

# HEI Energy Research Program

Progress on the Systematic Review of the Human Health Literature Related to Unconventional Oil and Natural Gas Development (UOGD)

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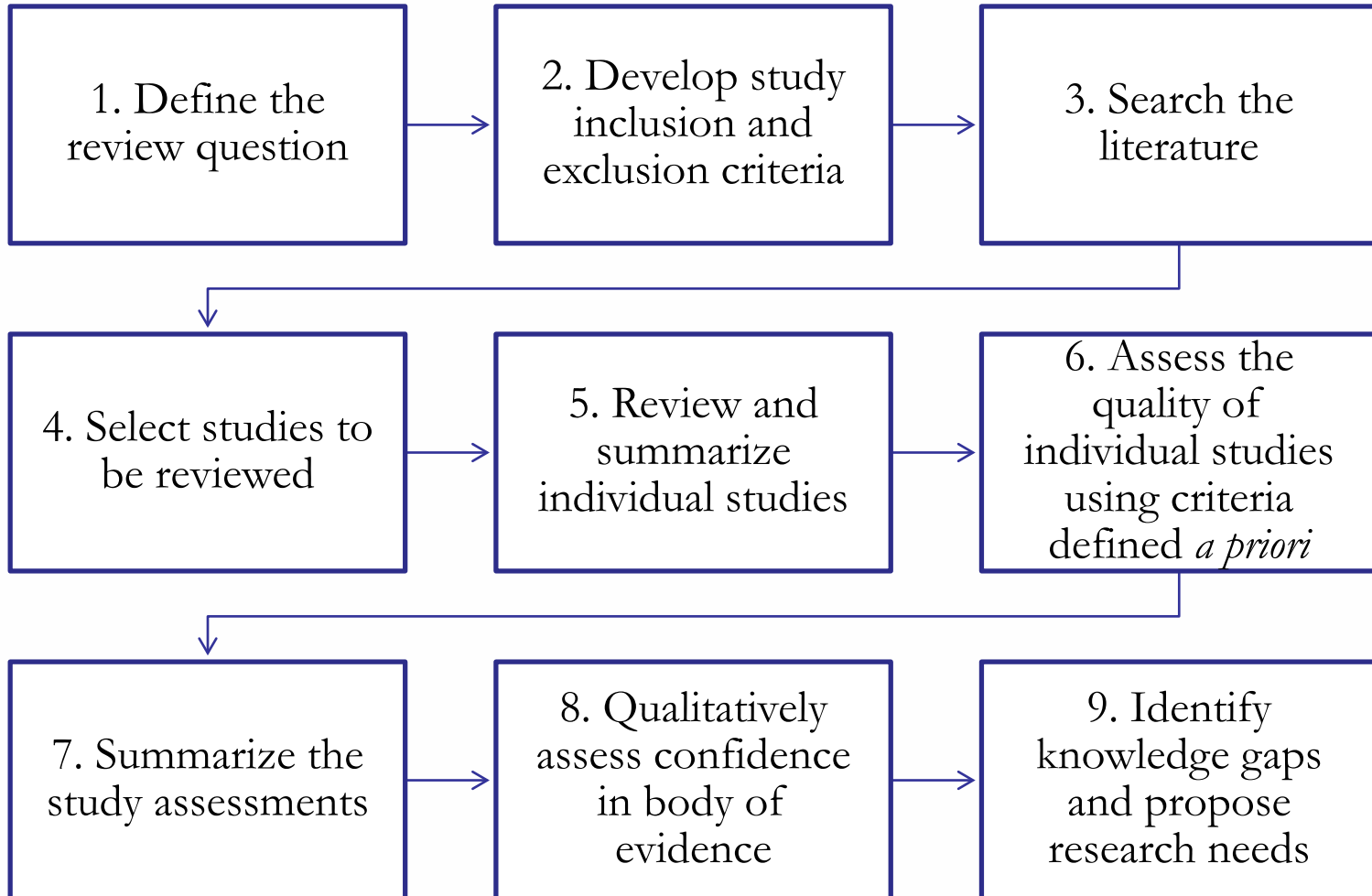


# Purpose of the Systematic Review

- Address public and academic interest in potential health effects of UOGD
- Research planning
- The report will:
  1. Describe the strengths and limitations of the literature,
  2. Summarize what the literature does and does not tell us about potential health effects,
  3. Offer recommendations for research to fill important knowledge gaps, and
  4. Build on previous UOGD and health reviews (CDPHE 2017, RFF 2017, and Stacy et al. 2017)



# Systematic Literature Review Approach



# Systematic Review Question

*Are there adverse human health effects associated with UOGD?*

- Is early life exposure to UOGD associated with:
  - adverse birth outcomes or morbidity in children?
- Is exposure to UOGD associated with:
  - cancer in children or adults?
  - asthma exacerbation or other respiratory outcomes?
  - hospitalization rates for specific health outcomes?
  - various transient symptoms (e.g., runny nose and itchy eyes)?



# Study Inclusion Criteria

Domain	Description
Study Type	Analytical epidemiology
Publication Type	Peer-reviewed journal article or report presenting primary research (published or accepted for publication); gray literature in final and complete form
Study Population	Humans living in areas where they might be exposed to chemical or non-chemical agents originating from UOGD
Exposure	Direct measurements or surrogates of UOGD exposures
Comparator Group	Variation in potential UOGD-related environmental exposures across people or over time
Health Outcomes Assessed	Human health outcomes, including health symptoms

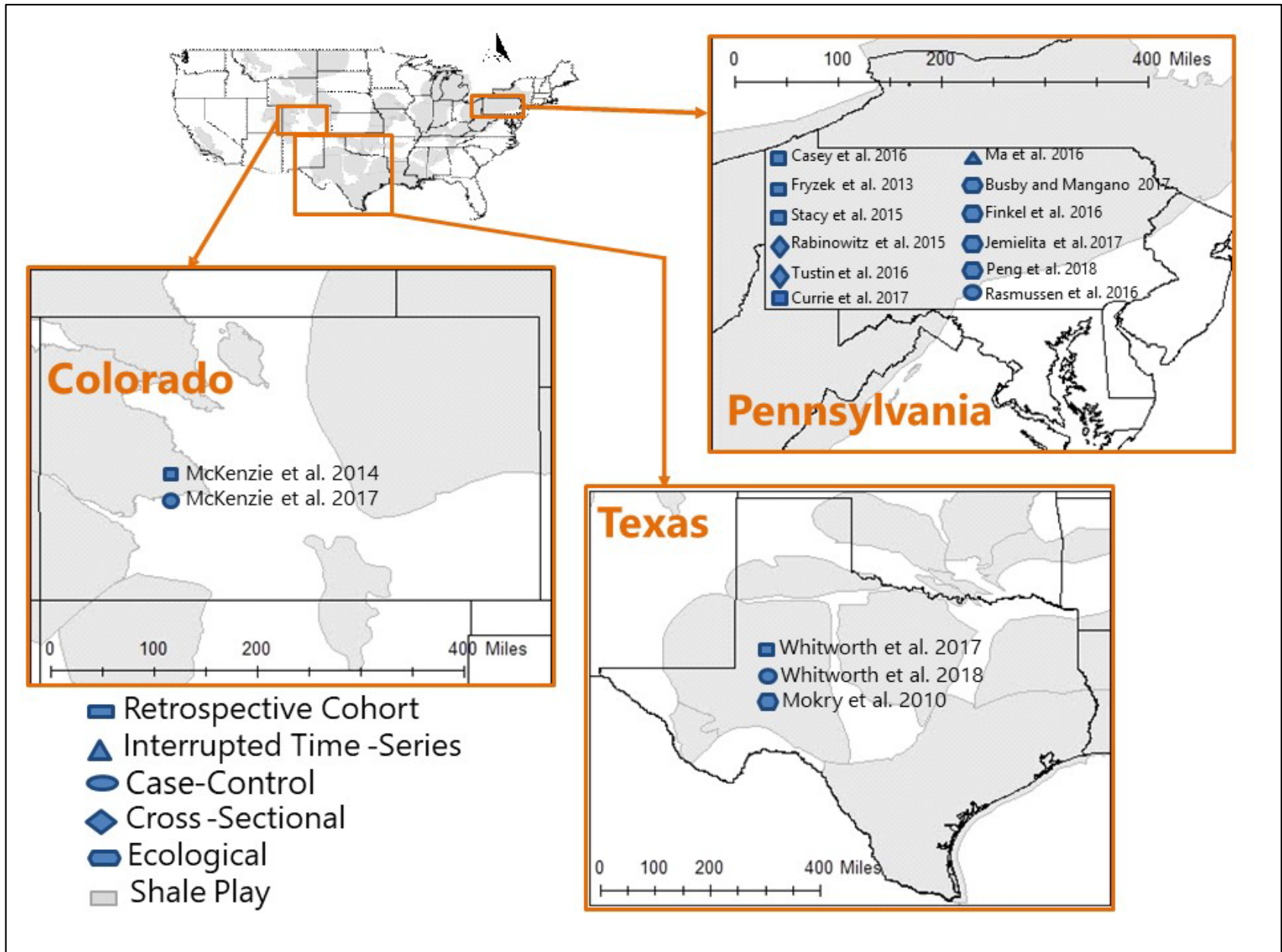


# Domains used to Assess Study Quality

1. Study Design
  2. Study Population
  3. Outcome Assessment
  4. Exposure Assessment
  5. Confounding
  6. Effect Modification
  7. Analytical Methods
  8. Presentation and Interpretation
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# Study Designs and Locations



# Outcomes Collected in the Included Studies- Perinatal Outcomes

Outcome	Description	Citation
Birth Weight	Birth weight (continuous)	McKenzie et al. 2014; Stacy et al. 2015 Casey et al. 2016; Currie et al. 2017 Whitworth et al. 2017
	Low birth weight (<2500 g)	McKenzie et al. 2014; Currie et al. 2017
	Small for gestational age	Stacy et al. 2015; Casey et al. 2016; Whitworth et al. 2017
Preterm birth	<37 weeks	Stacy et al. 2015; Casey et al. 2016; Whitworth et al. 2017; Whitworth et al. 2018
Birth Defects	Congenital heart defects; neural tube defects, oral clefts	McKenzie et al. 2014
	Structural and functional; developmental	Ma et al. 2017
APGAR	5-minute APGAR <7	Casey et al. 2016
Mortality	Fetal Death	Whitworth et al. 2017
	Early infant mortality	Busby and Mangano 2017
Infant Health Index	A combined score of multiple perinatal outcomes	Currie et al. 2017



# Outcomes Collected in the Included Studies-

## All Other Outcomes

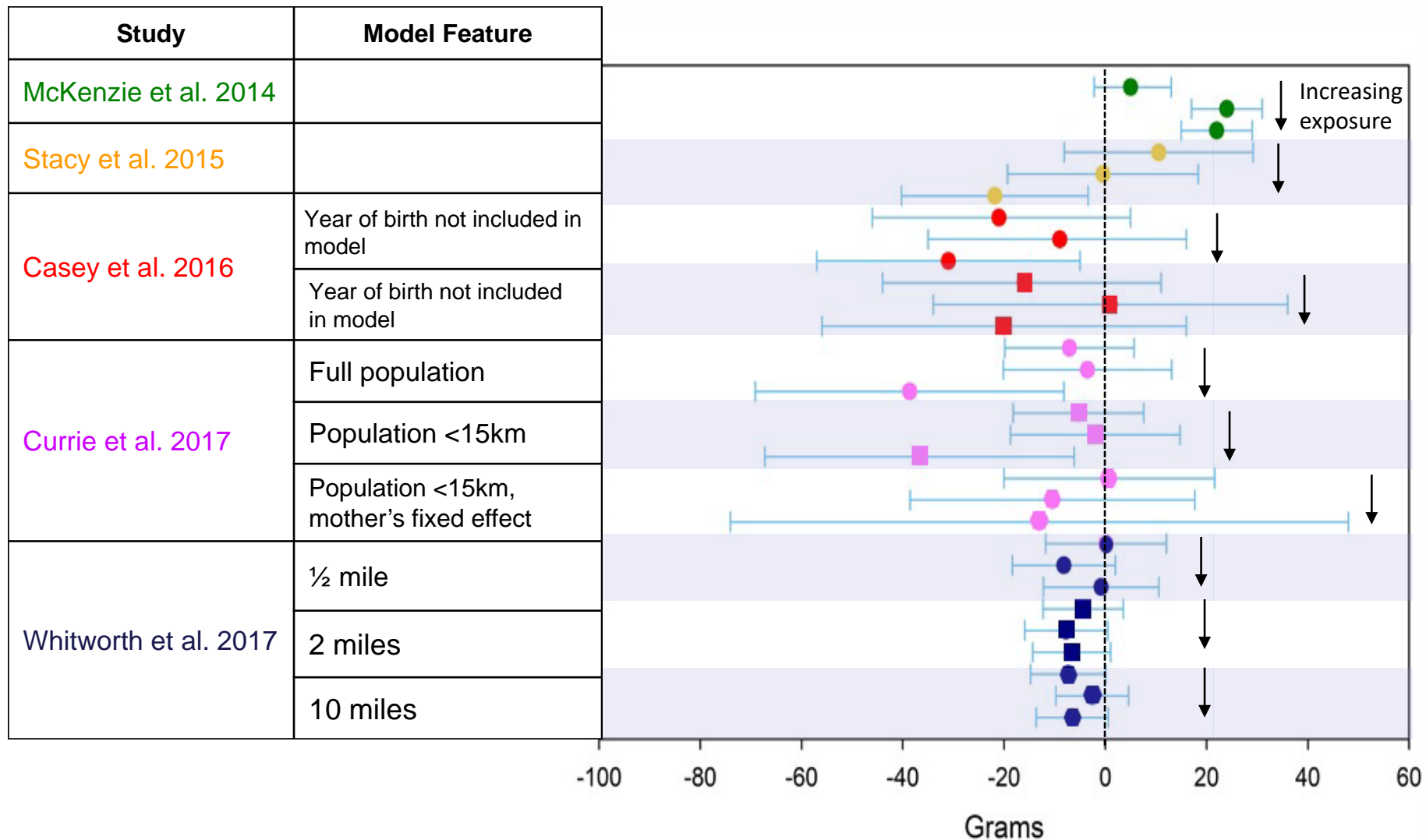
Outcome	Description	Citation
Cancers	All childhood leukemia subtypes	Mokry 2010; Fryzek et al. 2013; Finkel et al, 2016
	Non-Hodgkin's lymphoma	Mokry 2010; McKenzie et al. 2017
	Acute lymphoblastic leukemia	McKenzie et al. 2017
	All childhood cancer	Fryzek et al. 2013
	Central nervous system (CNS) tumors	Mokry 2010; Fryzek et al. 2013
	Urinary bladder cancer; thyroid cancer	Finkel et al. 2016
	Breast cancer	Mokry 2010
Respiratory	Oral corticosteroid order; asthma emergency department (ED) encounter; asthma hospitalization	Rasmussen et al. 2017
Hospitalizations	Any hospitalization	Jemielita et al. 2015
	Acute myocardial infarction (MI), chronic obstructive pulmonary disease (COPD), asthma, pneumonia, upper respiratory	Peng et al. 2018
Self-Reported Symptoms	Dermal; respiratory; cardiac; GI; neurological	Rabinowitz et al. 2015
	Current chronic rhinosinusitis; migraines; fatigue	Tustin et al. 2016

# Exposure Metrics used the Included Studies

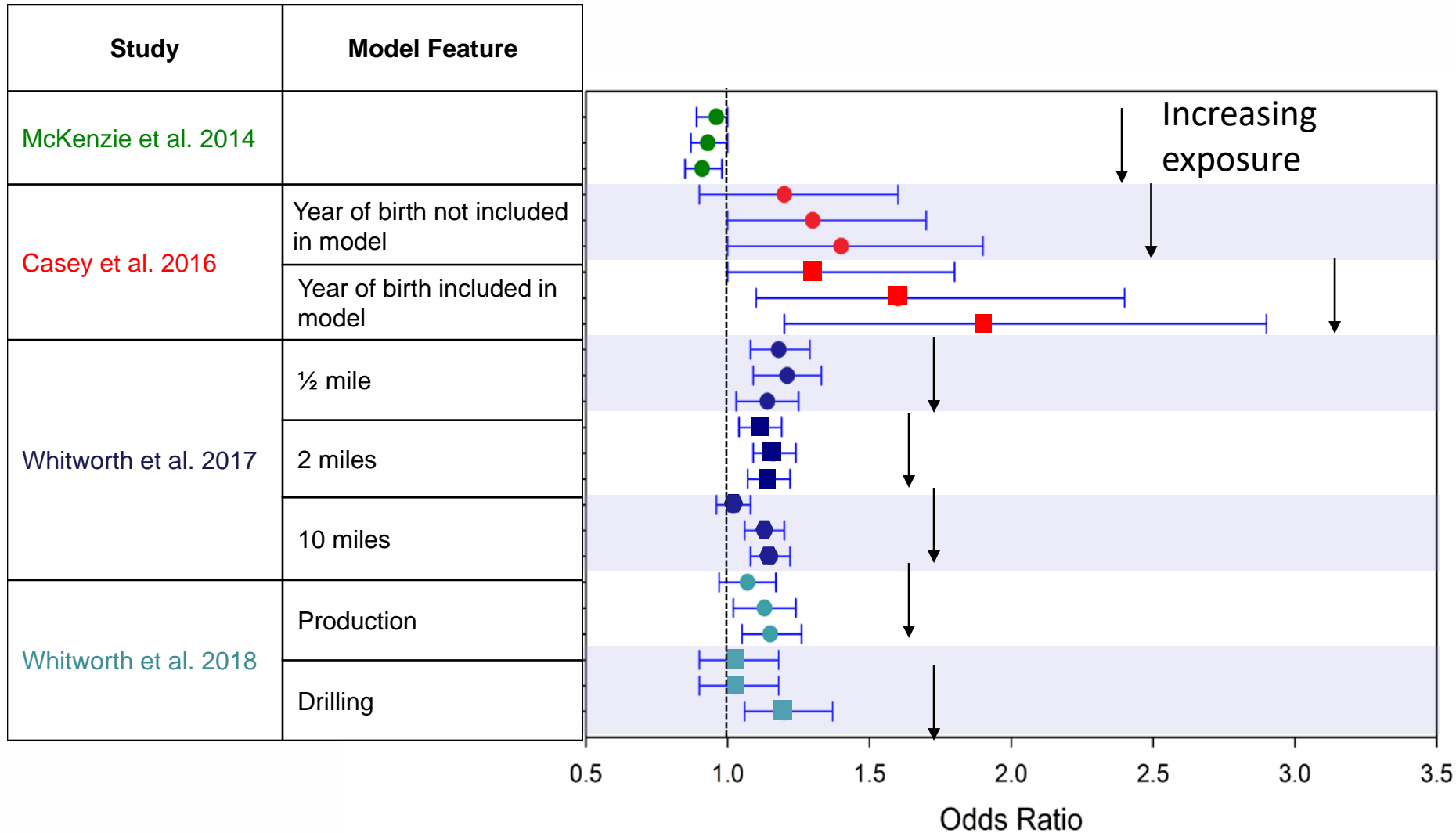
Metric Title	Description	Citation
Time-Period	Effect estimates compared between time periods (years; before or after spud date)	Mokry 2010; Fryzek et al. 2013; Finkel 2016; Busby and Mangano 2016
Distance	Distance between household and closest well	Rabinowitz et al. 2015
Well density	Active wells per km <sup>2</sup> within zip code	Jemielita et al. 2015
Spud date with time-series component	Product vector with indicator for spud date and proximity indicator	Ma et al. 2016; Currie et al. 2017; Peng et al. 2018
Inverse Distance Weighted	$IDW_a = \sum_{i=1}^n \frac{1}{d_i}$	McKenzie et al. 2014; Stacy et al. 2015; McKenzie et al. 2017
Inverse Distance Weighted, distance squared	$IDW_a = \sum_{i=1}^n \frac{1}{d_i^2}$	Whitworth et al. 2017
Inverse Distance Weighted, distance squared, by activity	Activity Metric for separate UOGD phases	Rasmussen et al. 2016; Casey et al. 2016; Tustin et al. 2016; Whitworth et al. 2018

spud date = the beginning of drilling a well

# Summary of Reported Effects: Birth Weight



# Summary of Reported Effects: Preterm Birth\*



\*Stacy et al. 2015 not included in plot



# Ongoing Assessment

- Domains assessed specific to body of literature:
  - Consistency between studies
  - Strength of association
  - Biological plausibility
  - Exposure measurements/metrics
  - Confounding
  - Temporal variability
  - Generalizability
  
- Report release: **Summer 2018**

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**Thank you!**

