UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

MEMORANDUM

Date: March 4, 2020

SUBJECT: Rodenticides: Tier I Update Review of Human Incidents

PC Code: 112701, 112001, 112802, 119901, 128967, 067701, 067705, 067707, 086002, 086003, 088601, 202901
Decision No.: 559636
Petition No.: NA
Risk Assessment Type: NA
TXR No.: NA

MRID No.: NA

DP Barcode: D456699

Registration No.: NA
Regulatory Action: NA
Case No.: NA
CAS No.: 56073-10-0, 28772-56-7, 63333-35-7, 56073-07-5, 104653-34-1, 82-66-6, 42721-99-3, 3691-35-8, 81-81-2, 129-06-6, 1314-84-7, 67-97-0
40 CFR: NA

Ver.Apr.08

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Summary and Conclusions

In order to minimize exposure to rodenticide products by children and wildlife, the 2008 Risk Mitigation Decision (RMD) for Ten Rodenticides included risk mitigation measures requiring rodenticide products used in homes and marketed to general residential consumers be sold only with bait stations (May 28, 2008).[1] One mitigation measure in the 2008 RMD was to prohibit the use of four second-generation anticoagulants – brodifacoum, bromadiolone, difenacoum, and

[1] https://www.regulations.gov/document?D=EPA-HQ-OPP-2006-0955-0764

difethialone – in residential consumer products. Most rodenticide products complied with the mitigation measures required in the RMD as of June 4, 2011. The phase out production of the final 12 non-compliant products began in June 2014 and production of these products stopped on December 31, 2014. Distribution to retailers ended March 31, 2015.

Rodenticides were previously reviewed in 2015 (S. Recore and E. Evans, D426573, D426554, 11/24/2015). At that time, OPP's risk mitigation measures had only recently been fully implemented so there was insufficient information available to determine if the mitigations had impacted the frequency or severity of incidents involving rodenticides.

HED has performed an updated analysis of exposure incidents reported to both Incident Data System (IDS) and American Association of Poison Control Centers (AAPCC).
In IDS, first-generation anticoagulant incidents increased by 60% from 2009 to 2018.[2] In AAPCC, first-generation anticoagulant incidents decreased over time from 337 incidents in 2004 to 187 incidents in 2017. In both databases, the second-generation anticoagulants (i.e. long acting anticoagulant rodenticides) incident reports have declined over time. Over the time period reviewed, the number of second-generation anticoagulant incidents reported IDS (2008-2018) decreased by 79% and the number of second-generation anticoagulant incidents reported to AAPCC (2004 to 2017) decreased by 70%. Second-generation anticoagulant incidents reported are expected to continue to decline because second-generation anticoagulant rodenticides are no longer registered for use in products marketed to residential consumers.

During the same time periods of comparison in IDS and AAPCC (2008-2018 and 2004-2017, respectively), the annual frequency of exposure incident involving non-anticoagulant incident reports increased over time. The number of non-anticoagulant incidents reported to IDS (2008 to 2018) increased 81% and the number of incidents reported to AAPCC (2004 to 2017) increased by 76%. HED does not have access to more detailed data to examine the reason for this trend, but the observed increase may be the result of non-anticoagulants having replaced the second-generation anticoagulants for residential consumer use.

While there has been an increase in the frequency non-anticoagulant incidents, IDS and AAPCC data suggest that the overall the total frequency of rodenticide incidents reported to both IDS and AAPCC appears to be decreasing over time. In IDS the total number of rodenticide incidents decreased from 198 incidents in 2009 to 146 incidents reported in 2018 (26% decline). Similarly, the total number of rodenticide incidents reported to AAPCC declined from 19,432 rodenticide incidents reported in 2004 to 8,494 incidents in 2017 (56% decline).

In addition, reviewing AAPCC data, a comparison of child rodenticide exposures from 2011 to 2017 identifies a 46% decline in child rodenticide incident reports.

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[2] This increase in the first-generation anticoagulant (FGAR) is a trend reflected only in IDS; the reported incident counts are low. IDS identified 10 FGAR incidents in 2009 and 52 FGAR incidents in 2018. Further, FGAR incidents in AAPCC have declined over a similar time period.

This suggests that the 2008 RMD may have contributed to an overall decrease in exposure incidents involving rodenticide products.

Finally, 21 occupational exposure incidents reported to the NIOSH SENSOR-Pesticides database from 2011-2015, nine occupational exposure incidents reported to California PISP from 2012-2016, and two incidents from IDS (2015-2019) were summarized.

Detailed Review

I. ACTION REQUESTED

The rodenticides are being considered under the FQPA-mandated Registration Review program established to review, on a 15-year cycle, pesticides for which a Re-registration Eligibility Decision has been made. HED's RAB II has requested that TEB conduct a Tier I Update review summary of recent incident data from IDS and SENSOR as per standard protocol under the Agency's Registration Review Program. One component of the Agency's Registration Review Program is consideration of human incident data. In conjunction with a human health risk assessment based on other data sources, such human incident data can assist the Agency in better defining and characterizing the risk of pesticides/pesticide products.

It is important to remember that reports of adverse health effects allegedly due to a specific pesticide exposure (*i.e.*, an "incident") are largely self-reported and therefore, generally speaking, neither exposure to a pesticide or reported symptom (or the connection between the two) is validated or otherwise confirmed. Typically, causation cannot be determined based on incident data, and such data should be interpreted with caution. Nonetheless, incident information can be an important source of feedback to the Agency: incidents of severe outcome, or a suggested pattern or trend among less severe incidents, can signal the Agency to further investigate a particular chemical or product. Epidemiology studies can also be useful and relate the risk of disease, *e.g.*, cancer, and exposure to an agent such as a pesticide product in the general population or specific sub-groups like pesticide applicators.

II. BACKGROUND

In the U.S., rodenticides are registered for use by the Environmental Protection Agency's (EPA or Agency) Office of Pesticide Programs (OPP or Office) for use against pest rodents (e.g., rats, mice, gophers, etc.) associated with a variety of use sites (e.g., agricultural fields, restaurants, homes, etc.). Rodenticides were reviewed under OPP's Reregistration program in the 1990s. As a result of these reviews, potential risks from rodenticide agricultural field uses and residential tracking powder products were successfully mitigated via classification as restricted use pesticides (RUP; the one exception was manual underground baiting products for use in agricultural fields, which did not necessitate an RUP classification). Additionally, rodenticides employed to preserve native plant and animal species on islands were determined to be appropriately managed by the U.S. Fish and Wildlife Service, rendering mitigation unnecessary. The path forward to mitigate risk (which included children and wildlife exposure to rodenticide products) from the remaining rodenticide use pattern (rodenticides formulated as baits/pellets

used against commensal rodents[3] in residential-type settings) resulted in the Rodenticide Stakeholder Workgroup (RSW), a subcommittee under the federally-chartered advisory body, the Pesticide Program Dialogue Committee (PPDC). The RSW issued recommendations, and helped inform the Agency's 2008 Risk Mitigation Decision for Ten Rodenticides (RMD). Under the terms of the 2008 RMD, products marketed to the general non-professional user or homeowner as well as those applied by professional applicators were to be modified to adopt a variety of mitigation measure to continue to meet the FIFRA standard. These risk mitigation measures included requiring rodenticide products used in homes or marketed to general residential consumers be used in bait stations. The RMD also required the second-generation anticoagulant class of rodenticides to be sold in a way to limit sales to general residential consumers. The RMD provided registrants until June 4, 2011 to comply with the mitigation measures. However, as of June 4, 2011 not all rodenticide products complied with the RMD requirements. On January 29, 2013, the Agency issued a Notice of Intent to Cancel (NOIC) for the remaining 12 non-compliant products[4] manufactured by Reckitt Benckiser that did not meet the Agency's current safety standards. In May 2014, EPA reached an agreement with Reckitt Benckiser to begin phase out production of the 12 d-CON non-compliant products in June 2014, and stop all production by December 31, 2014. In March 31, 2015, Reckitt ceased distribution of existing stocks of these products.

An analysis of human incidents involving exposure to commensal rodenticides was conducted previously in 2011 (S. Recore, D395567, 10/28/2011) in support of the Rodenticide Risk Mitigation Decision (RMD), and the subsequent Notice of Intent to Cancel (NOIC). It was concluded that

> "When looking across human incident data sources, as well as the open literature, rodenticides are found to be involved in numerous incidents, especially involving children less than 6 years old. These exposures to children are especially evident in the analysis of the AAPCC data which showed an average of 15,000 exposures per year occur to children under 6 years old from 1999 to 2009. While exposures generally result in no clinical harm to children, the resulting human exposures to rodenticides have the potential to result in severe outcomes and/or medical care."
>
> "Subsequently, it follows that the RMD proposal (containing rodenticides in bait stations that are tamper-resistant) may mitigate child incidents involving rodenticides."

For this evaluation, OPP evaluated its Incident Data System (IDS) and aggregate data reported in the American Association of Poison Control Centers (AAPCC) Annual Report for rodenticide incident trends over time, particularly, exposures to children, as a result of the 2008 RMD.[5] Additionally, OPP evaluated NIOSH Sentinel Event Notification System for Occupational Risk

[3] Commensal rodents are rodents that live in close association with humans and depend upon them for shelter and/or for some of their sustenance. In the continental U.S., the term commensal rodents includes Norway rats (*Rattus norvegicus*), roof rats (*Rattus rattus*), and house mice (*Mus musculus*).

[4] Registration Numbers: 3282-3, 3282-4, 3282-9, 3282-15, 3282-65, 3282-66, 3282-74, 3282-81, 3282-85, 3282-86, 3282-87, and 3282-88

[5] These rodenticides are not included in the AHS, and therefore this study does not provide information for this report.

(SENSOR)-Pesticides, California Pesticide Illness Surveillance Program (PISP), and IDS for occupational incidents. The purpose of the review and database search is to identify potential patterns in the frequency and severity of the health effects attributed to commensal rodenticide exposure. The rodenticides included in this report can be grouped according to three main categories: first-generation anticoagulants[6], second-generation anticoagulants[7] , and non-anticoagulants[8]. They are classified as follows:

- First-generation anticoagulant
  - chlorophacinone (PC Code 067707)
  - diphacinone (PC Code 067701)
  - diphacinone sodium salt (PC Code 067705)
  - warfarin (PC Code 086002)
  - warfarin sodium salt (PC Code 086003)

- Second-generation anticoagulant
  - brodifacoum (PC Code 112701)
  - bromadiolone (PC Code 112001)
  - difenacoum (PC Code 119901)
  - difethialone (PC Code 128967)

- Non-anticoagulant[9]
  - bromethalin (PC Code 112802)
  - cholecalciferol (PC Code 202901)
  - zinc phosphide (PC Code 088601)

III. RESULTS/DISCUSSION

a. IDS (Incident Data System)

OPP's IDS includes reports of alleged human health incidents from various sources, including mandatory Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Section 6(a)(2) reports from registrants, other federal and state health and environmental agencies, and individual consumers. Since 1992, OPP has compiled these reports in IDS. IDS contains reports from across the U.S. and most incidents have all relevant product information recorded. Reports

[6] First-generation anti-coagulants rodenticides disrupt the production in the liver of vitamin K dependent blood-clotting factors II (prothrombin), VII, IX, and X.

[7] The second-generation anticoagulants rodenticides, like the first generation anticoagulants, block the formation of the active form of vitamin K, which in turn inhibits the production of coagulation factors in the liver. These are more acutely toxic than first generation agents and can cause lethal effects to rodents in a single dose.

[8]The non-anticoagulants rodenticides work in a variety of ways and no single common mechanism exists.

[9] Strychnine (PC code 076901) will be included in the strychnine DRA and is not included in this memorandum. However, a brief summary of incidents is provided here - The current IDS analyses from May 28, 2015 to January 6, 2020, one strychnine incident was reported to Main IDS and one strychnine incident was reported to Aggregate IDS. These incidents were classified as moderate and minor severity, respectively. The SENSOR-Pesticides analysis from 2012 to 2015, identified three incidents related to strychnine. Two of these incidents were moderate in severity and one incident was high in severity.

submitted to the IDS represent anecdotal reports or allegations only, unless otherwise stated in the report.

IDS records incidents in one of two modules: Main IDS and Aggregate IDS:

- Main IDS contains incidents resulting in higher severity outcomes and provides more detail with regard to case specifics. This system stores incident data for death, major and moderate incidents, and it includes information about the location, date and nature of the incident. Main IDS incidents involving only one active ingredient (as opposed to pesticide products with multiple active ingredients) are considered to provide more certain information about the potential effects of exposure from the pesticide.

- Aggregate IDS contains incidents resulting in less severe human incidents (minor, unknown, or no effects outcomes). These are reported by registrants only as counts in what are aggregate summaries.

Narrative information for fatal and major severity incident reported to IDS from 2012-2019 for all the rodenticides reviewed are included in Table A in the Appendix.

FIRST-GENERATION ANTICOAGULANTS

Chlorophacinone (PC Code 067707):

For the Main IDS, from January 1, 2015 to July 12, 2019, there was one incident reported for chlorophacinone in the database. This incident occurred in 2016 and involved multiple people who were potentially exposed to chlorophacinone when they passed through Standing Rock Sioux Tribe Reservation. Many people reported symptoms including cough, bloody nose, fatigue and coughing up blood. An EPA investigation found that chlorophacinone had been illegally distributed across 5,400 acres.[10] This incident was classified as minor to moderate severity.

In Aggregate IDS, from January 1, 2015 to July 12, 2019, there were no incident reported involving chlorophacinone.

Diphacinone (PC Code 067701):
For the Main IDS, from January 1, 2015 to July 12, 2019, there were 28 incidents reported that involved the active ingredient diphacinone. Of these 28 incidents, 26 incidents involved the single active ingredient diphacinone (only). Twenty-three of these incidents were classified as moderate severity and three incidents were classified as major severity. The other two diphacinone incidents reported involved multiple active ingredients.

For Aggregate IDS for the five years from January 1, 2015 to July 12, 2019, there were 180 incidents reported involving diphacinone. These incidents were classified as minor severity.

[10] https://bismarcktribune.com/news/state-and-regional/meyer-ranch-buffalo-under-quarantine-for-rozol-poison/article_7230182c-a174-51e2-88f8-b2977a936462.html?utm_medium=social&utm_source=email&utm_campaign=user-share

Diphacinone Sodium Salt (PC Code 067705):

For the Main IDS, from January 1, 2015 to July 12, 2019, there were no incidents reported for diphacinone sodium salt in the database.

In Aggregate IDS, from January 1, 2015 to July 12, 2019, there were 10 incidents reported involving diphacinone sodium salts. These incidents were classified as minor severity.

Warfarin (PC Code 086002):

There were no incidents reported to either Main or Aggregate IDS, from January 1, 2015 to July 12, 2019, warfarin.

Warfarin Sodium Salt (PC Code 086003):

There were no incidents reported to either Main or Aggregate IDS, from January 1, 2015 to July 12, 2019, warfarin sodium salt.

SECOND-GENERATION ANTICOAGULANTS

Brodifacoum

For the Main IDS, from January 1, 2015 to July 12, 2019, there were 15 incidents reported that involved the active ingredient brodifacoum. Of these 15 incidents, 13 incidents involved the single active ingredient brodifacoum (only). Twelve incidents were classified as moderate severity and one incident was classified as major severity. The other two brodifacoum incidents reported involved multiple active ingredients.

In Aggregate IDS, from January 1, 2015 to July 12, 2019, there 85 incidents reported involving brodifacoum. These incidents were classified as minor severity.

Bromadiolone

For the Main IDS from January 1, 2015 to July 12, 2019, there were eight incidents reported that involved the active ingredient bromadiolone. Of these eight incidents, five incidents involved the single active ingredient bromadiolone (only). These incidents were classified as moderate severity. The other three bromadiolone incidents reported involved multiple active ingredients. In Aggregate IDS, from January 1, 2015 to July 12, 2019, there 61 incidents reported involving bromadiolone. Three incidents were classified as having no or unknown effects and 58 incidents were classified as minor severity.

Difenacoum

From January 1, 2015 to July 12, 2019, there were no incidents reported involving difenacoum reported to either Main or Aggregate IDS.

Difethialone

For the Main IDS, from January 1, 2015 to July 12, 2019, there were no incidents reported involving difethialone.

In Aggregate IDS, from January 1, 2015 to July 12, 2019, there were seven incidents reported involving difethialone. Four incidents were classified as having no or unknown effects and three incidents were classified as minor severity.

NON-ANTICOAGULANTS

Bromethalin

For the Main IDS from January 1, 2015 to July 12, 2019, there were 37 incidents reported that involved the active ingredient bromethalin. Of these 37 incidents, 35 incidents involved the single active ingredient bromethalin (only). Thirty-one incidents were classified as moderate severity, two incidents were classified as major severity and two incidents resulted in death. These two death incidents were suicides. The other two triallate incidents reported involved multiple active ingredients.

In Aggregate IDS, from January 1, 2015 to July 12, 2019, there were 195 incidents reported involving bromethalin. These incidents were classified as minor severity.

Cholecalciferol

For the Main IDS, from January 1, 2015 to July 12, 2019, there was one incident reported involving cholecalciferol that resulted in a death. Further review of this incident indicates that the incident is most likely not due to cholecalciferol exposure. In Texas in 2019, a 52-year old female became intoxicated and fell down three steps and may have hit her head. Her husband also suspects that she may have ingested the product. There is no further information available.

In Aggregate IDS, from January 1, 2015 to July 12, 2019, there were eight incidents reported involving cholecalciferol. These incidents were classified as minor severity.

Zinc Phosphide

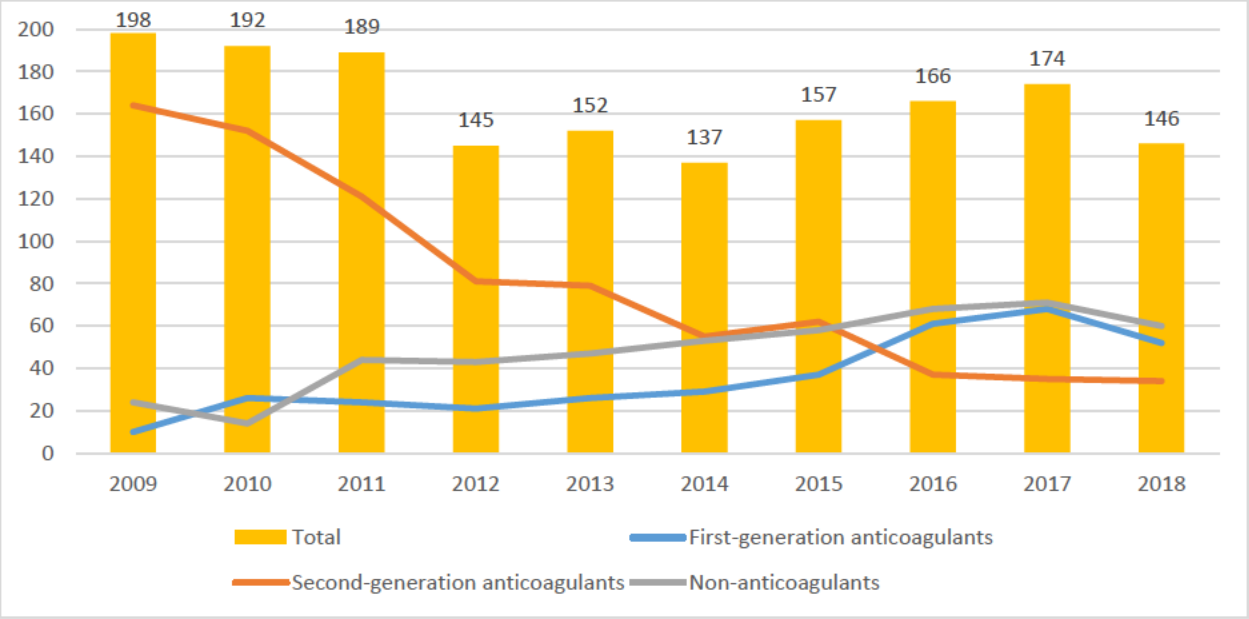
For the Main IDS for the five years from January 1, 2015 to July 12, 2019, there were nine incidents reported that involved the active ingredient zinc phosphide. Of these nine incidents, eight incidents involved the single active ingredient zinc phosphide (only). Seven incidents were classified as moderate severity and one incident was classified as major severity. The other zinc phosphide incident reported involved multiple active ingredients.

In Aggregate IDS, from January 1, 2015 to July 12, 2019, there were 15 incidents reported involving zinc phosphide. These incidents were classified as minor severity.

RODENTICIDE IDS INCIDENT TRENDS

As a result of the previously mentioned 2008 RMD mitigations, exposures to second-generation rodenticides and total rodenticide incidents were expected to decrease over time.[11] OPP reviewed the annual trend of total rodenticide incidents, first-generation anticoagulant incidents, second-generation anticoagulant incidents and non-anticoagulant incidents reported to Main and Aggregate IDS from 2009 to 2018. The total number of rodenticide incidents appears to be decreasing slightly from 198 incidents in 2009 to 146 incidents reported in 2018. The number of second-generation anticoagulant incidents has decreased by 79% from 164 incidents in 2009 to 34 incidents in 2018. First-generation anticoagulant incidents and non-anticoagulant incidents both increased over this time period by 60% and 81% respectively. This may be the result of non-anticoagulants and first-generation anticoagulant rodenticides having replaced the second-generation anticoagulants for residential consumer use.

Figure 1. Total Rodenticide Incidents, First-generation anticoagulants, First-generation anticoagulants, and Non-anticoagulant Incidents Reported to Main and Aggregate IDS from 2009 to 2018.



b. American Association of Poison Control Centers (AAPCC)

The American Association of Poison Control Centers (AAPCC) is a non-profit, national organization founded in 1958 that represents the poison control centers of the United States and

[11] First-generation anticoagulants increased from 10 incidents in 2009 to 52 incidents in 2018. Non-anticoagulant incidents increased from 24 incidents in 2009 to 60 incidents in 2018

the interests of poison prevention and treatment of poisoning. All of the calls to a poison control center are managed by a medical professional trained to answer questions about poisons. The American Association of Poison Control Centers (AAPCC) produces an annual summary report giving statistics and information on all the poisonings reported to PCCs in a calendar year.

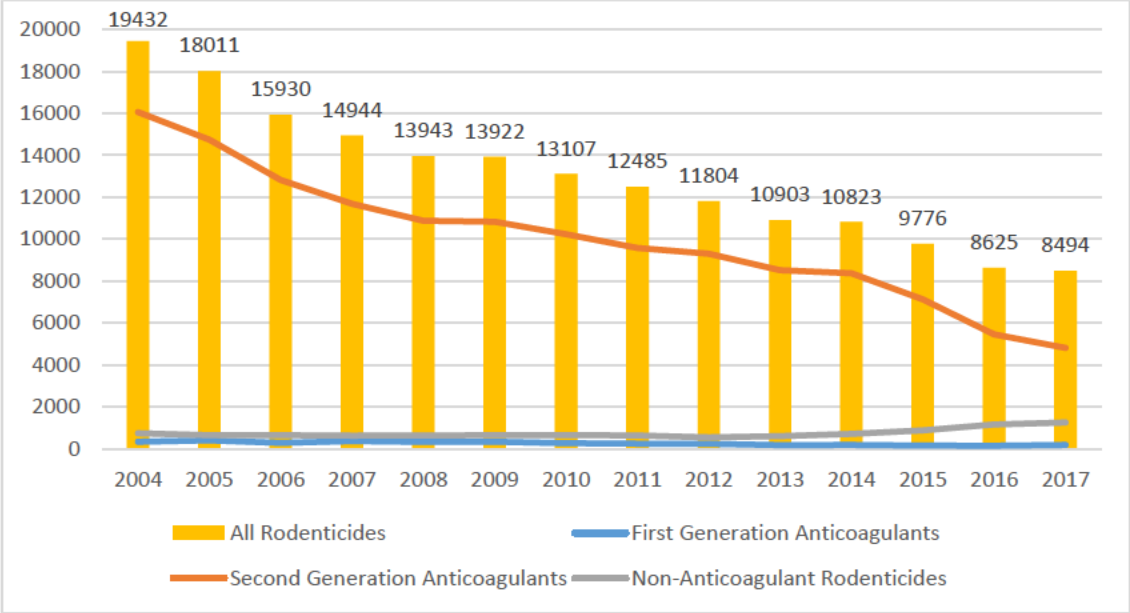
1. AAPCC Annual Report Trends

AAPCC data was previously reviewed by HED for the 2011 human incidents report (S. Recore, D395567, 10/28/2011) analyzing exposure to commensal rodenticides. AAPCC Incidents from 1999-2009 were reviewed. HED found that approximately 16% of all reported exposures to pesticides are due to rodenticide exposures and 26% of all reported pesticide-related exposures to children under 6 are due to rodenticide exposures.

In the current analysis, the AAPCC annual reports are available through year 2017. The phase-out of the remaining non-compliant products began in June 2014 and was complete as of March 31, 2015. HED believes there is enough information available to determine if the mitigations have impacted the frequency of incidents occurring.

A review of the number of incidents associated with rodenticides was conducted. Overall, the total number of rodenticide incidents reported to AAPCC has been declining steadily since 2004 with 19,432 rodenticide incidents reported in 2004 and 8,494 incidents reported in 2017 (Figure 2). First generation anticoagulant rodenticides decreased from 337 incidents in 2004 to 187 incidents in 2017. The second-generation anticoagulants incidents were slowly declining from 2004 to 2015 with a larger reduction in reported incidents in 2016 and 2017. There has been an increase in the number of incidents associate with non-anticoagulant products. These incidents increase from 600 incidents in 2013 to 1,252 incidents in 2017.

Figure 2. First-Generation Anticoagulant Rodenticides, Second-Generation Anticoagulant Rodenticide, Non-Anticoagulant Rodenticides, and Total Rodenticide Incidents Reported to AAPCC from 2004 to 2017.



2. Children's Rodenticide Exposure

As previously stated, the 2008 RMD included risk mitigation measures requiring rodenticide products used in homes and marketed to general residential consumers be sold only with bait stations and second-generation anticoagulants were no longer allowed for residential consumer products. Most rodenticide products complied with the mitigation measures required in the RMD as of June 4, 2011. The phase out production of the final 12 non-compliant products began in June 2014 and production of these products stopped on December 31, 2014. Distribution to retailers ended March 31, 2015.

AAPCC data was reviewed for reduction in reported rodenticide incidents in children under the age of six years old. The baseline year for this annual incident review is 2011 which was the beginning of the mitigation implementation. In 2011 there were 11,674 reported rodenticide incidents among children under the age of six. Reports of children's exposures to rodenticides have decreased every year since then. In 2017[12], there were a total of 6,307 incidents reported for children under the age of six. A comparison of child rodenticide exposures from 2011 to 2017 identifies a 46% decline in child rodenticide incident reports.

3. AAPCC Publication on Bromethalin Exposure Incidents

In addition to the summary data reported in AAPCC's Annual Report, Feldman et al. (2019) conducted a more focused analysis of bromethalin exposures reported to the AAPCC's National Poisoning Data System (NPDS) during 2008 to 2017.[13] The investigators were specifically interested in bromethalin because of OPP's risk mitigation and the shift from long-acting

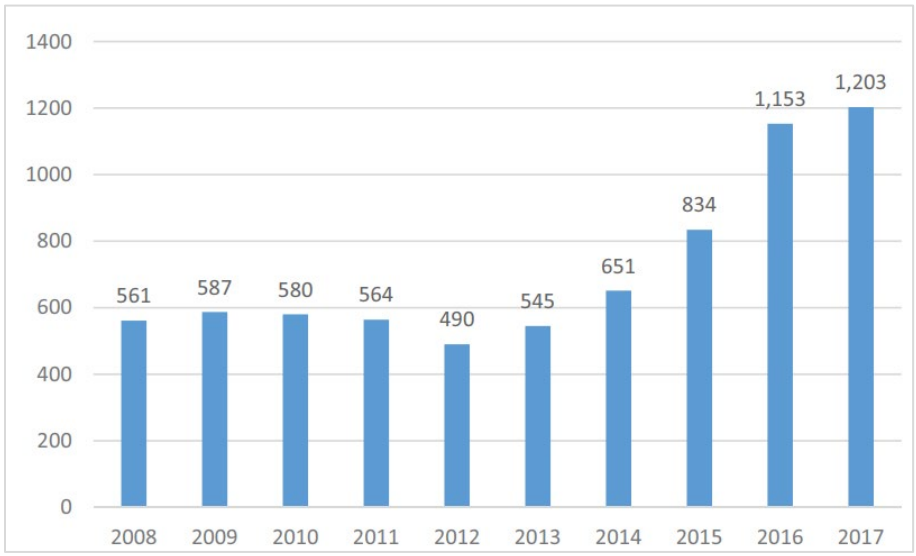
[12] At the time of this report, the most recent AAPCC annual report is for 2017.

[13] Feldman R, Stanton M, Borys D, Kostic M and Gummin D (2019). Medical outcomes of bromethalin rodenticide exposures reported to US poison centers after federal restriction of anticoagulants. Clinical Toxicology, 2019 Mar 20:1-6. doi: 10.1080/15563650.2019.1582776. [Epub ahead of print]

anticoagulants to bromethalin and other non-anticoagulant rodenticides. As such, the investigators first characterized AAPCC exposure incidents involving only bromethalin and then assessed the severity of medical outcomes in exposed children and adults.

Feldman et al.'s characterization of AAPCC bromethalin incidents is excerpted in Figure 3 and provides a summary of the annual number of calls reported to NPDS during 2008 to 2017. As shown, the total number of bromethalin exposure incidents increased from 561 incidents in 2008 to 1,203 includes in 2017, representing a 114% increase.

Figure 3. Annual calls to U.S. Poison Centers for bromethalin exposures. Excerpted from Feldman et al. (2019).



The total number of bromethalin exposure incidents summarized in Figure 3 includes 7,140 single or multi-substance bromethalin incidents. When restricted to incidents that only involved bromethalin and were followed to a known medical outcome, there were 2,674 exposure incidents that were further evaluated by Feldman et al. (2019) based on the age of the exposed individual and severity of reported symptoms. With respect to young children, the investigators reported that 2,157 of these 2,674 exposure incidents involved children less than six-years old. (81%). None of these pediatric exposures resulted in death or major effects and 6 (0.28%), 72 (3.34%), and 2,079 (94.93%) resulted in moderate, minor, or no effects, respectively.

Feldman et al. (2019) also reported narrative information on three major effect incidents and two fatalities. These incidents all involved adults and suggest that the exposed individuals intentionally ingested bromethalin.

In characterizing their findings, the investigators highlight that the data should be interpreted with caution because AAPCC-NPDS data is obtained passively through calls to PCCs and only includes patients followed to known health outcomes. There is also no information on use rates of different products, which makes it difficult to fully interpret trends. While the investigators note these limitations, they concluded that overall the data suggest that unintentional bromethalin

exposures reported to AAPCC's had a low incidence of clinical effects. The investigators also indicate that, "no major effects or deaths were seen in pediatric exposures" and "a majority of the possible bromethalin exposures involving adults reported to poison centers resulted in minor or no effects, though seizures, death and one questionable case of coagulopathy were documented."

c. Post-Mitigation Incident Trends

As previously stated, the 2008 RMD included risk mitigation measures requiring rodenticide products used in homes and marketed to general residential consumers be sold only with bait stations. In addition, the second-generation anticoagulants – brodifacoum, bromadiolone, difenacoum, and difethialone – were no longer allowed for residential consumer products. Most rodenticide products complied with the mitigation measures required in the RMD as of June 4, 2011. The phase out production of the final 12 non-compliant products began in June 2014 and production of these products stopped on December 31, 2014. Distribution to retailers ended March 31, 2015.

In both IDS and AAPCC trends, the second-generation anticoagulants (i.e. long acting anticoagulant rodenticides) incidents reported declined over time. Over the time period reviewed, the number of second-generation anticoagulant incidents reported IDS (2008-2018) decreased by 79% and the number of second-generation anticoagulant incidents reported to AAPCC (2004 to 2017) decreased by 70%. Second-generation anticoagulant incidents reported are expected to continue to decline because second-generation anticoagulant rodenticides are no longer registered for use in products marketed to residential consumers.

In both IDS and AAPCC non-anticoagulant incident reports increased over time. Over the time period reviewed, the number of non-anticoagulant incidents reported to IDS (2008 to 2018) increased 81% and the number of incidents reported to AAPCC (2004 to 2017) increased by 76%. This may be the result of non-anticoagulants having replaced the second-generation anticoagulants for residential consumer use.

AAPCC data was also reviewed for reduction in reported rodenticides incidents in children under the age of six years old. A comparison of child rodenticide exposures from 2011 to 2017 identifies a 46% decline in child rodenticide incident reports.

Overall the total number of rodenticide incidents reported to both IDS and AAPCC appears to be decreasing over time.

In addition, Feldman et al. (2019) conducted a more focused analysis of bromethalin exposures reported to the AAPCC's National Poisoning Data System (NPDS) during 2008 to 2017. The investigators were specifically interested in bromethalin because of OPP's risk mitigation and the shift from long-acting anticoagulants to bromethalin and other non-anticoagulant rodenticides.

With respect to young children, the investigators report that 2,157 of these 2,674 exposure incidents involved children less than six-years old. (81%). None of these pediatric exposures resulted in death or major effects and 6 (0.28%) 72 (3.34%), and 2,079 (94.93%) resulted in moderate, minor, or no effects, respectively.

While the investigators note these limitations, they conclude overall that the data suggest that unintentional bromethalin exposures reported to AAPCC's had a low incidence of clinical effects.

II. Review of Occupational Incidents

a. SENSOR-Pesticides (2011-2015)

The Center for Disease Control's National Institute for Occupational Safety and Health (CDC/NIOSH) manages a pesticide surveillance program and database entitled the Sentinel Event Notification System for Occupational Risk (SENSOR)-Pesticides.[14] All cases must report at least two adverse health effects. Evidence for each case is evaluated for its causal relationship between exposure and illness based on the NIOSH case classification index.[15] Using standardized protocol and case definitions, SENSOR-Pesticides state coordinators, operating out of the state's department of health, receive state pesticide incident reports from local sources, then follow up with case sources to get incident scenario to obtain medical records and verify exposure scenario information.[16] This database includes pesticide illness case reports from multiple states from 1998-2015.[17]

A query of SENSOR-Pesticides from 2011-2015[18] identified a total of 69 cases involving rodenticides. Of these, 48 cases were residential exposures and 21 cases were occupational exposure scenarios. For the purposes of this memo, the occupational SENSOR-Pesticides cases are analyzed, whereas the residential cases will not be. The residential rodenticide exposure scenarios and trends for recent years have been characterized in detail in the above IDS and NPIC portions of this memo. Further, the incidents in SENSOR-Pesticides from 2011-2015 predate the rodenticide mitigation measures which focused on improving homeowner protections, primarily for children. These mitigations were announced in 2008 but were not fully implemented until 2015; thus homeowner incident trends post-mitigation cannot be analyzed in the current SENSOR dataset. HED will continue to monitor the rodenticides incidents in SENSOR-Pesticides when newer data years are provided to EPA from NIOSH.

As a NIOSH-led program, the SENSOR-Pesticides provides valuable depth of detail on circumstances of occupational pesticide incidents; which are evaluated by NIOSH to ensure reported incidents are related to an exposure, and all SENSOR-Pesticides incidents must report at least two adverse health effects; asymptomatic cases are not included in this dataset.
The 21 occupational incidents have been analyzed here in order to provide characterization of occupational incident exposure scenarios. Table B in the Appendix provides narrative information for all 21 occupational cases.

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[14] SENSOR-Pesticides webpage: http://www.cdc.gov/niosh/topics/pesticides/overview html.
[15] https://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef.pdf
[16] https://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sevindexv6.pdf
[17] Currently participating states are: California, Florida, Illinois, Louisiana, Michigan, Nebraska, New Mexico, North Carolina, Oregon, Texas and Washington. The participating states for a given year vary depending on state and federal funding for pesticide surveillance.
[18] As of the writing of this memo in January 2020, the most current year of SENSOR-Pesticides data provided to EPA by NIOSH is 2015.

Of the 21 occupational cases, one case was high in severity, five cases were moderate in severity, and 15 cases were low in severity. Ten cases sought care in an ER or hospital; and 11 cases contacted poison control for treatment and guidance (all 11 cases that contacted poison control were low in severity).

The high severity case applied ZP Tracking Powder (EPA Reg. No. 12455-16), a restricted-use product (RUP). He later experienced chest pain, throat irritation, nausea, profuse sweating, and went to the ER where he was diagnosed with myocardial infarction. This case was in the hospital for five days.

The majority of the cases were handling a zinc phosphide product when exposed (n=13). Most cases were exposed to either granular (n=10) or pelleted (n=6) product formulations. The majority of cases experienced inhalation exposure (n=17) or dermal exposure (n=6).[19] Several veterinary workers were exposed secondarily when treating dogs that had ingested zinc phosphide product.

Occupational exposure scenarios for the 21 occupational cases were as follows:

- 12 cases were applying products when they were exposed, including:
  - 10 cases who were applying rodenticide products, primarily zinc phosphide pellets, manually; and
  - Two were applying with hand-held equipment
- Five cases were veterinarians or vet techs exposed to zinc gas after treating dogs that had ingested zinc phosphide
- One case was a retail worker who inhaled powder while cleaning a spill of gopher bait
- One case was an agricultural worker who encountered rat bait dust when cleaning out a barn
- In one case, an untrained applicator mixed two products together improperly and was exposed.
- In one case, the type of occupational exposure was unknown.

The health effect most frequently reported among the 21 occupational rodenticide cases was nausea, followed by: altered taste (metallic or chemical taste), vomiting, upper respiratory pain/irritation, and shortness of breath.

State SENSOR-Pesticides Data

Additional state-level SENSOR-Pesticides incident data for occupational rodenticide cases was provided to HED by the Texas Department of State Health Services. Texas is an active participant in the SENSOR-Pesticides program. Texas reported four occupational rodenticide incidents from 2015-2017. Two cases involved exposure to a warfarin product (this product was cancelled in 2017), one case involved a bromethalin product, and one case involved a diphacinone product. Two cases were handling rodenticide products in the workplace and got

[19] Cases may report multiple routes of exposure.

product on their skin; in both cases dermal symptoms were reported. In one of the dermal exposure cases, the case was handling a diphacinone product and he accidentally placed his hand on his mouth. He reported skin irritation and burning around his mouth. The other two cases were handling rodenticide products at work and got product in their eyes and reported ocular symptoms. One of the ocular exposure cases was a warehouse worker who was pulling down a bag of Trounce rat pellets and the dust got into his eyes.

b. California Pesticide Illness Surveillance Program (PISP) (2012-2016)

The Pesticide Illness Surveillance Program (PISP) maintains a database of pesticide-related illnesses and injuries. Case reports are received from physicians and via workers' compensation records. The local County Agricultural Commissioner investigates circumstances of exposure. Medical records and investigative findings are then evaluated by DPR technical experts and entered into an illness registry.

PISP contains both residential and occupational pesticide incidents. PISP has limited coverage (only California) and is therefore not useful for identifying national trends over time. However, the incident information is entered by professionals with expertise in pesticides who extensively follow-up on each reported case, establishing a high degree of confidence in the information provided for each reported incident. As with SENSOR-Pesticides, only the occupational rodenticide incidents reported to PISP have been analyzed for this memo.

A query of PISP from 2012-2016 for all rodenticide active ingredients identified nine occupational cases. Six of the nine occupational cases involved exposure to zinc phosphide. Seven cases were applying a product when they were exposed, one case was an accidental ingestion from a daycare worker, and one case was a retail store workers who became ill when cleaning up a spill. Nausea and vomiting, followed by sore throat, were the most frequently reported symptoms among the PISP cases. Table C in the Appendix provides a table describing these nine occupational rodenticide incidents.

c. Main IDS (2015-2019)

Main IDS from 2015 – 2019 identified two occupational incidents. The first incident report occurred in 2016 and was major in severity. This case was exposed to zinc phosphine gas at work when he went into a walk-in freezer that was storing cabbage baits that had been treated with the product. Later that day, they experienced a headache. A week later when the employee returned to work, he experienced headache, double vision, vertigo and memory lapses.

The second case occurred in 2019 and was major in severity. This case was a pregnant employee who was in a company vehicle for about 6 hours/day for her entire pregnancy and before she was pregnant as well. She noticed a foul odor and developed a headache. She suspected she was inhaling the fumes from the product so she opened the hood of the vehicle and found 12 packages of the rodenticide glued to the hood. The product was a diphacinone product. She requested two new vehicles, both of which also had the diphacinone rodenticides glued on the engine hoods. This case delivered a baby girl who was anemic and jaundiced. The daughter was also Coombs positive. The Coombs' test is used to detect the presence of antibodies which

indicates the condition of hemolytic anemia. The product that was placed in the vehicle was Tomcat Rat & Mouse Bait; EPA Reg. # 12455-83. The 6a2 report indicated this product was "discontinued"; however it is still actively registered. The label does allow for its use in "transport vehicles" such as ships, trains and aircraft. The label is silent on automobiles. However, the label also states "Do not place near or inside ventilation duct openings."

d. Occupational Incident Summary

Overall, there was a low frequency of occupational incidents reported in SENSOR-Pesticides, California PISP, and Main IDS. In SENSOR-Pesticides, most occupational case reports were low in severity (PISP does not assign severity). However, there were three occupational exposure incident reports that were major or high in severity. One high severity case was reported in SENSOR-Pesticides which involved exposure to zinc phosphide, and two major severity incidents were reported in Main IDS, one involved zinc phosphide and the other involved exposure to diphacinone. The high severity case in SENSOR-Pesticides applied ZP Tracking Powder (EPA Reg. No. 12455-16), a restricted-use product (RUP). He later experienced chest pain, throat irritation, nausea, profuse sweating, and went to the ER where he was diagnosed with myocardial infarction. This case was in the hospital for five days.
The high severity zinc phosphide occupational incident in Main IDS was exposed when he went into a walk-in freezer that was storing cabbage baits that had been treated with the product. Later that day, the case experienced headache. A week later when the employee returned to work, he experienced headache, double vision, vertigo and memory lapses. The high severity diphacinone incident involved a pregnant female employee driving company vehicles that had diphacinone products glued in the vehicle. She experienced headache and nausea and delivered a baby with hemolytic anemia.

In both the SENSOR-Pesticides and PISP datasets, most occupational case reports involved symptomatic exposures to a zinc phosphide product (62% and 67%, respectively); primarily during the manual application of the product by the case.

IV. CONCLUSION

In order to minimize exposure to rodenticide products by children and wildlife, the 2008 Risk Mitigation Decision (RMD) for Ten Rodenticides included risk mitigation measures requiring rodenticide products used in homes and marketed to general residential consumers be sold only with bait stations (May 28, 2008).[20] One mitigation measure in the 2008 RMD was to prohibit the use of four second-generation anticoagulants – brodifacoum, bromadiolone, difenacoum, and difethialone – in residential consumer products. Most rodenticide products complied with the mitigation measures required in the RMD as of June 4, 2011. The phase out production of the final 12 non-compliant products began in June 2014 and production of these products stopped on December 31, 2014. Distribution to retailers ended March 31, 2015.

HED reviewed incident trends over time in both IDS and AAPCC. In IDS, first-generation anticoagulant incidents increased by 60% from 10 incidents in 2009 to 52 incidents in 2018. In AAPCC, first-generation anticoagulant incidents decreased over time from 337 incidents in 2004

[20] https://www.regulations.gov/document?D=EPA-HQ-OPP-2006-0955-0764

to 187 incidents in 2017. In both databases, the second-generation anticoagulants (i.e. long acting anticoagulant rodenticides) incident reports have declined over time. Over the time period reviewed, the number of second-generation anticoagulant incidents reported IDS (2008-2018) decreased by 79% and the number of second-generation anticoagulant incidents reported to AAPCC (2004 to 2017) decreased by 70%. Second-generation anticoagulant incidents reported are expected to continue to decline because second-generation anticoagulant rodenticides are no longer registered for use in products marketed to residential consumers.

In both IDS and AAPCC non-anticoagulant incident reports increased over time. Over the time period reviewed, the number of non-anticoagulant incidents reported to IDS (2008 to 2018) increased 81% and the number of non-anticoagulant incidents reported to AAPCC (2004 to 2017) increased by 76%. This may be the result of non-anticoagulants having replaced the second-generation anticoagulants for residential consumer use.

Overall, in the AAPCC data, reports of children's exposure to all rodenticides continues to decline over time. Further, although the reports of non-anticoagulant incidents reported have increased somewhat, overall, the frequency of all rodenticide incidents combined appears to be decreasing in both IDS and AAPCC.

With regard to the occupational rodenticide exposure incidents; there was a low frequency of occupational incidents reported in SENSOR-Pesticides, California PISP, and Main IDS. However, there were three occupational exposure incident reports that were major or high in severity.

In SENSOR-Pesticides, most occupational case reports were low in severity. PISP does not assign severity. In both the SENSOR-Pesticides and PISP datasets, most occupational case reports involved exposures to a zinc phosphide product (62% and 67%, respectively); primarily during the manual application of the product by the case. Case by case narrative descriptions for all the incidents reviewed for Main IDS, SENSOR-Pesticides, and California PISP are provided in the three tables in the Appendix.

Appendix

Table A. Commensal Rodenticide Death and Major Severity Incident Reported to IDS from January 1, 2015 to July 12, 2019								
Incident Package Report	**Incident Date**	**Location**	**Reg Number**	**Product Name**	**PC Code**	**Ingredient Name**	**Exposure Severity**	**Incident Description**
028692 - 00001	2/2/2016	WV	061282-00046	RAMIK GREEN	067701	Diphacinone	Major	Accidental ingestion of pellet by an 80-year-old male with Alzheimer's.
029067 - 00002	6/1/2016	VINTON, LA	012455-00005-003240	TOMCAT ALL-WEATHER BAIT CHUNX	067701	Diphacinone	Major	A 65-year-old male used the product around his property for 2-3 months. He did not wear gloves but did wash his hands immediately after use. After using the products for his arthritis started flaring up and his wrists were swollen and sore.
032147 - 00002	1/22/2019	PAYSON, AZ	012455-00083-003240	TOMCAT RAT & MOUSE BAIT PLACE PAC (DISCONTINUED)	067701	Diphacinone	Major	A pregnant adult female was in a company vehicle for about 6 hours/day for her entire pregnancy and before she was pregnant. The product had been glued inside the hood and on the engine of the vehicle. Following her moths of exposure to the product, she delivered a baby girl who was anemic and jaundiced. The daughter is also COOMBS positive.
027563 - 00001	2/7/2015	FRITCH, TX	003282-00066	D-CON BAIT PELLETS	112701	Brodifacoum	Major	A 53-year-old male potentially ingested product.
028237 - 00001	11/16/2015	ROANOKE, VA		BROMETHALIN (NON-SPECIFIC)	112802	Bromethalin	Death	Suicide
028362 - 00001	12/1/2015	TROY, NY	012455-00123-003240	TOMCAT MOUSE KILLER II	112802	Bromethalin	Major	Suicide attempt
031433 - 00001	9/9/2018	TX	090780-00010	TOMCAT MOUSE KILLER CHILD & DOG RESISTANT, REFILLABLE STATION	112802	Bromethalin	Death	Suicide
031549 - 00001	6/18/2018	CEDAR HILL, TX	012455-00095	F-TRAC ALL-WEATHER BLOX	112802	Bromethalin	Major	A 78-year-old female was hospitalized and was experiencing abdominal pain, vomiting, abdominal distention, constipation, low grade fever, vomiting, stroke, hallucinations, and shakiness. Caller was unsure if patient had

Table A. Commensal Rodenticide Death and Major Severity Incident Reported to IDS from January 1, 2015 to July 12, 2019								
Incident Package Report	**Incident Date**	**Location**	**Reg Number**	**Product Name**	**PC Code**	**Ingredient Name**	**Exposure Severity**	**Incident Description**
								contact with the product. At the time of call no diagnosis had been made.
032006 - 00001	2/10/2019	TX	007969-00383-003282	D-CON XVI KILLS HOUSE MICE REFILLABLE BAIT STATION CORNER FIT STATON + 20 BAIT POUCHES	202901	Cholecalciferol	Death	A 52-year-old female died. The night before she was intoxicated, fell down three steps and may have hit her head. Her husband also suspects that she may have ingested the product.
029628 - 00001	11/14/2016	FORT COLLINS, CO	056228-00006	ZINC PHOSPHIDE CONCENTRATE	088601	Zinc phosphide (Zn3P2)	Major	An adult was exposed to phosphine gas at work when he went into a walk-in freezer that was storing cabbage baits that had been treated with the product. Later that day, they experienced a headache. A week later when the employee returned to work, they experienced headache, double vision, vertigo and memory lapses.

Table B. Occupational Rodenticide Incidents Reported to SENSOR-Pesticides 2011-2015							
Case ID	**Year**	**Severity**	**Case Narrative**	**Medical Diagnosis or Notes (doctor or PCC)**	**Product**	**Reg #**	**PC Code**
LA04651	2015	high	Patient went to the ER & symptomatic; had placed some ZP tracking powder for rats and woke up feeling if he could cough and clear his throat, he would feel better- was admitted to hospital.	chest pain; throat irritation; nausea; diaphoresis; hypertensive; myocardial infarction	ZP tracking powder - Restricted use product	12455-16	088601
CA22815	2015	low	Farmworker was spreading Rozol pocket gopher bait and began vomiting.	exposure to rodenticide	Rozol pocket gopher bait ii	7173-244	067707
TX07298	2014	moderate	Exterminator was mixing products and forgot to put away his food prior to application	accidental ingestion, muscle weakness	D-con bait pellets	3282-86	128967
WA01129	2014	moderate	Patient breathed in fumes from a mixture containing zinc phosphide pellets. The fume inhalation resulted in respiratory, ocular, and neurological symptoms.	acute exposure to phospine gas	Amdro mole & gopher bait	12455-30	088601
TX06853	2014	moderate	Workplace exposure	PCC notes: reports 1st degree burns on 10-12% of his neck/torso/genital area	K-rat	1769-91	086002
WA01149	2014	low	Vet tech exposed to dog's vomit; Immediately experienced burning eyes	Felt chemical. Huge headache. Vision changes for a few minutes, a couple of hours after as she looked at computer screen.	Sweeney's poison peanuts mole & gopher bait ii	149-16	088601

Table B. Occupational Rodenticide Incidents Reported to SENSOR-Pesticides 2011-2015							
Case ID	**Year**	**Severity**	**Case Narrative**	**Medical Diagnosis or Notes (doctor or PCC)**	**Product**	**Reg #**	**PC Code**
WA01484	2014	low	Vet tech exposed to dog's vomit		Sweeney's poison peanuts mole & gopher bait	149-16	088601
NY02761	2014	low	Male applied tracking powder for rats. The next morning he felt fatigued, loss of appetite, and muscle weakness. He inhaled product during application.	loss of appetite, muscle weakness, fatigue	ZP tracking powder - RUP	12455-16	088601
CA22074	2014	low	Inhaled some powder while cleaning up a spill of gopher bait.	chemical inhalation	Acme gopher killer	12455-30	088601
OR02649	2013	low	Reports he accidently ingested a few granules of the zinc phosphide he was putting down for gopher traps.		Hopkins zinc phosphide pellets	61282-49	088601
CA21012	2013	low	While filling rodent traps around the school, inhaled dust/vapor of pelleted rodent bait and reported symptoms.	irritation, pharynx			067701
WA00605	2012	low	After mixing a concentrated solution of an insecticide at a customer's house, a 51 y/o licensed PCO wiped his eyes with his glove and got some of the product in his eyes. He experienced ocular symptoms; went to the ER	chemical exposure to both eyes, chemical conjunctivitis			112001
NE00029	2012	moderate	She was sprinkling zinc phosphide from a 4wheeler and whenever they would hit a bump it would puff out of the bucket. She was wearing a dust mask.		Zinc phosphide	8612-4048	088601

Table B. Occupational Rodenticide Incidents Reported to SENSOR-Pesticides 2011-2015							
Case ID	**Year**	**Severity**	**Case Narrative**	**Medical Diagnosis or Notes (doctor or PCC)**	**Product**	**Reg #**	**PC Code**
TX07112	2012	low	A pesticide operator was handling powdered rat poison and he feels he might have inhaled some, got some on his skin and hands. Now he has headache, sinus problems and hang over feeling. He felt dizzy yesterday after donating blood.		Zinc phosphide rat poison	6704-36	088601
CA20522	2012	low	Handled gopher poison pellets after they had been put into a gopher hole and gotten wet. (gloves not required on label)	gopher poison exposure	Sweeney's poison peanuts mole & gopher bait ii	149-16	088601
TX07192	2012	low	case accidently sprayed wrong product with Detour for rodents.		K-rat	1769-91	086002
MI02599	2011	low	Cleaning a barn, believes he may have swallowed some rat bait dust.	headache, nausea, vomiting. PCC, ER	D-con ready mixed kills rats and mice	3282-04	086002
OR02148	2011	low	Veterinary worker/veterinarian was exposed to zinc gas from a dog that had ingested zinc phosphate rodenticide & vet team gave enema.				088601
OR02149	2011	low	Veterinary worker/veterinarian was exposed to zinc gas from a dog that had ingested zinc phosphate rodenticide & vet team gave enema.				088601
WA00253	2011	low	It was an acute toxic case for the dog. Owners had no idea what she got into. They later brought in the pesticide. Case wanted to make sure the vomit smelled like food- it's a good diagnostic tool. It can off-gas. Dog owners		Gopha-rid	12455-30	088601

Table B. Occupational Rodenticide Incidents Reported to SENSOR-Pesticides 2011-2015							
Case ID	**Year**	**Severity**	**Case Narrative**	**Medical Diagnosis or Notes (doctor or PCC)**	**Product**	**Reg #**	**PC Code**
			mentioned mole-rid product they had applied about 2 weeks earlier; maybe dog had gotten into it.				
TX06727	2011	moderate	Case was working with several pesticides 2-3 days prior to his symptoms and inhaled fumes.	Lungs on fire constantly. Last two days chest hurts, burning sensation and pressure through the back. Cough	Bromethalin rat & mouse block	47629-11	112802

Table C. Occupational Rodenticide Incidents Reported to California Pesticide Illness Surveillance Program (PISP) 2012-2016						
Year	**Case Number**	**Ag/ Non-Ag**	**Pesticide**	**Activity**	**Medical Description**	**Narrative Description**
2012	83	Non-Ag	Zinc Phosphide	Other	Dizziness, nausea, intermittent faintness, pallor within 5 minutes of exposure.	A gardener applied a gopher bait for two of his clients. The problem persisted, so he put his ungloved hand in the hole to take a picture to show to a pest control company. He developed symptoms, called poison control and was advised to seek care.
2012	227	Non-Ag	Zinc Phosphide	Routine Indoor	Repeated vomiting, starting within two hours of ingestion. At the hospital, the only abnormal observations were low potassium level and some non-specific abnormalities seen on an ultrasound of the liver.	A 43-year old home daycare provider prepared zinc phosphide brought from Mexico by following some casual (not label) instructions. She then became distracted, & later that evening drank the orange juice in which she had dissolved the fumigant.
2013	567	Non-Ag	Zinc Phosphide	Applicator	Nausea and vomiting. He was observed overnight for concerns associated with his heart.	A man used a napkin to protect his skin while hand-applying a rodenticide in his shed but may have had dermal exposure to the product. About 8 hours later, he became ill and sought care. He was unable to identify the specific product he used by name.
2013	1423	Ag	Zinc Phosphide	Applicator	Dry and sore throat, dry mouth, nausea, vomiting, coughing, high fever, watery eyes. He smelled a strong garlic odor coming in the open windows and vents of the tractor's cab. He was still experiencing symptoms upon interview 2.5 months later.	A fieldworker mixed, loaded & applied zinc phosphide for 3 days & felt ill. He sought care on the third day. He continued working for a week until he was too ill to work. His employer did not provide a respirator as they were unaware it was required.
2014	199	Non-Ag	Diphacinone	Applicator	Sore throat and mild nausea. His medical examination showed no abnormalities. He felt fine two days later.	A school maintenance man regularly filled bait stations with rodenticide. One day, he didn't wear gloves while scooping the pellets with a cup. Two days later he became ill and was concerned he had inhaled rodenticide dust, so he sought care.

Table C. Occupational Rodenticide Incidents Reported to California Pesticide Illness Surveillance Program (PISP) 2012-2016						
Year	**Case Number**	**Ag/ Non-Ag**	**Pesticide**	**Activity**	**Medical Description**	**Narrative Description**
2014	1033	Non-Ag	Zinc Phosphide	Transport /Storage/ Disposal	Shortness of breath, lightheaded, and sore throat. He reported that he no longer had symptoms by the end of the following day.	A retail store worker found an open box of rodenticide and disposed of it. When he put the pesticide in the trash, he inhaled dust that came back up. He began to feel ill. He notified the store manager and sought care.
2014	1117	Non-Ag	Bifenthrin, Bromadiolone, Chlorfenapyr, Fipronil, Iron Phosphate, Permethrin	Applicator	Slight rash & redness along inside of left arm & on bilateral sides. 2 days later: rash persisted & new symptoms of dizziness, nausea, vomiting, slurred speech, blurred vision, tight hands, & shortness of breath. Relationship based on initial symptoms.	A structural pest control employee noticed a rash consistent with the straps of a backpack sprayer Friday night. He started to feel worse after work on Monday. No leaks were found but pesticide could have spilled on the straps. Several other pesticides were used as well.
2015	469	Ag	Zinc Phosphide	Applicator	Eye pain and irritation. He said he felt something hit his cheek below the left eye but was not sure if it was dust or the material he was applying. He rinsed his eye and showered.	A farm owner and certified applicator was applying rodenticide pellets to the edge of his field when a sudden gust of wind may have gotten some fine particulates at the bottom of his safety glasses. As a precaution, he sought care.
2015	1099	Ag	Chlorophacinone	Applicator	Nausea, vomiting, diarrhea, stomach ache, bad taste in the mouth.	A worker applied gopher bait in an orchard using a pocket gopher burrow builder attached to the back of a tractor. He developed symptoms the next day. He speculated that he may have been exposed while emptying the bag of bait into the hopper.