Executive Summary: Health Impact Review of SB 6529

Protecting agricultural workers and community members from pesticides
(2017-2018 Legislative Session)

Evidence indicates that SB 6529 has the potential to increase available pesticide use information and data, which in turn has potential to increase analyses of and improve understanding of pesticide application, inform policy change, influence application practices, reduce acute and chronic pesticide-related health outcomes, and decrease health disparities. The notification provisions included in SB 6529 would have unclear impacts on health and health disparities.

BILL INFORMATION

Sponsors: Senators Saldaña, Ranker, Cleveland, Rolfes, Van De Wege, Miloscia, Chase, Conway, McCoy, Hunt, Keiser, Hasegawa

Summary of Bill:

- Requires that application-specific pesticide use records be provided to Washington State Department of Health (DOH) on a monthly basis.
- Requires DOH to make pesticide use record data publicly available.
- Requires pesticide applicators to notify DOH four days prior to pesticide application by aerial, air-blast, or fumigation methods.
- Requires DOH to develop and maintain a list of individuals who request to receive notification of pesticide applications on adjacent properties.
- Requires DOH to notify all child day care centers (day care centers), schools, and individuals requesting notification within ¼ mile of the application site at least two hours before application occurs.
- Authorizes DOH to develop rules around the notification process and to assess a civil fine (up to $7,500) for certain violations.

HEALTH IMPACT REVIEW

Summary of Findings:

This Health Impact Review found the following evidence regarding the provisions in SB 6529:

Pathway 1: Pesticide use reporting

This review assumes that requiring pesticide applicators to submit application-specific pesticide use records to DOH on a monthly basis would result in records being submitted to and publicly published by DOH, which in turn would increase pesticide use data and information available to researchers, local health jurisdictions, policymakers, and other stakeholder groups. This informed assumption is based on discussions with staff from DOH, California Department of Pesticide Regulations (CDPR), and California Environmental Health Tracking Program (CEHTP).

- **Strong evidence that** publicly publishing application-specific pesticide use data would result in increased analyses and improved understanding of pesticide use, potential exposure, risk factors, and associated health outcomes.
- **A fair amount of evidence** that improved understanding would result in changes to and adoption of pesticide application policies and practices that reduce exposure.
- **Very strong evidence** that improved pesticide application policies and practices would result in reduced acute and chronic pesticide-related health outcomes.
- **Very strong evidence** that reduced acute and chronic pesticide-related health outcomes would result in reduced health disparities by occupation, race and ethnicity, and for sensitive populations like children and pregnant women.

Pathway 2: Application-specific notifications

- **Unclear impact** whether notifying day care centers, schools, and individuals requesting notification before an application event would result in reduced acute and chronic pesticide-related health outcomes.

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April 27, 2018

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Acknowledgement

We would like to thank the experts who provided consultation and technical support during this Health Impact Review.

Contents

List of Abbreviations

AHS	Agricultural Health Study
BMPs	Best Management Practices
CalEnviroScreen	California Communities Environmental Health Screening tool
CalEPA	California Environmental Protection Agency
CDPH	California Department of Public Health
CDPR	California Department of Pesticide Regulation
CEHTP	California Environmental Health Tracking Program
CHAMACOS	Center for the Health Assessment of Mothers and Children of Salinas
CHARGE	California Childhood Autism Risks from Genetics and Environment
Day care centers	child day care center
DHS/OHA	Department of Human Services and Oregon Health Authority
DNR	Washington State Department of Natural Resources
DOH	Washington State Department of Health
EPA	U.S. Environmental Protection Agency
FFDCA	Federal Food, Drug and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FTE	full-time equivalent
HUC	Hydrologic Unit Code
IBL	Information By Location
L&I	Washington State Department of Labor and Industries
LHJs	local health jurisdictions
MSFW	migrant and seasonal farmworkers
NAWS	National Agricultural Workers Survey
NIOSH	National Institute for Occupational Safety and Health
ODA	Oregon Department of Agriculture
OEHHA	Office of Environmental Health Hazards Assessment
OEPHS	Office of Environmental Public Health Sciences
OSHA	Occupational Safety and Health Administration
PMT	Pesticide Mapping Tool
PNASH	Pacific Northwest Agricultural Safety and Health Center
PRIA	Pesticide Registration Improvement Act of 2003
PLT	Pesticide Linkage Tool
PUR	Pesticide Use Reporting (California)
PURS	Pesticide Use Reporting System (Oregon)
The Panel	The President's Cancer Panel (2008-2009)
WPS	Worker Protection Standards
WSDA	Washington State Department of Agriculture
WTN	Washington Tracking Network

Introduction and Methods

A Health Impact Review is an analysis of how a proposed legislative or budgetary change will likely impact health and health disparities in Washington State (RCW 43.20.285). For the purpose of this review 'health disparities' have been defined as the differences in disease, death, and other adverse health conditions that exist between populations (RCW 43.20.270). This document provides summaries of the evidence analyzed by State Board of Health staff during the Health Impact Review of Senate Bill 6529 (SB 6529) from the 2017-2018 Legislative Session.

Staff analyzed the content of SB 6529 and created a logic model depicting possible pathways leading from the provisions of the bill to health outcomes. We consulted with experts and contacted stakeholders with diverse perspectives on the bill. State Board of Health staff can be contacted for more information on which stakeholders were consulted on this review. We conducted objective reviews of the literature for each pathway using databases including PubMed and Google Scholar.

Since there is limited research on the impacts of pesticide use reporting and pesticide application-specific notifications, we conducted key informant interviews to gather additional supporting evidence. In total, we conducted 18 key informant interviews, including 11 informants from pesticide regulatory and state agencies in California, Oregon, and Washington; 4 informants representing pesticide applicators and growers; 2 informants representing academia; and 1 informant representing farmworkers. We also spoke with 3 subject matter experts from Washington State Department of Health (DOH), Office of Environmental Public Health Sciences (OEPHS). A full list of key informant interviewees and subject matter experts is provided in Appendix A.

Interviews were conducted within time and process constraints. The primary intent of key informant interviews was to gather supporting evidence. Interviews also assisted with understanding different viewpoints, challenges, and benefits to the bill; however, we did not intend to gather all potential viewpoints. Interviewees were selected purposively, with emphasis on pesticide regulatory agencies, individuals who testified during the public hearings for SB 6529, and key researchers identified through the literature review. We identified further key informants using snowball methodology. While we followed-up with many of these recommendations, we were not able to contact all individuals due to time limitations. Therefore, results should not be construed as comprehensive or representative of all perspectives.

Interview questions were tailored to provide the most information, and focused on the benefits and challenges of pesticide use reporting and application-specific notifications. We took detailed notes during the conversations, and coded and analyzed these notes to identify themes. We then summarized these themes and incorporated salient results into the HIR document, as applicable. All results from key informant interviews are presented in summary by theme, and are not attributed to individual interviewees.

The following pages provide a detailed analysis of the bill including the logic model, summaries of evidence, and annotated references. The logic model is presented both in text and through a flowchart (Figure 1). The logic model includes information on the strength of the evidence for each relationship. The strength-of-evidence has been defined using the following criteria:

- **Not well researched:** the literature review yielded few if any studies or only yielded studies that were poorly designed or executed or had high risk of bias.
- **A fair amount of evidence:** the literature review yielded several studies supporting the association, but a large body of evidence was not established; or the review yielded a large body

of evidence but findings were inconsistent with only a slightly larger percent of the studies supporting the association; or the research did not incorporate the most robust study designs or execution or had a higher than average risk of bias.

- **Strong evidence:** the literature review yielded a large body of evidence on the relationship (a vast majority of which supported the association) but the body of evidence did contain some contradictory findings or studies that did not incorporate the most robust study designs or execution or had a higher than average risk of bias; or there were too few studies to reach the rigor of 'very strong evidence'; or some combination of these.
- **Very strong evidence:** the literature review yielded a very large body of robust evidence supporting the association with few if any contradictory findings. The evidence indicates that the scientific community largely accepts the existence of the association.

This review was subject to time constraints, which influenced the scope of work for this review. The annotated references are only a representation of the evidence and provide examples of current research. In some cases only a few review articles or meta-analyses are referenced. One article may cite or provide analysis of dozens of other articles. Therefore the number of references included in the bibliography does not necessarily reflect the strength-of-evidence. In addition, some articles provide evidence for more than one research question so they are referenced multiple times.

Analysis of SB 6529 and the Scientific Evidence

Summary of relevant background information

- Pesticides are regulated at the federal level by: Food Quality Protection Act (1996); Federal Insecticide, Fungicide and Rodenticide Act (FIFRA); Federal Food, Drug and Cosmetic Act (FFDCA); Pesticide Registration Improvement Act of 2003 (PRIA); U.S. Environmental Protection Agency (EPA) Pesticide Labeling; and 2015 Worker Protection Standards (WSP).
- In addition to federal regulations, Washington State also has a number of reporting and record-keeping requirements for pesticide applicators. Four state agencies are responsible for regulating and investigating pesticide use in Washington State:[1]
    - Department of Agriculture (WSDA) is responsible for adopting rules to require the registration and restrict the use of pesticides, to test and certify pesticide applicators, to issue handler and worker pesticide training documentation, and to provide technical assistance to pesticide applicators and workers.
    - Department of Health (DOH) is responsible for tracking and investigating pesticide-related illness and for providing technical assistance to health care providers and partner agencies.
    - Department of Labor and Industries (L&I), Division of Occupational Safety and Health (DOSH) is responsible for developing pesticide safety and health rules, and enforcing these rules by inspecting worksites for unsafe working conditions.
    - Department of Natural Resources (DNR) is responsible for pesticide application and notification on forest lands.
- WAC 16-228-1220 prohibits application of pesticides in a way that allows physical drift or volatilization resulting in damage to adjacent land, humans, desirable plants or animals.[2]
- RCW 17.21.420 authorizes and requires WSDA to maintain a list of medically pesticide-sensitive individuals. The agency must provide the list of individuals to pesticide applicators twice per year, and applicators are responsible for notifying individuals prior to application.[3]
- Currently in Washington State, there are no exclusion zones for agricultural pesticide application near schools. There are certain label-required exclusion zones that apply to fumigants, to certain pesticides near waterbodies (U.S. District Court Order), and to "sensitive" crops. There are also restrictions for aircraft or air-blast applications on properties abutting or adjacent to occupied schools in session, hospitals, and nursing homes, but there is nothing specific that prohibits pesticide applications near schools, childcare facilities, or farmworker housing (Joel Kangiser, Compliance Program Manager, Pesticide Management Division, WSDA, personal communication, April 2018).
- Arizona, California, Connecticut, Florida, Hawaii, Minnesota, New Hampshire, New Jersey, New York, and Oregon have enacted pesticide use reporting programs or surveys that collect annual totals. Reporting program requirements vary by state (e.g., voluntary or mandatory reporting; geographic resolution; actual or estimated total amount; publicly available dataset/annual report or data not published).[4]

Summary of SB 6529

- Requires that application-specific pesticide use records be provided to DOH on a monthly basis.
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- Requires pesticide applicators to notify DOH four days prior to pesticide application by aerial, air-blast, or fumigation methods.
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Health impact SB 6529

Evidence indicates that SB 6529 has the potential to increase available pesticide use information and data, which in turn has potential to increase analyses of and improve understanding of pesticide application, inform policy change, influence application practices, reduce acute and chronic pesticide-related health outcomes, and decrease health disparities. The notification provisions included in SB 6529 would have unclear impacts on health and health disparities.

Pathways to health impacts

The potential pathways leading from the provisions of SB 6529 to decreased health disparities are depicted in Figure 1.

Pathway 1 evaluated the provisions in the bill related to pesticide use reporting, and represents the most direct pathway between the pesticide use related provisions in SB 6529 and health outcomes. We made the informed assumption that requiring pesticide applicators to submit application-specific pesticide use records to DOH on a monthly basis would result in the agency publicly publishing records and increasing pesticide data and information available to researchers, local health jurisdictions (LHJs), policymakers, and other stakeholders.[5-8] There is strong evidence that publicly publishing pesticide use data would result in increased analyses and improved understanding of pesticide use, potential exposure, risk factors, and associated health outcomes.[5,7,9-12] There is a fair amount of evidence that improved understanding would result in changes to and adoption of pesticide application policies and practices that reduce exposure.[5-7,13-18] There is very strong evidence that improved pesticide application policies and practices would result in reduced acute and chronic pesticide-related health outcomes,[9,19-26] resulting in reduced health disparities by occupation,[25,27-32] race and ethnicity,[21,24,25,28,31-36] and for sensitive populations like pregnant women and children.[4,19,24,25,37-39]

Pathway 2 evaluated the provisions in the bill related to pesticide application-specific notifications. *Pathway 2* is briefly depicted in Figure 1, and a more in-depth discussion is provided starting on page 20. Overall, we determined that there is an unclear impact whether notifying day care centers, schools, and individuals requesting notification before an application event would result in reduced acute and chronic pesticide-related health outcomes.

Due to time limitations we only researched the most direct connections between the provisions of the bill and health disparities and did not explore the evidence for all possible pathways. For example, potential pathways that were not researched include:

- *Cost:* We did not evaluate impacts of costs or funding related to creating, implementing, or maintaining a pesticide use reporting system or application-specific notification system.

- *Technology:* Similarly, we did not research the technology requirements and alternatives related to creating, implementing, or maintaining these systems.

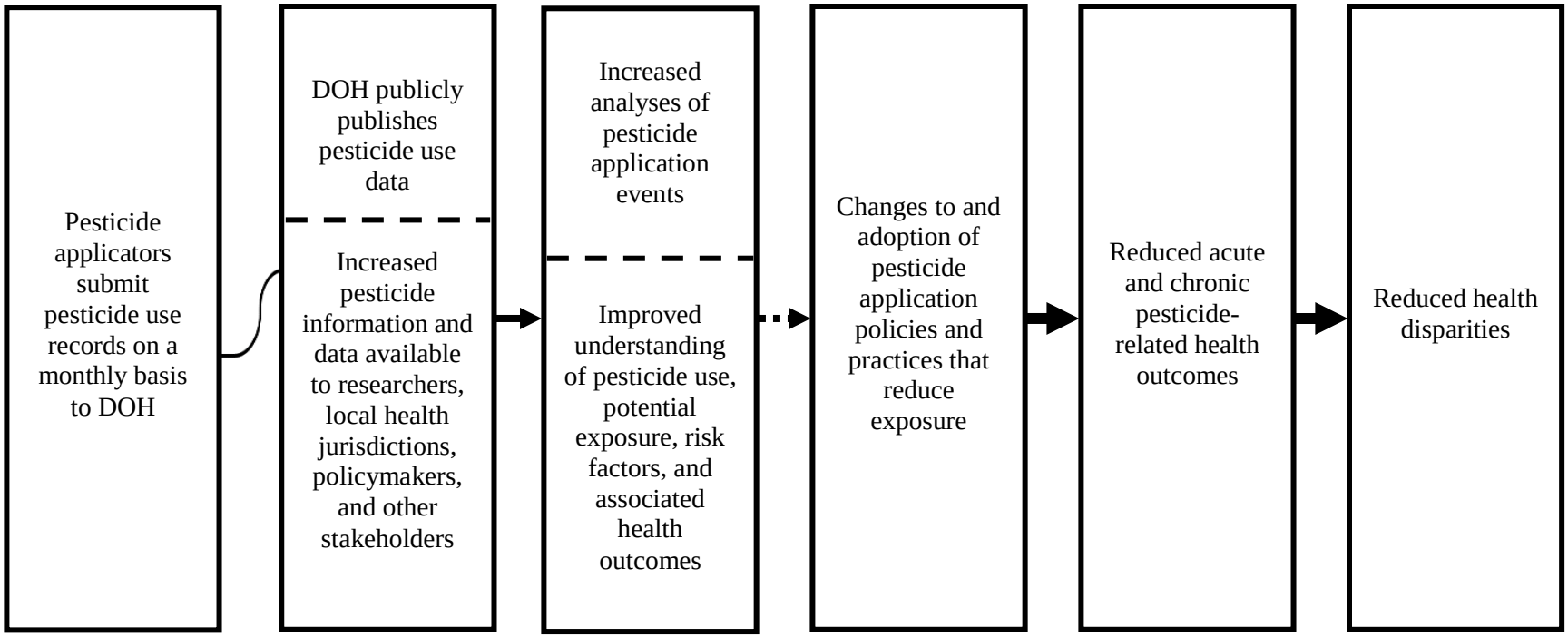
The California Department of Pesticide Regulation (CDPR), California Environmental Health Tracking Program (CEHTP), and Oregon Department of Agriculture (ODA) have implemented pesticide use reporting systems and may have information on cost and technology considerations.

Magnitude of Impact

Although pesticide drift is illegal, cases of drift do occur in Washington State. A pesticide-related illness case is related to agricultural drift when "a person is exposed to a pesticide that has drifted away from the application target, and the exposure contributes to that person experiencing signs or symptoms of pesticide poisoning."[40] Based on data from DOH, from 2010 through 2016, there were 1,330 cases of pesticide illness in Washington State, and 391 cases (29%) were the result of agricultural drift.[40] Evidence from the National Institute for Occupational Safety and Health (NIOSH) shows that the magnitude of pesticide-related illness is likely underestimated as many affected individuals do not seek medical treatment, exposed individuals may not be accurately diagnosed, or cases may not be reported to the proper agencies.[22,27] Under-reporting of occupational pesticide exposure and illness among farmworkers is consistent with focus group findings detailed in a 2004 DOH report titled *Improving Data Quality in Pesticide Illness Surveillance*.[35] The majority of reported pesticide illness cases in Washington from 2010-2016 were due to air-blast ground sprayers and aerial applications.[28] From 2010 through 2016, there were 120 cases of pesticide illness among children aged 0-14, and 14 cases (12%) were the result of agricultural drift.[40] The DOH Pesticide Program notes nine cases (since 2010) where pesticide illness due to drift has occurred on school or day care center properties. While all of the identified cases were in adults, it is possible that children are either not getting acutely ill from this type of exposure or that pesticide-related illness in children at school and day care is not as readily recognized or reported to authorities as it is for adults (Joanne Prado, DOH, personal communication, April 2018).

Logic Model

Pathway 1



Pathway 2

Pesticide applicators notify DOH four days prior to pesticide application by aerial, air-blast, or fumigation methods.*

* See page 20 for full discussion

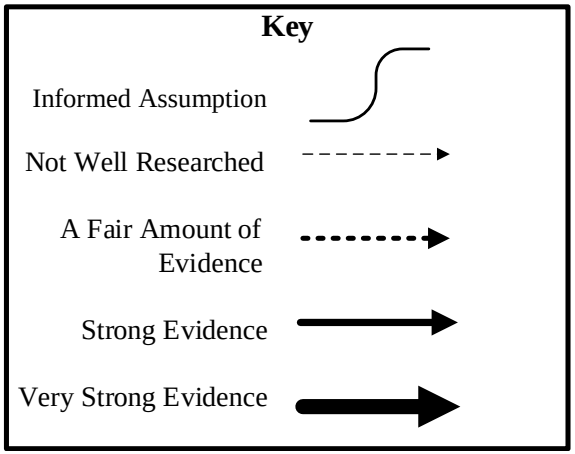


Figure 1

Senate Bill 6529

Protecting agricultural workers and community members from pesticides

Summaries of Findings

Pathway 1: Pesticide use reporting

Will requiring pesticide applicators to submit application-specific pesticide use records to DOH on a monthly basis result in the agency publicly publishing the results thereby increasing pesticide use data and information available to researchers, LHJs, policymakers, and other stakeholders?

We have made the informed assumption that requiring pesticide applicators to submit application-specific pesticide use records to DOH on a monthly basis would result in records being submitted to and publicly published by DOH, which in turn would increase pesticide use data and information available to researchers, LHJs, policymakers, and other stakeholder groups. Although not outlined in the bill, DOH staff have noted that Washington Tracking Network (WTN) would be an appropriate vehicle for providing public access to pesticide use data (Glen Patrick, Deputy Director, OEPHS, DOH, personal communication, March 2018). WTN is a publicly-accessible online data presentation and visualization application that allows users to search, view, and export environmental and public health data (e.g., air quality, drinking water, lead exposures, and social determinants of health). According to program staff, WTN users include programs at DOH (e.g. Office of Emergency Preparedness and Response), Accountable Communities of Health, LHJs, Washington State agencies (e.g., Department of Ecology), non-profit organizations, health practitioners, and the general public. In 2017, WTN's query portal received 84,160 pageviews and the Information By Location (IBL) tool, which offers map views of specific data, was viewed 60,393 times (Heather McCauley, WTN Communications and Evaluations Coordinator, OEPHS, DOH, personal communication, March 2018). Additionally, WTN staff provide technical assistance and outreach to users, as requested. For example, during Washington State's wildfire season, WTN staff supported DOH's Office of Emergency Preparedness and Response by displaying real-time wildfire data to allow staff to respond to incidents.

In response to pesticide illness data requests, DOH Pesticide Program staff and WTN staff collaborated to present data derived from pesticide illness investigations on WTN in 2016.[8] Following promotional activities, WTN pageviews for pesticide data increased fourfold between May and June 2016 (Heather McCauley, DOH, personal communication, March 2018). Since going live in January 2016, the pesticide pages have received 847 pageviews, and the pesticide topic pages have received 702 pageviews. Therefore, we assume that providing pesticide use data on WTN would make the information available to interested users, including researchers and other stakeholders.

California's Pesticide Use Reporting (PUR) system presents additional evidence that requiring growers to submit monthly use reports containing application-specific data and publicly publishing data increases available information (see Appendix B for a comparison between California's PUR system and existing Washington regulations referred to in SB 6529). In 1990, California became the first state to require full reporting of all pesticide use in agriculture (Food Safety Act of 1989, Chapter 1200, AB 2161). CDPR's PUR program has more than 2 million pesticide use records collected each year.[5] CDPR conducts trend analyses examining pesticide use on particular crops and in specific pesticide categories (e.g., reproductive toxins, carcinogens, insecticide organophosphates, and carbamate chemicals).[7] According to CDPR,

available data may inform risk assessment, worker safety, public health, endangered species, water and air quality, pest management alternatives, local enforcement, and processor and retailer requirements.

To improve the utility of California's complex PUR database, in partnership with California Department of Public Health (CDPH), the Public Health Institute's (PHI) CEHTP launched three approaches to make pesticide use data more accessible and understandable to diverse data users and relevant for public health research, communications, and policies.[5] First, the Pesticide Linkage Tool (PLT), aimed at highly skilled public health researchers, is a custom application that includes features which enable users to "more efficiently and accurately estimate spatiotemporal relationships between pesticide use and health outcomes of interest."[5] Second, CEHTP developed an online Pesticide Mapping Tool (PMT) using the Google Maps interface for a broader set of users to visualize and explore agricultural pesticide data. Launched in 2009, the PMT allows users to choose from pesticide categories of public health relevance (e.g., carcinogens, reproductive and developmental toxics) and to query data by application date, crop, year, individual pesticide, pesticide category, etc. Users can view results at the county, township, or square mile section level and can look at trends in pesticide use over time. Accessed over 4,500 times between March 2017 and March 2018, the PMT can query and quickly return results for nearly 100 million pesticide records (Max Richardson, Senior Policy Manager, CEHTP, personal communication, March 2018). Third, in response to stakeholder concerns regarding pesticide use near public schools, staff used the PLT to tailor "data and research methods to provide high-resolution estimates of pesticide use near public schools in California."[5]

The California Environmental Protection Agency's (CalEPA) Office of Environmental Health Hazards Assessment (OEHHA) also uses PUR data in its California Communities Environmental Health Screening tool (CalEnviroScreen). OEHHA developed CalEnviroScreen as part of the agency's environmental justice program. The mapping tool uses data from national and state sources to rank census tracts in California based on potential exposure to pollutants, adverse environmental conditions, socioeconomic factors, and prevalence of certain health conditions.[6] Data could be similarly displayed in Washington, and WTN would provide the same functionality as CalEnviroScreen by incorporating pesticide use data into the existing WTN IBL tool (Glen Patrick, DOH, personal communication, April 2018).

California's PUR program provides evidence that requiring monthly application-specific pesticide use reporting increases availability of pesticide use data. The availability of data coupled with CEHTP's and OEHHA's efforts to improve data usability suggests that collecting and publicly publishing pesticide use data in user-friendly applications has the potential to increase data and information available to researchers, LHJs, policymakers, and other stakeholders.

Will publicly-available pesticide use data result in increased analyses and improved understanding of pesticide use, potential exposure, risk factors, and associated health outcomes?

There is strong evidence that publicly-available application-specific pesticide use data would likely result in increased analyses and improved understanding of pesticide use, potential exposure, risk factors, and associated health outcomes. The majority of population-level epidemiological studies examining pesticide use and human health draw on California data

because it provides sufficient granularity (e.g., geographic location) and specificity (application date, time, crop, etc.) which allows for robust analysis. As the most comprehensive pesticide use dataset in the world, California's PUR program provides multiple examples of how state agencies and researchers have used pesticide use data to learn more about application patterns, associated health outcomes, and risk factors. For example, CDPR, CDPH, and OEHHA collaborate to use pesticide use data to evaluate possible human illness clusters in epidemiological studies.[7] CEHTP's PLT has been used to examine the relationship between agricultural pesticide use and autism, hypospadias, neural tube and other birth defects, gastroschisis, and congenital heart defects.[5] Eight published peer-reviewed scientific articles have used the PLT for data analysis and many more have used CDPR's PUR data (Max Richardson, CEHTP, personal communication, March 2018). For instance, PUR data and participant data from a longitudinal birth cohort study were used to estimate the amount of elemental sulfur applied near a child's residence during the week, month, and year preceding a pulmonary evaluation.[9] While elemental sulfur is considered relatively safe for use in both conventional and organic farming, results added credibility to reports of drift of elemental sulfur after agricultural application.[9] Although pesticide use data does not imply pesticide exposure, data provides insight into where additional research efforts may be necessary to improve understanding and safety of pesticides.

Additionally, CEHTP used PUR data to assess pesticide use around 2,511 California public schools in the 15 California counties with the highest total reported agricultural pesticide use in 2010. The analysis found that "[9] of the 10 most commonly used pesticides near [California] schools have a chemical persistence in the range of days to months; 6 of 10 remain chemically active for 50 days or longer."[5] Researchers also found that "Hispanic children were 46% more likely than non-Hispanic white children to attend [public] schools with any pesticides of [public health] concern applied nearby and 91% more likely than non-Hispanic white children to attend schools in the highest quartile of agricultural pesticide use."[10] The resulting 2014 report, entitled *Agricultural Pesticide Use Near Public Schools in California*, was used by EPA Region 9 to help select schools for a pilot project that attempted to develop a screening tool for detecting pesticide residues on outdoor surfaces.[5] However, the pilot project was never completed due to technical difficulties (Randy Segawa, Special Advisor, Pesticide Programs Division, CDPR, personal communication, April 2018). Journalists and other stakeholders have also used CEHTP's 2014 report and PMT to increase public awareness of and inform policy conversations on pesticide use near schools.

OEHHA's CalEnviroScreen has been used to compare the distribution of environmental hazards and vulnerable populations across California communities. One analysis of CalEnviroScreen Version 1.1 found that "[e]nvironmental hazards were more regressively distributed with respect to race/ethnicity than poverty, with pesticide use and toxic chemical releases being the most unequal."[11] While the tool does not quantify the probability of harm or health risk, researchers concluded that it can identify communities that warrant further attention and can help policymakers and decision makers "prioritize their activities to the benefit of communities disproportionately burdened by multiple environmental health hazards."[11] Additionally, CDPR used CalEnviroScreen 2.0 results scores in determining use around communities as part of its air monitoring planning.[41]

In addition to these examples of how California's PUR data has been used, key informant interviewees also identified benefits related to the logistics and content of a pesticide use reporting system. Logistically, interviewees from California felt that that their pesticide use reporting system decreased the staff time needed to respond to data requests and decreased the number of public records requests related to pesticide use and application since users were able to access data on their own. Most of the benefits interviewees cited were related to the content and data generated by a pesticide use reporting system. Stakeholders felt that a pesticide use reporting system would provide more facts and information about pesticide use in Washington State, including the quantity and location of pesticides that are applied. One interviewee explained that pesticide use reporting data would expand the type of research possible in Washington State, including research studies related to drift, childhood exposure to pesticides, and chronic health impacts for children in agricultural communities. Similarly, other interviewees explained that having access to pesticide use data and being able to determine patterns of use are important to be able to conduct population level epidemiological studies. Overall, interviewees with a positive view of pesticide use reporting felt that the system would expand research opportunities, decrease the cost of data collection, optimize study design, show potential exposure patterns, and allow for investigations about the root causes of health concerns. Washington interviewees anticipated using future data from a pesticide use reporting system to improve enforcement and compliance efforts, to examine pesticide use trends, and to conduct research on pesticide use, potential exposures, drift, and health.

None of the key informant interviewees representing Washington grower or applicator associations could see any benefit to pesticide use reporting. As an example of potential challenges, a few key informant interviewees referenced Oregon's decision to discontinue its PURS as evidence of its lack of value. However, Oregon Department of Agriculture (ODA) staff reported PURS was discontinued primarily due to lack of funding during the 2007 to 2009 recession and state budget cuts (Sunny Jones, Former Pesticide Use Reporting Specialist, Pesticide Program, ODA, personal communication, April 2018). During the first iteration of PURS (partial implementation 2002 to 2003), the database was launched and began collecting data before the program was fully developed. Users experienced a variety of reporting challenges related to database usability, and the project was put on hold due to funding issues until the second iteration was rolled out in 2007. The second iteration incorporated a revamped user interface that had undergone testing to improve user-friendliness.[12] Additionally, ODA staff conducted PURS training sessions across the state to help growers and applicators submit reports (Sunny Jones, ODA, personal communication, April 2018).

While reporting methods improved, ODA and Department of Human Services and Oregon Health Authority (DHS/OHA) staff shared that the geographic unit under which pesticide use was reported (Hydrologic Unit Code [HUC]: Basin – level 3, 6 digits)[12] was too large to be meaningful in any analysis (DHS/OHA, personal communication, March 2018; Sunny Jones, ODA, personal communication, April 2018). To alleviate growers' and applicators' privacy concerns the data were reported at a scale and grouped into categories of unlike commodities (e.g., fruits and nuts), which severely limited analysis. ODA partially attributed the decision to discontinue Oregon's PURS to the fact that, "[w]e did not have enough information to know if the program did or did not provide value, because the interested parties fought each other so much that we ended up with a program that was not useful for anyone. We also did not have a fully implemented program long enough [only 2 years of complete data] to determine its

potential value" (Sunny Jones, ODA, personal communication, April 2018). A subsequent bill, which did not pass, proposed more granular reporting which agency staff agreed would have been more useful for analyses.

Other challenges that interviewees expressed about PURS included concerns related to:

- *Overregulation:* Interviewees representing Washington growers and applicators were concerned about additional regulation in an industry that is already heavily regulated. They felt that a pesticide use reporting system would be burdensome, duplicative, and redundant.
- *Proprietary:* During public hearings, Washington growers and pesticide applicators expressed concern about making pesticide use information publicly available.[1] They mentioned that pesticide application formulas and schedules are proprietary, and sharing this information may negatively impact their businesses and competitiveness.[1] Interviewees representing grower or applicator associations expressed concerns that a pesticide use reporting system was an invasion of privacy and that sharing proprietary information about pesticide application would have negative ramifications for their businesses. It should be noted, however, that while Kern County Department of Agriculture anticipated proprietary concerns from growers related to pesticide use reporting, they have not received any proprietary-related complaints or concerns to date (Glenn Fankhauser, Kern County Department of Agriculture, personal communication, March 2018).
- *Data interpretation:* Many interviewees, including interviewees representing pesticide regulatory agencies and growers and applicators, said that pesticide use reporting data could be misleading and create opportunities for misunderstanding. California interviewees stated that their data was not readily accessible to users without some prior knowledge about pesticides. While some pesticide use information is available through CEHTP's PMT, staff made decisions about the level of detail to include in their public interface to make the system as easy to use and to make the data as easy to understand as possible. Some California interviewees were also concerned that people may not understand that pesticide use does not equate to pesticide exposure. Interviewees expressed that people may not understand that some chemicals are of greater concern or pose greater risk to human health than other chemicals, and that more context around the data would be needed to fully understand economic, scientific, and health implications.
- *Public perception:* Similarly, without greater context and understanding, interviewees were concerned that a reporting system could change public perception and result in negative views of the agricultural industry. Interviewees were also concerned that a pesticide use reporting system would lead to targeting of the agricultural industry by attorneys and activists, potentially resulting in legal ramifications.
- *Resources:* Interviewees representing Washington growers and applicators were also concerned that a pesticide use reporting system was a poor use of time and money. They stated that a pesticide use reporting system would not protect people from pesticide exposure or prevent drift from occurring. Therefore, given the amount of resources needed to create and maintain a pesticide use reporting system, interviewees felt that resources would be better used in ways that would reduce potential exposures.

Despite potential concerns and challenges, evidence suggests that application-specific pesticide use reporting as outlined in SB 6529 has the potential to help increase understanding of pesticide use, potential exposure, risk factors, and health outcomes. Oregon provides an example of how the usefulness of pesticide use reporting can be hampered by rushing implementation, reporting use at too large a scale, or rolling up the data into dissimilar categories. Conversely, evidence from California indicates that publicly accessible application-specific pesticide use data has the potential to support analyses and to improve understanding of how pesticide use may be associated with health outcomes and issues of environmental justice.

Will increased understanding of pesticide use, potential exposure, risk factors, and associated health outcomes result in changes to and adoption of pesticide application policies and practices that reduce exposure?

We found a fair amount of evidence that increased understanding of pesticide use, potential exposure, risk factors, and associated health outcomes may result in pesticide application policy change. For example, there are various federal regulations addressing pesticide application safety and reporting. Changes at the national level impact practices in Washington State and can increase application safety and reduce exposure. For example, EPA issued updated WPS in 2015. These updates included more protective training requirements for workers and handlers; more protective entry restrictions and notification requirements associated with pesticide applications; more protective decontamination requirements for workers and handlers; and more protective Personal Protective Equipment requirements (Pedro Serrano, Technical Services Safety Program Manager, Division of Occupational Safety and Health, L&I, personal communication, April 2018). WSDA adopted and implemented these practices in 2017, and L&I is currently incorporating these changes into their guidelines.

In California, CDPR uses PUR data to "more accurately assess risk and as a result make more realistic risk management decisions" rather than making judgments that are too cautious.[7] Additionally, CDPR's Worker Health and Safety Branch uses data to "guide and inform worker exposure studies, aid in the development of mitigation measures to protect workers from pesticide exposures, and help determine where to focus outreach on worker safety regulations and new mitigation measures."[7]

Informed by CEHTP's 2014 analysis of PUR data, CDPR implemented regulations to prohibit or limit pesticide application around California public schools and licensed day care facilities. CDPR cited the report as part of its rationale to update and standardize regulations on pesticide use near schools statewide.[5] Effective January 1, 2018, applications of pesticides by aircraft, air-blast sprayer, and fumigants within ¼ mile of California public K-12 schools and licensed day care facilities are prohibited during school hours (Monday through Friday, 6:00 a.m. to 6:00 p.m.).[13]

CalEPA and other state agencies have used OEHHA's CalEnviroScreen tool to identify communities that face multiple burdens of pollution and socioeconomic disadvantage for the purpose of prioritizing investments in these areas.[6] For example, California's Department of Toxic Substances Control uses the tool "to prioritize its enforcement, complaints, and groundwater investigations" in communities identified as most burdened by pollution from multiple sources, including agricultural pesticide use.[6]

According to CDPR, "almost every pesticide application produces some amount of drift," even when those applications are performed to regulatory standards.[5] While state agencies seek to control the harmful effects of pesticides, evidence indicates that adoption rates of drift-reducing practices by commercial applicators remain highly variable.[14] To better understand current use patterns and the motivations behind the adoption and non-adoption of preferred practices, researchers in Indiana conducted a survey of commercial pesticide applicators within the state. Findings indicate that applicators were motivated to adopt drift-reduction practices by "the desire to be a good neighbor and a desire to be a good land steward."[14] Authors concluded that innovative, voluntary approaches may be used to raise awareness of sites sensitive to pesticide drift in rural landscapes.[14] Similarly, key informant interviewees representing Washington applicators and growers expressed their desire to be good neighbors and to adopt practices to improve pesticide application safety.

Studies examining adoption of agricultural Best Management Practices (BMPs) in the United States provide further insight into the variables that influence practice adoption. A systematic review of agricultural BMP adoption in the United States suggests that policymakers can improve the likelihood of adoption through complementary social approaches. The review of 46 studies from 1982 to 2007 found that extension training (e.g., 1-day training events), information, local networks, and environmental awareness programs and knowledge had statistically significant positive influences on BMP adoption.[15] Findings suggest that effective BMP adoption efforts should combine complementary social factors to increase their overall impact. For example, "using networks to implement extension efforts and disseminating information presents a logical way to combine and extend the reach of factors found to have a significant effect on BMP adoption."[15] Authors concluded that findings suggest policymakers can use a two-tiered approach to BMP adoption: tier-one would have an implementation focus, targeting growers most likely to adopt and tier-two would continue to increase individual capacity and awareness by using networks to inform other growers about the benefits to adoption.[15] More recently, a Louisiana study examined adoption of BMPs among crop and pasture farmers (n=105) and whether the likelihood of adoption was influenced by socioeconomic and demographic characteristics and variables representing opinions held by the farmers.[16] Results indicate that "farmers' perceptions regarding practices and the suitability of the practice to current farming methods strongly influenced adoption."[16]

The University of Washington's Pacific Northwest Agricultural Safety and Health (PNASH) Center has also conducted research on the adoption of best practices related to pesticide application. PNASH collaborated with WSDA, growers, managers, handlers, pesticide safety educators, and pest control consultants to develop the *Practical Solutions for Pesticide Safety* guide.[17] This collection, available in English and Spanish, contains 26 solutions and additional practical information identified on farms and reviewed and developed in partnership to meet the needs of farm managers and farmworkers. "[Ideas] were selected to be practical and to protect those most at risk – pesticide handlers and their families."[17] The development of the guide also suggests that growers and applicators may be more likely to adopt best practices if efforts collaboratively involve the agricultural industry as experts.

Collectively, these findings suggest that targeted educational and outreach efforts to growers and pesticide applicators would likely increase adoption rates of new pesticide application practices.

Results indicate that an individual's perception of practices can influence their likelihood to adopt; meanwhile, a grower or applicator's perceptions can be influenced by information regarding potential impacts to growers, neighboring communities, and the local environment.[14-16,18] Additionally, local networks and extension training programs and institutions are likely trusted sources through which to inform growers and applicators of policy changes to increase the likelihood of application practice adoption.[14-16] One study found that farmers may be more likely to adopt management best practices if links between their practices and environmental impacts are well documented, and if there is an expectation of future regulations.[18] This conclusion suggests that increasing data and research through pesticide use reporting to better understand potential connections between pesticide application use patterns and public health in Washington could make growers more likely to adopt pesticide application best practices.

California is the only state we are aware of whose PUR system has led to clearly identifiable policy changes. In addition, the literature reviewed pertaining to adoption of best practices relates to agricultural best practices more broadly. For these reasons and the purpose of this analysis, we have downgraded the strength-of-evidence to a fair amount of evidence rather than strong evidence.

Will reduced exposure to pesticides result in reduced acute and chronic pesticide-related health outcomes?

We found very strong evidence that reducing pesticide exposure would likely result in reduced acute and chronic pesticide-related health outcomes. According to the American Academy of Pediatrics, "[a]cute poisoning risks [from pesticides] are clear, and understanding of chronic health implications from both acute and chronic exposure are emerging."[19] Acute pesticide illnesses range in severity and symptoms according to the type of pesticide and seriousness of the exposure. Signs and symptoms of high severity illness or injury include, coma, cardiac arrest, renal failure, and respiratory depression.[20] Low severity illness or injury often manifests as skin, eye, or upper respiratory irritation and may include fever, headache, fatigue, or dizziness.[20-22]

According to an independent Joint Fact Finding Study Group, commissioned by Hawaii's State Department of Agriculture and Kaua'i Mayor's Office, a review of available peer-reviewed literature identified 20 chronic health conditions associated with general pesticide exposure including, Parkinson's disease, asthma, thyroid disease, endocrine disruption conditions, and others.[23] Further a 2010 report by the President's Cancer Panel (the Panel) found that exposure to pesticides (insecticides, herbicides, and fungicides) has been linked to brain and central nervous system, breast, colon, lung, ovarian, pancreatic, kidney, testicular, and stomach cancers, as well as Hodgkin and non-Hodgkin lymphoma,[24] multiple myeloma, and soft tissue sarcoma.[25] Additionally, pesticide-exposed agricultural workers show elevated rates of prostate cancer, melanoma, other skin cancers, and cancer of the lip.[25]

Under FIFRA, there are 17,385 primary registered pesticide products, and EPA lists approximately 1,256 pesticide active ingredients used in these products (Office of Compliance and Enforcement, U.S. EPA, Region 10, personal communication, April 2018). Other sources have noted that many active ingredients are toxic.[25] While inert ingredients in pesticides are not required to be tested for causing chronic diseases such as cancer, many of these ingredients are also toxic. For example, "xylene is used as the inert ingredient in almost 900 pesticides and has been associated with increased risk of brain tumors, rectal cancer, and leukemia."[25] The Panel

notes that researchers have had difficulty clearly determining cancer risks associated with individual agents because agricultural chemicals are often applied as mixtures.

Epidemiological studies also provide evidence that chronic exposure to pesticides is associated with adverse birth and developmental outcomes, such as preterm birth, low birth weight, congenital abnormalities, pediatric cancers, neurobehavioral and cognitive deficits, and asthma.[19] Neurotoxic pollutants, like organophosphate pesticides, are known to be toxic to the developing brain and have been linked to loss of cognition, shortening of attention span, impairment of executive function, behavioral disorders, and increased prevalence of autism, attention deficit and hyperactivity disorder, learning disabilities, and dyslexia.[24] Case-control studies and reviews have linked insecticide exposure to increased risk of brain tumors and acute lymphocytic leukemia.[19] Leukemia rates are consistently elevated among children who grow up on farms, among children whose parents used pesticides in the home or garden, and among children of pesticide applicators.[25]

The Center for Environmental Research and Children's Health at the University of California, Berkeley's School of Public Health has partnered with the Salinas Valley Community to conduct the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) Study to examine the potential impact of pesticides and other environmental exposures on the health of pregnant women and children living in the agricultural community. This longitudinal study of more than 600 children living in Salinas, California found that residential proximity to sulfur applications was associated with increased odds of respiratory symptoms and asthma medication use, even when controlling for a variety of maternal factors.[9] Results indicate a restrictive effect of low-level elemental sulfur exposure on children's lungs and are consistent with reports of adverse respiratory effects associated with elemental sulfur in animal models, in workers, and in case reports of poisoning.[9] Another analysis of this cohort has documented associations between higher levels of biomarkers of organophosphate pesticides during pregnancy and poorer health and development.[26] Higher concentrations were associated with “shortened gestational duration, greater odds of abnormal neonatal reflexes, pervasive developmental disorder and poorer mental development at 2 years of age, poorer attention and hyperactive behaviors at 5 years, and lower IQ at 7 years."[26] Moreover, "prenatal and child organophosphate pesticide metabolite levels were associated with more asthma-related symptoms, and higher levels of organophosphate pesticide metabolites in the urine of children between birth and 5 years of age were associated with reduced lung function at 7 years of age."[26]

The Kauaʻi Joint Fact Finding Study Group concluded that, “[t]he medical literature and limited local information we reviewed make a case for the collection of better data and more systematic testing of the environment and populations residing closest to” agricultural land.[23] While an *association* between pesticide use and a chronic health condition is not proof of *causation*, potential acute and chronic health outcomes associated with pesticide exposure are well documented and we rated the strength-of-evidence for the association as very strong.

Will reduced acute and chronic pesticide-related health outcomes result in reduced health disparities?

There is very strong evidence that reducing acute and chronic pesticide-related health outcomes would likely reduce health disparities. Data indicate that agricultural workers and Hispanic/Latino individuals disproportionately experience pesticide exposure and that pregnant

women and children are more sensitive to pesticide exposure. Since these groups are disproportionately affected by acute and chronic pesticide-related health outcomes, SB 6529 has the potential to reduce health disparities by occupation, race and ethnicity, and for sensitive populations like children and pregnant women.

Disparities by occupation

Nationally, the rate of pesticide illness among agricultural industry workers is estimated to be 37 times greater than the rates for nonagricultural workers.[27] However, researchers note that rates likely underestimate the actual magnitude of occupational pesticide-related illness and injury.[27] In Washington State, nearly 60% of confirmed pesticide illness cases from 2010 to 2016 were the result of occupational exposures and 68% of those cases impacted farmworkers.[28]

Agricultural work in the United States continues to rank among the most dangerous among civilian occupations. The Occupational Safety and Health Administration (OSHA) states, "[f]armworkers are at high risk for fatal and nonfatal injuries, work-related lung diseases, noise-induced hearing loss, skin diseases, and certain cancers associated with chemical use and prolonged sun exposure."[29] In 2011, crop production agricultural workers' injury rate was 5.5 per 100 workers while the rate for all workers was 3.8 per 100 workers.[29] The U.S. Bureau of Labor Statistics reported 261 fatal work injuries recorded among crop production workers in 2016, a 13% increase from the 230 fatal injuries reported in 2015.[30] In 2016, crop production workers had a fatal injury rate 5.8 times greater than that of all-workers (fatal injury rate of 20.9/100,000 full-time equivalent (FTE) workers and 3.6/100,000 FTE, respectively).[30]

Occupational exposures and social determinants of health also put agricultural workers at risk for chronic and acute health outcomes.[31] Sponsored by the National Institute of Health, the Agricultural Health Study (AHS) of more than 89,000 participants found that while farmers and pesticide applicators do not experience higher overall rates of cancer than other men and women in the study states (Iowa and North Carolina), they are at increased risks for specific cancers.[25] AHS results show that farmers and pesticide applicators have significantly higher prostate cancer risk; female spouses of agricultural workers have a significantly higher incidence of melanoma; and female pesticide applicators have significantly higher incidence of ovarian cancer.[25] Other studies have found that farmworkers have lower health care utilization rates compared to the general U.S. population due to a number of factors, including limited access to care, language and cultural barriers, concern about job loss, and lack of transportation.[31] Poverty and limited access to healthcare services also disproportionately affect Washington's rural communities and can adversely affect health outcomes for farmworkers.[32]

Because agricultural workers are more likely to be exposed to pesticides and more likely to experience worse health outcomes associated with pesticide exposure, by reducing pesticide exposure and related illness, SB 6529 has potential to reduce health disparities by occupation.

Disparities by race and ethnicity

Evidence indicates that occupational pesticide exposure disproportionately affects Hispanic/Latino individuals.[21,25,28] U.S. Department of Agriculture's 2012 nationwide data estimates 45% of all hired farmworkers were Hispanic (50% of farm laborers and supervisors, and 16% of farm managers).[42] Data from the 2013-2014 National Agricultural Workers Survey (NAWS), administered by the U.S. Department of Labor, indicate the majority of respondents

identified as Hispanic (80%), were Spanish speakers (74%), and report Mexico as their country of birth (68%).[33] According to NAWS, the proportion of agricultural workers that are migrant workers has dropped from roughly 50% in 1999-2000 to 16% in 2013-2014, which suggests the population is becoming more established and settled in the United States.[33]

In Washington State, census data indicate that 12.5% of the population is Hispanic/Latino.[34] However, in the same year, Hispanic/Latino individuals accounted for 40% of pesticide-illness cases.[28] Moreover, 89% of farmworkers in DOH illness data are Hispanic/Latino and the majority are Spanish speakers.[28] According to the Panel, migrant and seasonal workers and their families often have disproportionate exposures to pesticides due to working and housing conditions.[25] The disproportionate exposure of Hispanic/Latino farmworkers to pesticides poses an environmental injustice to these workers, many of whom are afraid to seek medical treatment or protest exposure due to concerns about being demoted, fired, or not being rehired the following season.[24,35] Individuals who lack documented status face additional barriers to reporting exposure (e.g., fear of detainment, deportation, and/or separation from family in the U.S.). Similarly, focus groups conducted by DOH found that farmworkers were less likely to report pesticide exposure due to fear of retaliation and loss of income, and uncertainty about how to get medical care, workers' compensation policies and costs, and immigration consequences.[35]

According to the 2018 *Washington State Health Assessment*, compared to other Washingtonians, fewer Hispanic adults reported having health insurance coverage or a medical healthcare provider, and Hispanic women had lower first trimester prenatal care initiation rates than white women.[32] Existing literature also reveals that migrant and seasonal farmworkers (MSFW) families' experience disparities across multiple social determinants of health,[31,36] which may increase the risk of pesticide exposure. For example, one systematic review identified a highly transient lifestyle, poor labor compensation for long work hours, limited English proficiency, substandard or limited housing and workplace provisions, limited health care access, and acculturation as unique challenges MSFW experience as a result of low socioeconomic status, ethnicity, and agricultural occupation.[36]

Since occupational pesticide exposure and illness disproportionately affects Hispanics/Latinos who are also more likely to experience worse pesticide-related health outcomes, by reducing pesticide exposure and related illness, SB 6529 has potential to reduce health disparities by race and ethnicity.

Disparities among sensitive populations—pregnant women and children

It is well-documented that children are more susceptible to exposure to environmental toxics as a result of their behavior. Children breathe more air and drink more water relative to their size, and spend more time on the floor and put more things into their mouths compared to adults.[4,37] According to the Panel, "[c]hildren are at higher risk for cancer and other adverse health effects from pesticide exposure, and their risks are linked to parental pesticide exposure prior to conception, *in utero* exposures, and direct exposures throughout childhood."[25] Evidence indicates that fetuses, infants, and children are "particularly sensitive to neurotoxic pollutants, even at very low levels of exposure, because of the vulnerability of early-stage development of the human brain."[24] As children grow, they may be exposed through a variety of pathways including their diet, pesticide spray drift, and take-home exposure on clothing and footwear of agricultural workers.[19] A community-based participatory research study in Washington's Lower

Yakima Valley analyzed house dust sampled from farmworker homes and non-farmworker homes. Results show that compared to non-farmworker house dust, farmworker house dust had statistically significantly higher concentrations of 4 out of 5 organophosphates.[38] Similarly, a previous analysis of this cohort of farmworkers and non-farmworkers and their children found seasonal and occupational differences in urinary metabolites of organophosphates.[38] Findings provide evidence supporting an occupational take-home pathway. Early life exposures to neurodevelopmental toxicants can have significant social and economic costs, which may be avoided through prevention of these exposures and associated disorders.[24]

Women who are pregnant or may become pregnant are also at risk from pesticide exposure.[43] Preconception and prenatal exposure to environmental toxics, including pesticides, may result in negative birth outcomes.[43] In addition, prenatal exposure to pesticides may also result in worse health outcomes later in life, including increased risk of childhood cancers and impaired reproductive function.[43] The California Childhood Autism Risks from Genetics and Environment (CHARGE) study linked commercial pesticide application data from the California Pesticide Use Report (1997-2008) to the addresses of the 970 pregnant women.[39] They concluded that children with Autism spectrum disorder were 60% more likely to have had organophosphates applied nearby the home at some point during gestation (1.25 km distance; adjusted OR 1.60; 95% CI: 1.02-2.51) than children with typical development.[39] Additionally, research concluded that children with a developmental delay were 150% more likely to have carbamate pesticides applied near their home during pregnancy (1.25 km distance; adjusted OR = 2.48; 95% CI: 1.04-5.91).[39] CHARGE study results suggested that both associations lessened the further from agricultural land, which lends support to an exposure-response gradient.

As pregnant women and children are more sensitive to pesticide exposure and more likely to experience adverse pesticide-related health outcomes, by reducing pesticide exposure and related illness, SB 6529 has potential to reduce health disparities for pregnant women and children.

Pathway 2: Application-specific notifications

SB 6529 also includes provisions that would require DOH to provide notification to all schools, day care centers, and individuals requesting notification within ¼ mile of the application site. We were unable to find any published literature examining the impact of pesticide notification systems on health outcomes or health disparities. We also learned through key informant interviews that there may be potential unintended consequences resulting from the notification system outlined in SB 6529, including the potential to worsen health outcomes.

Because of the lack of published literature and potential for unintended consequences, we could not draw a logic model or apply strength-of-evidence criteria to evaluate this pathway. Instead, we used findings from key informant interviews to discuss potential impacts related to whether applicators notifying DOH four days prior to notification would provide DOH with necessary information for notification; whether notification prior to an application event would provide information necessary for schools, day care centers, or individuals to take action to protect their health; whether increased information would result in schools, day care centers, or individuals taking action to reduce pesticide exposure; and whether schools, day care centers, or individuals taking action to lower risk of pesticide exposure would improve acute and chronic pesticide-related health outcomes.

Overall, we cannot conclude what impact the notification-related provisions of SB 6529 would have on health or health disparities. We found that the impact of the notification-related provisions of SB 6529 on health outcomes and health disparities was unclear, and would depend on whether DOH w able to provide effective guidance based on intended pesticide applications; whether individuals most at risk of pesticide exposure request notification; whether the information provided in the notification is the information schools, day care centers, and individuals need to take action to protect health; whether schools, day care centers, or individuals have the ability to act on information in a way that protects their health; and on whether provisions in the bill would result in unintended negative consequences.

Will requiring pesticide applicators to notify DOH four days prior to pesticide application by aerial, air-blast, or fumigation methods provide DOH with information they need to notify schools, day care centers, and individuals requesting notification?
DOH staff noted that the system would provide incomplete information for staff to provide sufficient notification. Since notifications would be based on predicted, not actual applications, there may be uncertainty about which pesticides are applied and the best protective actions to take to reduce exposure (Joanne Prado, DOH, personal communication, March 2018). For example, recommended protective actions may vary depending on the chemical applied, weather conditions, or time of day of the application. For this reason, it may be difficult for DOH to provide day care centers, schools, and individuals with guidance about the most effective actions to take to reduce exposure to pesticides (Joanne Prado, DOH, personal communication, March 2018).

Will requiring DOH to notify day care centers, schools, and individuals requesting notification within ¼ mile of application sites prior to application events provide information that day care centers, schools, and individuals need to take action to protect health?
It is unclear whether notifications would provide valuable information to day care centers, schools, and individuals. As part of SB 6529, DOH would be required to develop a list of individuals interested in receiving notification of pesticide applications on adjacent properties. DOH staff have noted that participation in notifications would be voluntary and that the agency would need to complete outreach efforts to make people aware of the list and to encourage individuals to sign-up (Joanne Prado, DOH, personal communication, March 2018). For notifications to be most effective and reduce health disparities, individuals signing-up for notifications should include individuals at greatest risk of pesticide exposure, including pregnant women, farmworkers and their families.[19,27,39,44] There is no evidence to indicate whether these individuals would be likely to sign-up for notifications, and many interviewees had concerns about DOH creating and maintaining a voluntary list of interested individuals.

One interviewee felt that DOH should more proactively create a list based on their knowledge of sensitive groups and locations. For example, they recommended that DOH should automatically notify schools, day care centers, long-term care facilities, businesses with outdoor workers, and neighboring growers. Another interviewee explained that, under the provisions in SB 6529, notification would not necessarily protect those most likely to experience exposure from pesticide drift since neighboring growers and farmworkers would have to sign-up to receive notifications. The interviewee explained that some growers would likely register to protect their workers, but others may choose not to sign-up, may not be aware of the list, or may need to be required to register. Also, farmworkers would have to register with their personal address which

may or may not be near their work location (which is where they would be most likely to be exposed to pesticide drift). Workers living in temporary housing may not have the information they need or the resources to access information through a notification system. Migrant workers may need to navigate multiple state systems and resources, and may not be able to effectively register for or respond to notifications.

To better reach individuals most at risk of exposure to pesticide drift, Kern County, California completed a pilot project that alleviated the necessity of individual farmworkers signing-up for notifications. Growers in the county alert the Kern County Department of Agriculture two days prior to pesticide appliction, and the county's online system automatically generates email notifications to all neighboring growers of the application site. The intent of the system is to facilitate communication between neighboring growers and to enable them to take action to reduce potential exposures, increase worker safety, and reduce the potential for harm if drift does occur (Glenn Fankhauser, Agricultural Commisioner, Kern County Department of Agriculture, personal communication, March 2018). Following the successful pilot, the notification program has since been implemented countywide. Interviewees noted that the system has increased communication between neighbors and improved coordination between growers to protect worker safety. Growers in the county have been using the system to change workers schedules, move workers to a different field, or to reschedule application activities. The system has been well received by the Kern County Department of Agriculture, growers, and activists, and is the only such system in the country (Glenn Fankhauser, Kern County Department of Agriculture, personal communication, March 2018).

In addition, before adopting its current ban on pesticide applications within ¼ mile of school property, California considered a pesticide notification system similar to the provisions outlined in SB 6529. Under California's Proposed Section 6693, pesticide applicators would have been required to provide application-specific notifications to schools within a ¼ mile of the application site 48 hours before application.[13] CDPR received public comment from school administrators concerned about liability and workload and agricultural commissioners concerned about resources needed to enforce the requirements and respond to notification-related questions.[13] Section 6693 was eventually deleted from the proposal, and CDPR concluded that "the application-specific notification may have minimal value…notifications for all pesticides is unprecedented and [CDPR] cannot accurately determine the impacts to all parties."[13]

Since Fall 2016, California has been completing two pilot projects to determine the effectiveness of application-specific notification for schools in Kern and Monterey Counties. The programs found that few individuals or schools were interested in receiving pesticide application notifications (Randy Segawa, Pesticide Programs Division, CDPR, personal communication, March 2018). Kern County Department of Agriculture noted that they received initial pushback and concern from school staff uncertain about how to prioritize notifications based on safety and health concerns, when to take action, what action to take, and how and what information to share with parents and families (Glenn Fankhauser, Kern County Department of Agriculture, personal communication, March 2018). While formal results from these pilot projects are not yet available, since the pilot began Kern County, Department of Agriculture has received no application notices from growers that they would be applying near one of the six schools involved in the pilot project (Glenn Fankhauser, Kern County Department of Agriculture, personal communication, March 2018), suggesting that voluntary application-specific

notifications may not be an effective communication mechanism between pesticide applicators and school sites.

Similarly, while WSDA currently maintains an opt-in list of 111 medically pesticide-sensitive individuals, no evaluation has been done to determine the completeness of the list, whether applicators are providing notification, and whether individuals are taking action to protect their health based on notification (Joel Kangiser, WSDA, personal communication, March 2018). Between 2012 and 2018, WSDA investigated 14 allegations by individuals on the registry that they were not properly notified (Joel Kangiser, WSDA, personal communication, March 2018). In addition, WSDA stated that requiring individuals to renew each year to remain on their medically pesticide-sensitive individuals list was likely burdensome.

While drift would remain illegal under a notification system, a few interviewees, including one interviewee representing grower and applicator associations, stated that a notification system could shift the burden of responsibility from growers and applicator to schools, day care centers, and individuals. Interviewees were concerned that decreased accountability could result in less safe application practices.

Will providing information through notifications to day care centers, schools, and interested individuals result in these groups taking action to lower their risk of pesticide exposure?
Some interviewees were concerned that individuals may not take action as a result of notifications. Interviewees talked about three main barriers to taking action: lack of guidance, timing, and specific challenges for farmworkers.

California's pilot notification systems and the WSDA medically pesticide-sensitive individuals list do not currently provide guidance or recommended actions that individuals or schools should take to reduce the likelihood of pesticide exposure. This places the burden of decision-making and determining protective health actions on these groups. Similarly, provisions in SB 6529 do not include requirements to ensure that health and health behavior change messaging are incorporated into notifications. DOH noted that staff would have a role in assisting schools to provide health risk information about pesticides and in characterizing the potential for pesticide exposure (Joanne Prado, DOH, personal communication, March 2018). In addition, the School Nurse Organization of Washington shared with DOH that they would need information from the agency about the health risks related to pesticide exposure and guidance about protective actions to reduce pesticide exposure for students and staff (Joanne Prado, DOH, personal communication, March 2018). Since provisions in SB 6529 do not require health and health behavior change messages as part of notifications, this may limit the ability of day care centers, schools, and individuals to take protective actions, especially since health behavior change research shows that information alone is not sufficient to change behavior.[14,45,46]

Interviewees also expressed concern that a two-hour advance notification may not provide enough time for individuals to take action. For example, one interviewee explained that applications can occur at any time of the day or night and that individuals may not see notifications during nighttime hours to be able to take action.

Specific to farmworkers, interviewees felt that farmworkers may have limited power to leave unsafe conditions or to tell growers that conditions were unsafe without facing repercussions.

DOH focus groups found that farmworkers under-reported pesticide exposure due to fear of retaliation and loss of income, and uncertainty about how to get medical care, workers' compensation policies and costs, and immigration consequences.[35] Furthermore, because farmworkers may not work on the same property each day, the notification system may not have the ability to notify those working on adjacent properties. In addition, the U.S. Department of Health and Human Services publishes the National Standards for Culturally and Linguistically Appropriate Services (CLAS Standards). These standards state that health information is most effective when it is responsive to diverse cultural health beliefs and practices, preferred languages, health literacy, and other communication needs.[47] While SB 6529 specifies that notifications must be provided in English and Spanish using text messages, email, or phone calls, further evidence is needed to demonstrate the effectiveness of these methods at reaching the intended audiences, providing information necessary to take action, and resulting in behavior change. For example, while farmworkers on properties adjacent to pesticide application sites are at high risk for exposure through drift,[27,40] one study found that they may not have consistent access to notifications sent via text message, email, or phone call.[48] These factors may reduce the ability of farmworkers to take protective actions.

Will taking action to lower risk of pesticide exposure based on notifications improve acute and chronic health outcomes?

Overall, we found that the impact of the notification-related provisions of SB 6529 on health outcomes and health disparities was unclear. The impact of the bill on health outcomes would depend on whether DOH is able to provide effective guidance based on intended pesticide applications; whether individuals most at risk of pesticide exposure request notification; whether the information provided in the notification is the information schools, day care centers, and individuals need to take action to protect health; and on whether schools, day care centers, or individuals have the ability to act on information in a way that protects their health.

There are also a number of other potential unintended consequences that may result from the notification-related provisions in the bill and that may negatively impact health outcomes. Based on public testimony and findings from key informant interviews, other unintended and potentially negative consequences may include:

- *Over-reporting or over-notification of pesticide application events:* Many interviewees expressed a belief that growers and applicators would notify every day that they were going to apply in four days or set-up daily automatic notifications. One California interviewee was also concerned that even annual notification requirements could result in growers listing every possible chemical they may use to "cover their bases." Interviewees were concerned that this type of over-reporting or over-notifying would provide schools and individuals with inadequate information about actions to take to protect health, cause individuals to become needlessly alarmed, or result in "notification fatigue." Some interviewees felt that notifications would also spread fear and generate negative perceptions of the agricultural industry and distrust of government agencies.[49] Based on risk communication research, these factors could also alter people's perceptions in a way that perceived risk no longer matches actual risk, resulting in either unnecessary stress or apathy.[50] In either case, this may reduce the effectiveness of a notification system.
- *Changes in pesticide application:* During public testimony, growers noted that the notification provisions in SB 6529 may actually lead to more frequent or greater

application of pesticides, especially if applicators must notify DOH four days in advance of application.[1] One interviewee stated a concern that notifications would push growers and applicators to apply because they had made a notification and that they may apply when conditions were not ideal. This could result in applications being made during unsafe conditions or more frequently, resulting in greater applications and more potential for exposure and drift. If this were to occur, SB 6529 may actually increase exposure to pesticides, decrease the safety and efficacy of pesticide application, or worsen health outcomes. Similarly, California found that regulatory changes prohibiting pesticide application near schools Monday through Friday, 6:00 a.m. to 6:00 p.m. likely causes growers and applicators to shift pesticide applications to nighttime hours. This could result in higher nighttime air concentrations of pesticides (Randy Segawa, Pesticide Programs Division, CDPR, personal communication, March 2018). Although students are not in school during nighttime hours, these changes could have potential unknown impacts on pesticide concentrations and exposure patterns to surrounding communities.

- *Impacts resulting from the four day notification period.* During public testimony, individuals expressed concerns related to the business practices of growers, the safety or efficacy of pesticide application practices, and the stability of the food system and agricultural products as a result of the four-day notification period.[1] Many interviewees felt that the four-day advance notification did not allow for the flexibility applicators need to apply during safe weather conditions or in response to emerging pest concerns. One interviewee provided an example that one grower lost half of their crop by waiting 20 hours after identifying a pest concern to apply pesticide. Moreover, untreated pests and diseases can negatively impact nearby farms with susceptible crops, broadening potential crop losses and impacts to growers and consumers. In addition, interviewees noted that, for aerial applications, it is unsafe to land a plane once it has been loaded with pesticide and that applicators must find another field if they cannot apply on the scheduled field. These types of scenarios make the four-day advance notification of application challenging.

- *Implications for agricultural operations*. During public testimony, growers expressed concerns related to the burden of reporting, burdens related to increased costs and staffing, potential negative shifts in the perception of agriculture and growers, and potential lawsuits.[1] Some interviewees also mentioned potential changes to agricultural practices as a result of notification systems. One California interviewee shared that the school notification system pilot project had prompted some growers to shorten crop rotation or change their growing schedule.

Overall, it is unclear what impact application-specific notification would have on acute and chronic pesticide-related health outcomes.

Annotated References

1. **Legislature Washington State. Original Bill Report Senate Bill 6529. Olympia, Washington. 2018.**

Senate Bill 6529 is an act relating to protecting agricultural workers and community members from pesticides. The bill report provides relevant background information and summarizes provisions of the original bill. It provides a summary of the role of relevant state agencies related to pesticide application. It also provides a summary of public testimony recieved during public hearings related to the bill.

2. **WAC 16-228-1220. What are the restrictions applying to any person holding, handling, using, or disposing of pesticides and their containers?**

Washington Administrative Code 16-228-1220 addresses the restrictions applying to any person holding, handling, using, or disposing of pesticides and their containers. The rule states, "no person shall apply pesticides if weather conditions are such that physical drift or volatilization may cause damage to adjacent land, humans, desirable plants or animals."

3. **17.21.420 RCW. Pesticide-sensitive individuals- List procedure.**

RCW 17.21.420 outlines the procedure for the Washington State Department of Agriculture to develop and maintain a list of pesticide-sensitive individuals. RCW 17.21.430 outlines the notification procedure.

4. **Howard Dennis. State Pesticide Reporting Programs. Pesticide Regulation Program: Maryland Department of Agriculture; 2013.**

This document presents the Maryland Department of Agriculture's understanding of pesticide use reporting programs in Arizona, California, Connecticut, Florida, Hawaii, Minnesota, New Hampshire, New Jersey, New York, Oregon, and the District of Columbia as of September 2013.

5. **Richardson M. J., Madrigal D. S., Wilkie A., et al. Environmental Health Tracking Improves Pesticide Use Data to Enable Research and Inform Public Health Actions in California. *J Public Health Manag Pract.* 2017;23 Suppl 5 Supplement, Environmental Public Health Tracking:S97-S104.**

This article describes California Environmental Health Tracking Program (CEHTP) efforts to make the Pesticide Use Reporting (PUR) program data more accessible, understandable, and useful to diverse data users. Established in 1990, PUR is the world's most comprehensive pesticide reporting system with records on all agricultural pesticide applications by licensed pesticide applicators (about 80 million records from 1991 to 2014). The complexity and volume of PUR data make it challenging to access. CEHTP launched three approaches to improve data utility: a Pesticide Linkage Service aimed at highly skilled public health researchers, an online Pesticide Mapping Tool for a broader range of stakeholders, and in-depth analysis and reporting on pesticide use data to provide information relevant to public policy. The Pesticide Linkage Service provides: 1) geographic refinement for pesticide application records to better approximate agricultural field boundaries and 2) GIS intersection of PUR applications records with specific spatial-temporal windows for defined populations and for high volumes of data.

"These features allow researchers to more efficiently and accurately estimate spatiotemporal relationships between pesticide use and health outcomes of interest." The publicly available Pesticide Mapping Tool uses the Google Maps interface for users to visualize and explore agricultural pesticide data. Rather than listing 1000+ compounds included in PUR data, the mapping tool allows users to choose from categories of public health relevance (e.g., carcinogens, reproductive and developmental toxicants). Users can query application date, crop, year, individual pesticide, pesticide category, etc. In response to evidence of disproportionate use near Hispanic schoolchildren, "CEHTP tailored data and research methods to provide high-resolution estimates of pesticide use near public schools in California." Analysis of pesticide use around 2,511 schools assessed found that Hispanic children were 91% more likely than non-Hispanic white children to attend a school near the highest agricultural pesticide use. This underscores the "entrenched disproportionate hazards and continued needs of environmental justice communities." These tools have supported public health research and analyses, increased public awareness of pesticides and health (e.g., news coverage), and policy changes at the state and county levels. For example, in Monterey County a program was launched to notify 3 highly impacted schools 5 days in advance of any fumigant application within one quarter mile. Authors conclude that public health research and surveillance efforts are necessary to improve the ability to identify and monitor chronic health impacts related to pesticide exposure.

6. **California Environmental Protection Agency. CalEnviroScreen. 2018; 3.0:Available at: https://oehha.ca.gov/calenviroscreen. Accessed March, 2018.**

The Office of Environmental Health Hazard Assessment (OEHHA) developed the California Communities Environmental Health Screening (CalEnviroScreen) as part of the California Environmental Protection Agency's (CalEPA) Environmental Justice Program. CalEnviroScreen is a screening tool that evaluates the burden of pollution from multiple sources in communities (e.g., pesticides) while accounting for potential vulnerability in the adverse effects of pollution. The tool uses data from national and state sources to rank census tracts in California based on the potential exposures to pollutants, adverse environmental conditions, socioeconomic factors, and prevalence of certain health conditions. It is being used by CalEPA and other state agencies to identify communities that face multiple burdens of pollution and socioeconomic disadvantage for the purpose of prioritizing investments in these areas. For example, a working group of CalEPA and its boards and departments used CalEnviroScreen to identify disproportionately impacted areas where it could improve environmental justice efforts through compliance and enforcement strategies.

7. **California Department of Pesticide Regulation. A Guide to Pesticide Regulation in California: 2017 Update.Sacramento, California: California Department of Pesticide Regulation;2017.**

This guide provides information on pesticide laws and regulations, the California Department of Pesticide Regulation's (CDPR) organizational structure, an explanation of regulatory and registration processes, a description of local and state enforcement activities, and details on DPR initiatives to protect people and the environment. Chapter 9 (Pesticide Use Reporting) describes the historical evolution of pesticide use reporting in California (1934 - present day). Beginning in 1990, California was the first state to require full reporting of all pesticide use in agriculture (The Food Safety Act of 1989; Chapter 1200, AB 2161). Each record represents one production agricultural application of a pesticide product or a monthly summary of other kinds of

applications. Monthly agricultural pesticide use reports must include: 1) date and time of application; 2) geographic location including the section, township, range, and base line/meridian; 3) Operator identification number (issued by the county agricultural commissioner [CAC] to property operators); 4) operator name and address; 5) field location and site identification number; 6) commodity, crop or site treated; 7) acres or units planted and treated; 8) whether the application was by air, ground or other means; 9) for field fumigations in nonattainment areas - fumigation method/details; and 10) amount of product applied with its U.S. Environmental Protection Agency (EPA) registration number or, if the product is an adjuvant (substance used to enhance the effectiveness of pesticides), its California registration number. Beginning in 2002, California has collected pesticide use information from businesses that apply pesticides at California public K-12 schools and licensed childcare centers (school sites). School specific data are presented in the California School Pesticide Use Report (CSPUR), which CDPR hopes will assist in adopting effective, least-toxic pest management practices around children. CDPR conducts trend analyses examining pesticide trends on specific crops and in specific pesticide categories (e.g., reproductive toxins, carcinogens, insecticide organophosphates and carbamate chemicals). Available data may inform risk assessment, worker safety, public health, endangered species, water and air quality, pest management alternatives, local enforcement, and processor and retailer requirements. For example, use report data "provides actual use data so CDPR can more accurately assess risk and as a result make more realistic risk management decisions" rather than making judgments that are too cautious. Additionally, CDPR's Worker Health and Safety Branch uses data to "guide and inform worker exposure studies, aid in the development of mitigation measures to protect workers from pesticide exposures, and help determine where to focus outreach on worker safety regulations and new mitigation measures." In collaboration with CDPR, the State Department of Public Health and the Office of Environmental Health Hazard Assessment use the data to evaluate possible human illness clusters in epidemiological studies.

8. **Pesticide: Illness all Cases- Data obtained from the Department of Health's Pesticide Program. 2017; Available at. Accessed March, 2018.**

The Washington Tracking Network's (WTN) publicly available online database includes pesticide illness cases in Washington State from 2010 to 2016. A human illness case is defined as "a person who is exposed to a pesticide and experiences signs and/or symptoms of pesticide poisoning." In 2016 (most current published data), pesticide illness occurred at a rate of 2.94 cases per 100,000 Washingtonians (211 cases; 7,183,700 population). Under Chapter 70.104 RCW, DOH is responsible for protecting and enhancing the public health and welfare related to the use of pesticides. "This includes determining and documenting health effects resulting from pesticide poisonings, and delineation of public health risks."

9. **Raanan Rachel, Gunier Robert B., Balmes John R., et al. Elemental Sulfur Use and Associations with Pediatric Lung Function and Respiratory Symptoms in an Agricultural Community (California, USA).** ***Environ Health Perspectives.*** **2017;125(8).**

Raanan et al. evaluated associations between residential proximity to elemental sulfur applications and respiratory symptoms and spirometry of children living in an agricultural community. Considered relatively safe for use in both conventional and organic farming, elemental sulfur is the most heavily used pesticide in California. Researchers used participant data from the Center for the Health Assessment of Mothers and Children of Salinas

(CHAMACOS) longitudinal birth cohort study. Data from the California Pesticide Use Reporting (PUR) System was used to estimate the amount of elemental sulfur applied within 0.5, 1, and 3 km of a 7-year old child's residence during the week, month, and 12 months prior to pulmonary evaluation. Researchers controlled for maternal smoking during pregnancy; season of birth; particulate matter (less than or equal to 2.5 mm in aerodynamic diameter); breastfeeding duration; child's sex, age, and height; technician; and other covariates. The analysis found that proximity to sulfur applications within both 0.5- and 1-km radii during the 12 months preceding the respiratory assessment was associated with increased odds of respiratory symptoms and asthma medication use. "Specifically, asthma medication usage and respiratory symptoms increased [OR=3.51; 95% confidence interval (CI): 1.50, 8.23, p=0.004; OR=2.09; 95% CI: 1.27, 3.46, p=0:004, respectively] and forced expiratory volume in 1 second decreased (b= −0.143; 95% CI: −0.248, −0.039, p=0.008) per 10-fold increase in the estimated amount of sulfur used within 1 km of child residence during the year prior to pulmonary evaluation." Results indicate a restrictive effect of low-level elemental sulfur exposure on children's lungs. Findings are consistent with reports of adverse respiratory effects associated with elemental sulfur in animal models, in workers, and in case reports of poisoning. Authors conclude that "[t]his study also lends credibility to reports of drift of elemental sulfur after agricultural application."

10. **California Environmental Health Tracking Program. Agricultural pesticide use near public schools in California. California Department of Public Health. 2014.**

This report demonstrates one methodology to conduct ongoing surveillance of agricultural pesticides to understand pesticide use patterns and to provide information to those who strive to improve children's health. This study used data from California's Pesticide Use Reporting (PUR) program and other sources to estimate pesticide applications within 1/4 mile of school property boundaries. Pesticides included in the study are categorized into 6 groups (i.e., carcinogens, reproductive and developmental toxicants, cholinesterase inhibitors, toxic air contaminants, fumigants, and priority pesticides for assessment and monitoring) and are considered within the report to be "pesticides of public health concern." Researchers assessed 2,511 public schools in the 15 counties with the highest total reported agricultural pesticide use in 2010, and they linked geographic school data to over 2.3 million pesticide use records. While the majority of schools (64%) did not have any pesticides of public health concern applied within 1/4 mile, "the top 5% of schools with any pesticide use nearby (45 schools attended by over 35,000 students) had amounts of pesticides applied within 1/4 mile ranging from 2,635-28,979 lb." Researchers found that pesticide use near schools in California varied among counties and that Hispanic children were more likely to attend schools near the highest use of pesticides of public health concern. "Hispanic children were 46% more likely than White children to attend schools with any pesticides of concern applied nearby and 91% more likely than White children to attend schools in the highest quartile of use." Researchers determined that the data (California-specific) and technology exist to accurately and efficiently assess pesticide use near potentially sensitive populations with a high degree of geographic resolution. However, they also identified needs, including routine and standardized collection, digitization, and reporting of data on agriculutral field locations of each pesticide use permit (for PUR system) and ongoing surveillance of the use of pesticides of public health concerns near potentially sensitive locations to understand trends and usage patterns.

11. **Cushing Lara, Faust John, August Laura Meehan, et al. Racial/Ethnic Disparities in Cumulative Environmental Health Impacts in California: Evidence From a Statewide Environmental Justice Screening Tool (CalEnviroScreen 1.1).** ***American Journal of Public Health.*** **2015;105(11):2341-2348.**

Cushing et al. used the environmental justice screening tool (CalEnviroScreen 1.1) to compare the distribution of environmental hazards and vulnerable populations across California communities. The tool uses publicly available data (2004-2013) related to 17 indicators to calculate relative cumulative impact scores. Researchers were able to compare cumulative impact scores across California zip codes on the basis of their location, urban or rural character, and racial/ethnic makeup. The analysis found the unadjusted odds of living in one of the 10% most affected zip codes were greater for Hispanics (6.2), African Americans (5.8), Native Americans (1.9), Asian/Pacific Islanders (1.8), and other or multiracial individuals (1.6) than for non-Hispanic Whites. "Environmental hazards were more regressively distributed with respect to race/ethnicity than poverty, with pesticide use and toxic chemical releases being the most unequal." Researchers concluded that simple screening tools can be used to prioritize areas disproportionately burdened by environmental health hazards for action.

12. **Oregon State Department of Agriculture. Pesticide Use Reporting System 2008 Annual Report.2009.**

This report summarizes findings from Oregon's 2008 Pesticide Use Reporting System (PURS) and represents the second full calendar year of data collection. In 2008, reporters filed 363,566 reports of pesticide use into PURS. Agriculture accounted for 77.3% of the 19,696,784 pounds of active ingredient pesticides used in Oregon. The Oregon Department of Agriculture (ODA) identified challenges with product identification, computer literacy among PURS users, and PURS requirements. First, reporters expressed frustration when searching products by EPA registration number (unique identifier) because it returned multiple options for what growers and applicators considered to be the same product. Under Oregon law, products with different names that use the same formulation are different products. Second, requiring online reporting proved difficult for some reporters who had never used, owned, or had access to a computer. Additionally, although ODA attempted to build PURS to accomodate the needs of individulas in areas with slow dial-up Internet access, individuals in these areas reported the process was difficult and time-consuming. ODA released an update in October 2008 to help address instances in which reporters submitted duplicate reports, and agency staff agreed that changes likely reduced the number of duplicate reports. The report does not include an analysis of use trends as only two years worth of data were collected and available.

13. **California Department of Pesticide Regulation. Proposed regulations for pesticide use near school sites.2016.**

This document outlines the public comments received by and regulatory text changes made by the California Department of Pesticide Regulation (CDPR) regarding the proposed regulatory action pertaining to pesticide applications near schoolsites. Proposed Section 6693 required that the property owner and pesticide applicator provide application-specific notification to schoolsites 48-hours prior to applications within a 1/4 mile of a school site made pursuant to Section 6691, subsection (b), Monday through Friday, 6:00 a.m. to 6:00 p.m. School administrators shared concerns about the notifications, including potential liability and potential workload increase associated with notifications. Agricultural commissioners were concerned

about the resources necessary to enforce the requirements and to respond to inquiries generated by the notifications. Based on public comments, CDPR deleted the proposed Section 6693 and determined that "[t]he application-specific notifications may have minimal value since the proposed regulation prohibits many of the applications with the highest drift potential." The report states, "[n]otifications for all pesticides is unprecedented and CDPR cannot accurately determine the impacts to all parties." Pilot projects for application-specific notification to schools are being conducted in Kern County and Monterey County; results will inform CDPR's reassessment of the need, impacts, and method for application-specific notification.

14. **Reimer A. P., Prokopy L. S. Environmental attitudes and drift reduction behavior among commercial pesticide applicators in a U.S. agricultural landscape. *J Environ Manage.* 2012;113:361-369.**

Reimer et. al. note that the adoption of drift-reducing practices among commercial applicators remains variable. They explain, “rather than pursue additional regulation, states have attempted to use widespread education and training campaigns to curtail pesticide drift. Despite the proliferation of training and education efforts, pesticide drift continues to be an environmental and health concern and result in conflicts between applicators and neighbors.” The authors surveyed commercial pesticide applicators in Indiana to further understand environmental attitudes, awareness, and concern for pesticide drift, and current adoption of best practices to reduce drift. Approximately 541 (61.5%) commercial applicators in Indiana completed the survey. Overall, they found that applicators had positive environmental attitudes, but low concern for pesticide drift. They found high adoption for equipment modifications to reduce pesticide drift, including regular inspection of equipment, increased droplet size, lowered spray boom heights, and use of low-drift spray nozzles. Applicators stated that adoption of best practices was related to operational benefits, such as satisfying customer needs, complying with regulations, and increasing effectiveness of applications (i.e. reducing drift ensures more pesticide reaches the intended crop). Overall, the authors concluded that “applicators were motivated to adopt drift-reduction practices by the desire to be a good neighbor and a desire to be a good land steward.”

15. **Baumgart-Getz Adam, Prokopy Linda Stalker, Floress Kristin. Why farmers adopt best management practices in the United States: A meta-analysis of the adoption literature. *Journal of Environmental Management.* 2011;96(2012):17-25.**

Baumgart-Getz et al. present a meta-analysis of 46 studies (a combination of published and unpublished) from 1982-2007 addressing the adoption of agricultural Best Management Practices (BMPs) in the United States. It summarized "the influence of 31 social factors assessed over 25 years of BMP adoption." The study provides a quantitative summary of available adoption literature and determines the effect size and confidence interval for those social factors of adoption commonly researched. Included studies met the following criteria: 1) focused on adoption of BMPs – rather than willingness to adopt or likeliness to adopt; 2) were conducted in the United States; and 3) had enough information to calculate an effect size. Findings indicate that extension training (e.g., 1-day training efforts) has a positive influence on adoption of BMP [effect size = 0.0844; 95% Confidence Interval (CI): (0.0371-0.1318); p = 0.0016]. However, the overall education category and formal education are insignificant. Meanwhile, both capital and information positively influenced adoption of BMP and were statistically significant [effect size = 0.1192; 95% CI: (0.0688-0.1696); p<0.0001; and effect size = 0.186; 95% CI: (0.0529-

0.3191); p=0.0088, respectively]. Additionally, “both agency and local networks have relatively large impacts (0.3178 and 0.334 respectively) and heterogeneity below 50%.” While researchers found tenure to be a positive predictor of BMP adoption, they found that heterogeneity accounts for 90.8% of the variation in this variable and recommend future studies standardize how it is collected and interpreted. Authors found the farmers' attitudes towards risk, adoption payments, and perceived quality of a local ecosystem variables were insignificant. Finally, environmental awareness sub-categories program and knowledge were positive, significant predictors of adoption. "This suggests that rather than addressing how agriculture, in general, can degrade water bodies, efforts should focus on how the actions of individuals on their farm impact water quality (knowledge)." Researchers found that "having specific familiarity of program goals and efforts has the largest impact and is an important step preceding BMP adoption." Authors suggest that effective BMP adoption efforts should "combine complementary social factors to increase their overall impact." A two-tiered approach is proposed as a means by which policymakers can promote BMP adoption.

16. **Adusumilli Naveed, Wang Hua. Analysis of soil management and water conservation practices adoption among crop and pasture farmers in humid-south of the United States. *International Soil and Water Conservation Research.* 2017;2018.**

Authors use data from the 2016 Nutrient Management Survey, conducted by the Louisiana Master Farmer Program, to examine the factors affecting adoption of Best Management Practices (BMPs) to conservation. Explanatory variables analyzed include farmers' belief about the relationship between farming practices and water quality, type of farm operation, percent of land owned, number of acres farmed during the most recent cropping year, participation in federal programs, source of technical assistance (i.e., support from Louisiana State University AgCenter Research or Extension and/or Natural Resource Conservation Services), number of years in farming, annual gross farm revenue, education level, and age of the farmer. Analysis of the Soil management practices equation found that farmers' attitudes concerning conservation, crop only farm, and previous enrollment in a federal conservation cost-share program have a positive and significant effect on the likelihood of BMP adoption. The analysis also found landowners were statistically significantly less likely to adopt conservation practices than those who farmed leased-land. Previous studies have shown mixed results as to whether land ownership has a positive, negative, or neutral influence on conservation practice adoption. Additionally, those who had been farming for less than 15 years were less likely to adopt BMPs. An analysis of water management practices found having crops only, previous enrollment in a conservation cost-share program, and higher educational attainment were positively and and significantly associated with likelihood of adopting conservation practices. Findings indicate that farmers' perceptions regarding practices and the suitability of the practice to current farming methods strongly influenced adoption. Authors recommend strengthening institutions to accelerate adoption among farmers renting land for farming and suggest that policymakers should consider the attributes and characteristics of farmers as they define their strategies for an effective conservation policy.

17. **Galvin Kit, Krenz Jen, Harrington Marcy, et al. Practical Solutions for Pesticide Safety: A Farm and Research Team Participatory Model. *Journal of Agromedicine.* 2016;21(1):113-122.**

This article summarizes the participatory research model used to develop the Practical Solutions for Pesticide Safety guide, which contains 26 solutions and additional practical information tailored to the needs of farm managers and farmworkers. Project principles were: "(1) workplace chemicals belong in the workplace, and (2) pesticide handlers and farm managers are experts, with direct knowledge of production practices." The Expert Working Group (EWG) met two to four times a year for five years and included managers and handlers, English and Spanish speakers, and representatives from small and large operations. Additionally, per the EWG's suggestion, 26 farms (79% response rate) agreed to host a site visit during which they shared pesticide handling and safety measures with the research team. Practical solutions were identified and evaluated based on five criteria: practicality, adaptability, health and safety, novelty, and regulatory compliance. A Regional Advisory Committee (RAC) was formed to review the format and content of the guide for the target audience of farm owners and managers. "Production of the final guide benefited from mulitple reviews and edits in each language." The guide is available online in Spanish and English and has been disseminated at industry trade conferences, education sessions, and through a Pacfic Northwest-based worker's compensation company.

18. **Savage J.A., Ribaudo M.O. Impact of environmental policies on the adoption of manure management practices in the Chesapeake Bay watershed. *Journal of Environmental Management.* 2013;129:143-148.**

Savage et al. evaluated whether agricultural producers within the Chesapeake Bay watershed were more likely to implement agricultural best practices compared to producers outside the watershed as a result of stricter pollution control policies within the watershed. They compared the likelihood of producers to use comprehensive nutrient management plans, to remove manure from their operation (i.e., transport it outside of the watershed), and to decrease the number of animals per acre. They found that producers inside the watershed were 13% more likely to implement a comprehensive nutrient management plan and 7.5% more likely to haul manure from their operation as compared to producers outside the watershed. They also found that animal densities were significantly lower inside the watershed than outside. While they were not able to determine causality, the authors stated that these trends can be attributed to specific policy efforts inside the Chesapeake Bay watershed since other existing regulations cover all states. In addition, Savage et al. also presented background information stating that voluntary approaches to implement best practices to reduce pollution are generally not effective, and that agricultural producers typically do not believe their farms are contributing to water quality problems. The authors state that, "two ways in which a voluntary program could succeed are if farmers consider society's demand for water quality when making production decisions and if conservation practices increase net returns." As part of the pollution control policies in the Chesapeake Bay, research and modeling was completed to provide evidence of the link between agricultural practices and water quality. The authors concluded that farmers may be more likely to adopt management best practices if links between their practices and environmental impacts are well documented, and if there is an expectation of future regulations.

19. **American Academy of Pediatrics. Policy Statement Pesticide Exposure in Children. *Pediatrics.* 2012;130(6):e1757-e1763.**

In this policy statement regarding pesticide exposure in children, the American Academy of Pediatrics (AAP) states, "[a]cute [pesticide] poisoning risks are clear, and understanding of

chronic health implications from both acute and chronic exposure are emerging." AAP cites epidemiologic evidence which demonstrates associations between early life exposure to pesticides and pediatric cancers, decreased cognitive function, and behavioral problems. Children may be exposed through a variety of pathways including their diet, pesticide spray drift, and take-home exposure on clothing and footwear of agricultural workers. Epidemiological studies show evidence that chronic exposure is associated with adverse birth outcomes including preterm birth, low birth weight, and congenital abnormalities, pediatric cancers, neurobehavioral and cognitive deficits, and asthma. Numerous case-control studies and reviews have linked insecticide exposure to increased risk of brain tumors and acute lymphocytic leukemia. It recommends improvements to public health tracking and regulatory action on pesticides as means by which to reduce exposure. AAP recommendations to government include: 1) marketing changes; 2) labeling (e.g., risk to children, in Spanish); 3) setting goals to reduce overall exposure; 4) mandatory reporting of suspected poisonings with centralized surveillance system; 5) ban export of products that are banned or restricted in the U.S. for toxicity concerns; 6) continually evaluate pesticide safety; 7) advance less toxic pesticide alternatives; 8) support toxicologic and epidemiologic research to identify and understand associated health risks; 9) support health provider education to diagnose and treat pesticide poisonings.

20. **Centers for Disease Control and Prevention. Severity Index for Use in State-based Surveillance of Acute Pesticide-Related Illness and Injury. 2001.**

The severity index provides simple, standardized criteria for assigning severity to cases of acute pesticide-related illness and injury. Categories range from S-1 (death) to S-4 (low severity illness or injury).

21. **Alarcon WA, Calvert G. M., Blondell J.M, et al. Acute Illnesses Associated with Pesticide Exposure at Schools. *Journal of the American Medical Association.* 2005;294(4):455-466.**

Alarcon et. al. analyzed data related to pesticide-related illness at schools from three sources: National Institute for Occupational Safety and Health's Sentinel Event Notification System for Occupational Risk (SENSOR), California Department of Pesticide Regulation, and Association of Poison Control Center's Toxic Exposure Surveillance System (TESS). Authors determined incidence rates and severity of acute pesticide-related illness among 2,593 students, parents, and school staff at daycares, elementary and secondary schools between 1998 and 2002. They found that the incidence of acute pesticide-related illness among children increased significantly from 1998 to 2002, with an overall incidence rate of 7.4 cases per million children. However, the authors note that these databases likely underreport cases of pesticide illness in children. Most cases (89%) were of low severity, which included symptoms such as skin, eye, or upper respiratory tract irritation. Approximately 31% of cases were associated with pesticide drift from nearby agricultural land, and most of these cases resulted from insecticide and fumigant applications. A higher proportion of children were exposed from drift events as compared to adults (40% versus 25% respectively). The authors note that there are no federal requirements limiting pesticide exposures at schools, and that states with regulations addressing pesticide application on school property do not protect from drift. They offer five recommendations to reduce exposure to pesticide drift at schools: 1) Reduce or eliminate application methods that cause drift; 2) Shift application to times when students and staff are not on school property; 3) Ensure applicators comply with existing regulations related to pesticide application; 4) Require

pesticides only be applied by trained applicators; and 5) Establish pesticide spray buffer zones around school.

22. **Namulanda G., Monti MM, Mulay P., et al. Acute Nonoccupational Pesticide-Related Illness and Injury- United States, 2007-2011. *Morbidity and Mortality Weekly Report.* 2016;63(55):5-10.**

This National Institute for Occupational Safety and Health (NIOSH) report summarizes 2007-2011 data on illnesses and injuries arising from nonoccupational exposure to conventional pesticides reported by 7 of the 12 states, including Washington, that participate in the Sentinel Event Notification System for Occupational Risk (SENSOR)-Pesticide program. Authors cite evidence that approximately 857 million pounds of conventional pesticides were used in the United States in 2007 and agricultural uses accounted for approximately 80% of total conventional pesticide use. The report addresses pesticide-related illness and injuries from acute exposure events (i.e., single, repeated, or continuous exposure to one or more pesticides that generally occurs for 8 hours or less). State-level surveillance programs may receive and accept case reports about pesticide-related illness and injury from a variety of sources, including health care facilities, laboratories, poison control centers, agricultural departments, and affected persons or family members. "A case of acute pesticide-related illness and injury is characterized by an onset of symptoms that are dependent on the formulation of the pesticide product and involve one or more of the following: 1) systemic signs or symptoms (including respiratory, gastrointestical, allergic, and neurologic), 2) dermatologic lesions, and 3) ocular lesions." A case is deemed nonoccupational if the pesticide exposure occurred at a place other than the patient's place of work. Like occupational exposures, the data provided likely underestimates the actual magnitude of acute nonoccupational pesticide-related illness and injury. Between 2007-2011, 429 cases of nonoccupational pesticide-related illness and injury cases were reported in Washington State (Incidence Rate = 1.29/100,000). Of the 5,795 nonoccupational pesticide-related cases reported across the 7 states, insecticides accounted for the majority of cases (63%), followed by herbicides (10%). Most cases (73%) occured among individuals 18 years and older, and 12% occurred among children age five or younger.

23. **Asquith Adam, Evslin Lee, West-Hurd Kathleen, et al. Pesticide Use by Large Agribusinesses on Kaua'i Findings and Recommendations of The Joint Fact Finding Study Group.2016.**

This report presents The Joint Fact Findings (JFF) Study Group's analysis of pesticide usage by agribusiness on Kaua'i. The Study Group spent more than 2,500 hours in 2015 gathering data to address five questions: 1) How much land do the companies actually farm; 2) What pesticides do they use, how much, when and where; 3) Is there discernable evidence of environmental harms; 4) Is there discernable evidence of human health harms; and 5) How effective is government oversight and regulation? The Study Group encountered a variety of challenges, including: "patchy and fragmented information; incomplete and often important but proprietary data; small statistical samples; confounding demographic variables; a lack of solid human and environmental health exposure data; and evolving scientific and regulatory views." The literature review identified 20 health conditions associated with general pesticide exposure including, prostate cancer, leukemia, Non-Hodgkins lymphoma (NHL), multiple myeloma, Parkinson’s disease, asthma, diabetes, thyroid disease, endocrine disruption conditions, obesity, and renal disease in adults. Among children, possible associations include asthma, leukemia, brain tumors,

birth defects, premature birth, low birth weight, decreased cognitive function, and neurobehavioral problems like Attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorders. While an association is not proof of causation, the JFF Study Group concluded, "[t]he medical literature and limited local information we reviewed make a case for the collection of better data and more systematic testing of the environment and populations residing closest to seed companies."

24. **Landrigan Philip J, Fuller Richard, Acosta Nereus J R, et al. The *Lancet* Commission on pollution and health. *The Lancet Commissions.* 2017;391(10119):462-512.**

Landrigan et al. provide an overview of pollution, currently the largest environmental cause of disease and premature death in the world. For example, authors cite evidence that fetuses, infants, and children are "particularly sensitive to neurotoxic pollutants, even at very low levels of exposure, because of the vulnerability of early-stage development of the human brain." Neurotoxic pollutants, like organophosphate pesticides, are known to be toxic to the developing brain and have been linked to loss of cognition, shortening of attention span, impairment of executive function, behavioral disorders, and increased prevalence of autism, attention deficit and hyperactivity disorder, learning disabilities, and dyslexia. Prospective epidemiological birth cohort studies have detected associations between prenatal exposures to developmental neurotoxicants and disease. Neonicotinoid imidacloprid is the most widely used insecticide in the world, with nearly 4 million kg used in the U.S. in 2014. "Despite their extensive use and known neurotoxicity to insects, very little information is available on the possible human health effects of neonicotinoids." Additionally, the International Agency for Research on Cancer has determined that glyphosate (Roundup) is a "probable human carcinogen." Evidence exists that agricultural workers exposed to glyphosate experienced increase occurrence of non-Hodgkin lymphoma, and animal studies also show strong evidence of dose-related carcinogenicity at several anatomical sites. The disproportionate exposure of Hispanic farmworkers to acutely toxic organophosphate pesticides poses an environmental injustice to these workers, many of whom are undocumented immigrants who are afraid to protest exposure to pollution. Researchers note that other chemicals may exist "whose ability to cause silent injury to the developing human brain have not yet been discovered." Early life exposures to neurodevelopmental toxicants can have significant social and economic costs, which may be avoided through prevention of these exposures and associated disorders. The Commission recommends a variety of practices to reduce pollution exposures including: 1) establishing sound chemicals management programs to test the safety and toxicity of chemicals and 2) establishing and enforcing environmental laws and regulations and base regulation on the polluter-pays principle.

25. **President's Cancer Panel. 2008-2009 Annual Report Reducing Environmental Cancer Risk. U.S. Department of Health and Human Services; National Institutes of Health; National Cancer Institute;2010.**

This report summarizes the President's Cancer Panel's (the Panel) findings and conclusions regarding the state of environmental cancer research, policy, and programs addressing known and potential effects of environmental exposures on cancer. The report was informed by testimony received from 45 invited experts from academia, government, industry, the environmental and cancer advocacy communities, and the public and additional informational gathering. Chapter 2 of the report describes the agricultural workforce, the population group most heavily exposed to agricultural chemicals, and hazards associated with specific chemicals.

Authors note that, unlike other industries in the U.S., families (including children and spouses) typically share in agricultural work. Migrant or seasonal workers and their families often experience disproportionate exposures to pesticides due to working and housing conditions. However, due to a variety of factors (e.g., lanugage, health care access, mobility) it is difficult to assess the magnitude of health problems migrants suffer as a result of their exposure to agricultural chemicals.

26. **Gunier Robert B., Bradman Asa, Harley Kim G., et al. Will buffer zones around schools in agricultural areas be adequate to protect children from the potential adverse effects of pesticide exposure? *PLOS Biology.* 2017;15(12):e2004741.**

The Center for Environmental Research and Children's Health (CERCH) supports the California Department of Pesticide Regulation's (CDPR) proposed regulation to implement buffer zones around schools and daycares to reduce children's exposure during the day to pesticides. Since 1999, CERCH at the University of California, Berkeley's School of Public Health has partnered with the Salinas Valley Community to conduct the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) Study to examine the potential impact of pesticides and other environmental exposures on the health of pregnant women and children living in the agricultural community. This longitudinal study includes more than 600 children who were enrolled before birth (50%) or at 9 years of age (50%); participants were 15 to 17 years old at the time of publication. The study has documented associations between higher levels of biomarkers of pesticides and poorer health and development. "[H]igher concentrations of organophosphate pesticide (OP) urinary metabolites in maternal urine during pregnancy were associated with shortened gestational duration, greater odds of abnormal neonatal reflexes, pervasive developmental disorder and poorer mental development at 2 years of age, poorer attention and hyperactive behaviors at 5 years, and lower IQ at 7 years." Additionally, "prenatal and child OP metabolite levels were associated with more asthma-related symptoms, and higher levels of OP pesticide metabolites in the urine of children between birth and 5 years of age were associated with reduced lung function at 7 years of age." CERCH authors note various challenges to determining the full health effects of pesticides. Limitations associated with exposure assessment "may result in measurement error and bias towards the null hypothesis in health outcome studies." Authors also note that estimating human exposure from Pesticide Use Reporting (PUR) data would likely underestimate exposure as it only includes "residential exposure and not the individual's cumulative exposure across multiple settings." These realities as well as differences in the nature of pesticides and application methods complicate efforts to identify the correct buffer distance(s) from treated fields to protect public health. Authors also highlight that the proposed policy considers exposures to children but does not aim to reduce exposures to pregnant women in the community. As evidence indicates that exposure during the in utero period may have the greatest adverse effects, CERCH recommends policymakers establish other protective measures (e.g., protective city planning and zoning for new residential developments) to reduce exposures to pregnant women and community members.

27. **Calvert G. M., Beckman J., Prado J.B., et al. Acute Occupational Pesticide-Related Illness and Injury- United States, 2007-2011. *Morbidity and Mortality Weekly Report.* 2016;63(55):12-16.**

This National Institute for Occupational Safety and Health (NIOSH) report summarizes the data on illnesses and injuries arising from occupational exposure to conventional pesticides reported

by 12 states, including Washington, from 2007 to 2011. All 12 states that participate in the Sentinel Event Notification System for Occupational Risks (SENSOR)–Pesticide program to track pesticide-related illness and injury require physicians to report confirmed and suspected cases to state health authorities. "Persons are considered to have an occupational pesticide-related illness or injury if they become ill or injured soon (i.e., within seconds to hours) after an exposure to one or more pesticides." An illness and injury is defined as occupational if the exposure to the pesticide occurred at the individual's place of work. According to the SENSOR-Pesticide criteria, cases are classified as definite, probable, possible, and suspicious on the basis of the level of detail known for each case. Reports that cannot be categorized as such are not included in the report analysis. Illness and injury severity is categorized as: low-severity - usually resolves without treatment and <3 days are lost from work; moderate-severity - not life threatening, requires medical treatment, and 5 or fewer days of work lost; 3) high-severity - life threatening, requires hospitalization, >5 days lost from work, may result in permanent impairment; and 4) fatal. From 2007 to 2011, SENSOR-Pesticides received 2,606 reports of occupational exposures accounting for 31% of all reported cases. "Rates of illness and injury among agricultural industry workers (18.6/100,000) were 37 times greater than the rates for nonagricultural workers (0.5/100,000)." However, authors note rates likely underestimate of the actual magnitute of acute occupational pesticide-related illness and injury as many affected persons do not seek medical care, nor call appropriate authorities. Those who do seek treatment may not be accurately diagnosed or the case may not be reported. Additionally, rates of pesticide illness and injury may have been affected by inaccurate estimates of the agricultural industry population. The transient and seasonal nature of agricultural employment makes it difficult to count workers. This is further complicated by the fact that workers with undocumented U.S. immigration status tend to avoid government contact. Between 2007 and 2011, pyrethroids (21%) and organophosphorous compounds (14%), both insecticides, accounted for over one-third of acute occupational pesticide-related illness and injury cases reported to the SENSOR-Pesticide program. Researchers found incidence rates to be highest in Washington but noted that the state has stronger protections for agricultural workers and a larger, more robust pesticide illness and injury surveillance compared to other states, "which likely accounts for some differences in incidence rates."

28. **Acute Pesticide-Related Illness Among Farmworkers. *House Labor & Workplace Standards Committee*. 65th Legislature ed. Washington State Department of Health: Joanne Prado; 2017.**

This presentation by Joanne Prado, Pesticide Illness Surveillance Epidemiologist at DOH, to the House Labor & Workplace Standards Committee addresses pesticide-related illness and associated risk factors for farmworkers based on pesticide illness surveillance activities in Washington State.

29. **Agricultural Operations Overview. Available at: https://www.osha.gov/dsg/topics/agriculturaloperations/. Accessed April, 2018.**

OSHA reports, "[f]armworkers are at high risk for fatal and nonfatal injuries, work-related lung diseases, noise-induced hearing loss, skin diseases, and certain cancers associated with chemical use and prolonged sun exposure." In 2011, crop production agricultural workers' injury rates were 5.5 per 100 workers compared to 3.8 for all workers.

30. **National Census of Fatal Occupational Injuries in 2016 [press release]. 2017.**

The U.S. Bureau of Labor Statistics reported there were a total of 5,190 fatal work injuries recorded in the United States in 2016, a 7% increase from the 4,836 fatal injuries reported in 2015. This is the third consecutive increase in annual workplace fatalities and the first time more than 5,000 fatalities have been recorded by the Census of Fatal Occupational Injuries (CFOI) since 2008. In 2016, farmers, ranchers, and other agricultural managers had a fatal injury rate of 23.1/100,000 full-time equivalent (FTE) workers compared to an All-worker fatal injury rate of 3.6/100,000 FTE workers. Crop production specifically accounted for 261 fatal worker injuries for a rate of 20.9/100,000 FTE workers. CFOI also reported that foreign-born workers made up about 20% of the total fatal work injuries; 37% of these workers were born in Mexico, followed by 19% from Asian countries.

31. **Castañeda Sheila F., Rosenbaum René P., Holscher Jessica T., et al. Cardiovascular Disease Risk Factors Among Latino Migrant and Seasonal Farmworkers. *Journal of Agromedicine.* 2015;20(2):95-104.**

Castaneda et. al. compared risk factors for cardiovascular diseases by sex and among migrant and seasonal farmworkers. The authors note that, "[migrant and seasonal farmworkers] continue to be an economically and socially disadvantaged group, due to unstable working and living conditions and various barriers to obtaining health and social services." They also state that farmworkers have lower health care utilization rates compared to the general U.S. population due to a number of social determinants of health, including limited access to care, language and cultural barriers, concern about job loss, and lack of transportation. For this study, Castaneda et. al. evaluated the incidence of diabetes, smoking, obesity, hypertension, and high cholesterol among migrant and seasonal farmworkers. They found that migrant workers were 2.15 times as likely of being obese compared to seasonal workers, but did not detect any other differences by farmworker status. Instead, they found greater differences by sex, and conclude that future research may need to focus on sex differences among farmworkers.

32. **Washington State Department of Health. 2018 Washington State Health Assessment.2018.**

The *State Health Assessment* provides an overall picture of the health and well-being of Washingtonians and informs the *State Health Improvement Plan.* This report provides data and identifies key health issues to be addressed through future prevention efforts, policy development, and communication to promote health.

33. **National Agricultural Workers Survey U.S. Department of Labor. Agricultural Worker Tables. FY2014.**

Established in 1989, the U.S. Department of Labor's National Agricultural Workers Survey (NAWS) is "an employment-based, random-sample survey of U.S. crop workers that collects demographic, employment, and health data in face-to-face interviews." While both migrant and seasonal agricultural workers are sampled in the NAWS, agricultural workers with an H-2A visa (a temporary-employment visa for foreign agricultural workers) are excluded. Of the 10,825 NAWS respondents interviewed during FY2014 80% identified as Hispanic and 74% were Spanish speakers. "The majority of agricultural workers continued to report Mexico as their country of birth; however fewer did so in 2013-2014 (68%) compared to 15 years earlier (80%)."

Since FY1999-2000, the proportion of migrant workers has dropped from roughly 50% in that year to 16% in FY2013-2014.

34. **U.S. Census Bureau Population Estimates Program. QuickFacts Washington; United States. 2016.**

The Census Bureau's Population Estimates Program (PEP) produces estimates of the population for the United States, its states, counties, cities, and towns, as well as for the Commonwealth of Puerto Rico and its munipios (county-equivalents for Puerto Rico). Estimates are updated annually. According to 2016 PEP estimates, Hispanic or Latino individuals comprise 12.4% of Washington State's population.

35. **Washington State Department of Health. Improving Data Quality in Pesticide Illness Surveillance. 2004.**

In 2000, DOH was awarded a grant from the National Institutes of Occupational Safety and Health (NIOSH) to enhance the pesticide surveillance system. The specific aim of this project was to increase the value of the information generated by the Pesticide Incident Monitoring Surveillance system (PIMS) for designing interventions. As part of the project, focus groups were conducted to explore healthcare seeking behaivors among farmworkers. Six focus groups (~10 participants each; 31 women; 33 men) were conducted during the summer and fall of 2001. Four sessions consisted of participants who were mostly "settled out", formerly inter-state migrant farmworkers who were now living year-round in the region; researchers recruited participants for the final two sessions through the Enterprise for Progress in Community and Migrant Head Start programs in rural Yakima County, which serve inter-state migrant farmworkers. All session were conducted in Spanish, facilitators reiterated that participation was voluntary, and verbal consent was provided at the start of each session to avoid a written record that linked individuals to recordings or transcripts. Researchers found that nearly all participating farmworkers "had a good understanding of symptoms of pesticide-related illness and routes of pesticide exposure." Many felt they had experienced symptoms resulting from a workplace exposure, but few had sought medical treatment. "Nearly all agreed they would not seek medical care in the event of mild to moderate symptoms of pesticide poisoning." Participants identified key barriers to seeking health care as economic (e.g., could not afford lost wages for time spend seeking medical care). Less than 50% of participants knew they were eligible for workers' compensations coverage. Among those who were aware, most were concerned that when their employer was notified of the claim that they may be demoted, fired, or not rehired in the future. Additionally, while participants were very satisfied with health care provided, they shared a "general sense of dissatisfaction and mistrust of local health care providers for situations involving pesticide-related illness." Health care providers were perceived as more sympathetic to growers and not seriously considering symptoms as potentially related to pesticide exposure. Participants also cited the attitude of the supervisor or employer (encouraging or discouraging medical care) as a reason individuals would or would not seek health care. The full report provided recommendations to address these issues.

36. **Lim Yuen Mei, Song SuJin, Song Won O. Prevalence and Determinants of Overweight and Obesity in Children and Adolescents from Migrant and Seasonal Farmworker Families in the United States—A Systematic Review and Qualitative Assessment. *Nutrients.* 2017;2017(9):188.**

This systematic review synthesizes and assesses available data on the prevalence and modifiable health determinants of overweight and obesity (OW/OB) in migrant and seasonal farmworker (MSFW) children and adolescents. Authors note, "[t]he limited number of previously reported research on MSFW families suggests that their unique sociodemographic characteristics and lifestyle predispose them to poor health outcomes including OW/OB." Ten cross-sectional studies met the inclusion criteria: articles or dissertations investigating prevalence and association between health determinants and OW/OB in MSFW children and adolescents (<20 years) in the US. Authors found that "children's education, household food insecurity, parents' weight status, parents' distorted perception of their children's weight status, and parents' participation in the federal nutrition assistance program were significantly associated with the children's and adolescents' risk of OW/OB." Authors suggest promoting culturally relevant public health programs and implementation of a systematic health surveillance plan for MSFWs and their children to combat OW/OB among MSFW children and adolescents.

37. **Principles of Pediatric Environmental Health: Why Are Children Often Especially Susceptible to the Adverse Effects of Environmental Toxicants? 2012; Available at: https://www.atsdr.cdc.gov/csem/csem.asp?csem=27&po=3. Accessed 9 April 2018.**

The Agency for Toxic Substances and Disease Registry (ATSDR) provides an overview summarizing reasons that children are often more susceptible to exposures to environmental toxics than adults. Reasons include rapid growth and development, physical size, and behaviors.

38. **Smith Marissa N., Workman Tomomi, McDonald Katie M., et al. Seasonal and occupational trends of five organophosphate pesticides in house dust. *Journal of Exposure Science and Environmental Epidemiology*. 2016;27(4):372-378.**

In 1998, the University of Washington's Center for Child Environmental Health Risks Research began conducting a community-based participatory research project with a Community Advisory Board (CAB) to investigate exposure patterns and impacts of organophosphate pesticides on the children of farmworkers (FW; n = 100 families) and non-farmworkers (NFW; n = 100 families) in the Lower Yakima Valley of Washington State. FW families consisted of at least 1 agricultural (pome fruit farm) adult worker and a referent child aged 2-6 in the household; NFW families included an adult who worked in factories, daycare settings, dairies, stores, or schools as well as a referent child between 2-6 years of age. This study focused on the occupational take-home pathway, in which FWs can carry pesticide residues home on their clothing, boots, hair, and bodies. Pesticide residues become trapped in house dust where they are not subject to usual degradation processes (sunlight and rain), leading to potentially longer half-lives. Family members who come into contact with affected dust may be exposed to these toxic chemicals. Authors cite evidence that children are both particularly sensitive to toxic chemicals and are at increased risk of exposure to dust as they spend more time on and near the ground. The CAB requested researchers examine seasonal differences (agricultural seasons: thinning, harvest, and non-spray) and focus on fieldworkers rather than pesticide handlers and applicators. A total of 499 house dust samples were collected from 198 unique households across the three agricultural seasons between 2005 and 2006. "[A]dult participants identified the area where the child played most frequently and the dust was collected from that area" using a standardized vacuum cleaner unit, collection template (0.5x0.5 m2), and cleaning method. House dust was anazlyed from 120 households in all three seasons, 61 households in two seasons, and 17 households in one season. FW households comprised 44, 48, and 47% of house dust samples analzyed for the pesticides in

the thinning, harvest, and non-spray seasons, respectively. NFW households made up 56, 52, 53% of house dust samples analyzed in each agricultural season. Compared to NFW house dust, FW house dust had higher concentrations of 4 out of 5 organophosphate pesticides: azinphos-methyl ($p<0.005$; between 5- and 9-fold dependent on agricultural season), phosmet ($p<0.005$; 5–7-fold), and malthion and chlorpyriphos ($p<0.005$; 1.8–9.8-fold). Diazinon did not significantly differ between FW and NFW house dust, but it did show a defined seasonal pattern that peaked in the harvest season. Results indicate that "concentrations for both occupational groups are dependent on agricultural season with the highest concentrations observed during the thinning and harvest seasons." While NFW households almost always experienced peak concentration of organophosphate pesticides during harvest season, FWs often experienced elevated concentrations in both the thinning and harvest seasons. Similarly, previous analysis of this cohort of FWs and NFWs and their children found seasonal and occupational differences in urinary metabolites of organophosphate pesticides. Both the house dust organophosphate pesticide concentrations and urinary metabolite concentrations peak during the thinning and harvest seasons, "indicating that there is an important relationship between house dust concentrations of organophosphate pesticides and internal organophosphate dose." This study and previous findings of higher urinary organophosphate pesticide metabolite concentrations among children of FWs than in NWFs' children provide evidence supporting an occupational take-home pathway.

39. **Shelton J. F., Geraghty E. M., Tancredi D. J., et al. Neurodevelopmental disorders and prenatal residential proximity to agricultural pesticides: the CHARGE study. *Environmental Health Perspectives.* 2014;122(10):1103-1109.**

Shelton et al. evaluated whether residential proximity to agricultural pesticides during pregnancy is associated with autism spectrum disorders (ASD) or developmental delay (DD) in California's population-based case control Childhood Autism Risks from Genetics and Environment (CHARGE) study. Previous studies have found associations between commonly used pesticides and abnormal and impaired neurodevelopment in children. Authors cite evidence that "[t]he majority of pesticides sold in the U.S. are neurotoxic and operate through one of three primary mechanisms: a) inhibition of acetylcholinesterase (AChE), b) voltage-gated sodium channel disruption, and/or c) inhibition of gamma-aminobutyric acid (GABA)." In addition to both serving as inhibitory neurotransmitters, AChE is involved in the development of learning, cognition, and memory; and GABA is necessary for the development and maintenance of neuronal transmission. Researchers linked the commercial pesticide application data from the California Pesticide Use Report (1997-2008) to the addresses of the 970 participants during pregnancy [ASD (n=486); DD (n=168); typically developing (TD) referents (n=316)]. "Pounds of active ingredient applied for organophophates, organochlorines, pyrethroids, and carbamates were aggregated within 1.25-km, 1.5-km, and 1.75-km buffer distances from the home." Researchers found children with ASD were 60% more likely to have organophosphates applied nearby the home at some point during gestation [1.25 km distance; adjusted OR (aOR)= 1.60; 95% CI: 1.02-2.51] than TD children. "Children with DD were nearly 150% more likely to have carbamate pesticides applied near the home during pregnancy (1.25 km distance; aOR = 2.48; 95% CI: 1.04-5.91)." Results indicate that both associations lessened as the buffer size grew larger, which lends support to an exposure-response gradient. Additionally, "[c]hildren of monthers residing near pyrethroid insecticide applications just before conception or during third trimester were at greater risk for both ASD and DD, with ORs ranging from 1.7 to 2.3." Authors conclude results support evidence linking neurodevelopmental disorders with gestational

pesticide exposures, particularly organophosphates, and provide new information regarding ASD and DD associations with, respectively, pyrethroids and carbamates.

40. **Washington State Department of Health Washington Tracking Network. Pesticide Drift- Data obtained from the Department of Health's Pesticide Program. 2017.**

The Washington State Department of Health Pesticide Program collects data related to pesticide illness and conducts investigations. They recieve reports of suspected pesticide illnesses from health care providers, Washington Poison Center, Washington State Department of Labor and Industries, and Washington State Department of Agriculture. They determine a case is related to agricultural drift when "a person is exposed to a pesticide that has drifted away from the application target, and the exposure contributes to that person experiencing signs or symptoms of pesticide posioning." Between 2010 and 2014, there were 903 cases of pesticide illness in Washington State, and approximately 303 cases (34%) were the result of agricultural drift. In 2014, there were 253 cases of pesticide illness in Washington State at a rate of 3.63 cases per 100,000 people . This number was up from 128 cases (rate of 1.90 cases per 100,000 people) in 2010. Sixteen counties had rates higher than the state rate, and the five counties with the highest rates were Grant (50.25) , Douglas (24.38), Whatcom (20.90), Adams (20.69), and Yakima (14.88) Counties. There were 50 cases of pesticide illness in children 0-14 years of age. Specific to drift events, in 2015 there were 44 cases of pesticide illness resulting from 24 agricultural drift events. The majority of these cases were due to air-blast ground sprayers and aerial applications. The three counties with the highest rates of drift-related pesticide illness were Grant (38.40), Douglas (22.69), and Yakima (6.43) Counties. Between 2013 and 2015, there were 4 drift-related pesticide illness cases in children 0-14 years of age.

41. **California Department of Pesticide Regulation. Pesticide Air Monitoring Network. 2016.**

This presentation by the CDPR discussed potential enhancement of the pesticide air monitoring network, including a proposed method to rate communities for pesticide use. Data presented include CalEnviroScreen (Version 2.0) scores.

42. **Farm Labor: Background. 2016; Available at: https://www.ers.usda.gov/topics/farm-economy/farm-labor/background.aspx. Accessed 29 March, 2018.**

This webpage provides an overview of agricultural labor statistics specific to hired farmworkers in the United States. Available information includes: 1) the number and geographic distribution of hired farmworkers; 2) demographic characteristics; 3) unemployment rates by occupation; 4) wages; 5) legal status, country of origin, and migration patterns of hired crop farmers; and 6) links to key data sources.

43. **American College of Obstetricians and Gynecologists. Committee Opinion: Exposure to Toxic Environmental Agents.2013.**

The American College of Obstetrics and Gynecologists provides a summary of research examining preconception and prenatal exposure to environmental toxics and the effect of exposure on reproductive health across the lifecourse. Women who are pregnant or may become pregnant are also at risk from pesticide exposure. Preconception and prenatal exposure to

environmental toxics, including pesticides, may result in negative birth outcomes. In addition, prenatal exposure to pesticides may also result in worse health outcomes later in life, including increased risk of childhood cancers and impaired reproductive function. Specifically, endocrine disrupting chemicals have been shown to interfer with the role of certain hormones, homeostasis, and developmental progress. "The evidence that links exposure to toxic environmental agents and adverse reproductive and developmental health outcomes is sufficiently robust[.]" The Committee Opinion discusses the disproportionate impact low-wage immigrant populations and those, particularly women, who experience occupational exposures. Authors provide guidance for reproductive care professionals as to preventative efforts they may take to support the health of their patients.

44. **Lee S. J., Mehler L., Beckman J., et al. Acute pesticide illnesses associated with off-target pesticide drift from agricultural applications: 11 States, 1998-2006. *Environ Health Perspect.* 2011;119(8):1162-1169.**

Lee et al. use data from the National Institute for Occupational Safety and Health's (NIOSH) Sentinel Event Notification System for Occupational Risks (SENSOR)-Pesticides program and the California Department of Pesticide Regulation (CDPR) to estimate the incidence of acute illnesses from pesticide drift from outdoor agricultural applications and characterize drift exposure and illnesses. Between 1998 and 2006, researchers identified 2,945 cases associated with 643 agricultural pesticide drift events from 11 states (including Washington). Findings indicate that 47% of cases were exposed at work, 92% experienced low-severity illness, and 14% were children under 15 years of age. The annual incidence ranged from 1.39 to 5.32 per million persons over the 9-year period, while the "overall incidence (in million person-years) was 114.3 for agricultural workers, 0.79 for other workers, 1.56 for nonoccupational cases, and 42.2 for residents in five agriculture-intensive counties in California." Organophosphorus compounds were the most common pesticide chemical class involved in drift events (28%). Soil applications with fumigants accounted for 9% of drift events and were responsible for the largest percentage (45%) of cases. Aerial applications were 39% of drift events and accounted for 24% of cases. Herbicides, insecticides, or multiple classes were significantly associated with moderate/high illness compared with fumigants. Authors identified common factors contributing to drift cases as weather conditions, improper seal of the fumigation site, poor communication between applicators and growers or others, and applicator carelessness near nontarget areas. Authors note the Environmental Protection Agency (EPA) updated safety requirements for soil fumigants (effective early 2011) to include a prohibition within 0.25 miles of "difficult-to-evacuate" sites (e.g., schools, daycare centers, medical facilities). However, this analysis found 82% of fumigant-related cases occurred more than 0.25 miles from the application site. These findings suggest that "the new buffer zone requirements, independent of other measures to increase safety, may not be sufficient to prevent drift exposure."

45. **Glanz K., Rimer B.K., K. Viswanath. *Health Behavior and Health Education: Theory, Research, and Practice.* 4th Edition ed. San Francisco, CA: Jossey-Bass; 2008.**

Glanz et al. present current theories and models of health behavior change. Many theories note that information alone is not sufficient to change behavior. Instead health behavior change is dependent on a number of factors, spanning from an individual's underlying beliefs, knowledge, and attitudes to broader political, economic, and social determinants of health.

46. **Kelly M. P., Barker M. Why is changing health-related behaviour so difficult? *Public Health.* 2016;136:109-116.**

The authors propose six common errors of politicians and policy-makers in thinking about health behavior change. Kelly explains that information alone is not enough to change people's behaviors and that, "giving people information does not make them change." He also explains it is false that, "if you tell people what is good for them and what they need to do to protect their health, they will do it." He states that based on our historical and current knowledge of behavior change science, we recognize that even when people are armed with information, behavior change is challenging. He concludes that behavior change requires an understanding of people's motivation and context, including their social and economic environment.

47. **National Culturally and Linguistically Appropriate Services Standards. Available at: https://www.thinkculturalhealth.hhs.gov/clas/standards. Accessed 8 March 2018.**

The National Standards for Culturally and Linguistically Appropriate Services (CLAS) outline best pratices to provide "effective, equitable, understandable, and respectful quality care and services that are responsive to diverse cultural health beliefs and practices, preferred languages, health literacy, and other communication needs."

48. **Sandberg J.C., Spears Johnson C.R., Nguyen H.T., et al. Mobile and traditional modes of communication among male Latino farmworkers: Implications for health communication and dissemination. *Journal of Immigrant and Minority Health.* 2016;18(3):522-531.**

Sandberg, et al. surveyed a total of 267 farmworkers in North Carolina between 2012 and 2013. They found that the number of farmworkers owning cell phones and smart phones is increasing. However, few farmworkers maintain consistent phone numbers. The authors conclude that, "strategies to use cell phones to improve health or share research findings will face obstacles in this population."

49. **Kasner E.J., Fenske R.A., Galvin K., et al. Review of Agricultural Spray Notification Systems. Pacific Northwest Agricultural Safety and Health Center, University of Washington School of Public Health;2016.**

Kasner et. al. completed a systematic review of pesticide spray notification systems used in the United States and internationally. They identified six pesticide spray notification systems, including two in Washington State and four used internationally. The two systems identified in Washington State include the list of pesticide medically-senstive individuals maintained by the Washington State Department of Agriculture and the requirements for schools and daycares to notify and post when using pesticides on school property. They also evaluted SprayWatch (applicator-to-resident notification in New Zealand), Spraydays (applicator-to-resident notfication in United Kingdom), DriftWatch (registry notification to protect sensitive crops in U.S. and Canada), and Pesticide Eco-Alternatives Center (pesticide awareness campaign in China). They did not identify any farm-to-farm or applicator-to-grower notification models. They evaluted each for notification method, lead time of notification, distance between notiying and notified parties, message content, mobile-compatability, and estimated cost per year. Growers in the United Kingdom who participated in the pilot trial of the Spraydays notification system stated concerns related to "unecessarily alarming the public, unpredicatability of spray

date due to quick changes in weather, limited computer literacy, and increased work burden on those farmers with more residential neighbors." Assuming that costs, work burdens, and legal liabilities are minimized, Kasner et al. concluded that a remote farm-to-farm spray notification system appears to be a promising means by which to prevent farmworker exposure to pesticide drift. Implementation of such agricultural workplace spray notification systems will require engagement of key stakeholders, including pesticide applicators, farm owners and managers, farmworker groups, research and education communities, and state agencies.

50. **Sandman P.M. Crisis Communication Best Practices: Some Quibbles and Additions. *Journal of Applied Communication Research.* 2006;34(3):257-262.**

Sandman defines three risk communication scenarios: 1) when people are insufficently concerned about a hazard in proportion to the actual risk; 2) when people are excessively concerned about a hazard in proportion to the actual risk; and 3) when people are appropriately concerned about a hazard in proporition to the actual risk. He notes that communication in the face of insufficient concern from the public must focus on increasing concern and motivating action. Excessive concern results in the need for "outrage management," and may harm the reputation of an organization or agency if communication is not managed appropriately. Sandman explains that the most effective risk communication occurs when the public has appropriate concern given the seriousness of the hazard.

Appendix A. Key Informant Interviews

Since there is limited research on the impacts of pesticide use reporting and pesticide application-specific notifications, we conducted key informant interviews to gather additional supporting evidence. In total, we conducted 18 key informant interviews, including 11 informants from pesticide regulatory and state agencies in California, Oregon, and Washington; 4 informants representing pesticide applicators and growers; 2 informants representing academia; and 1 informant representing farmworkers. We also spoke with 3 subject matter experts from Washington State Department of Health (DOH), Office of Environmental Public Health Sciences (OEPHS).

Interviews were conducted within time and process constraints. The primary intent of key informant interviews was to gather supporting evidence. Interviews also assisted with understanding different viewpoints, challenges, and benefits to the bill; however, we did not intend to gather all potential viewpoints. Interviewees were selected purposively, with emphasis on pesticide regulatory agencies, individuals who testified during the public hearings for SB 6529, and key researchers identified through the literature review. We identified further key informants using snowball methodology. While we followed-up with many of these recommendations, we were not able to contact all individuals due to time limitations. Therefore, results should not be construed as comprehensive or representative of all perspectives.

Interview questions were tailored to provide the most information, and focused on the benefits and challenges of pesticide use reporting and application-specific notifications. We took detailed notes during the conversations, and coded and analyzed these notes to identify themes. We then summarized these themes and incorporated salient results into the HIR document, as applicable. All results from key informant interviews are presented in summary by theme, and are not attributed to individual interviewees.

Key informant interviewees

Stephen Bernath, Deputy Supervisor, Forest Practices
Washington State Department of Natural Resources

Laura Butler, Special Assistant to the Director and Aquaculture Coordinator
Washington State Department of Agriculture

Jon DeVaney, President
Washington State Tree Fruit Association

Glenn Fankhauser, Agricultural Commissioner
Kern County Department of Agriculture

Richard Fenske, Professor and Associate Chair
University of Washington, School of Public Health
Department of Environmental and Occupational Health Sciences
Director, Pacific Northwest Agricultural Safety and Health Center

Heather Hansen, Executive Director
Washington Friends of Farms and Forests

Heather Healy, Chief Deputy Agricultural Commissioner
Monterey County Agricultural Commissioner's Office

Jim Jesernig
Washington Potato and Onion Association

Sunny Jones, Former Pesticide Use Reporting Specialist
Oregon Department of Agriculture

Joel Kangiser, Compliance Program Manager, Pesticide Management Division
Washington State Department of Agriculture

Edward Kasner, Senior Fellow
University of Washington, School of Public Health
Department of Environmental and Occupational Health Sciences
Pacific Northwest Agricultural Safety and Health Center

Gavin Morse, President
Association of Washington Aerial Applicators

Millie Piazza, Environmental Justice Coordinator
Washington State Department of Ecology

Max Richardson, Senior Policy Manager
California Environmental Health Tracking Program, Public Health Institute

Andrea Schmitt, Attorney
Columbia Legal Services

Todd Schoonover, Industrial Hygiene Research Manager
Safety & Health Assessment & Research for Prevention (SHARP)
Washington State Department of Labor and Industries

Randy Segawa, Special Advisor, Pesticide Programs Division
California Department of Pesticide Regulation

Pedro Serrano, Technical Services Safety Program Manager
Division of Occupational Health and Safety (DOSH)
Washington State Department of Labor and Industries

DOH OEPHS subject matter experts

Heather McCauley, Washington Tracking Network Communications and Evaluation Coordinator

Glen Patrick, Deputy Director

Joanne Prado, Pesticide Illness Surveillance Epidemiologist

Appendix B. Pesticide Use Reporting Requirements Comparison: California & Washington (proposed)

California[7] *Records are retained and reported to CDPR*	**Washington** *Records are retained according to existing RCWs (17.21.100 / 49.70.119); SB 6529 would require records be reported to DOH*
Date and time of application;	The year, month, day and beginning and ending time of the application of the pesticide each day the pesticide was applied;
Geographic location (section, township, range, and base line/meridian);	The location of the land where the pesticide was applied;
Commodity, crop or site treated;	The crop or site to which the pesticide was applied;
Amount of product applied with its U.S. EPA registration number *Or if the product is an adjuvant (substance used to enhance the effectiveness of pesticides), its California registration number.*	The product name used on the registered label and the U.S. EPA registration number, if applicable, of the pesticide which was applied;
Operator identification number (issued by the county agricultural commissioner to property operators);	The licensed applicator's name, address, and telephone number and the name of the individual or individuals making the application and their license number, if applicable;
Operator name and address;	
Acres or units planted and treated;	The number of acres, or other appropriate measure, to which the pesticide was applied;
Field location and site identification number;	
Whether the application was by air, ground or other means;	
Specific to field fumigations in nonattainment areas - fumigation method/details	
	The amount of pesticide applied per acre or other appropriate measure;
	The concentration of pesticide that was applied;
	The direction and estimated velocity of the wind during the time the pesticide was applied. This subsection (i) shall not apply to applications of baits in bait stations and pesticide applications within structures
	Any other reasonable information required by the director in rule.