walking on a trail. She saw a tractor spraying an orchard nearby and walked up to the applicator.

There was one report of a pesticide exposure that occurred at a school. A pool technician added an adjuvant to the swimming pool while the child was in the water.

Table 5: Pesticide Types and Mode of Exposure for Children < 18-years old, 2019

	Agricultural		Non-Agricultural				
Pesticide Type	**Direct Contact**	**Off-Site Movement**	**Direct Contact**	**Off-site Movement**	**Residue**	**Other*/ Unknown**	**Total**
Antimicrobial	-	-	53	4	1	11	**69**
Fumigant	-	-	-	-	1	-	**1**
Herbicide	1	2	1	-	0	-	**4**
Insecticide	-	2	28	5	29	4	**68**
Repellent	-	-	3	-	-	-	**3**
Rodenticide	-	-	2	-	-	-	**2**
Pool Adjuvant	-	-	1	-	-	-	**1**
Misc./Combo	-	8	1	-	1	1	**11**
Total	**1**	**12**	**89**	**9**	**32**	**16**	**159**

* *Other* is a combination of three different exposure types: *Other Exposure*, *Multiple Exposure*s and *Unknown*.

MORBIDITY AND MORTALITY

Of the 1,198 cases evaluated as associated with pesticide exposure, 22 people (2%) were hospitalized and 119 (10%) reported time lost from work or normal activity (e.g., going to school) (Table 6). Ten (45%) of the 22 people hospitalized had ingested pesticide. Of those 10 people, eight (80%) acknowledged self-harm, of which one was fatal, where an individual ingested an organophosphate insecticide.

Table 6: Summary of Pesticide-Associated Hospitalization and Disability, 2019

Relationship	Cases	Number Hospitalized[1]	Number with Lost Work Time[2]
Definite/Probable	1,034	18	110
Possible	164	4	9
Total	**1,198**	**22**	**119**

[1] Number of associated cases who were admitted and were hospitalized at least one full day (24-hour period).
[2] Number of associated cases who missed at least one full day of work or normal activity such as school.

PROGRAM MONITORING OF AIR BLAST SPRAYERS

In 2019, applications of agricultural use pesticides using air blast sprayers accounted for 13 episodes, that resulted in 172 associated cases, representing the highest number and proportion for both agricultural episodes (15%) and cases (42%). Air blast sprayers are one of the most commonly used type of ground application methods for orchards and vineyards as they provide good surface coverage and canopy penetration, and have high capacity (tank volume, flow rate, and pressure). These machines are generally mounted on tractors or trucks and designed to apply pesticides to a relatively large area by using a combination of air and liquid to deliver droplets under pressure to the target site.

PISP data from 2010 to 2019, revealed 110 episodes involving air blast sprayers that resulted in 649 illness cases (Table 7). A single incident can affect multiple individuals. Applications using air blast sprayer had the highest number of episodes in three years of the ten-year period and the highest number of cases in seven years of the ten-year period Thus, DPR formed the Air Blast Mitigation Workgroup to review previous exposure incidents examine prior research studies and drift modeling to evaluate incidents related to air blast sprayers and explore potential mitigation approaches based on findings.

Table 7. Type of Equipment Used to Apply Agricultural Use Pesticides, 2010-2019				
Top 5 Application Equipment	**Number of Episodes**	**Number of Cases**	**% of Total Episodes**	**% of Total Cases**
Ground, Other or Unspecified	144	332	16%	10%
Air blast Sprayers	110	649	12%	20%
Helicopter	56	220	6%	7%
Ground, Boom Below/Behind	50	164	6%	5%
Fixed Wing Aircraft	44	241	5%	8%
Total	**884**	**3195**		

Most of the individuals exposed to pesticides applied by an air blast sprayer were bystanders (609, 94%) via off-site movement (540, 83%) (Table 8). Bystanders who were performing tasks that contributed to an agricultural commodity account for three-fourths of the cases (e.g., field workers). Non-agricultural bystanders consist of individuals not involved in the production of agricultural commodity, for example, residents at home, families driving on a road, or construction workers.

Table 8. Occupational Status and Activity of Individuals Exposed from Air Blast Sprayer, 2010-2019				
	Agricultural Bystander	**Handler**	**Non-Agricultural Bystander**	**Total**
Non-Occupational	-	-	45	**45**
Occupational	452	40	112	**604**
Total	**452**	**40**	**157**	**649**

Investigations conducted by the CAC identified a label or regulatory violation in 75% of the episodes involving bystanders. Two common violations identified were failing to measure or consider wind speed prior to applying and failing to turn off the nozzles when turning at the end of the row. Both of these violated label and regulatory requirements which resulted in drift to bystanders.

No contributory violations[*] were noted in 25% of the episodes involving bystanders exposed to applications by air blast sprayers. In most of these incidents, the CACs were not notified of the incident until days later; therefore, investigators were unable to initiate the investigation in a timely manner and collect samples to verify off-site movement.

Based on review of the investigation reports, labels and regulatory requirements, many incidents involving air blast sprayers could have been avoided had the applicator complied with the label and regulatory requirements. This suggests pesticide handlers could benefit from additional and more

[*] PISP defines contributory violations as Drift, Early Reentry, Failure to Use Required Equipment and Other Misuse, and not all may be applicable in this analysis.

effective training and outreach on the frequency and impacts of air blast drift and the importance of following the label and regulations. Additionally, prompt reporting of pesticide incidents to the CAC and CDPR could also be beneficial in identifying areas of concern with air-blast applications for the purpose of enforcement and targeted outreach.

FURTHER INFORMATION

Tabular summaries presenting different aspects of 2019 pesticide illness data are available online at http://www.cdpr.ca.gov/docs/whs/pisp.htm, or by contacting the Worker Health and Safety Branch at (916) 445-4222 or email PISP at PISP@cdpr.ca.gov. Additionally, the public can retrieve reports of pesticide illness and generate reports according to their own specifications using CalPIQ, which is available at http://apps.cdpr.ca.gov/calpiq. Through this online pesticide illness query application, users can retrieve cases evaluated as definitely, probably, or possibly related to pesticides from 1992 through the most recent year published.

APPENDIX A: ACRONYMS

Ag PCB	Agricultural Pest Control Business
CAC	County Agricultural Commissioner
CalPIQ	California Pesticide Illness Query
CalREDIE	California Reportable Disease Information Exchange
CCR	California Code of Regulations
CDPH	California Department of Public Health
CPCS	California Poison Control System
DFROII	Doctor's First Reports of Occupational Illness and Injury
DIR	Department of Industrial Relations
DPR	California Department of Pesticide Regulation
LHO	Local Health Officer
OEHHA	Office of Environmental Health Hazard Assessment
OHB	Occupational Health Branch (of CDPH)
PIR	Pesticide Illness Report
PISP	Pesticide Illness Surveillance Program
U.S. EPA	United States Environmental Protection Agency

APPENDIX B: GLOSSARY

Agricultural: Cases or episodes that implicate exposure to pesticide(s) intended to contribute to the production of agricultural commodities, including livestock. This includes: 1) agricultural research facilities, 2) handling of raw agricultural commodities in packing houses, 3) drift from agricultural applications into non-agricultural areas, and 4) transportation and storage of pesticides on farm lands. It excludes forestry operations, although they are classified as agricultural for regulatory purposes. It also excludes manufacture, transportation, and storage of pesticides prior to arrival at the site of agricultural production.

Activity Type: Activity of the individual at the time of exposure.

Applicator: Applies pesticides by any method or conducts activities considered ancillary to the application (e.g., cleans spray nozzles in the field).

Emergency Response: Emergency response personnel (police, fire, ambulance, and HAZMAT personnel) responding to a fire, spill, accident, or any pesticide incident in the line of duty.

Field Worker: Works in an agricultural setting performing tasks such as advising, scouting, harvesting, thinning, irrigating, driving tractor (except as part of an application), field packing, conducting cultural work in a greenhouse, etc. Researchers performing similar tasks in an agricultural field are also included

Handler, Other or Unspecified: Assists with tasks following an application (i.e., tarp removal during a structural application or soil fumigation, and not ancillary to the application or mix/load activity).

Manufacturing and Formulation: Manufactures, processes, or packages pesticides. This includes "mixing" if it is done in a plant for application elsewhere.

Mechanical: Maintains (e.g., cleans, repairs, conducts maintenance) pesticide contaminated equipment used to mix, load, or apply pesticides, as well as the protective equipment used by individuals involved in such activities. This excludes the following: 1) maintenance performed by applicators on their equipment incidental to the application; and 2) maintenance performed by mixer/loaders on their equipment incidental to mixing and loading.

Mixer/Loader: Mixes and/or loads pesticides. This includes: 1) removing a pesticide from its original container; 2) transferring the pesticide to a mixing or holding tank; 3) mixing pesticides prior to application; 4) driving a nurse rig; or 5) transferring the pesticide from a mix/holding tank or nurse rig to an application tank.

Other Activity: Activity is not adequately described by any other activity category. This includes but is not limited to: 1) dog groomers not handling pesticides; 2) individuals handling pesticide treated wood; 3) two or more activities with potential for pesticide exposure.

Packaging/Processing: Handles (packs, processes, or retails) agricultural commodities from the packing house to the final market place. Field packing of agricultural commodities is classified as field worker.

Routine (Other/Unspecified): Conducts activities in an environment with minimal expectation for exposure to pesticides but is not adequately defined as indoor or outdoor. This includes individuals exposed to pesticides while inside a vehicle.

Routine Activity: Combination of three Routine activities: *Routine Indoor*, *Routine Outdoor* and *Routine (Other/Unspecified)*.

Routine Indoor: Conducts activities in an indoor environment with minimal expectation for exposure to pesticides. This includes people in offices and businesses, residential structures, etc. who are not handling pesticides.

Routine Outdoor: Conducts activities in an outdoor environment with minimal expectation for exposure to pesticides. This excludes field workers in agricultural fields. This includes gardeners who are not handling pesticides.

Transport/Storage/Disposal: Transports or stores pesticides between packaging and preparation for use. This includes shipping, warehousing, and retailing, as well as storage by the end-user prior to preparation for use. Disposal of unused pesticides (not ancillary to an application or mix/load activity) is also included in this activity. This excludes driving a nurse rig to an application site.

Application Site: Site of the pesticide application. For crops, this includes applications at the growing site and to the commodity while being packed for sale. For incidents involving drift, the intended application site is listed.

Associated Case: A case that has been evaluated as definitely, probably, or possibly related to pesticide exposure.

Associated Episode: An episode in which at least one corresponding case was evaluated as associated.

Case: Representation of an individual's exposure to a pesticide(s) that may or may not result in an illness and injury.

Disability Days: Number of days in which an individual missed at least one full day (24-hour period) of work or other normal activity, such as school.

Episode: An event in which a particular source appears to have exposed one or more people (cases) to pesticides.

Equipment: Defines the type of application equipment regardless of who performed the application.

Aerosol Can: Disposable pressurized cans designed for intermittent use. The pesticide is propelled out of the can by an inert compressed gas propellant. This excludes foggers.

Aerosol/Fog Generating Equipment: Refillable application equipment designed to disperse pesticide as a small airborne droplet, either in confined spaces or outdoor areas.

Air, Other or Unspecified: Aerial application equipment, other or unspecified. This includes two or more types of aerial application equipment.

Air Blast Sprayer: Ground application equipment with a pump that delivers spray into an air stream created by a large fan at the back of the spray equipment.

Automatic Equipment, Chlorinator: Chlorination units that automatically inject chlorine into water for disinfection purposes. This includes chlorinators for swimming pools, packing houses, and food processing plants.

Automatic Equipment, Other or Unspecified: Equipment that automatically injects the pesticide to the target area. This includes equipment attached to milking machinery, dishwashers, ozone generators, etc. This excludes specific automatic equipment already described.

Back Pack Sprayer: Sprayer where the tank is worn on the back of the applicator. This may include compressed, motorized, liquid, or dust.

Chamber: A sealed enclosure used for fumigating or sterilizing its contents.

Drip Irrigation: Chemigation through drip irrigation equipment.

Fixed Wing Aircraft: A fixed wing aircraft.

Fogger: Disposable pressurized cans designed for the total release of the contents in a single use. The pesticide is propelled out of the can by an inert compressed gas propellant.

Ground Boom Below/Behind: Ground application equipment with a spray boom located below and behind the equipment operator with the spray nozzles pointed downward.

Ground Boom, Other or Unspecified: Ground application equipment with a spray boom, where the location of the boom was not specified.

Ground, Other or Unspecified: Ground application equipment, unknown or unspecified. This includes two or more types of ground application.

Hand Pump Sprayer: Hand-held compressed air sprayer with small volume tanks (1 to 5 gallons). This excludes *Back Pack Sprayers*.

Hand, Other or Unspecified: Hand-held types of application equipment not already specified where the equipment must propel the pesticide from a reservoir. This includes two or more types of hand-held application equipment.

Helicopter: A helicopter.

Immersion Equipment: Tanks, trays, sinks, etc. used for the dipping of animals, produce, bulbs, medical equipment, dishes, pots and pans, etc.

Implements with Handles: Mops, brushes, and other implements with handles.

Implements without Handles: Cloths, towels, rags, sponges, and other implements without handles.

Manual Application Methods, Other or Unspecified: Manual type of application methods not already specified where the pesticide is not propelled by any type of equipment. This includes two or more types of manual application methods.

Manual Placement: Pesticide is manually placed directly to a target site. This includes bait stations, hand tossed pellets, and direct pouring of a pesticide onto a target surface from a container (such as pouring liquid chlorine directly into swimming pool water). This excludes the placement of fumigation pellet packs in chambers and under tarps.

Other Equipment: Any application methodology not described in any of the equipment categories. This includes two or more types of application equipment.

Power Dusters: Ground application equipment used to apply dust formulated pesticides.

Pressurized Hose-Line Sprayer: Hand-held spray equipment attached by a long hose to a power-pressurized tank.

Shank Injection with Tarps: Ground application equipment that uses a shank or other piece of equipment to directly apply a pesticide into the soil and a tarp is placed over the soil to restrict the pesticide to the application site.

Shank Injection without Tarps: Ground application equipment that uses a shank or other piece of equipment to directly apply a pesticide into the soil except when a tarp is placed over the soil, which is classified under shank injection with tarps. This also excludes surface applied pesticides that are subsequently incorporated into the soil by a cultivator.

Tarp: Tarp placed over a commodity or structure and designed to restrict a fumigant to the application site.

Unpressurized Hand-Held Spray Equipment: Hand-held spray bottles (usually plastic) with built-in finger triggers. This includes battery powered continuous spray products and application syringes.

Not Applicable: No application equipment is involved or exposure from original container without known method of application.

Hospitalization: Number of days in which an individual was hospitalized at least one full day (24-hour period).

Illness type: Categorization of the type of symptoms experienced by the affected individual.

Asymptomatic: Exposure occurred, but did not result in illness/injury. Cholinesterase depression without symptoms falls in this category.

Respiratory: Health effects involving any part of the respiratory tree.

Systemic: Any health effects not limited to the respiratory tree, skin, and/or eyes. Cases involving multiple illness symptom types including systemic symptoms are included in the systemic category

Topical: Health effects involving only the eyes and/or skin. This excludes outward physical signs (e.g., miosis, lacrimation) related to effects on internal bodily systems. These signs are classified under 'Systemic.'

Incident Setting: Location where the incident occurred. The location may not coincide with the application site.

Animal Premise (Veterinary Hospital, Kennels, Not Livestock): Veterinary services, animal research laboratories, animal kennels, animal control facilities, dog grooming facilities, and other services provided for companion animals. This excludes livestock.

Crop/Livestock Processing Facility: Facilities involved in packing, manufacturing, or processing foods or beverages for human consumption and feed products for animals and fowl.

Farm: Areas where agricultural crops are grown. This excludes the following: 1) nurseries and greenhouses which are classified under *Nursery*; 2) livestock and poultry farms; and 3) forestry operations

Food Processing Facility: A commercial operation that manufactures, packages, labels or stores food for human consumption, and provides food for sale or distribution to other business entities such as food processing plants or food establishments. This includes centralized kitchens that make meals for distribution.

Forest: Establishment engaged in the operation of timber tracts, tree farms, reforestation projects and other forest related activities.

Hospital/Medical: Establishments that provide medical, surgical, and other health services to people. This includes offices and clinics of doctors and dentists, hospitals, medical and dental laboratories, kidney dialysis centers, and other health related facilities.

Industrial or Other Manufacturing Facility: Facilities involved in the mechanical or chemical transformations of materials or substances into new products. This excludes: 1) facilities engaged in manufacture or formulation of pesticides; and 2) facilities engaged in treatment of wood to protect against pest damage.

Landscape, Other: Landscaped ornamental shrub, tree, and other areas. This excludes landscaped areas in any other incident setting.

Livestock Production Facility: Ranches, dairies, feedlots, egg production facilities, hatcheries, and other establishments involved in keeping, grazing, or feeding livestock or poultry for the sale of them or their products. This includes veterinary services provided for livestock.

Multi-Unit Housing: Apartments and multi-plexes and other buildings on property. This includes swimming pools and landscaped areas on the property.

Nursery: Facilities (including greenhouses) growing and selling plants, bulbs, seeds, etc. This includes the production of seedlings for transplanting into agricultural fields or forests.

Office/Business: Commercial establishments including public and private business offices. This excludes retail establishments and service establishments.

Other Setting: Location of exposure occurred at a site not adequately described in any other incident setting category. This includes, but is not limited to, telephone poles, fences, water supply systems, and wastewater treatment plants.

Park: An area of public land set aside for recreation. This includes public swimming pool facilities. This excludes recreational facilities such as amusement parks, physical fitness facilities, etc. which are classified under *Service Establishment*.

Pesticide Manufacturing Facility: Facilities engaged in manufacture and/or formulation of pesticides.

Prison: Establishments for the confinement and correction of offenders as ordered by courts of law. This includes California youth authority facilities.

Residence (Other or Unspecified): Human habitation of unknown type, or of a type not adequately described as single family home, multi-unit housing, labor housing, or residential institution.

Residential Institution: Dormitories, nursing homes, homeless shelters, and similar facilities.

Residential: A combination of three residential settings: *Single Family Home*, *Multi-Unit Housing*, and *Residence (Other or Unspecified)*.

Retail Establishment: Businesses engaged in selling merchandise for the consumption of the end-user and providing services related to the products. This excludes restaurants which are classified under *Service Establishment*.

Road/Rail or Utility Right of Way: Roads, rails or utilities, and adjacent right-of-way areas. This includes aqueducts, canals, levees, manholes, landscaped median strips, and vehicles moving along roadways.

School: Establishments that provide academic or technical instruction. This includes daycare centers.

Service Establishment: Establishments primarily engaged in providing services to individuals, businesses, and government. This includes restaurants, hotels, fitness facilities, etc. This excludes medical service establishments.

Single Family Home: The house and other structures on property intended for use by a single family. This includes swimming pools and landscaped areas on the property.

Wholesale Establishment: Establishments primarily engaged in the warehousing and direct distribution of merchandise to retail establishments or other wholesale establishments. This includes warehousing operations that ship directly to the public.

Non-agricultural: Case or episode in which the pesticide(s) was not intended to contribute to the production of agricultural commodities. This includes: 1) residential pesticide uses, 2) structural pest control, 3) rights-of-way, 4) parks, 5) landscaped urban areas, and 6) manufacture, transportation and storage of pesticides except on farm lands.

Non-occupational: The individual was not on the job at the time of the incident. This category includes individuals on the way to or from work (before the start or after the end of their workday).

Occupational: The individual was on the job at the time of the incident. This includes both paid employees and volunteers working in similar capacity to paid employees.

Pesticide Type: Type of pesticide based on functional class.

Antimicrobials: Pesticides used to kill or inactivate microbiological organisms (e.g., bacteria, viruses).

Cholinesterase Inhibitors: Pesticides known to inhibit the function of the cholinesterase enzyme.

Fumigants: Pesticide in gas or vapor formulation that is released into the air or injected into the application site.

Relationship: Degree of correlation between pesticide exposure and resulting symptomology.

Definite: Relationship indicating a high degree of correlation between the pattern of exposure and resulting symptomatology. Requires both medical evidence (e.g., measured cholinesterase inhibition, positive allergy tests, characteristic signs observed by medical professional) and

physical evidence of exposure (e.g., environmental and/or biological samples, exposure history) to support the conclusions.

Probable: Relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable.

Possible: relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.

Inadequate: relationship in which there was not enough information collected to determine if the pesticide(s) contributed to ill health.

Indirect: relationship in which the pesticide(s) exposure is not responsible, but pesticide regulations or product label requirements contributed to the illness (e.g., heat stress while wearing chemical resistant clothing).

Asymptomatic: a case in which the affected individual did not develop symptom(s).

Unlikely: relationship in which a correlation cannot be ruled out absolutely, but medical and/or physical evidence suggest a cause other than pesticide exposure.

Unrelated: relationship in which there was conclusive evidence of a cause other than pesticide exposure.

Route of Exposure: Route by which the pesticide(s) enters or comes in contact with the body.

Dermal: Exposure via direct contact with the skin

Ingestion: Intentional or unintentional oral ingestion or substance entering the oral cavity. This includes ingestion of residue (on food, produce, toys).

Inhalation: Breathing or inhaling vapors, gases, mists, fumes, odor or particulates into the respiratory tract/lungs.

Injection: Substance was injected into the body by a syringe or when a mechanical injury occurred, involving a contaminated object puncturing the skin.

Multiple: Indicates exposure occurred by two or more distinct route.

Ocular: Exposure via contact with the eyes.

Type of Exposure: Characterizes the nature of the exposure.

Direct Contact: A combination of two different exposure types: *Direct Spray/Squirt* and *Spill/Other Direct*.

Direct Spray/Squirt: Material propelled by the application or mix/load equipment. Contact with the material can be by direct projection or ricochet. This includes exposure of mechanics working on application or mix/load equipment when the material is forced out by pressure.

Multiple Exposures: Contact with pesticides occurred through two or more distinct mechanisms regardless of the number of pesticides involved.

Off-site Movement: Spray, mist, vapors, or odor carried from the target site by air during an application or mix/load activity. Drift as an exposure mechanism does not necessarily correspond to drift as a violation.

Other Exposure: Other known route of exposure that is not included in any other exposure category. This includes, but not limited to: 1) vapors, odor or other indirect contact from pesticide(s) not related to an application; 2) exposure from smoke or pyrolytic products from a fire where pesticides are burning; and 3) pesticide transfer from contaminated equipment (e.g., from contaminated hand/glove to eye).

Residue: The part of a pesticide that remains in the environment for a period of time following an application or drift. This includes odor after the completion of an application.

Spill/Other Direct: Any of the following: 1) contact where the material is not propelled by the application or mix/load equipment; 2) expected direct contact during use (e.g., washing dishes in a disinfectant solution); 3) leaks, spills, etc. not related to an application; and 4) exposure of people who are in the target area during fumigation/fogging.