



August 11, 2014

To whom it may concern:

As requested, following are my comments on the July 2014 report entitled “Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland”. This is an extensive, wide-ranging and ambitious health impact assessment (HIA); as such, my evaluation includes some overarching comments as well as feedback on specific elements of the HIA (such as air pollution, in which I have more expertise than water pollution and other pathways). I describe areas in which the report could be improved but also attempt to recognize strong elements of the report with which I agree, to provide some context for my comments. My evaluation also recognizes the stated design of the project to “provide a baseline assessment of current regional population health, an assessment of potential public health impacts, and possible adaptive and public health mitigation strategies in the event that natural gas extraction takes place within Maryland’s Marcellus Shale resource”. In addition, my evaluation recognizes the fact that the report will not be revised, but still includes suggested improvements to provide insight to policymakers and information in the event that follow-up activities occur.

Comments

- P. xvi: The decision to use public databases for the baseline health assessment rather than primary data collection is entirely reasonable; collection of novel field data would be well beyond the scope of an HIA of this type, and it would be unlikely to influence the core analyses or recommendations.
- p. xvii: More detailed responses on the physical determinants of health (and other sections within the executive summary) are found within the various subsections of the main text. But briefly, although there is an extensive list of health outcomes and their patterns between Garrett and Allegany County, or between these counties and the rest of Maryland, there is not much context provided about why specific health outcomes are listed or what the implications might be. A conceptual model presented earlier would have been helpful for the reader only focused on the executive summary, so it is clear why one would be concerned about some of the health outcomes listed in the context of the Marcellus Shale. For example, an observation is made that colorectal cancer rates are

high in these counties relative to the state and the country, but this outcome is never explicitly discussed in the context of the public health impacts of unconventional natural gas development and production (UNGDP) in Maryland. There is nothing intrinsically wrong with the information, and there are many carcinogenic endpoints of interest, but a tighter focus on specific health outcomes of concern or a clear description of how these outcomes connect with the health effects of UNGDP would be more useful. In general, for an HIA, I often ask the question of whether the recommendations could have been made in the absence of a piece of information presented, which would be a sign either that the information is extraneous or the recommendations are not sufficiently refined. There is little in the recommendations that would have changed if the baseline health assessment looked radically different, which means either the baseline health assessment should have been more focused or the recommendations should have more clearly taken the population characteristics into account.

- p. xix: “We identified the hazards that most concern community members through a detailed scoping process”; it is important for scoping to reflect the concerns of the community, but it should also reflect the content of the scientific literature, and it would be important to be clear about this fact. The subsequent text reinforces that the hazards were based in part on published scientific knowledge of potentially important health effects, but this should be explicit upfront.
- p. xx: While it is true that direct insight about the impact of UNGDP is lacking and it would take some time to develop this insight, if UNGDP is associated with pollutants demonstrated elsewhere to have health effects, there is no need to wait for new studies to determine mitigation strategies. Studies of proximity to UNGDP are a separate category, but insight about emissions of pollutants or precursors to pollutants known to influence public health can be directly applied. Subsequent text that describes impacts of fine particulate matter or emissions of VOCs reinforces that the broader literature can provide significant insight.
- p. xxii: Conducting a pilot noise monitoring study was an excellent addition to the report. But how can it be true that “...the compressor station noise levels were 55.78 dBA over a 24-hour period, 52.75 dBA during daytime hours and 51.75 dBA during nighttime hours”? 24-hour average must be in between daytime and nighttime. In general, the text should be clearer about averaging times for noise and other pollutants, which are often not explicitly mentioned.
- p. xxv: Nice list of recommended mitigation measures. But why only assess and protect against HAPs, when there are criteria air pollutant impacts as well? This text may be using “toxic air pollutants” in a colloquial sense, but regulators may read it differently. Also, some of the recommendations do not stand alone well in the executive summary, without reading the detail in the main text – for example, “Require a quality assurance plan” is vague – what is being QAd? Even from the main text, it is somewhat unclear what is being discussed, unless someone is intimately familiar with CGDPs.

- p. xxvi: List of air quality monitoring recommendations is excellent, especially the involvement of the community in the air monitoring. The recommendation to conduct source apportionment is important but also no small task; this has implications for sampling strategy, sample size, statistical analysis approaches, and so forth. The main text also appears to call for a single monitoring site, which would reduce community engagement and make source apportionment impossible. The authors may instead want to recommend distributed sampling by community members (and others) at a larger number of locations.
- p. 1: “HIA is not a quantitative risk assessment, rather it provides information that is qualitative in nature that can be used to assess whether and how community wellbeing may be impacted, both directly and indirectly”; this is technically not correct, as HIA can provide quantitative as well as qualitative information. This description seems to imply that quantification is precluded. Similarly, on p. 2, the NAS report did not say that quantitative risk assessment is beyond the scope of HIA; it says directly that HIA “includes attributes of health risk assessment”, has an entire section about quantification, states that “quantitative analyses of uncertainty are common in related fields, such as health risk assessment, and are relevant if the key health effects are quantified in the HIA”, and so forth. It is perfectly appropriate for this report to have focused on qualitative information, given the timeline and scope of activities, but it should not be stated that this is the way that HIA needs to be done.
- p. 9: “In this study, we are limited to assessing vulnerability using sociodemographic data and county-level health data. We were unable to obtain individual health data including family history of disease for populations in both counties.” – the report is overly self-critical with this statement and others like it. It is impossible for any large-scale HIA or population health assessment to have individual health data with family history of disease. Only a small number of cohort studies have this information, none would be specific to these counties, and broadly speaking, these data are not necessary for this more general baseline health assessment. The data relied upon are appropriate and consistent with best practice for this sort of effort.
- p. 10: Stated life expectancy for MD (67.8 years) cannot possibly be correct; perhaps this is supposed to be 76.8? Also, how is it that life expectancy is longer but in Garrett and Alleghany Counties there are more poor physical health days, more preventable hospital stays, higher rates of multiple chronic diseases, higher rates of smoking, higher mortality rates for multiple specific diseases, higher all-cause mortality rates, etc.? Are there important differences in age distributions that explain this (are the rates raw or age-adjusted)? Or are only the outcomes shown that are higher for Garrett and Alleghany, and not the ones that are lower? It would be important to ensure that the data are all (approximately) taken from the same year and the same underlying population assumptions, and to try to knit the data together in some logical way, rather than simply providing a list of comparisons. In addition, as mentioned above, there should be some

connection with a conceptual model that explains why certain health outcomes are of concern.

- p. 18: “The linkage between hazards, exposures, and adverse health outcomes is established using epidemiological studies”; this is often true, but toxicological evidence can also establish these linkages, and is the foundation for much of the estimated health risk from HAPs. Especially given the long lead time for some epidemiology, the authors probably don’t want to indicate that a causal linkage could not be made from only animal data. Also, as mentioned above, it is not necessary for UNGDP epidemiology to be completed to draw insights about health effects; it would be sufficient to understand exposures to constituents whose health effects were characterized elsewhere.
- p. 19: Search is not appropriately described; I suspect that the search was for “(‘fracking’ OR ‘hydraulic fracturing’ OR ‘natural gas’ OR ‘unconventional natural gas’ OR ‘Marcellus shale’) AND (‘air quality’ OR ‘air pollution’ OR ‘water quality’ OR ‘water pollution’ OR ‘radiation’ OR ‘health effects’ OR ‘adverse health outcomes’ OR ‘public health’)”. Parentheses are very important to show exactly what was searched, since otherwise a very different set of studies might have been found. This search is reasonable on its face, as it should capture studies of exposures associated with fracking, but it would need to be supplemented by other searches or lists of studies of the health effects of those exposures (which would not need to be directly characterized in a fracking context). Subsequent text shows that many of these studies were described, but the process by which those studies were found was not clarified.
- p. 20: I’m not normally a fan of these types of scoring systems, since they combine incommensurate information and can lead to odd conclusions. But it was a reasonable choice in this case, given that a similar scale was used in one of the only other fracking HIAs conducted to date. But this implies that comparing the results with the Battlement Mesa HIA would be useful in this report. The authors later state that these types of comparisons are generally not warranted, but if the same scale is used, it would be interesting to know if similar conclusions were reached.
- p. 24: Looking at the list of chemicals used in fracking and cross-referencing with a list of carcinogens is a good first step, but this leaves out magnitude of emissions, exposure pathways, potency, and non-cancer health effects. In other words, this gives a decent list to start an analysis, but this is nowhere close to a priority list of compounds. Subsequent sections help to refine the narrative, but it would be a good “teachable moment” in the report to emphasize the information gap.
- p. 34: This section nicely estimates emission rates of PM_{2.5}, NO_x, and VOCs, three key air pollutants from a health perspective. This is extremely valuable information, as it could be connected with published health damage functions, prior atmospheric modeling outputs, or other approaches to approximate exposures. Or, it could be simply compared with other important sources or source categories to provide context about the magnitude of emissions. However, the report simply lists the values without any further analysis or

discussion. This is a missed opportunity. Even if the HIA was not meant to be quantitative, having quantified emissions rates to compare with other source sectors is valuable information for stakeholders.

- p. 38: “Overall, local health departments and clinics should monitor for increase in stroke morbidity and mortality in areas with UNGDP activities due to a decrease in local air quality because of PM_{2.5} and PM₁₀”; this is a somewhat impractical recommendation, as the magnitude of concentration change and resulting effect would be unlikely to be so large to be observable by a local health department or clinic. Suggesting that epidemiological studies or quantitative risk assessments include stroke outcomes makes sense, but hoping to see effects through local surveillance does not.
- p. 40: The setback recommendation is not unreasonable, but the information presented is not sufficient to feel comfortable with the suggested distance. First, the setback distance will differ for pollutants and source types; traffic gradients will drop off more rapidly than gradients from taller stacks, and pollutants such as ultrafine particles or CO will drop off more rapidly than PM_{2.5}, while ozone could be scavenged in the near field and formed downwind. More specifically, the Colorado study cited as the foundation of the setback recommendation compared samples < 0.5 mile vs. > 0.5 mile, but did not have a strong empirical foundation for the choice of 0.5 miles, used an array of area samples to characterize levels > 0.5 mile, and did not investigate alternative cutpoints. McKenzie et al. state directly that “the actual distance at which residents may experience greater exposures from air emissions may be less than or greater than a ½ mile, depending on dispersion and local topography and meteorology”. The authors should be clear that a setback distance adequately protective of air pollution from UNGDP activity has not yet been empirically determined.
- p. 63-64: Very nice and comprehensive list of health impact pathways (beyond air pollution) associated with an increase in truck traffic. It should be noted that the air pollution section embedded truck traffic into the emissions increase estimation but did not otherwise emphasize this connection or delineate pollutants that may be specific to diesel trucks versus other sources.
- p. 75: This section provides a reasonable description of cumulative risk assessment, although as the NAS report on HIA emphasized, health impact assessment and cumulative risk assessment share many common features. As such, it is not clear whether the very nice list of bullets from the site visit to Doddridge County emphasizes the need for cumulative risk assessment or reinforces the value of the HIA conducted by the authors. Many of the examples are not examples of synergistic effects or the need to characterize cumulative burdens, but rather of the need for a holistic assessment of the influence of the social and physical environment on health outcomes, which is the objective of the HIA.
- p. 84: The section on the regulatory structure for air focuses almost entirely on greenhouse gases, even emphasizing the greenhouse gas component for pollutants such as

VOCs and hydrogen sulfide that have other influences on public health and multiple other regulatory components. This is inconsistent with the stated (and reasonable) focus within the HIA on pollutants with local health impacts and the exclusion of greenhouse gases from the analysis. This makes it more challenging for the reader to understand how, for example, various criteria pollutants or toxic pollutants are regulated and managed.

- p. 91: The list of recommendations for air quality is sensible but missing a few elements. First, as stated above, it is not clear how strong the foundation of a 2000 foot setback is, so there probably needs to be a recommendation (per R2) to investigate this question prior to determining the setback distance. Having covering for trucks is helpful, but given the emphasis on some diesel combustion pollutants in the earlier sections, should there not also be combustion technology recommendations (i.e., diesel particulate filters)?
- p. 96: A user-friendly mapping tool for community members is an excellent idea. I would make the minor observation that there are many mapping tools already in use at EPA and elsewhere, and DHMH would benefit from leveraging those tools rather than developing a new interface from scratch.
- p. 98: The list of recommended health studies is excellent. Focusing on birth outcomes and dermal, mucosal, and respiratory irritation that would show nearer-term impacts and would be relatively more prevalent in the population is a very good strategy. It is also mentioned briefly that exposure assessment programs will need to be included, but this would be a substantial effort that would need to be planned well and implemented very soon. An excellent surveillance system would not yield meaningful insights if the only exposure metric available were proximity-based rather than pollutant exposure-based. This is not trivial to do, given the numerous candidate pollutants and the challenges in doing widespread monitoring, but it would be very important to develop in parallel with a surveillance system.
- p. 129: There is no 2012 U.S. Census. There is either 2010 U.S. Census or 2012 estimates from the American Community Survey or other related databases. Need to be clearer on information used for the population data.
- p. 133: In general, the appendix devotes far more space to the baseline assessment than would be necessary for the HIA, while at the same time containing important information that would fit better in the main report. While the report will not be revised, it would be of value to stakeholders to see maps of vulnerable populations and have geographic areas in which a large number of vulnerable populations live highlighted. A more focused presentation that mapped demographics at high spatial resolution would be far more valuable than the information as currently presented.
- p. 138: There were multiple misstatements in this section. Figure 15-10 does not show “very high concentrations”, with levels fairly consistent with other areas of Maryland. And it is a bit of a non sequiter to say that the spatial pattern of PM_{2.5} in Maryland in 2011 is consistent with a national trend of asthma incidence increasing from 2000-2010 – the literature references and other text refer to exacerbations of existing asthma, not

asthma development, and the data have nothing to do with longitudinal trends of air pollution. The authors should be careful in sections like these, since these types of misstatements can engender confusion among stakeholders.

- p. 139: The NATA section also has a few misstatements. Cancer risks are not really calculated from personal exposure; they are calculated from a simple dispersion model tied to an emissions inventory, with a time-activity adjustment. This is obviously meant to represent personal exposure, but the phrasing implies something more precise. Non-cancer risks are variably referred to as respiratory only or respiratory and neurological – neurological endpoints were included, and multiple others were considered as well in 2005. More substantively, the text simply states that 2002 and 2005 differ for unknown reasons, but the data are readily available on the EPA website to figure this out. For example, a cursory skim would show that the respiratory risks were almost entirely driven by acrolein levels, which would allow one to quickly determine whether there were any methodological changes explaining the differences. While these comparisons were not central to the analysis, it would be important for any information presented to be factually correct and thorough (or, if the NATA analysis has no bearing on the HIA recommendations, it should not be included in the report).

In summary, this was a solid report that provided insight about key pathways linking UNGDP with public health, with a concrete list of recommendations that are well supported by the literature. While there are clearly areas of potential improvement or refinement, and some of the content was not central to the decisions at hand, the HIA is based on a solid foundation and provides important insight for decision makers. Please feel free to contact me if you have any questions.

Sincerely,



Jonathan Levy
Professor of Environmental Health
Boston University School of Public Health