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Dear Dr. Mitchell:

As requested, this letter summarizes my peer review of:

- \* Draft for public comment, "Detailed Scoping Report: Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland", December 2013; and
- \* Final health impact assessment, "Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland", July 2014

Both of these reports were authored by the Maryland Institute for Applied Environmental Health, School of Public Health, University of Maryland, College Park.

### **Overview**

As I understand the charge, it was

- \* For the Scoping Document, to identify whether there are any issues omitted from the Scoping Document which should be considered for inclusion as part of a public health assessment of the potential impacts of development of the Marcellus Shale in Maryland; and
- \* For the Final Report, to evaluate how the Final Report addresses the issues raised in the Scoping Document and to provide questions or comments that need to be addressed

### **General Comments**

It is commendable that Maryland has conducted a health impact assessment prior to initiating unconventional natural gas development and development (UNGPD) employing hydrofracking technology. The draft health impact assessment report was provided to the public for review and it is evident that the final report not only addresses the issues that were raised by the Scoping Document, but also responds to comments from the public, indicating that there was a robust and participatory public process. The Final HIA Report highlights a number of potential public health concerns. In my view the value of a health impact assessment is to identify

all potential health threats in order to inform the construction of a tight environmental health safety net. In that regard, the HIA is comprehensive, thorough and in my view completely covers the issues that need to be addressed in the context of future UNGPD in Maryland.

Generally speaking, if UNGPD is permitted in Maryland, there are several aspects that are of critical importance for public health. First, the mitigation measures proposed in the HIA should be carefully evaluated in the context of other factors, including input from local communities, technical and engineering feasibility and the availability of alternative mitigation measures not considered by the authors of the HIA.

No number of mitigation measures can provide one hundred percent assurance of UNGPD safety and it is therefore important that the Maryland DHMH and the affected counties would have adequate funding for surveillance activities as well as follow up investigations that would assess potential health impacts and allow for identification of ways that mitigation measures need to be improved as well as potential health impacts. Again, the specific HIA recommendations for health tracking should be carefully evaluated in the context of other factors including the relevance of suggested health endpoints, the ability to build on existing surveillance efforts, and technical feasibility of alternative surveillance methods.

According to the Final HIA, since the Marcellus Shale formation in Maryland is comprised of “dry” and not “wet” gas it is unlikely to be targeted for UNGPD development in the near future. Thus, Maryland may be able to carry out measures to mitigate adverse effects of hydrofracking well prior to inception of such activities. This could include exploring many of the recommendations in the draft HIA including collection of baseline data on drinking water contamination and health as well as working with the affected counties to scale up health-related resources, e.g., availability of adequate housing, sanitation services and healthcare for an expanding workforce.

It is of utmost importance that Maryland would allow local input into decision-making about permits for UNGPD. Local public health agencies in Allegany and Garrett counties need adequate support in order to play their role in engaging the public, especially the health community, in these processes.

The Marcellus Shale formation extends through a multistate area including Maryland, New York, Ohio, Pennsylvania, Virginia, and West Virginia; the regulatory status of UNGPD varies widely within this region. Many of the health concerns embedded in the HIA are centered around the workforce that is involved with UNGPD operations, for example, occupational hazards, healthcare coverage, health status and their impacts on communities. Of note is that possibly the two counties, Garrett and Allegany, would benefit in several ways if potential UNGPD operations would provide the opportunity for local residents to join that workforce. Perhaps the University of Maryland could help facilitate that via establishment of training programs to help move local populations into this new workforce. Alternatively, Maryland could do this in collaboration with two nearby states, West Virginia and Pennsylvania, who also have an interest in developing jobs in their rural communities. Maryland could also consider a more aggressive approach to assuring healthcare coverage for the workforce; again, it is possible that this could be done in collaboration with the two adjacent states.

In addition to specific concerns that are described below, there are some general recommendations that I would like to put forward with regard to provision of public information and involvement of the public moving forward:

1. *Continue the Process of Assessing Health Impacts:* Regardless of when and how Maryland moves forward with UNGPD activities, ongoing health tracking activities are warranted. I recommend that the MD DHMH appoint a panel of experts and citizens to constitute an unconventional gas production health assessment committee. Such a committee could conduct ongoing review of health-related data and other issues.
2. *Address Right-To-Know:* Assure public transparency of health relevant data and timeliness of data reporting and analysis. In the absence of reliable information from state and local health authorities, misinformation is likely to result in skewed policy decisions.
3. *Engage the Public:* UNGPD is of great concern both in those communities and statewide and public engagement activities need adequate resources to assure that the State is reaching out and involving the public proactively. DHMH will require resources for public communications engagement, particularly for those most concerned about health, for example, local health agencies, health providers and members of the public.
4. *Address Methane Emissions:* The HIA did not include global warming as part of its scope of effort. Yet, the EPA has identified greenhouse gases (GHG) as public health threats under the Clean Air Act. Of particular concern is methane, identified in the HIA as a potential drinking water contaminant but also considered to be a potent GHG. Unless adequately controlled methane emissions are likely to occur at all stages of development and production of unconventional gas wells and in transport and use of natural gas. The EPA has not made a regulatory determination about methane as a pollutant under the Clean Air Act but industry has been crafting sets of voluntary measures that can be taken to prevent methane leaks both to water and air. Moreover, the use of natural gas in Maryland has been increasing over time regardless of the point of origin of the natural gas, and Maryland already has a vast natural gas infrastructure (production and post production) that may be leaking methane. Maryland may wish to consider the health risks of methane releases and what actions, if any, can be taken in advance of federal regulatory oversight to assure that natural gas development, transport and use – now and in the future -- minimize emissions of methane to air and water.

### Specific Comments

#### **Draft Scoping Report and 8. Scoping Update**

The Draft Scoping Report clearly defined the proposed scope of work for the Health Impact Assessment (HIA) and the ten themes that were drawn from public input received during stakeholder engagement meetings -- air quality, water quality, baseline health assessment, healthcare infrastructure, occupational issues, secondary impacts, climate change/weather, benefits, populations of concern, and zoning. An eleventh theme, economic impact, was suggested by public comments but this theme, along with occupational issues and climate change/weather, was not included in the scoping of the HIA. This is understandable however the decision not to focus on climate impacts caused the final HIA to neglect concerns about methane leakage that need to be addressed as part of the public health response to UNGPD. Likewise, there was a decision not to include issues related to water use and the adequacy of water supplies. Instead, the decision was to assess of potential water contaminants in association with UNGPD and to consider water supply as "a hydrology and civil engineering issue that will not be considered in this assessment". That is understandable, however, water scarcity can lead to circumstances in which communities have fewer choices for drinking water supplies,

increasing the potential health threat from contamination of those remaining supplies.

By design the Draft Scoping Report defined economic impacts as being outside of the health arena, since they are being addressed by the Towson University Regional Economic Studies Institute. Since the economic impacts may have positive or negative effects on health, it may be appropriate to take a later look at how the RESI study may (or may not) change the conclusions of the HEI.

The Scoping Update (8.0) describes how the scoping was modified in response to 46 public comments that were received in response to the Draft Scoping Report. The major changes had to do with incorporating the entire report into a single report to be produced on a longer timeline, and presenting a progress report at a public meeting in Western Maryland in June 2014. The Scoping Update modified the plan for the baseline health assessment by adding a new set of comparison counties inclusive of nearby areas in Pennsylvania and West Virginia; this was an excellent decision. A number of new indicators were added as well; these are all valid and relevant indicators. For the impact assessment, the Scoping Update added a number of new hazard scenarios, which also are appropriate and address community concerns. The Scoping Update provided more information about why methane was not included as a potential hazardous air pollution, the rationale being that they would be required to address the extraneous issues around the use of natural gas as a "transition fuel" and consequent "climate tradeoffs". I do not understand this logic. Regardless of such an analysis the HIA could have nonetheless explored the data supporting methane as a greenhouse gas, ranked it as a hazard alongside other potential hazards, and, if appropriate, identify gas releases consequent to UNGDP and how to minimize such releases.

The scoping document, which I have read as a combination of the original Draft Scoping Report, in combination with the Scoping Update, in retrospect may have been overly ambitious. However, it was responsive to both scientific and stakeholder concerns and it provided a logical and clear framework for the final report. With the exception of omitting consideration of methane as a potential air pollutant, I think that the scoping for the HIA was complete.

## **6. Executive Summary**

The Executive Summary needs to undergo a final editing process. I suggest the use of table and figures for summarizing the numbers rather than the narrative presentation. The list of recommendations in the Executive Summary and in Section 12 is redundant. The Executive Summary is so lengthy and has so many subsections that I fear that much of your potential audience will not read it; it could be much shorter.

## **9. Baseline Health Assessment**

The baseline health assessment is thorough.

In Section 9.3, how do demographics compare with the rest of the state, especially the proportion of the population who are very young, or aging? More detail about the demographics of infants and newborns could have been obtained from Maryland birth certificate data.

In Section 9.4 it would have been helpful if the specific vulnerable populations in Garrett and Allegany Counties

had been identified up front. Also, is the worker population associated with unconventional gas well development a vulnerable population? Another group that could specifically be called out is the significant proportion of the population of both counties (~18%) who are over 65 and thus potentially more vulnerable, e.g., to air pollutant exposures, as well as, of course, infants and children. According to the scoping document, the elderly population was of particular concern to stakeholders in Garrett County. Finally as noted health behaviors are associated with vulnerability and the smokers in the two counties certainly should be considered as more vulnerable e.g. to air pollution health effects.

In section 9.5.1 is it possible to specifically identify the number of residences in Garret and Allegany on private drinking water wells? In Maryland, how are such wells monitored and what I known about the condition and depth of such wells?

The assessment cites average annual PM2.5 concentrations. However, peak levels also are relevant especially to cardiovascular endpoints. Are there data on ozone concentrations? Gas development has been associated with higher regional ozone levels. For PM2.5 and ozone in Allegany and Garrett Counties, what is the relative contribution of local versus distal sources? Might unconventional oil and gas development in adjoining states impact the air quality in these two counties?

Some of the data in Section 9.5 seem inconsistent. There is a longer life expectancy for Allegany and Garrett County residents yet they suffer more poor physical health days and more preventable hospital stays. Were these latter two rates age-adjusted? Likewise, a number of health conditions (hypertension, adult obesity, diabetes, cancer, chronic respiratory disease, flu deaths, cardiovascular and cerebrovascular diseases, etc.) generally have increased incidence, prevalence and/or mortality with age and it would seem that these comparisons were not age-adjusted as well. If age-adjustment is not feasible, an alternative for the analyses in the appendix would be to age-stratify (e.g., adults, 18-65; adults, >65).

For birth outcomes, the cutoff for low birthweight (<2800 g) is unusual; normally 2500 g is used as a cutoff both by the CDC and the World Health Organization. Was this the actual cutoff used or is this a typo? The 9.1% rate for Allegany seems to me to be consistent with the rate for Maryland and also consistent with a more diverse population compared with Garrett, which seems to be less racially diverse and more affluent. Ditto with regard to the percentage of premature births for Allegany; 13% is actually quite consistent with the Maryland rate of 12.9%. Hopefully these statistics are for singleton births but that is not at all clear from the report. What seems to me to be important is that Garrett County has lower rates of low birthweight and preterm births than either Allegany County or Maryland as a whole. In this context the infant mortality rates for both counties are surprisingly high. Are these elevations sustained over time and statistically robust? If so, what factors, other than prematurity and low birthweight, have been identified among these populations as risk factors for infant mortality?

## **10. Impact Assessment**

Generally the approach taken in the impact assessment is reasonable, well-informed and expertly executed.

For Table 10-1 I would suggest the inclusion of water sampling for both area-level and individual-level exposure assessment. This is particularly important in locations where people are served by private wells

and/or very small drinking water systems.

In section 10.2.3 it is noted that duration and frequency of exposures are metrics that are used in the evaluation. Where is intensity of exposure a factor? Is it built into the judgment of whether there is a "Likelihood of health effects"? (Certainly if there were no exposure the likelihood of effects would be nil.)

The Hazard Ranking scheme in Table 10-2 in my view continues to need to be reconsidered. While understanding the problems encountered with the former scheme (high/moderate/low) the new scheme ridiculously forces that all potential hazards be considered to be either high, moderately high, or low probability occurrences. I think that the basic confusion that has been created is that where as these are at one point meant to be probabilistic statements (about high, moderately high and low likelihood to have a negative impact on public health) in the table they are given as statements about severity (high, moderately high, and low public health impact). These are two concepts. For example, a 10% increase in cancer is a higher public health impact than a 10% increase in eczema. But both of these are the same likelihood of a public health impact. So as a first step, are these judgments about severity or probability?

I would suggest considering reverting to language that has been used elsewhere in the same circumstance. In so doing, careful consideration should be given to statements earlier in the report with regard to the Hill criteria for establishment of causality. On the one hand the report states that information to fulfill the Hill criteria "is not currently available in the context of UNGDP." Yet classifying a potential exposure as "high impact" plausibly can be interpreted as a statement of causation. Given the methodology that was used (ranking the hazards, using community input "to distinguish those hazards that should be of greatest concern", why not something like the following?

- Not of concern (or Of little concern)
- Of concern
- Of greatest concern

On Figure 10-2 numbers of carcinogens are graphed. I am guessing that there a large amount of overlap between the carcinogens that have been identified by these various authoritative bodies and wonder whether a stacked bar showing the total number. Or (given there are so few) show them in a table. As it is, one could have the impression that there are a much larger total number of potential carcinogens than there are in reality. The same is actually true for Figure 10-3. Perhaps in that case (or for both figures) you could give the total number of chemicals in the caption.

Of note in regard to 10.3.1.1 you could state that while there are not data for ozone and PAHs there are data for ozone forming chemicals as well as for PM that are indicative of the increased presence of both of these substances.

Further down you cite a statistics that of 353 chemicals associated with the UNGDP process "25% may have carcinogenic potential". This does not seem to square with your own review of carcinogenesis of these chemicals.

Figure 10-4 seems to show an unusual seasonal pattern for increased levels of SO<sub>2</sub>, CO and PM 2.5 in winter in

Garrett County. What is known about local sources and specifically is there reason to be concerned about combustion of fuel oil and/or use of wood burning stoves in that community as a background for potential emissions from UNGDP?

Section 10.3.1.2 well describes the concerns about occupational exposure to silica in relation to UNGPD activities but does not describe the recommendations that OSHA and NIOSH have made for ways to reduce exposure to the silica.

On page 60 it is noted that benzene levels in West Virginia were “higher than” levels reported for Colorado. Is it not possible this was a function of distance? I note that the measurements in West Virginia were taken at 625 feet from well pads whereas measurements in Colorado were taken within 0.5 miles (<2,640 ft) from well pads. Data from Ft. Worth TX and from “Southwest and Northwest PA” were cited but without reference to distance. There are of course other factors that would need to be considered in making such comparisons, such as, the “wetness” of the gas, the particular activities underway at the various sites, and variability among these sites with regard to temperature and wind speed. Rather than focus on these differences among geographic areas perhaps it would be best to focus on the results from West Virginia, if you think that they are from comparable areas (e.g., areas with similar gas composition.)

Figure 10-7: One of the axes does not have units. Generally in discussing scenarios I think it is important to emphasize that these scenarios are based on models that make certain operating assumptions. I think it would be helpful to note that the forecasted emissions could be lower and that your later recommendations will address ways to achieve that.

10.3.1.4: In terms of the McKenzie study, I think it would be more correct to state: “The results suggest that, given the levels of hazardous pollutants monitored near UNGDP facilities, researchers estimated that residents who lived closer to the wells were at greater risk of adverse health outcomes related to UNGDP-related air emissions compared to those who lived more than ½ mile away.” The birth outcomes studies (McKenzie 2014 and Hill 2013) are reviewed uncritically. The McKenzie paper is quite strongly indicative of malformations in association with residential proximity to gas wells in Colorado, and more weakly so for other birth outcomes. I note that while the authors of the McKenzie paper note a number of possible flaws, none are reported in the Final Report. The Hill paper, as far as I can tell, has only been published as an abstract and it was not possible for me to review the methodology that was used; I question it’s inclusion if it is not yet published. Perhaps it is; the citation in the Final Report does not provide enough detail to identify the paper in a scientific journal and I couldn’t find it. On the other hand, the Fryzek study is critically reviewed and “serious flaws”. I agree with the critique however there are similar flaws in a number of the epidemiological studies that they have cited and this is the only study for which such flaws are noted. All studies should be eyed critically. This statement applies to all of the studies reported through 10.3.1.5.5.

10.3.1.5.4: Some care should be taken to distinguish effects on birth weight directly attributable to preterm birth, versus reduced birth weight for gestational age. Also as to whether studies are ascertaining change in birthweight, or gestational age, as a continuous variable versus change in percentages of the population falling below cutpoints (i.e., delivering “preterm” or “low birthweight”). In other words, preterm babies will as a matter of course tend to be low birthweight. However, there are numerous environmental exposures that are associated with lower birthweight independent of gestational age. Both of these conditions negatively impact

the health of children at birth and through life, but in different ways.

10.3.1.5.5: The presentation is a bit confusing. The two Woodruff studies are independent populations although it is possible that the California population (2006) was nested within the US population (2008). The exposures that were evaluated in these studies were air pollutants, not social stress as concluded in this section.

10.3.2.8: As an additional limitation I would add that much of the activity by governments to assess water quality in association with UNGPD have focused on evaluation of drinking water in response to complaints rather than systematic sampling. Further it has been difficult to link information about water contamination with background data collected prior to UNGPD (and in many regions with UNGPD there has been a long history of conventional gas production) as well as with practices at individual locations (in other words, were wells drilled and maintained properly, or not?)

10.3.4.1: I am dubious about the public health significance of "micro-earthquakes", which occur with a wide variety of human activities, including excavation for construction. To date, no patterns of micro-earthquake activity have been identified that predict earthquakes. However, in terms of possible earthquakes, it should be noted that the Western Maryland area generally is quite vulnerable in terms of having many unreinforced brick structures and very little experience with earthquake preparedness and response.

10.3.6 Healthcare Infrastructure: Generally the report covered the proposed scope. However there is one area that was not clearly covered, the emergency response system. My understanding from the scoping report is that there are concerns that first responders in these counties may not be adequately prepared for responding to emergencies related to UNGPD either in the context of industrial accidents or major storms.

10.3.6.2: Rates of insurance coverage presumably are much higher in 2014, and will be even higher in 2016, than in 2011. It is interesting to speculate how the Affordable Care Act will impact migrant gas workers who may be operating under different exchanges in their home states than in Maryland. If they change their residence to Maryland then they would fall under Maryland rules but otherwise enforcement would be in the hands of another state. And, if they have coverage from another state would they be covered in Maryland for non-emergent care? (I should know this, but I do not.) Given the size of the Marcellus formation and that a relatively small amount is in Maryland I would suspect there would be workers from Pennsylvania, Ohio, and West Virginia, as well as Maryland.

10.2.6.4: Multiple assumptions are included in this presentation that I think tend toward an upper bound estimate of impact on the healthcare system. I am convinced that there will be a substantial impact and that, in any case, the system in these two counties already is overstrained by shortages. However, I would doubt that extractive industry workers exert the same demand as individuals in the general population which includes individuals who are not able to work.

10.3.7: By design this Final Report does not address the economic (and presumably health given the social determinants of health) benefits that might accrue from UNGPD. Yet. It attempts to assess cumulative risk. I would suggest that a full cumulative risk assessment would need to be informed by Economic Report prepared for the commission by the Regional Economic Studies Institute (RESI), which is said to be a separate and

independent activity. I note that the Draft Scoping Report proposed to “consider potential benefits associated with HVHF” via conduct of “focus groups with residents in West Virginia and/or Pennsylvania who have already been impacted by HVHF.” The Scoping Update did not mention this effort. The results of these focus groups are not reported in the Final Report.

## **11. Regulatory Landscape**

This section is generally accurate and well written but does not give a good sense of how the various jurisdictional levels could work together in Maryland to control UNGPD related health hazards.

11.1: Specifically the Halliburton Loophole exempted fluids used in UNGPD from protections under EPA laws but did not prohibit EPA from regulating all UNGPD activities. Interestingly, the Halliburton Loophole does not prohibit the EPA from using its authority under TSCA to require chemical disclosure of UNGPD activities.

## **12. Recommendations**

The Final Report provides an excellent framework for a risk management strategy should Maryland undertake UNGPD activities. Generally the recommendations are sound, and well-supported.

However, some of the details should be further explored in the context of Maryland environmental health policy generally. For example, many facilities in Maryland (like transfer stations) have air emissions above background levels but R14 suggests that minimal setback distances that will allow pollutant levels to drop below background.

Most of the recommendations for increased monitoring seem reasonable. In some cases, even low-probability scenarios are addressed through recommendations that could be difficult to implement. For example, they have recommended soil monitoring (Recommendation 24) for numerous contaminants that (other than the radionuclides) are often found in soils and would be difficult to attribute to UNGPD activities. In other instances (NORM for example) further study, but not monitoring, is recommended (Recommendation 26) although monitoring for NORM was included in Recommendation 24.

In terms of seismic activity (Recommendations 30-32) it is not clear to me that these recommendations are in the context of monitoring that already is underway. The Maryland Geological Survey should be consulted about what actions, if any, are needed to improve the seismic monitoring system in advance of any potential UNGPD activity.

12.7.1: There are a number of constructive proposals here. However, there is an assumption that local communities would more tightly control truck speeds and traffic patterns; I am not sure this is well-founded.

12.7.2: Clearly as noted by the Final Report there is an important role to be played by local communities. However it should be noted that it can be more difficult for local authorities to confront large and powerful local interests (e.g. holders of mineral rights) than more distant state and federal authorities. Generally in environmental health a balance is needed whereby local voices are heard and there are strong federal and state expectations that minimal standards are met to protect the public's health. In short, it needs to be a

partnership. The State can play a role in strengthening the expectations that health will be protected while assuring that there are avenues for local decision making.

12.8: Several excellent points are included here. The recommendations should recognize requirements under the ACA for individual health insurance and the ability of the State to assure that workers are insured.

12.9: I agree with the notion of increasing surveillance activities, however, Garrett and Allegany Counties together do not have enough births annually to support a birth outcomes surveillance system. More areas would need to be included not only to monitor trends but also to provide a base of comparisons given that there are secular trends in many birth outcomes. Before undertaking an epidemiological study of “dermal, mucosal and respiratory irritation” in Garrett and Allegany counties the state may wish to have an expert consultation, and/or conduct a pilot study. My personal experience is that reporting of all of these conditions can be subject to reporting biases and that especially dermal conditions are difficult to diagnose via questionnaires and interviews. For skin rashes, what are the specific diagnoses to be studied (e.g., eczema)? What does the report mean by “mucosal” symptoms? Are these upper respiratory symptoms? Are “respiratory symptoms” of concern or asthma or some other diagnoses of respiratory disease?

12.10: These are reasonable recommendations, hopefully being implemented nationally.

## **15. Appendix I: Baseline Health Assessment**

This appendix contains the underpinnings for the health assessment section for “9. Baseline Health Assessment”. It generally follows the plan laid out in the Draft Scoping Report and the Scoping Update. However, I could not identify some maps that the Draft Scoping Report proposed to develop along with a fairly complex statistical analysis (p. 22). Specifically, this would have involved: (1) construction of choropleth maps for both Garrett and Allegany Counties and the state of Maryland overlaying of individual demonstrating cumulative burden from existing TRI and natural gas facilities for a specific vulnerable subpopulations; (2) employing several spatial assessment methods to ascertain the sociodemographic profile of populations burdened by individual and aggregate facilities each county at the census tract level using mean distance analysis, spatial coincidence, and proximity analysis; and using SAS and R to perform statistical analyses to assess burden disparities and potential zones of impact. Further the Draft Scoping Report proposed to explore the use of US EPA National Air Toxics Assessment data to assess neighborhood level exposures for residents within a specific radius of well pads including those at the “tail end” of the exposure distribution. These analyses were not found as well. Neither of these assessments was mentioned in the Scoping Update.

## **Conclusions**

In closing (Section 13), the Final Report rightfully cites a number of limitations to the HIA approach that was utilized. Moreover there were several areas that the Scoping Report identified that were not included in the Final Report. Nonetheless, and notwithstanding the many points that I have raised in this review, I think that this approach is a major step forward in identifying potential health threats in conjunction with proposed UNGPD in Maryland. I commend the faculty and staff at the Maryland Institute for Applied Environmental Health for this outstanding effort, which, despite limitations, is a major milestone in addressing the health of Marylanders in relation to unconventional gas production and development activities. Thanks so much for

providing me the opportunity to review this important report.

Truly yours,

A handwritten signature in black ink that reads "Lynn R. Goldman". The signature is fluid and cursive, with a long horizontal stroke at the end.

Lynn R. Goldman, M.D., M.S., M.P.H.  
Dean, Milken Institute School of Public Health