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November 9, 2020

Clerk of the Board of Supervisors
Hall of Administration, 4th Floor
800 S. Ventura Avenue
Ventura, California 93009

via email: clerkoftheboard@ventura.org

Re: WSPA Comments on Proposed Amendments Ventura County Coastal and Non-Coastal Zoning Ordinance – Agenda Item 47

Dear Members of the Ventura County Board of Supervisors,

The Western States Petroleum Association (WSPA) appreciates this opportunity to provide comments on the proposed amendments to Article 7, Section 8107-5 of the Ventura County Non-Coastal Zoning Ordinance (NCZO) and Article 5, Section 8175-5.7 of the Ventura County Coastal Zoning Ordinance ("CZO") (collectively, the "Proposed Amendments"). WSPA is a non-profit trade association representing companies that explore for, produce, refine, transport and market petroleum, petroleum products, natural gas, and other energy supplies in California and four other western states. The industry contributes \$152 billion dollars every year in economic activity and directly contributes \$21.6 billion dollars in local, state and federal tax revenue to support schools, roads, public safety and other vital services. More specifically, in Ventura County alone, the oil and gas industry contributes over \$200 million dollars in state and local tax revenue annually.

On November 10, 2020, the Board will hold a public hearing to consider adoption of the County-initiated amendments. These Proposed Amendments reflect a radical disregard of property rights held by oil and gas operators and mineral rights owners throughout the County, and their ability to rely upon previously issued permits in order to continue the operation of their business. It also marks an abrupt reversal of the County's prior position regarding when permit rights should be considered vested and protected within the County.

WSPA believes that oil and gas producers in the County operating under existing use permits have a vested right to continue those operations, and that approval of the Proposed Amendments would violate those vested rights. Furthermore, the process for reviewing and considering the Proposed Amendments has been seriously flawed. For the reasons detailed below, we urge the County to reject the Proposed Amendments, and ensure that all members of the public have a fair and equal opportunity to participate in future decision-making process.

WSPA joins in the letters previously submitted by industry members, royalty owners, and the Ventura County Coalition of Labor, Agriculture and Business.

I. The County's Vested Rights Analysis is Flawed

As Exhibit 1 to the November 10, 2020 Letter to the Board, the July 30, 2020 Staff Report (PL20-0052) incorrectly applies vested rights laws and concepts to the matter at hand. The Proposed Amendments would violate producers' vested rights to continue lawful oil and gas operations.

A. *The County's Current Analysis Goes Against Prior Precedent on Vested Rights.*

Ventura County has historically recognized producers' existing permits as creating vested rights to continue to produce oil and gas, as noted in County Counsel's 2014 report on this very point.

When a conditional use permit has been issued and then relied upon by the permittee, giving rise to a vested right, the permit becomes immunized from impairment or revocation by subsequent government action [absent menace to public health and safety or a public nuisance].

(Memorandum from County of Ventura County Counsel's Office ("County Counsel 2014 Memorandum") [attached as Exhibit 19 to Board Letter at p. 155 of PDF]. See also, May 30, 1989 Letter from Ventura Resource Management Agency to Chase Production Company attached as Exhibit 19 to Board Letter at p. 170 of PDF (Exhibit 3 to California Resources Corporation's July 29, 2020 Comment Letter)) [noting that no permit modifications are needed for a proposed drilling program "based on **the vested rights** of the three 'blanket' Conditional Use Permits you currently hold"].) Historic treatment of oil and gas operations within Ventura County clearly shows that the County has recognized that producers have a vested right to continue operations if they received a use permit authorizing such operations and have subsequently acted on that permit. The age of the permit does not change a determination that it provides vested rights.

The vested rights doctrine relies upon the constitutional principle that a vested right is a property right, which cannot be taken without due process or just compensation. (County Counsel 2014 Memorandum, at p. 3 citing *Urban Renewal Agency v. Cal. Coastal Zone Conservation Comm'n* (1975) 15 Cal.3d 577, 583-584.) The Proposed Amendments will impact permitted development. When a conditional use permit has been issued and relied upon by the operator, a vested right is conferred and the permit is then immunized from impairment or revocation by subsequent government action. County Counsel went so far as to conclude that the County's "ability to impose new conditions on antiquated oilfield permits is very limited" and may only apply when "a compelling public necessary, such as danger, harm or public nuisance, or significant violations exist." (County Counsel 2014 Memorandum, p. 1.)

As also noted in WSPA's July 29, 2020 and September 10, 2019 comment letters, the County's new analysis reverses prior precedent and incorrectly applies vested rights law and concepts to the matter at hand. The County's Proposed Amendments would drastically impair producers' vested right to continue authorized operations and, as such, would constitute an unconstitutional taking under the law. Oil and gas producers in Ventura County operating under existing use

permits have a vested right to continue those operations and rescission of those vested rights would not only be unlawful but constitute an unconstitutional taking.

B. Applicable Case Law Does Not Allow the County to Break Down Previously Issued Permits and Ignore an Operators' Right to Continue Drilling New Wells.

California case law recognizes that mineral resources oil and gas extraction often requires relocation, re-drilling and deepening over time as reserves are depleted at various locations on the affected property. (See *Hansen Bros. Enter. v. Bd. of Supervisors* (1996) 12 Cal. 4th 533 (*Hansen*)). In *Hansen*, the California Supreme Court specifically found that the diminishing asset doctrine is recognized in California and explained that mineral extraction uses, like oil and gas development, are unlike other uses that operate within an existing structure or boundary. Because of this, the Court specifically noted that mineral extraction anticipates the extension of activities into areas of the property that were not being exploited at the time a zoning change was approved. (*Id.* at 553.) Not all oil and gas reserves in Ventura County can be economically produced with the existing active and idle wells currently in place. A single well is limited in the oil reserves that it can reach. Although oil and gas are fluid to some extent, each reservoir is unique. Some oil reservoirs have very high viscosity and may require thousands or millions of years to move in such a way that would make it accessible through existing wells.

The existing permits issued to these operators contemplate that they have a right to develop the resource, subject to the terms of their permit. These permits cannot simply be rewritten to ignore this right, as the Proposed Amendments will do.¹

California case law has clearly defined vested rights as it relates to property owners and mineral extraction. The doctrine of vested rights seeks to protect property owners and developers who have substantially relied on past permits and proceeded accordingly with the government's acknowledgment. Oil and gas operators in Ventura have received permits to pursue oil and gas development, they have drilled a number of wells in pursuit of this goal and performed considerable work in this effort, and incurred substantial liabilities in good faith reliance on the entirety of the permits awarded, regardless of date. As already established by the County, these permits created vested rights. There is no contention that oil and gas operators in the County have failed to perform substantial work, make large investments or incur substantial liabilities in reliance on these permits. As such, these operators have acquired vested rights under these permits to continue the activities and operations authorized by the permits. The County cannot arbitrarily revoke these permits without a showing that the permittees are causing a nuisance or menace to public health. No such showing has been made.

¹ The County has previously recognized that it may not impose new discretionary permit requirements for certain components of a previously permitted activity. As recognized by County Counsel in its 2014 legal memorandum, "for purposes of analyzing the scope of a vested right to operate a business, a business cannot be broken down into components and vested rights recognized for less than the entire business operation." (County Counsel 2014 Memorandum, quoting *Hansen, supra*, 12 Cal.4th at 566 [indicating that there is "no authority for refusing to recognize a vested right to continue a component of a business that itself has a vested right to continue using the land on which it is located for operation of the business"].)

Given the well-established case law described above, as well as the potential legal liabilities, the Board should reject the Proposed Amendments..

C. The Proposed Amendments Are Vague and Ambiguous as to Application to Existing Vested Rights.

Given the current language of the Proposed Amendments, oil and gas operators are not able to discern the extent to which existing operations will be required to conform to the guidelines set out in the Proposed Amendments. For example, the proposed amendment to NCZO 8107-5.2.a states: “All existing oil and gas exploration and production operations are subject to the oil development operational standards set forth in Section 8107-5.6 to the extent: (i) such standards impose greater restrictions than those set forth in existing permit conditions, laws, or regulations applicable to the operation, and (ii) application of such standards does not impair any vested right of an operator under California law.”

Further, to the extent that the County intends to regulate subsurface activities or other activities comprehensively regulated by the State, such as pipelines and flaring, such regulation is preempted.²

These ambiguities deprive the public of a full and meaningful opportunity to comment on the issues presented with an understanding of the impacts of the County’s Proposed Amendments. Given the intense public interest on this issue, the County must clarify its position on this issue.

II. The County Failed to Follow CEQA Requirements

A. The County’s Action Constitutes Improper Piecemealing Under CEQA

On September 15, 2020, the County Board of Supervisors certified an Environmental Impact Report (“EIR”) for the Ventura County 2040 General Plan Update (“GPU”) and approved the GPU. The GPU included a number of measures that restrict and establish additional requirements for new oil and gas development in the County. However, the County failed to analyze or disclose the impacts of the cumulative changes to oil and gas regulations by impermissibly piecemealing its analysis in the GPU EIR and omitting consideration of the already envisioned Proposed Amendments.

The purpose of a cumulative impacts analysis is to avoid considering projects in a vacuum, because failure to consider cumulative harm may risk environmental disaster. (*Whitman v. Bd. of Supervisors* (1979) 88 Cal.App.3d 397, 408.) Agencies cannot allow “environmental considerations [to] become submerged by chopping a large project into many little ones—each with a minimal potential impact on the environment—which cumulatively may have disastrous consequences.” (*Bozung v. Local Agency Formation Comm’n* (1975) 13 Cal.3d 263, 283-284 [superseded by statute on separate grounds].) Without cumulative analysis, piecemeal approval

² The Attorney General has previously concluded that “there will . . . be a conflict with state regulation when a local entity, attempting to regulate for a local purpose, directly or indirectly attempts to exercise control over subsurface activities.” (59 Ops.Cal.Atty.Gen. 461, 478 [1976 Cal. AG LEXIS 82].)

of several projects with related impacts will lead to severe environmental harm. (*San Joaquin Raptor/Wildlife Rescue Ctr. v. Cnty. of Stanislaus* (1994) 27 Cal.App.4th 713, 720.)

The County has impermissibly piecemealed the GPU and the Proposed Zoning Code Amendments. The certified GPU EIR *expressly* anticipates the additional Proposed Amendments to the Zoning Code, yet the County has made no effort to include and consider cumulative impacts from the Proposed Zoning Code Amendments in the GPU EIR. The GPU and Proposed Amendments are fundamentally related. The Proposed Amendments will necessitate new discretionary permits, which will trigger the policies included in the GPU. The combined impacts of the GPU and Proposed Amendments will have drastic effects on the oil and gas industry, and ignoring these cumulative impacts constitutes improper piecemealing under CEQA. In addition, the County's improper piecemealing has further deprived the public of its right to informed review of the Proposed Amendments.

This issue is of utmost importance to stakeholders, as well as the public, and it is imperative that both are afforded a meaningful opportunity to participate in the process

B. Potential Environmental Impacts Associated with the Additional Restrictions and the Reduction of Domestic Production Were Not Considered

In failing to consider the cumulative impacts of the GPU and the Proposed Amendments, the County has omitted critical analysis of potential environmental impacts, including of impacts to mineral resources, housing availability, and anticipated greenhouse gas emissions (GHG).

While the Proposed Amendments will negatively impact the oil and gas industry in Ventura, these regulatory restrictions will not reduce the State's consumption of crude oil. California has the fifth-largest share of U.S. crude oil reserves and is the seventh-largest producer of crude oil in the nation.³ The proved oil reserves for the state have remained roughly stable from 2014 to 2018 (the last year of available data).⁴ Throughout this time, in-state production has continued to decline. From 1986 to 2019, oil production within California has declined by 54%.⁵

Despite the decreased in-state production, the demand for oil within the State has remained high and is not likely to decrease in the near future. California is the second-largest consumer of petroleum products in the nation and the largest consumer of motor gasoline and jet fuel. Almost nine-tenths of the petroleum consumed in the state is used in the transportation sector.⁶ Although the State has supported and subsidized the sale or lease of electric vehicles for

³ California, State Profile and Energy Estimates, *available at* <https://www.eia.gov/state/analysis.php?sid=CA#84>.

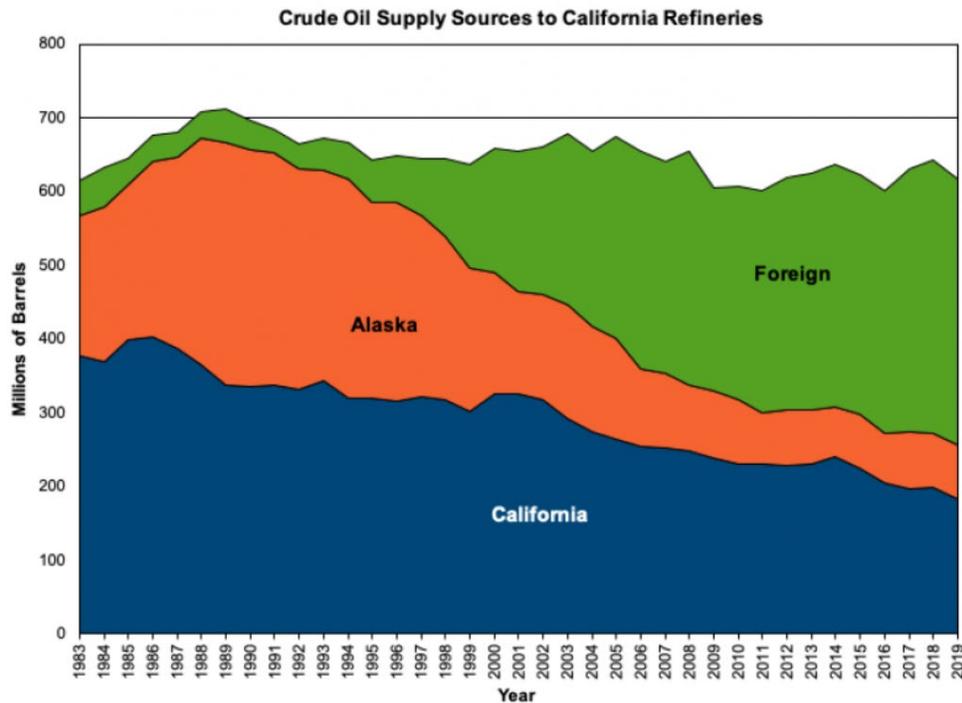
⁴ U.S. Energy Information Administration, Form EIA-23L, Annual Report of Domestic Oil and Gas Reserves, 2014-2018, Figure 2, *available at* <https://www.eia.gov/naturalgas/crudeoilreserves/>.

⁵ California Energy Commission, *Oil Supply Sources to California Refineries*, *available at* <https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/oil-supply-sources-california-refineries>.

⁶ U.S. Energy Information Administration, California Profile Report, *available at* <https://www.eia.gov/state/analysis.php?sid=CA>.

decades, electric and hybrid vehicles still make up less than 2% of vehicles on the road in California.⁷

As oil produced within California declined since 1986, imported oil from foreign countries has been used to replace the persistent demand within the State:



Source: California Energy Commission, *Oil Supply Sources To California Refineries*, available at <https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/oil-supply-sources-california-refineries>

This increase in imports from foreign countries will result in significant environmental effects that have not been analyzed by the County.

Reduced domestic drilling will result in greater imports of crude oil from out of state sources, primarily foreign countries.⁸ The use of foreign crude oil is associated with substantial emissions associated with transportation as foreign crude oil needs to be transported from between 4,000 miles (Ecuador) and 13,000 miles (Saudi Arabia) one-way to get to California. This causes the greenhouse gas (GHG) lifecycle emissions associated with foreign crude oil to

⁷ California Energy Commission, *Vehicle Population in California*, available at https://tableau.cnra.ca.gov/t/CNRA_CEC/views/DMVDataPortal_15986380698710/STOCK_Dashboard?

⁸ U.S. Energy Information Administration, *California gasoline prices increase following refinery outages and declining inventories* (May 23, 2019) available at <https://www.eia.gov/todayinenergy/detail.php?id=39592>.

be higher than conventionally-recovered California crude oil as well as increasing the spill risks associated with tankering crude oil and the resulting impacts on marine biology.⁹

Reduced domestic production of oil and gas is associated with increased emissions via higher reliance on imported oil from outside the County. The Draft Environmental Impact Report (DEIR) for the GPU noted that a reduction in crude oil production in Ventura County would result in an increased reliance on foreign oil imports. The GHG emissions associated with the production, processing, and transportation of crude oil into the County will result in increased GHG emissions.

In particular, the carbon intensity of Ventura crude oil is significantly lower than any of the foreign sources of crude oil that will be used to replace the lost production from the County.¹⁰ By reducing production in Ventura County, that crude oil will be replaced with additional imported oil that will necessarily have a higher carbon intensity and thus generate greater GHG emissions than the crude oil available within the County.

The increased setback distances imposed by these Zoning Amendments will also have significant impacts on the amount of land available for housing within the County. In considering a similar local prohibition on housing, the Supreme Court has held that a local agency “may reasonably anticipate that its placing a ban on development in one area of a jurisdiction may have the consequence, notwithstanding existing zoning or land use planning, of displacing development to other areas of the jurisdiction.” (*Muzzy Ranch Co. v. Solano Cty. Airport Land Use Comm’n* (2007) 41 Cal.4th 372, 383.) On that reasoning alone, the court held that the agency’s action might cause a reasonably foreseeable indirect physical change in the environment and therefore constituted a project subject to environmental review. (*Id.*) The County has performed no analysis on the potential impacts that these proposed amendments may have on existing and future housing availability.

Finally, section 15308 is inapplicable as it concerns actions by a regulatory agency, not legislative actions by a legislative body handling issues of zoning. (Cal. Code Regs., tit. 14, § 15308.) Regardless, the County has not provided substantial evidence that these restrictions are taken to “assure the maintenance, restoration, enhancement, or protection of the environment[.]” (*Ibid.*) There is no evidence that further restrictions are needed to mitigate environmental impacts for existing or future oil and gas operations. Rather, a technical review

⁹ See, e.g., National Energy Technology Laboratory, *An Evaluation of the Extraction, Transport and Refining of Imported Crude Oils and the Impact on Life Cycle Greenhouse Gas Emissions* (Mar. 27, 2009) available at <https://ethanolrfa.org/wp-content/uploads/2015/09/An-Evaluation-of-the-Extraction-Transport-and-Refining-of-Imported-Crude-Oils-and-the-Impact-on-Life-Cycle-Greenhouse-Gas-Emissions-.pdf> [“This analysis reveals that producing diesel fuel from imported crude oil results in WTT GHG emissions that are, on average, 59% higher than diesel from domestic crude oil (21.4 vs. 13.5 kg CO₂E/MMBtu LHV₂).”].)

¹⁰ See, e.g., California Environmental Protection Agency, Air Resources Board, *Calculation of 2019 Crude Average Carbon Intensity Value* (June 15, 2020), available at https://www2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/crude-oil/2019_crude_average_ci_value_final.pdf, at pp. 3-8; U.S. Energy Information Administration, *Foreign Sources of Crude Oil Imports to California 2019*, available at <https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/foreign-sources-crude-oil-imports>.

of recent epidemiological studies provide no reliable evidence of adverse health impacts caused by exposure to oil and gas drilling. (See Exhibit A [Dr. Garabrant Sept. 12, 2020 Report].)

III. The County has Violated the Brown Act

The requirements of the Ralph M. Brown Act (“Brown Act”) apply to meetings of the Board of Supervisors. (Cal. Gov. Code, § 54952.) Pursuant to the Ralph M. Brown Act (Brown Act), “public commission, boards and councils and the other public agencies in this State exist to aid in the conduct of the people’s business.” (Cal. Gov. Code § 54950.) The Brown Act specifically intends to ensure that all meetings of the legislative body are open, public, and all persons are permitted to attend. (Cal. Gov. Code § 54950.) Meetings subject to the Brown Act are not limited to face-to-face gatherings but include any communication meeting or device through which a majority of a legislative body deliberates, discusses or takes action. While the public’s business must be conducted in open, noticed meetings, the public also has the right to participate in all meetings. (Cal. Gov. Code § 54954.3(a).)

The Brown Act also prohibits requiring registration to attend a public meeting. No in-person participation is available, the agenda notes that the building is closed to the public, and notes that participants should attend online. However, none of the provided options for submitting comments are sufficient. The agenda notes that to comment via Zoom, a participant is required to register. Comments made while watching the livestream are only read at the “discretion of the chair” and thus this is not an adequate substitute for full and open participation. The agenda does not provide the necessary clarity required by the Brown Act that registration cannot be required to attend a public meeting. (Cal. Gov. Code, § 54953.3.) The Board of Supervisors has not adequately complied with this requirement to allow public participation in the current pandemic.

In addition, while the County provided instruction as to how the public can electronically attend hearings and provide public comment, in practice it’s a confusing and complicated process since each participation method has a separate registration process, deadline, and requirements. Not all Ventura County community members have equal access to the technology required to participate in virtual hearings. Thousands of Ventura County Residents are likely to be left out of what has already proved to be an incredibly contentious topic. Technological disparities including access to internet and reliable computers may prevent segments of the community from full participation in important aspects of the County’s decision-making process as required under the Brown Act.

The County must cure and correct these deficiencies, and should notify WSPA of any intent to address the defects identified above prior to the running of the 30-day period.

IV. The Board has Violated Due Process Requirements

In addition to the concerns regarding fair access to meetings under the Brown Act, the proceedings by the Board of Supervisors raise concerns regarding due process. The California Constitution guarantees the public’s right to participate in the meetings of public bodies, including their local governments. (Cal. Const., art. I, § 3, subd. (a), (b)(1).) WSPA is concerned

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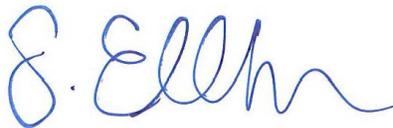
that stakeholders, and the public alike, have not and will continue to face obstacles to meaningful participation in the Board's meetings.

While there are major concerns regarding the County proceeding with a virtual hearing, WSPA also takes issue with the fact that the County has violated its own procedures regarding notification for permit holders. Both state and local law requires that the County to provide notice and an opportunity to be heard prior to modifying a permit. (Cal. Gov. Code § 65905; NCZO § 8111-6.2; CZO § 8181-10.1(d).) In 2015, the County recognized that any permit modifications would require notice and a public hearing to each affected permit holder. (Ventura County Letter, Dec. 15, 2015, p. 3 [attached as Exhibit 19 to Board Letter at p. 149 of PDF].) The County admitted that vested rights in existing permits *cannot* be unilaterally impaired by County under its general land use authority. (*Id.* at p. 2.) However, there has been no attempt to provide property notice to the affected permit holders or hold public hearings for each affected permit holders.

Public participation is vital to the rulemaking process, and the public must be given adequate opportunity for participation, even in the face of challenging public health concerns. WSPA is committed to a truly sustainable energy future and empowering the future energy mix, partnering with state, local and community leaders in civil public discourse and calling out potentially damaging policy changes such as the ones being considered here that threaten equality, economy, environment, and energy. As such, WSPA appreciates this opportunity to provide input. There are serious legal and policy implications regarding the Proposed Amendments and County's plans to hold a virtual hearing. We respectfully request that the Board of Supervisors reject the Proposed Amendments.

If you have any questions, please contact me at (916) 325-3117 or sellinghouse@wspa.org.

Respectfully,



Sophie Ellinghouse, Esq.

Exhibit A

DAVID H. GARABRANT, P.L.L.C.

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DAVID H. GARABRANT, M.D., M.P.H.

Mr. Jeffrey Dintzer
Alston & Bird, LLC
333 S. Hope Street, Suite 1600
Los Angeles, CA 90071

September 12, 2020

Dear Mr. Dintzer,

At your request, I have reviewed the recent publications regarding residential proximity to oil and gas development (OGD) and birth outcomes in California:

Gonzalez DJX, Sherris AR, Yang W, Stevenson DK, Padula AM, Baiocchi M, et al. Oil and gas production and spontaneous preterm birth in the San Joaquin Valley, CA: A case-control study. *Environ Epidemiol.* 2020;4(4):e099. Epub 2020/08/25.

Tran KV, Casey JA, Cushing LJ, Morello-Frosch R. Residential Proximity to Oil and Gas Development and Birth Outcomes in California: A Retrospective Cohort Study of 2006-2015 Births. *Environ Health Perspect.* 2020;128(6):67001. Epub 2020/06/04.

My Qualifications

I am Emeritus Professor of Epidemiology and Occupational Medicine at the University of Michigan School of Public Health, and Emeritus Associate Professor of Medicine at the University of Michigan School of Medicine. I am board certified in occupational and environmental medicine and internal medicine. I am also qualified as a specialist in the field of epidemiology, especially as it relates to the study of diseases related to exposures to chemical agents. While I have been on the faculty of the University of Michigan, I have served as Director of Occupational Medicine (1988-94), head of the Occupational Health Program (1992-95), Director of the Center for Occupational Health and Safety Engineering (1990-95), Director of the Occupational & Environmental Epidemiology program (2001-2007), and Founding Director of the Risk Science Center (2003-2017). My research since 1980 has focused on the long-term health effects of chemicals on humans and I have published over 360 research articles, book chapters, and abstracts related to this area. My full curriculum vitae is attached.

Overview of Studies of the Relationship Between Oil and Gas Drilling and Birth Outcomes

The central issue in looking for associations between oil and gas drilling (OGD) and birth outcomes is assessing the temporal relationship between the exposure of the pregnant woman to emissions from OGD and the risk of an abnormal birth outcome. The birth outcomes of interest in these studies (term birth weight [tBW], low birth weight [LBW], preterm birth [PTB], and small for gestational age [SGA]) are defined in part by the gestational age of the fetus at the time

the birth outcome is observed ¹. In order for an association between an OGD-related exposure and an abnormal birth outcome to be interpretable with respect to causation, the chemical agent must be known to be capable of causing the birth outcome at the concentrations observed and the exposure must occur during a gestational time when the fetus is susceptible to the effect.

Exposure Assessment

In order to find reliable associations between exposure to OGD-related emissions² and abnormal birth outcomes it is essential to have accurate information on these emissions, including specific chemical and non-chemical constituents, concentration, exposure pathways (air, water, soil evaporation), and accurate temporal information on when the emissions were present at the location of the pregnant mother. In addition, since air pollutant concentrations are dependent on wind direction and distance, meteorological information (with accurate temporal information) is essential. Since exposure to water contaminants may be dependent on hydrogeological factors, hydrogeological information is essential for some emissions.

There are two approaches to assessing exposures. The first is to model exposures at receptor locations (i.e., the residential location of the pregnant woman during gestation) based on measured emissions from the OGD sites, air dispersion modeling, and hydrogeological modeling of groundwater movement and evaporation. The second is to measure the participants' exposures by personal monitoring techniques. The first approach does not account for exposures from sources other than the OGD site and is inherently limited because it cannot evaluate the participant's true exposure from all sources. While the first approach may be appropriate to

¹ *Birth outcomes evaluated in Gonzalez 2020 and Tran 2020*

- Gestational age is the elapsed time between the last menstrual period and the date of interest.
- Full term birth is a pregnancy that completes 39 weeks of gestation.
- Term birth weight (tBW) is the birth weight (in grams) among pregnancies that complete ≥ 37 weeks of gestation.
- Low birth weight (LBW) is a birth < 2500 grams (regardless of the gestational age).
- Preterm birth (PTB) is a birth occurring before 37 weeks (< 37 weeks) of gestation.
- Small for gestational age (SGA) is a birth weight less than the US sex-specific 10th percentile of weight for each week of gestation.

² *The potential emissions from OGD activities include:*

- Air pollutants:
 - particulate matter (PM) with an aerodynamic diameter of < 2.5 μm (PM_{2.5})
 - diesel PM
 - nitrogen oxides (NO_x)
 - secondary ozone formation
 - mercury
 - volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene and xylene (BTEX) from truck traffic, drilling, hydraulic fracturing, production, and flaring
- Water contaminants that can contaminate potable water via leaks and spills or evaporate:
 - gas-phase hydrocarbons
 - chemicals mixed in drilling fluids
 - naturally occurring salts, metals, and radioactive elements within shale that surface with wastewater
 - recovered oil and gas
- Noise pollution associated with well pad construction, truck traffic, drilling, pumps, flaring of gases, and other processes
- Light pollution from night-time activities

evaluate dispersion of environmental pollutants in surrounding areas, it is not appropriate to evaluate adverse health effects at the personal level because of potential exposure misclassification.

Neither of the studies at issue (Gonzalez, 2020; Tran, 2020) has adequate information on emissions from OGD sites, with reliable temporal information, to provide any reliable estimate of any study participant's exposure at any point during gestation. Moreover, neither of the studies made any measurements of any participant's personal exposure at any point during pregnancy. Thus, neither study can establish that any pregnant woman was exposed to any specific agent from OGD at any specific time during gestation. Instead of measuring exposures, both studies simply calculated the distance from each pregnant woman's residence to OGD sites and created a summary score of how many OGD sites were within a specified radius. These scores are not reliable indicators of exposure of any pregnant woman to any specific chemical or physical agent from OGD sites, nor do they account for exposures from other sources such as highways, vehicle traffic, agricultural activities, or other industrial and commercial activities. It is unknown whether these exposure scores accurately reflect true exposures.

Exposure studies that have examined the relationships among outdoor air, indoor air, and personal air show that volatile organic compounds (VOCs), metals, PM_{2.5}, NO₂, and other pollutants are often higher in personal air than in indoor air, and are often higher in indoor air than in outdoor air (Adgate, 2007; Adgate, 2002; Baxter, 2013; Bonanno, 2001; Clayton, 2002; Evans, 2000; Janssen, 1998; Rojas-Bracho, 2000; Sexton, 2004; Shrestha, 2019; Wallace, 1986; Wallace, 1989; Wallace, 1988). In addition, outdoor air concentrations are often poorly correlated with personal air concentrations. There are many reasons for these relationships. First, personal air concentrations are affected by smoking, use of household chemicals (paints, furniture polish, spot removers, waxes, window cleaner, ammonia, pesticides, etc.), cooking (VOCs, particulates, NO₂), personal use of gasoline powered tools (lawnmowers, leaf blowers, edgers, etc.), occupational exposures, and other sources. Indoor air is affected by heating and air conditioning systems, ventilation rates, attached garages (gasoline vapors), wood and coal stoves (VOCs, particulates, PM_{2.5}, NO₂), indoor pets, whether windows are open or shut, the age of the dwelling, single versus multiple family dwellings, cleaning habits (sweeping, vacuuming, dusting), and other factors. Outdoor air is affected by local traffic, freeways, wildfires, wind and weather conditions, temperature, season, nearby industries, agriculture, construction, and other factors. Because of these differences, outdoor air concentrations cannot be assumed to reliably reflect any individual's personal exposure to any pollutant. The assumption in the Tran and Gonzalez studies that exposure scores based on the distances to OGD sites accurately reflects any individual's true personal exposure to any of the agents at issue is unfounded, has not been tested by any measurements, and is unlikely to be true.

Tran (Tran, 2020) counted the number of active oil and gas wells within 1 km of the study participant's address and combined this with monthly production volume (barrels of oil and oil equivalent, or BOE) to create an exposure index during each trimester of gestation. Exposure to production volume of active wells was then categorized as a) no active wells, b) 1-100 BOE/day (moderate), and c) more than 100 BOE/day (high). Tran also counted the number of inactive wells within 1 km of the participant's address and categorized exposure as a) no

inactive wells, b) one inactive well, c) 2-5 inactive wells, or d) 6 or more inactive wells. There were no assessments or measurements of any specific chemical or physical agent.

Gonzalez (Gonzalez, 2020) counted the number of wells within 10 km of the mother's residence that were in preproduction or production during each trimester of gestation, then estimated exposure to each well as the inverse of the distance squared (exposure = $1/\text{distance}^2$). These "exposures" were then summed for each trimester of each pregnancy and were categorized into exposure tertiles (tertiles 1, 2, and 3). Births without exposure in each trimester comprised a separate unexposed category (tertile 0). There were no assessments or measurements of any specific chemical or physical agent.

Neither Tran nor Gonzalez validated their exposure metrics to demonstrate that they were related to measured exposures at any residential site or, more importantly, to the actual exposures of any study participants. Both studies ignored meteorology and whether any participant's residence was upwind or downwind of any wells. Both studies ignored relevant hydrogeology and whether participants' residences were up-gradient or down-gradient from the wells. Thus, the exposure metrics used by Tran and Gonzalez reflect only their modeling assumptions and are not validated by any exposure measurements.

Birth Outcomes Assessment

The birth outcomes at issue are not independent of each other, as they based on assessing only two things: the duration of gestation and the weight at birth. These measures are compared to the frequency distributions in the general population to determine whether the duration of gestation is normal (PTB); whether the birth weight is low (LBW); whether for gestations of ≥ 37 weeks the birth weight is low (tBW); and whether the birth weight is lower than newborns of the same gestational age (SGA). These outcomes are correlated in many ways: preterm births (PTB) have low birth weights (LBW), newborns with low term birth weight (tBW) also have low birth weight (LBW), and newborns that are small for gestational age (SGA) have low birth weights (LBW) and low term birth weights (tBW). Because the three measures derived from birth weight (LBW, tBW, SGA) are all related, it is inappropriate to report them as though they are independent measures of adverse effects.

Covariates and Alternate Causes of Abnormal Birth Outcomes

Numerous factors may adversely affect birth outcomes, including maternal age, smoking, drug use, alcohol, infections during pregnancy (rubella, Zika), pharmaceuticals, malnutrition, poverty, lack of access to health care, prenatal care, maternal disease, pregnancy complications (gestational diabetes, hypertension), and genetics. Tran adjusted for individual level covariates of the infant (sex, month and year of birth) and the mother (age, race/ethnicity, educational attainment, prenatal care, and parity) and for area-level variables of urban/rural status, modeled NO_2 concentration, and income concentrations (derived from the census tract of residence). Gonzalez adjusted only for maternal age, race/ethnicity, educational attainment, parity, and birth year.

Thus, neither study assessed confounding due to smoking, drug use, alcohol, infections during pregnancy, pharmaceuticals, malnutrition, poverty, lack of access to health care, maternal disease, pregnancy complications, or genetics. The extent to which the observed associations

between OGD proximity and birth outcomes were biased by these potential confounders cannot be determined, and there is no reason to believe these factors did not cause spurious associations.

Results - Gonzalez 2020

Gonzalez reported only one birth outcome – spontaneous preterm birth. They reported a statistically significant increased risk of preterm birth for exposure tertile 3 during the gestational weeks 28-31, only in Hispanic and non-Hispanic Black women and only in women with < 12 years of education. There was no association between preterm birth during gestational weeks 20-27 or weeks 32-36 and any category of exposure to oil wells. In sensitivity analyses that examined different categories of distance to wells, there was no association between preterm birth and wells within 3 km (eTable 13). The positive association was essentially uniform in analyses that included wells within 5, 10, and 15 km. These analyses indicated that close wells (within 3 km) were not associated with preterm births, whereas far away wells were, regardless of whether they were within 5, 10, or 15 km. The authors did not explain how distant wells could affect birth outcomes while more proximal wells did not, nor did they provide any explanation for how wells might adversely affect only Hispanic and non-Hispanic Blacks but not non-Hispanic Whites, or why the associations were seen only in births to women of low education. These paradoxical and unexplained findings raise serious questions about the reliability of the Gonzalez study.

The major weaknesses of the Gonzalez study include no measurements of exposure to any specific agent, lack of assessment of confounding by numerous important causes of birth outcomes, and unexplained inconsistencies in the relationship between the exposure metric and preterm birth.

Results - Tran 2020

Tran reported statistically significant associations between well production volume and low birth weight (LBW) for moderate exposure (1-100 BOE/day) but not high exposure (more than 100 BOE/day). When participants were stratified by urban versus rural residence, there was a statistically significant positive association between LBW and high exposure in rural participants, but no positive association between LBW and high exposure in urban participants. In fact, among urban participants, there was a statistically significant inverse association (OR = 0.93, 95% CI 0.88-0.98) (Table S4) between LBW in trimester 3 and high exposure. These unexplained inconsistencies in findings for LBW argue against a causal interpretation. It is unexplained and unlikely to be true that OGD emissions cause LBW in rural births yet protect against them in urban births.

Tran reported no statistically significant positive association for preterm birth (PTB) in any trimester, at either moderate or high exposure, in either rural or urban participants. In fact, among urban participants, there was a statistically significant inverse association (OR = 0.82, 95% CI 0.77-0.88) (Table S5) between PTB in trimester 3 and high exposure. The authors did not explain how high exposure to OGD emissions might protect against PTB in urban participants, nor is this likely to be true. These results directly contradict the positive association reported by Gonzalez (described above) and the discrepancy between these two studies has no evident explanation other than that the results in Gonzalez may simply be spurious.

Tran reported statistically significant positive associations between small for gestational age (SGA) births and high exposure in rural participants, but not for moderate exposure in rural participants. Among urban participants, there were statistically significant associations between both moderate and high exposure and LBW, but the association was no stronger for high exposure than for moderate exposure. The associations seen in urban participants were quite small (odds ratios between 1.03 and 1.04) even though they were statistically significant and showed no evidence of dose-response. The associations seen in rural participants were stronger in the high exposure group and showed evidence of dose-response. The differences between the rural and urban participants were unexplained by the authors.

Tran reported no statistically significant differences in term birth weight (tBW) in either moderate or high exposure for among urban participants. Among rural participants tBW increased slightly in the moderate exposure group, then decreased significantly in the high exposure group. The differences between the rural and urban participants were unexplained by the authors.

Overall, the Tran study provided no association between OGD related exposures and the duration of gestation (PTB). Tran reported no consistent findings of adverse effects of OGD related exposures on the three measures derived from birth weight (LBW, tBW, SGA). Tran made no attempt to evaluate or explain the reasons for inconsistencies in the results for these three measures (LBW, tBW, SGA), nor did they make any attempt to determine which of these birth outcomes, if any, were significantly associated with OGD related exposures after adjusting of the other outcomes.

The statistically significant findings rarely showed evidence of increasing strength with increasing exposure (i.e., dose response) and the differences between urban and rural participants often were greater than the underlying associations. The reasons for these urban/rural differences were unexplained by the authors and they suggest that unmeasured confounders associated with urban/rural status were more strongly associated with birth outcomes than were the exposures.

Conclusions

Neither the Tran nor the Gonzalez study provides any reliable evidence that abnormal birth outcomes are causally associated with exposure to oil and gas drilling. Both studies have inadequate and unvalidated estimates of exposure that provide no reliable assessment of any study participant's exposure to OGD related chemicals or physical agents. Neither study assessed any participants' personal exposures from other sources, or from all sources combined (including OGD and other sources), to any chemical or physical agent, nor could they assess whether personal exposure from any source played any causal role in any birth outcome.

Neither study adequately controlled for other known causes of abnormal birth outcomes and neither study provides assurance that the reported results are not spurious because of confounding from these other factors. The associations reported in these studies may simply reflect unjustified modeling assumptions about their exposure metrics, uncontrolled confounding by other exposures, and unjustified assumptions about a lack of confounding by unmeasured covariates rather than causal relationships.

Because of these limitations these studies should not be relied upon in assessing the health risks to California residents from oil and gas development. Please feel free to contact me if any further comments or explanations are needed.

Sincerely,

A handwritten signature in blue ink, appearing to read "David H. Garabrant". The signature is fluid and cursive, with the first name "David" being the most prominent.

David H. Garabrant, MD, MPH
Emeritus Professor of Occupational Medicine and Epidemiology,
The University of Michigan
Ann Arbor, Michigan

References

1. Adgate JL, Mongin SJ, Pratt GC, Zhang J, Field MP, Ramachandran G, et al. Relationships between personal, indoor, and outdoor exposures to trace elements in PM(2.5). *Sci Total Environ*. 2007;386(1-3):21-32. Epub 2007/08/19.
2. Adgate JL, Ramachandran G, Pratt GC, Waller LA, Sexton K. Spatial and temporal variability in outdoor, indoor, and personal PM2.5 exposure. *Atmospheric Environment*. 2002;36:11.
3. Baxter LK, Dionisio KL, Burke J, Ebel Sarnat J, Sarnat JA. Exposure prediction approaches used in air pollution epidemiology studies: key findings and future recommendations. *J Expos Science Environ Epidemiol*. 2013;23(6):654-9.
4. Bonanno LJ, Freeman NCG, Greenberg M, Liroy PJ. Multivariate analysis on levels of selected metals, particulate matter, VOC, and household characteristics and activities from the Midwestern States NHEXAS. *Applied Occupational and Environmental Hygiene*. 2001;16(9):859-74.
5. Clayton CA, Pellizzari ED, Quackenboss JJ. National Human Exposure Assessment Survey: analysis of exposure pathways and routes for arsenic and lead in EPA Region 5. *J Expo Anal Environ Epidemiol*. 2002;12(1):29-43.
6. Evans GF, Highsmith RV, Sheldon LS, Suggs JC, Williams RW, Zweidinger RB, et al. The 1999 Fresno particulate matter exposure studies: comparison of community, outdoor, and residential PM mass measurements. *J Air Waste Manag Assoc*. 2000;50(11):1887-96. Epub 2000/12/09.
7. Gonzalez DJX, Sherris AR, Yang W, Stevenson DK, Padula AM, Baiocchi M, et al. Oil and gas production and spontaneous preterm birth in the San Joaquin Valley, CA: A case-control study. *Environ Epidemiol*. 2020;4(4):e099. Epub 2020/08/25.
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9. Rojas-Bracho L, Suh HH, Koutrakis P. Relationships among personal, indoor, and outdoor fine and coarse particle concentrations for individuals with COPD. *J Expo Anal Environ Epidemiol*. 2000;10(3):294-306. Epub 2000/07/26.
10. Sexton K, Adgate JL, Ramachandran G, Pratt GC, Mongin SJ, Stock TH, et al. Comparison of personal, indoor, and outdoor exposures to hazardous air pollutants in three urban communities. *Environ Sci Technol*. 2004;38(2):423-30. Epub 2004/01/31.
11. Shrestha PM, Humphrey JL, Carlton EJ, Adgate JL, Barton KE, Root ED, et al. Impact of Outdoor Air Pollution on Indoor Air Quality in Low-Income Homes during Wildfire Seasons. *International journal of environmental research and public health*. 2019;16(19). Epub 2019/09/25.

12. Tran KV, Casey JA, Cushing LJ, Morello-Frosch R. Residential Proximity to Oil and Gas Development and Birth Outcomes in California: A Retrospective Cohort Study of 2006-2015 Births. *Environ Health Perspect*. 2020;128(6):67001. Epub 2020/06/04.
13. Wallace L, Pellizzari E, Hartwell T, Zelon H. Concentrations of 20 volatile organic compounds in the air and drinking water of 350 residents of New Jersey compared with concentrations in their exhaled breath. *Journal of Occupational Medicine*. 1986;28(8):603-8.
14. Wallace LA. Major sources of benzene exposure. *Environmental Health Perspectives*. 1989;82:165-9.
15. Wallace LA, Hartwell TD, Whitmore R, Pellizzari ED. The California team study: breath concentrations and personal exposures to 26 volatile compounds in air and drinking water of 188 residents of Los Angeles, Antioch, and Pittsburg, CA. *Atmospheric Environment*. 1988;22(10):2141-62.

ATTACHMENT

David H. Garabrant, MD, MPH, MS, FACOEM, FACPM
Emeritus Professor of Occupational Medicine and Epidemiology
The University of Michigan School of Public Health

Education and Training

High School: Westfield High School
Westfield, New Jersey
1965 – 1968

Undergraduate: Tufts University
Medford, Massachusetts. Sept 1968 – June 1972
B.S., Chemical Engineering, June 1972

Graduate: Tufts University School of Medicine
Boston, Massachusetts. Sept 1972 – June 1976.
M.D. received June 1976

Internship: Medicine Intern
Georgetown University Hospital
Washington, D.C.
July 1976 – June 1977

Fellowship Internal Medicine, Ambulatory Care
Georgetown University Hospital
Washington, D.C.
September 1977 – June 1978

Residency: Occupational Medicine
Harvard School of Public Health
Boston, Massachusetts
September 1978 – June 1980
M.P.H. degree received June 1979
M.S. in Physiology (Occupational Medicine) received June 1980

Internal Medicine
Boston University Medical Center
Boston, Massachusetts
July 1980 – June 1981

Certification and Licensure

Licensure District of Columbia, 1978, (Certificate - 10775) (inactive)
Maryland, 1977, (Certificate - D-20626) (inactive)
Massachusetts, 1978, (Certificate - 42987) (inactive)
California, 1982, (Certificate - G-47344) (inactive)
Michigan, 1989, (Certificate - 054132) (active)

Board Certification Internal Medicine, 1981
Preventive Medicine, 1982
Subspecialty certification, Occupational Medicine, 1982

Academic, Administrative, and Clinical Appointments

Teaching Assistant in Medicine, Boston University School of Medicine, July 1980 – June 1981

Assistant Professor, University of Southern California School of Medicine, August 1981 – June 1988

Associate Professor, University of Southern California School of Medicine, June 1988 – November 1988

Associate Professor, University of Michigan School of Public Health, December 1988 – June 1996

Associate Professor of Medicine, Department of Medicine, University of Michigan School of Medicine, December 1989 – September 2002

Visiting Faculty, University of Indonesia School of Medicine, August 1995 – June 1996 (Sabbatical)

Professor of Occupational Medicine, University of Michigan School of Public Health, June 1996 – September 2007

Associate Professor, Department of Emergency Medicine, University of Michigan School of Medicine, September 2002 – September 2007.

Professor of Epidemiology, University of Michigan School of Public Health, June 2003 – September 2007

Founding Director, University of Michigan, Center for Risk Science and Communication, 2004 – 2018.

Emeritus Professor of Occupational Medicine and Epidemiology, University of Michigan School of Public Health, September 2007 – present

Emeritus Associate Professor of Emergency Medicine, University of Michigan School of Medicine, September 2007 – present

Honors And Awards

Graduated Magna Cum Laude, Tufts University, 1972.

Tufts University, Tau Beta Pi Engineering Honor Society, 1971

Awarded Training Grant for Study and Research in Occupational Medicine from the National Institute for Occupational Safety and Health, 1978, renewed 1979

Recipient of Preventive Oncology Academic Award, National Cancer Institute, 1987–1992

Chair, Safety and Occupational Health Study Section, National Institutes of Health, 1995–96.

Excellence in Research Award, University of Michigan School of Public Health, April 28, 2006

Top Docs 2006. Hour Detroit Magazine

Emeritus Professor, University of Michigan, September 2007

Research Excellence Award. University of Michigan Risk Center, October 16, 2007.

Franzblau, A., L. Zwica, K. Knutson, Q. Chen, S.-Y. Lee, B. Hong, P. Adriaens, A. Demond, **D. Garabrant**, B. Gillespie, J. Lepkowski, W. Luksemburg, M. Maier, and T. Towey, 2009, "An Investigation of Homes with High Concentrations of PCDDs, PCDFs and/or Dioxin-Like PCBs in House Dust," *J. Occupational and Environ. Hygiene*, 6:188-199. Best Indoor Environmental Quality Paper Award for 2009 awarded by American Industrial Hygiene Association.

Memberships in Professional Societies

American Occupational Medical Association 1982–88. Elected to fellowship, 1986

Western Occupational Medical Association, 1982–88

Board of Directors, 1984–88

Chairman, Educational Affairs Committee, 1986–88

American College of Preventive Medicine, 1985–present. Elected to fellowship, 1986

American Academy of Occupational Medicine, 1985–88

American College of Occupational and Environmental Medicine, 1988–present.

Elected to fellowship, 1988

Michigan Occupational Medical Association Board of Directors, 1989–91

Society for Epidemiologic Research, 1988–present

Michigan Public Health Association, 2001–present

Society for Risk Analysis, 2002–present

International Epidemiological Association, 2002–present

American Chemical Society, 2008–present

Editorial Positions, Boards, and Peer-Review Service

State of Washington Department of Labor and Industries. Chemically Related Illness Scientific Advisory Board. 1994–95.

Charter member, Safety and Occupational Health (SOH) Study Section for the National Institutes of Health, 1992-1996. Chairman, 1995–96.

Chair, Clinical Sciences Special Emphasis Panel. Alcohol and Toxicology (ZRG4) Study Section for the National Institutes of Health, November 1996.

Chair, NCI Review Panel on Breast Cancer and the Environment on Long Island. National Institutes of Health, January 31, 1997.

Member, NCI Review Panel on Regional Variation in Breast Cancer Rates in the United States. National Institutes of Health, Rockville, MD, November 9, 1998.

Member, NIOSH Special Emphasis Panel on Disease, Disability, and Injury Prevention Control Grants, National Institute for Occupational Safety and Health, Florence KY. February 21–23, 1999.

Member, NIEHS Special Emphasis Panel on Superfund Basic Research Projects, National Institute of Environmental Health Sciences, Research Triangle Park, NC. October 25–27, 1999.

Chair, NIOSH Site Visit to University of Washington Educational Resource Center. Seattle, Washington, November 7–9, 2001.

Chair, NIOSH Special Emphasis Panel on Training Programs in Occupational Health and Safety. St. Petersburg, Florida. February 17–20, 2002.

Mickey Leland National Urban Air Toxics Research Center, Houston, Texas. Appointed to Scientific Advisory Board, 2002–2009.

Member, NIH Special Emphasis Panel/Scientific Review Group 2006/10 ZLM1 ZH-P (O1), July 14, 2006

Member NIEHS Special Emphasis Panel/Scientific Review Group 2007/10. National Institute of Environmental Health Sciences, Research Triangle Park, NC. July 11–14, 2007.

Member, American Cancer Society Peer Review Committee on Physician Training Award in Preventive Medicine. American Cancer Society, Atlanta, Georgia. 2008–2012

Institute of Medicine of the National Academies of Sciences. Participant – GAO Workshop on Cancers Added to the World Trade Center Health Program (WTCHP) List of Covered Conditions. Washington, D.C. October 21, 2013.

Scientific Journal Board of Editors:

Journal of Occupational Medicine, Editorial Board. 1987-1992

Medical Journal of Indonesia, Editorial Board. 2000–present

Journal of Environmental and Public Health. 2009-2011

Reviewer, Scientific Manuscripts:

American Journal of Epidemiology
American Journal of Industrial Medicine
Chemosphere
Critical Reviews in Toxicology
Environmental Health Perspectives
Environmental Science and Technology
Epidemiology
Journal of Exposure Science and Environmental Epidemiology
Journal of Occupational and Environmental Medicine
Journal of the National Cancer Institute
Risk Analysis

Teaching

Attending Physician, Occupational Medicine Outpatient Clinic, University of Michigan Medical Center, Ann Arbor, Michigan, 1989-2011

Director, Occupational and Environmental Epidemiology Program, University of Michigan School of Public Health 2001-2007

Ph.D. Thesis Committee Member

N. Seixas, University of Michigan, School of Public Health, Ann Arbor, Michigan, 1990

A. Rocskay, University of Michigan, School of Public Health, Ann Arbor, Michigan, 1991

N. Nelson, University of Michigan, School of Public Health, Ann Arbor, Michigan, 1992

Carol Burns. The epidemiology of systemic sclerosis: a population based case control study. Ph.D. in Epidemiologic Science, University of Michigan, School of Public Health, Ann Arbor, Michigan, 1994

Jane Krebs. Mortality at an automotive stamping and assembly facility. Ph.D. in Epidemiologic Science, University of Michigan, School of Public Health, Ann Arbor, Michigan, 1995. Doctoral Committee Co-Chair.

Jacqueline Kurtz. An evaluation of peer and professional trainers in an occupational health and safety training program. Ph.D. in Environmental and Industrial Health, University of Michigan, School of Public Health, Ann Arbor, Michigan, 1995

Jon Fryzek. A case-control study of DDT and related compounds and pancreas cancer. Ph.D. in Epidemiologic Science, University of Michigan, School of Public Health, Ann Arbor, Michigan, 1996. Doctoral Committee Co-Chair.

Stephen Martin. 1,1 dichloro-2,2-bis(p-chlorophenyl)ethylene, testosterone levels and lipid profile in African American farmers and farm workers. University of Michigan, School of Public Health, Ann Arbor, Michigan, 2001.

Jeanette Jane Rainey. Epidemiological and environmental co-factors linked to endemic Burkitt's lymphoma in Kenya. Ph.D. in Epidemiologic Science, University of Michigan, School of Public Health, Ann Arbor, Michigan 2005

Gena Pauline Kucera. Hormone replacement therapy and nonsteroidal anti-inflammatory drugs on the risk of colorectal cancer in women. Ph.D. in Environmental and Industrial Health, University of Michigan, School of Public Health, Ann Arbor, Michigan, 2006. Doctoral Committee Chair.

Aaron Sussell. Incidence And Prevalence Of Occupational Contact Dermatitis In Automobile Manufacturing. PhD in Environmental Health Sciences, University of Michigan School of Public Health, 2007.

Andrea Steege. Access to health care among migrant farm workers. University of Michigan, School of Public Health, Ann Arbor, Michigan, 2009. Doctoral Committee Co-Chair.

Qixuan Chen. Bayesian Model Based Approach to Complex Survey Data Analysis. Department of Biostatistics, University of Michigan, School of Public Health, Ann Arbor, Michigan, 2009.

Committee, Organizational, and Volunteer Service

Director, Occupational Medicine, University of Michigan School of Public Health, Ann Arbor, Michigan, December 1988-94

Member, School of Public Health Executive Committee, University of Michigan, Ann Arbor, Michigan, 1989-1991.

Director, Center for Occupational Health, Safety, and Engineering, University of Michigan, Ann Arbor, Michigan, 1990-1995

Associate Director, Center for Occupational Health, Safety, and Engineering, University of Michigan, Ann Arbor, Michigan, 1995-2000

Director, Division of Occupational Health, University of Michigan School of Public Health.
1992 -1995

Member, Executive Committee, Department of Environmental and Industrial Health, University
of Michigan School of Public Health, Ann Arbor, MI. January 1992-1995.

Chair, Curriculum Committee, Department of Environmental and Industrial Health, University
of Michigan School of Public Health, 1996-97.

Chair, Advisory Committee on Academic Rank, University of Michigan School of Public
Health, 1997-99. Member 1996-97, 1999-00.

Member, Executive Committee, University of Michigan School of Public Health. 2000-2003.

Member, Student Recruitment Committee, Department of Environmental Health Sciences,
University of Michigan School of Public Health, 2001-03

Founding Director, Center for Risk Science and Communication, University of Michigan School
of Public Health, 2003-present

Member, Search Committee for Dean of University of Michigan School of Public Health, 2004-
05

Member, Executive Committee, University of Michigan School of Public Health, 2006-07

Member, Office of the Vice President for Research Conflict of Interest Committee, University of
Michigan, Ann Arbor, Michigan, 2009-2012

Member, Dean's Advisory Council, University of Michigan School of Public Health, 2012-
present

Visiting Professorships, Seminars, and Extramural Invited Presentations

1. "Colon Cancer and Job Activity." Invited Paper at Occupational Epidemiology Forum,
sponsored by USC, UCLA, and UC Irvine Schools of Medicine. Irvine, CA, 1983.
2. Annual Meeting of the Western Occupational Medical Association, "Pulmonary disease in
borax workers", San Francisco, California, 1982.
3. 4th Annual Rocky Mountain Conference on Occupational and Environmental Health,
"Respiratory symptoms from borax and boric acid aerosols", Park City, Utah, 1982.
4. American Occupational Medical Association Annual Meeting, "Occupational cancer", Los
Angeles, California, 1984.
5. "Respiratory Effects of Borax Dust." Invited Paper at Occupational Epidemiology Forum,
sponsored by USC, UCLA, and UC Irvine Schools of Medicine, Irvine, CA, 1984.
6. Panel Chairman. "Health Issues for Women in the Workplace." Annual Scientific
Meeting, American Occupational Medical Association, Los Angeles, CA, 1984.
7. "Occupational Cancer." Postgraduate Education Conference at the American Occupational
Medical Association Basic Curriculum Course, Salt Lake City, UT, 1984.
8. "Epidemiology for the Occupational Physician." Postgraduate Education Conference at the
Annual Scientific Meeting, American Occupational Medical Association, Los Angeles,
CA, 1984.

9. "Contact Dermatitis from Aziridine Hardener in Printing Ink." Invited Paper at Occupational Epidemiology Forum, sponsored by USC, UCLA, and UC Irvine Schools of Medicine, Irvine, CA, 1985.
10. Western Occupational Medical Association Conference, "Epidemiology of occupational cancer", Stanford University, Palo Alto, California, 1985.
11. "Toxicology." Workshop on evaluation of workers compensation patients exposed to hazardous chemicals. Postgraduate Education Conference. Presented by the State of California Division of Industrial Accidents and USC School of Medicine, Los Angeles, CA, 1985.
12. Special Studies Unit, Division of Occupational Safety and Health, Department of Industrial Relations, State of California, Sacramento, California, 1985.
13. V International Symposium, Epidemiology in Occupational Health, "Cancer mortality in the aircraft manufacturing industry", Los Angeles, California, 1986.
14. Epidemiology and cancer registries in the Pacific Basin V, "Cancer risks in the aircraft manufacturing industry", Kauai, Hawaii, 1986.
15. "Cancer Mortality in the Aircraft Manufacturing Industry." Invited Paper at Occupational Epidemiology Forum, sponsored by USC, UCLA, and UC Irvine Schools of Medicine, Irvine, CA, 1986.
16. "Occupational exposure to electromagnetic fields and adult leukemia." Invited Paper at Occupational Epidemiology Forum, sponsored by USC, UCLA, and UC Irvine Schools of Medicine, Irvine, CA 1987.
17. "Studies of electromagnetic fields and cancer risk." Seminar at Joint Symposium sponsored by Fred Hutchinson Cancer Research Center, University of Washington School of Medicine and Department of Preventive Medicine, USC. Seattle, WA, 1987.
18. "Electromagnetic fields and cancer risk," and "Exposure assessment in occupational and residential studies of ELF and leukemia." Invited lecturer, International Agency for Research on Cancer, Lyon, France, May 1988.
19. California Cancer Registries Conference 1988: Innovations in Research, "Coding and use of cancer registry data to look for occupational cancers", Newport Beach, California, October 1988.
20. 32nd Annual Western Occupational Health Conference, "When is cancer work related?", Irvine, California, October 1988.
21. "Toxicology of chrome." Invited guest, Aerospace Hazardous Waste Minimization Symposium, Los Angeles, CA, May 1988.
22. "Medical/Ethical Pitfalls of Occupational Medicine From a Clinicians Standpoint." Invited speaker, Southern California Edison Company, Oxnard, CA, July 1988.
23. "Prospective Study of Respiratory Effects of Formaldehyde in Medical Students". Invited speaker, UC Irvine, Department of Community and Environmental Medicine. October 20, 1988.
24. Invited lecturer, California Cancer Registries Conference 1988: Innovations in Research. Lecture topic: "Coding and Use of Cancer Registry Data to Look for Occupational Cancers", Newport Beach, California, October 1988.
25. Lecturer, "Physical Activity and Colon Cancer Risk", seminar sponsored by the University of Michigan, Ann Arbor, Michigan, September 1989
26. Chairperson, 41st Annual Selby Discussional, School of Public Health, University of Michigan, Ann Arbor, Michigan, September 1989

27. Lecturer, "Lung Disease in Borax Miners: Was Borax the Culprit?". School of Public Health, University of Michigan, Ann Arbor, Michigan, October 1989
28. Session Reporter, "Human Health Impacts of Halogenated Biphenyls and Related Compounds". University of Michigan, Ann Arbor, Michigan, November 8-9, 1989
29. Keynote Speaker, Joint Annual Meeting of The Michigan Occupational Medical Association, The Detroit Michigan Association of Occupational Health Nurses, and The Michigan Industrial Hygiene Society, "Electromagnetic Fields and Leukemia". Dearborn, Michigan, November 1989.
30. Lecturer, "Physical Activity and Colon Cancer". Ford World Headquarters, Dearborn, Michigan, January 1990.
31. Lecturer, "Multiple Chemical Sensitivities", press briefing at Dow-Elanco. Midland, Michigan, March 1990.
32. Speaker, "Man made mineral fibers and lung cancer". Presented at Pulmonary Division Grand Rounds, University of Michigan Medical Center, Ann Arbor, Michigan, December 7, 1990.
33. Speaker, "Epidemiologic study of end users of man-made mineral fiber". Report to Annual Scientific Session of the Thermal Insulation Manufacturers Association. Del Mar, California, October 30, 1990.
34. Conference Chairman, 42nd Annual Selby Discussional held at the University of Michigan, Ann Arbor, Michigan, November 8-9, 1990.
35. Invited speaker, "DDT and pancreas cancer". National Institute for Occupational Safety and Health, Cincinnati, Ohio, January 29, 1991.
36. Invited speaker, "Case control study of pancreas cancer among chemical manufacturing workers". University of Cincinnati School of Medicine, Department of Environmental Health Seminar Series. January 30, 1991.
37. Invited speaker, Epidemiologic studies of morbidity of man-made mineral fiber workers". In: Man-made mineral fibers: status of health risk assessment. Course given by the Department of Environmental Health Sciences, Johns Hopkins University School of Hygiene and Public Health. Baltimore, Maryland, March 4, 1991.
38. Invited speaker, "Electromagnetic fields and cancer". Annual meeting of the Semiconductor Industry Safety Association. Phoenix, Arizona, April 15, 1991.
39. Invited presentation, "DDT and pancreas cancer in a case control study of chemical workers." Society for Epidemiological Research Annual Meeting. Buffalo, New York, June 1991.
40. Conference Chairman, 43rd Annual Selby Discussional held at the University of Michigan, Ann Arbor, Michigan, November 1991.
41. Invited Faculty, National Cancer Institute, Division of Cancer Prevention and Control. 1992. Cancer Prevention and Control Academic Course. "Surveillance and special populations: occupations exposed to asbestos". August 7, 1992.
42. Conference Chairman, 44th Annual Selby Discussional held at the University of Michigan, Ann Arbor, Michigan, November 1992.
43. Invited speaker, Occupational Health Symposium Co-Sponsored by Bay Medical Education and the University of Michigan Center for Occupational Health and Safety. Saginaw, Michigan, March 12, 1993. "Occupational Cancers".
44. Invited speaker, Department of Epidemiology, University of Michigan Department of Epidemiology, March 18, 1993. "Recent Studies on EMF and Cancer".

45. Invited speaker, First Annual Cancer Conference. Recent Advances in Colorectal Carcinoma. Sponsored by the American Cancer Society, Detroit, Michigan, April 14, 1993. Epidemiology of Colorectal Cancer.
46. Conference Chairman, 45th Annual Selby Discussion held at the University of Michigan, Ann Arbor, Michigan, September 1993.
47. Invited speaker. Michigan State Medical Society Annual Meeting. "Electromagnetic Fields and Health". Detroit, Michigan, November 11, 1993.
48. Invited presentation. "Occupational exposures and urogenital cancers among leather workers". National Cancer Institute Workshop on Occupational Exposures and Urogenital Cancers. May 23-24, 1994, Rockville, Maryland.
49. Conference Chairman, 46th Annual Selby Discussion held at the University of Michigan, Ann Arbor, Michigan, October 13-14, 1994.
50. University of Michigan Comprehensive Cancer Center Grand Rounds. "DDT and Related Compounds and Pancreas Cancer. October 21, 1994.
51. Western Ohio Occupational Medical Association Annual Scientific Meeting. "Integration of Residents into Occupational Medicine Training". Toledo, Ohio, March 11-12, 1995.
52. Invited Speaker. BASF Corporation Isocyanates Review. Respiratory Disease from TDI and MDI. Wyandotte, Michigan, April 6, 1995.
53. Invited Speaker. Department of Public Health, Wellington School of Medicine. "DDT and pancreas cancer". July 28, 1995, Wellington, New Zealand.
54. Invited Speaker. First Annual Jakarta International Epidemiology Course. "Occupational Disease Epidemiology". December 4-15, Jakarta, Indonesia.
55. Invited Speaker. Faculty of Public Health, University of Indonesia. "Current Issues in Occupational Health". December 19, 1995, Depok, West Java, Indonesia.
56. Invited Speaker. Department of Cardiology, Faculty of Medicine, University of Indonesia. "Preparing an International Manuscript" April 9, 1996. National Cardiac Center, Harapan Kita Hospital, Jakarta, Indonesia.
57. Invited Speaker. Editorial Board of the Medical Journal of Indonesia. "Publishing in the International Medical Literature" April 9, 1996. University of Indonesia School of Medicine, Jakarta, Indonesia.
58. Invited Speaker. "Guidelines for Publishing in the International Medical Literature". May 21, 1996. Department of Internal Medicine Grand Rounds, University of Indonesia School of Medicine, Jakarta, Indonesia.
59. Invited Speaker. Symposium of Occupational Safety and Health to Anticipate the Era of Free Trade in the Year 2020. "Occupational Safety and Health in Developed Industrial Countries". May 23, 1996, University of Indonesia School of Medicine, Jakarta, Indonesia.
60. Invited Faculty, National Cancer Institute, Division of Cancer Prevention and Control. 1996 Cancer Prevention and Control Academic Course. "Special Populations and the Environment. High Risk Populations: Asbestos". August 9, 1996.
61. Invited Speaker. "Epidemiology of Pancreatic Neoplasia". Symposium: Current Concepts in Pancreas Cancer. Barbara Ann Karmanos Cancer Institute. Detroit, MI. September 12, 1997
62. Invited Speaker. "DDT and Related Materials and Pancreatic Cancer". NIEHS Center for Molecular and Cellular Toxicology, Wayne State University Institute of Chemical Toxicology. October 16, 1997.

63. Invited speaker. "Occupational Asthma". Symposium: Global Management of Airway Disease. University of Michigan Medical School, Division of Pulmonary and Critical Care Medicine. May 9, 1998 Livonia, Michigan.
64. Invited Speaker. "Occupational and Environmental Cancer". Annual Scientific Meeting of the Michigan Occupational and Environmental Medicine Association. September 11, 1998. Traverse City, Michigan
65. Invited Speaker. Epidemiology of Natural Rubber Latex Allergies in Health Care Workers. International Conference on Natural Rubber Latex Sensitivity. San Francisco, CA. Feb 9-10, 2001
66. Invited Speaker. Measurement of physical activity in the occupational setting. American Society for Preventive Oncology 25th Annual Meeting. New York City, NY. March 12, 2001.
67. Invited Speaker. XVI World Congress of Epidemiology. Montreal, Quebec. Risk of Solvent Exposure among Women with Scleroderma. August 20, 2002.
68. Invited Speaker. "Research studies of pesticide exposed populations." National Institute of Environmental Health Sciences, Division of Extramural Research and Training (DERT) Science Retreat. Wilmington, NC. November 21-22, 2002.
69. Invited presentation. Williams JM, Garabrant DH. Assessment of sight and hearing protection use in high school vocational, technical, and industrial education programs. Best Practices in Occupational Safety and Health, Education, Training and Communication. 6th International Conference, Scientific Committee on Education and Training in Occupational Health, ICOH. Baltimore, MD. October 28-30, 2002.
70. Invited presentation. Garabrant DH. Environmental and familial risks to pancreas cancer. University of Texas M.D. Anderson Cancer Center, Division of Cancer Prevention and Program in Cancer Prevention & Control. Houston, Texas. April 25, 2003.
71. Invited discussant. Garabrant DH. Manufacturing Science in Regulated Environments. Presented at the International Symposium on Development and Manufacturing Needs in Health Care Industries in the 21st Century. University of Michigan College of Engineering. Ann Arbor, Michigan September 19, 2003
72. Invited Speaker. Garabrant DH. 2003 Carey Pratt McCord Lecture. "Latex allergy in health care workers". Presented at the annual meeting of the Michigan Occupational and Environmental Medicine Association. Royal Oak, Michigan. November 6, 2003.
73. Invited Speaker. Garabrant DH. "The Michigan Dioxin Exposure Study". MidMichigan Medical Center-Midland Family Practice Department and Continuing Medical Education Department. Ann Arbor, Michigan. May 20, 2004.
74. Invited Speaker. Garabrant DH. "Biomarkers and Risk Assessment". Presented at the Association of Schools of Public Health Conference on Environmental Health Risk: Assessment, Management, and Communications. Minneapolis, Minnesota. July 11-13, 2004.
75. Keynote Speaker. Garabrant DH. "The University of Michigan Dioxin Exposure Study". Michigan Epidemiology Conference 2005. Ann Arbor, Michigan. March 11, 2005.
76. Invited Speaker. Garabrant DH. "Meta-Analysis as a Tool for Understanding Asbestos-Related Disease". Presented at the AIHce 2005 Annual Conference of the American Industrial Hygiene Association and American Conference of Governmental Industrial Hygienists. Anaheim, CA May 25, 2005

77. Invited Speaker. Garabrant DH. Mesothelioma risks among auto mechanics. Annual Scientific Meeting of the Michigan Occupational and Environmental Medicine Association. Lansing, MI. September 22, 2005.
78. Invited Speaker. Garabrant DH. "The University of Michigan Dioxin Exposure Study". Michigan's Premier Public Health Conference. Partnerships: Working Together to Improve the health of Michigan's Citizens. Michigan Association for Local Public Health. Grand Rapids, MI October 12, 2005
79. Moderator. Garabrant DH. Session IV Exposure Assessment. First Annual Air Toxics Research Workshop. Mickey Leland National Air Toxics Research Center. Houston, Texas. October 17, 2005.
80. Invited Speaker. Garabrant DH. Biomonitoring in Epidemiology Studies. Michigan Society of Toxicology Fall 2005 Meeting. Lansing, MI. November 4, 2005.
81. Invited speaker. DH Garabrant. Cohort mortality study of transmission and chassis workers. American Osteopathic College of Occupational and Preventive Medicine Mid-Year Conference. Pittsburgh, Pennsylvania. March 18, 2006.
82. Invited Speaker, Grand Rounds. Garabrant DH. Environmental and genetic factors in pancreas cancer. Department of Medicine, University of California, Irvine Medical Center, March 28, 2006.
83. Invited Presentation. Franzblau A, Garabrant D. The University of Michigan Dioxin Exposure Study: Project Overview. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
84. Invited Presentation. Olson K, Garabrant D. Prevalence of Exposure Routes in The University of Michigan Dioxin Exposure Study: Food Consumption, Recreational and Household Activities, Occupations and Demographics. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
85. Invited Presentation. Adriaens P, Garabrant D. Measurements of Soil Concentrations of PCDDs, PCDFs, and PCBs From a Community in Michigan, USA. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
86. Invited Presentation. Zwica L, Garabrant D. Measurements of Household Dust Concentrations of PCDDs, PCDFs, and PCBs From a Community in Michigan, USA. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
87. Invited Presentation. Hedgeman E, Garabrant D. Measurements of Serum Concentrations of PCDDs, PCDFs, and PCBs From a Community in Michigan, USA. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
88. Invited Presentation. Garabrant D. Environmental Factors That Explain Variation in Serum Dioxin Concentrations in a Community in Michigan, USA. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
89. Invited Presentation. Chang S-C, Garabrant D. Analysis of Patterns in PCDD, PCDF, and PCB Soil Concentrations From a Community in Michigan, USA. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
90. Invited Presentation. Lepkowski J, Garabrant D. Survey methodology in an environmental exposure study: methods to assure sound inference. Dioxin 2006 Conference, Oslo, Norway. August 21, 2006.
91. Invited Presentation. Garabrant D. Factors that predict serum dioxin concentrations in Michigan, USA. Dioxin 2007. Tokyo, Japan. September 3, 2007.

92. Invited Presentation. Chen Q, Garabrant D. Serum 2,3,7,8-TCDD concentration in a Michigan, USA population with no unusual sources of exposure. Dioxin 2007 Conference, Tokyo, Japan. September, 2007.
93. Invited Presentation. Knutson K, Garabrant D. Linear regression modeling to predict household dust TEQ and TCDD concentration. Dioxin 2007 Conference, Tokyo, Japan. September, 2007.
94. Invited Presentation. Hong B, Garabrant D. Impact of the changes in WHO TEF values from 1998 to 2005 on the total TEQ values in serum, household dust and soil. Dioxin 2007 Conference, Tokyo, Japan. September, 2007.
95. Invited Presentation. Franzblau A, Garabrant DH. Human exposure to dioxins from clay: a case report. Dioxin 2007 Conference, Tokyo, Japan. September, 2007.
96. Invited Presentation. Jolliet O, Garabrant D. Effect of age and historical intake on blood dioxin concentrations: pharmacokinetic modeling to support statistical analyses. Dioxin 2007 Conference, Tokyo, Japan. September, 2007.
97. Invited Presentation. Towey T, Garabrant, D. Multivariate statistical analysis of dioxin profiles to explain source contributions to serum dioxins. Dioxin 2007 Conference, Tokyo, Japan. September, 2007.
98. Invited Presentation. Trinh H, Garabrant D. spatial distribution of dioxins from an incinerator; a validation study. Dioxin 2007 Conference, Tokyo, Japan. September, 2007.
99. Invited Presentation. Garabrant DH. Biomonitoring Results from the University of Michigan Dioxin Exposure Study. The NAS and WHO on Dioxin and Dioxin-like Compounds: International Policy Implications and Potential Impact, Michigan State University, September 19, 2007.
100. Invited Presentation. Garabrant, DH. Factors that predict serum dioxin concentrations in Michigan, USA. 17th Annual Conference of the International Society for Exposure Assessment, Durham, NC. October 16, 2007.
101. Garabrant D. Effective messages in concerned communities: the dioxin exposure study. 2007 Bernstein Symposium. Nanotechnology and Health: Evidence and Impact. University of Michigan Risk Science Center. October 26, 2007.
102. Invited Presentation. Garabrant, DH. Factors that predict serum dioxin concentrations in Michigan, USA. Society for Risk Analysis 2007 Annual Meeting. San Antonio, TX, December 9-12, 2007..
103. Invited Presentation. Garabrant D. The University of Michigan Dioxin Exposure Study project overview. Society for Risk Analysis 2007 Annual Meeting. San Antonio, TX, December 9-12, 2007.
104. Invited Presentation. Garabrant D. Chlorpyrifos exposure, inhibition of butyrylcholinesterase, and paraoxonase (PON1) activity in pesticide manufacturing workers. EPICOH-NEUREOH 2008 Conference, San Jose, Costa Rica, June 11, 2008.
105. Invited Presentation. Jolliet O, Wenger Y, Adriaens P, Chang C-W, Chen Q, Franzblau A, Gillespie BW, Hedgeman E, Hong B, Jiang X, Knutson K, Lepkowski J, Milbrath MO, Reichert H, Towey T, Garabrant, D. Explaining age dependency using pharmacokinetic modeling in the analysis of blood TCDD concentrations. Dioxin 2008 Conference, Birmingham, England, August, 2008.
106. Invited Presentation. Garabrant DH. Project overview and results of linear regression models of serum dioxin levels. Dioxin 2008 Conference, Birmingham, England, August, 2008.

107. Invited presentation. Garabrant DH. Cancer Mortality among U.S. Automotive Transmission Manufacturing Workers Exposed to Metal Working Fluids,” 2008 MRF SYMPOSIUM. October 5-8, Dearborn, Michigan.
108. Invited Presentation. Jiang X, Chen Q, Garabrant D, Hong B, Gillespie B, Lepkowski J, Franzblau A, Adriaens P, Demond A. Logistic Regression Models of High Serum Dioxin Level. Dioxin 2009 Conference, Beijing, China, August 27, 2009.
109. Invited Presentation. Hong B, Garabrant D, Jiang X, Chen Q, Franzblau A, Gillespie B, Lepkowski J, Adriaens P, Demond A. Factors that Predict Serum Concentration of 2,3,7,8-TCDD in People from Michigan, USA. Dioxin 2009 Conference, Beijing, China, August 27, 2009.
110. Invited Presentation. Gillespie B, Reichert H, Chen Q, Franzblau A, Lepkowski J, Adriaens P, Demond A, Luksemburg W, Garabrant D. Estimating Population Percentiles Using the Turnbull Estimator When Some Data Are Below the Limit of Detection. Dioxin 2009 Conference, Beijing, China, August 27, 2009.
111. Invited Presentation. Garabrant D, Hong B, Jolliet O, Chen Q, Jiang X, Franzblau A, Lepkowski J, Adriaens P, Demond A, Hedgeman E, Knutson K, Towey T, Gillespie B. Public Health Impact of Dioxin Exposure Pathways in the UMDES, Based on Linear Regression Models. Dioxin 2009 Conference, Beijing, China, August 27, 2009..
112. Invited Presentation. Franzblau A, Hedgeman E, Jiang X, Chen Q, Hong B, Knutson K, Towey T, Adriaens P, Demond A, Gillespie B, Jolliet O, Lepkowski J, Garabrant D. The University of Michigan Dioxin Exposure Study: An Investigation of Serum Outliers for TEQ, 2,3,7,8-TCDD, 2,3,4,7,8-PeCDF, and PCB-126. Dioxin 2009 Conference, Beijing, China, August 27, 2009.
113. Invited Presentation. Franzblau A, Garabrant D, Gillespie B, Jiang X, Adriaens P, Demond A, Jolliet O, Lepkowski J. Implications of the EPA’s new preliminary remediation goals for residential soil based on the University of Michigan Dioxin Exposure Study. Dioxin 2010 Conference, San Antonio, Texas. September 12-16, 2010.
114. Invited Presentation. Garabrant D, Jiang X, Franzblau A, Adriaens P, Demond A, Gillespie B, Jolliet O, Lepkowski J, Hao W. The University of Michigan Dioxin Exposure Study: Relationship between residential soil, household dust, and serum dioxin levels. Dioxin 2010 Conference, San Antonio, Texas. September 12-16, 2010.
115. Invited Presentation. Hao W, Jolliet O, Jiang X, Garabrant D, Franzblau A, Adriaens P, Demond A, Gillespie B, Lepkowski J. The University of Michigan Dioxin Exposure Study: Dioxin intake due to fish and game consumption in a dioxin-contaminated area. Dioxin 2010 Conference, San Antonio, Texas. September 12-16, 2010.
116. Invited Presentation. Hao W, Jolliet O, Jiang X, Chang C-W, Towey T, Wenger Y, Garabrant D, Franzblau A, Adriaens P, Demond A, Gillespie B, Lepkowski J. The University of Michigan Dioxin Exposure Study: A pharmacokinetic modeling approach to investigate the predictors of serum TCDD concentration. Dioxin 2010 Conference, San Antonio, Texas. September 12-16, 2010.
117. Invited Presentation. Evidence of dioxin exposure in Michigan residents exposed to contaminated soils. The 37th Annual Summer Meeting of the Toxicology Forum. The Aspen Institute, Aspen, Colorado. July 12, 2011.
118. Invited Presentation. Garabrant DH. Improving measures in epidemiology: prospective cohort study of chlorpyrifos manufacturing workers. Symposium ILSI Argentina – ILSI HESI – SETAC Capitulo Argentino. Advances in Epidemiology: the impact of pesticides. September 28, 2011. Argentine Scientific Society, Buenos Aires, Argentina.

119. Invited Presentation. Garabrant DH. The University of Michigan Dioxin Exposure Study: Predictors of human serum dioxin concentrations in Midland and Saginaw Michigan. Society of Toxicology of Canada 43rd Annual Symposium. Montreal, Canada. December 4-6, 2011.
120. Invited Presentation. Franzblau A, Broadwater K, Luksemburg W, Maier M, Jiang X, Garabrant DH, Demond A. Serum Concentrations of Polychlorinated Dibenzo-p-dioxins Among Users of Ball Clay. Joint ISEE, ISES and ISIAQ Environmental Health Conference. 19-23 August 2013, Basel, Switzerland.
121. Invited presentation: Garabrant DH. Biomonitoring of chlorpyrifos excretion, butyryl cholinesterase activity, and acetyl cholinesterase activity among chlorpyrifos manufacturing workers. In: Use of spot biomonitoring samples for environmental epidemiology. International Society of Exposure Sciences 25th Annual Meeting. Henderson, NV October 22, 2015.
122. Invited presentation. Garabrant DH and Pastula SS. A comparison of asbestos fiber potency and elongate mineral particle (EMP) potency in humans. Monticello Conference. October 18, 2017. Charlottesville, Virginia.

Bibliography

Peer Reviewed Journals and Publications:

1. Peters JM, Wright WE, Garabrant DH. Occupational epidemiology: detection of cancer in the workplace. *West J Med* 1982; 137:555-559.
2. Bernstein RS, Sorenson WG, Garabrant DH, Reaux I, Keough B, Hunninghake G, Treitman M. Exposures to respirable airborne penicillium from a contaminated ventilation system: clinical, environmental, and epidemiological aspects. *Am Indus Hygiene Assoc J* 1983; 44:161-169.
3. Garabrant DH, Peters JM, Mack TM, Bernstein L. Job activity and colon cancer risk. *Am J Epidemiol* 1984; 119:1005-1014.
4. Garabrant DH, Peters JM, Bernstein L, Smith T. Respiratory and eye irritation from boron oxide and boric acid dusts. *J Occup Med* 1984; 26:584-586.
5. Garabrant DH, Wegman DH. Cancer mortality among shoe and leather workers in Massachusetts. *Am J Indust Med* 1984; 5:303-314.
6. Garabrant DH, Peters JM, Bernstein L, Smith T, Wright WE. Respiratory effects of borax dust. *Brit J Indust Med* 1985; 42:831-837.
7. Garabrant DH. Dermatitis to an aziridine hardening agent used in water based printing ink. *Contact Dermatitis* 1985; 12:209-212.
8. Peters JM, Garabrant DH, Wright WE, Bernstein L, Mack TM. Uses of a cancer registry to assess occupational cancer risks. *National Cancer Institute Monograph* 1985; 69:157-161.
9. Osorio AM, Bernstein L, Garabrant DH, Peters JM. Investigation of lung cancer among female cosmetologists. *J Occup Med* 1986; 28:291-295.
10. Froines JR, Garabrant DH. Quantitative evaluation of manicurists exposure to methyl, ethyl, and isobutyl methacrylate during production of synthetic fingernails. *App Indust Hyg* 1986; 1:70-74.
11. Garabrant DH, Fine LJ, Oliver C, Bernstein L, Peters JM. Abnormalities of pulmonary function and pleural disease among titanium metal production workers. *Scand J Work Health Environ* 1987; 13:47-51.

12. Kawamoto MM, Garabrant DH, Balmes JR, Fynboh R, Dimick DV, Simonowitz JA, Held J, Bernstein L. Respiratory effects of cotton dust exposure in the cotton ginning industry. *Am J Ind Med* 1987; 11:505-515.
13. Garabrant DH, Held J. Mortality study of aircraft manufacturing employees. *Scand J Work Health Environ* 1987; 13:170-171.
14. Peters JM, Garabrant DH, Preston-Martin S, Yu MC. Is trichloroethylene a human carcinogen? *Scand J Work Health Environ* 1987; 13:180.
15. Goldberg R, Garabrant DH, Peters JM, Simonowitz J. Excessive lead absorption resulting from exposure to lead naphthenate. *J Occup Med* 1987; 29:750-751.
16. Barone JA, Peters JM, Garabrant DH, Bernstein L, Krebsbach R. Smoking as a risk factor for noise-induced hearing loss. *J Occup Med* 1987; 29:741-745.
17. Preston-Martin S, Garabrant DH. Occupational risks for meningiomas of the CNS in Los Angeles County. *J Occup Med* 1988; 30:14-18.
18. Wright W, Bernstein L, Peters JM, Garabrant DH, Mack TM. Adenocarcinoma of the stomach and exposure to occupational dust. *Am J Epidemiol* 1988; 128:64-73.
19. Garabrant DH, Held JL, Langholz B, Bernstein L. Mortality of aircraft manufacturing workers in Southern California. *Am J Indust Med* 1988; 13:683-693.
20. Bowman JD, Garabrant DH, Sobel E, Peters JM. Exposures to extremely low frequency (ELF) electromagnetic fields in occupations with elevated leukemia rates. *App Indus Hyg* 1988; 3:189-194.
21. Goldberg R, Garabrant DH. Excessive lead absorption. *J Occup Med* 1988; 30:482.
22. Yu M, Mack TM, Garabrant DH, Peters JM. Tobacco, alcohol, diet, occupation, and carcinoma of the esophagus. *Cancer Research* 1988; 48:3843-3848.
23. Preston-Martin S, Peters JM, Yu MC, Garabrant DH, Bowman JD. Myelogenous leukemia and electric blanket use. *Bioelectromagnetics* 1988;9:207-213.
24. Ross RK, Bernstein L, Garabrant DH, Henderson BE. Avoidable non-dietary lifestyle risk factors for cancer. *Family Physician* 1988;38:153-160.
25. Uba G, Pachorek D, Bernstein J, Garabrant DH, Balmes JR, Wright WE. Prospective study of pulmonary function and symptoms among medical students exposed to formaldehyde. *Am J Indust Med* 1989;15:91-101.
26. Goldberg R, Bernstein L, Peters JM, Garabrant DH. Occupational fatalities in California, 1972-83. *Am J Indust Med* 1989;15:177-185.
27. Buckley JD, Robison LL, Swotinsky R, Garabrant DH, LeBeau M, Manchester P, Nesbit ME, Odom L, Peters JM, Woods WG, Hammond GD. Occupational exposures of parents of children with acute nonlymphocytic leukemia. A report from the Children's Cancer Study Group. *Cancer Research* 1989;49:4030-4037.
28. Hull C, Doyle E, Peters JM, Garabrant DH, Bernstein L, Preston-Martin S. Case-control study of lung cancer in Los Angeles County welders. *Am J Indust Med* 1989;16:103-112.
29. Peters RK, Garabrant DH, Yu M, Mack TM. A case-control study of occupational and dietary factors in colorectal cancer in young men by subsite. *Cancer Research* 1989;49:5459-5468.
30. Yu M, Garabrant DH, Huang TB, Henderson BE. Combustion products and other non-dietary risk factors for nasopharyngeal carcinoma in Guangzhou, China. *Int J Cancer* 1990; 45:1033-1039.
31. Coleman M, Cardis E, Ahlbom A, Aldrich T, Boyle P, Bracken D, Breyse P, Cabanes J, Cartwright R, Cox R, Feychting M, Floderus B, Garabrant D, Goldberg M, Heroux P, Knave B, Maddock B, Pearce N, Salzberg M, Saracci R, Savitz D, Silva M, Theriault G,

- Vineis P. Extremely low-frequency electric and magnetic fields and risk of human cancer. *Bioelectromagnetics* 1991; 11:91-99.
32. Ciccioni C, London SJ, Garabrant DH, Bernstein L, Phillips K, Peters JM. Occupational asbestos exposure and mesothelioma risk in Los Angeles County: Application of an occupational hazard survey job-exposure matrix. *Amer J Indust Med* 1991; 20:371-379.
 33. Garabrant DH, Held J, Langholz B, Peters JM, Mack TM. DDT and related compounds and risk of pancreas cancer. *J Nat Cancer Inst* 1992;84:764-771.
 34. Garabrant DH, Peters RK, Homa DM. Asbestos and colon cancer: lack of association in a large case control study. *Am J Epidemiology* 1992;135:843-853.
 35. Peters RK, Pike MC, Garabrant DH, and Mack TM. Diet and colon cancer in Los Angeles County, California. *Cancer Causes and Control* 3:1992;457-473.
 36. Garabrant DH, Held J, Homa D. DDT and pancreatic cancer. *J. National Cancer Institute* 1993;85:328-329.
 37. Homa DM, Garabrant DH, Gillespie B. A meta-analysis of colorectal cancer and asbestos exposure. *Amer J Epidemiol* 1994;139: 1210-1222.
 38. London SJ, Bowman JD, Sobel E, Thomas DC, Garabrant DH, Pearce N, Bernstein L, Peters JM. Exposure to magnetic fields among electrical workers in relation to leukemia risk in Los Angeles County. *Amer J Indust Med* 1994;26:47-60.
 39. Patellos MC, Garabrant DH. Occupational cancer. *Primary Care Clinics*. 1994; 21 vol 2: 329-348.
 40. Wegman DH, Eisen EA, Xu X, Woskie SR, Smith RG, Garabrant DH. Acute and chronic respiratory effects of sodium borate particulate exposures. *Environ Health Perspectives* 1994; 102 (Suppl 7): 119-128.
 41. Bunn WB, Brandt-Rauf PW, Christian JH, Engelberg AL, Garabrant DH, Greaves WW, Guidotti TL, Harris JS, Herzstein J, Hoffman BH, Holthouser MG, McCunney RJ, McLellan RK, Richman J, Stave J, Wald P. Recommended library for occupational and environmental physicians. *J Occup Med* 1994; 7; 779-783.
 42. Garabrant DH, Sulistomo A. The functions of occupational medicine clinics. *Indonesian Journal of Occupational Medicine*. 1996; 1: 4-8.
 43. Mankani S, Homa D, Garabrant DH. Effectiveness of nicotine patches in a workplace smoking cessation program: an eleven month follow-up study. *J Occup Med* 1996; 38: 184-189.
 44. Simpson C, Garabrant DH, Torrey S, Robins TG, Franzblau A. Hypersensitivity pneumonitis-like reaction and occupational asthma associated with 1,3,-bis(isocyanatomethyl) cyclohexane pre-polymer. *Amer J Indust Med* 1996; 30: 48-55.
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 47. Akbar N, Basuki B, Garabrant DH, Waspadji S, Noer S. Risk of anti-hepatitis A virus in an urban population in Jakarta. *Medical Journal of Indonesia*. Oct-Dec 1996.
 48. Akbar N, Basuki B, Mulyanto, Garabrant DH, Sulaeman A, Noer HMS. Ethnicity, socioeconomic status, transfusion and risk of hepatitis B and C infection. *J Gastroenterol Hepatol* 12; 752-757:1997.

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