Logan Airport Health Study

EXECUTIVE SUMMARY

MAY 2014

Massachusetts Department of Public Health

Bureau of Environmental Health

BACKGROUND

Chapter 159 of the Acts of 2000 included a line item directive that stated "*the Director of the Bureau of Environmental Health Assessment* [presently named the Bureau of Environmental Health] *of the department shall conduct an environmental risk assessment of the health impacts of the General Lawrence Logan Airport in the East Boston section of the city of Boston on any community that is located within a 5 mile radius of the airport and is potentially impacted by the airport.*" The 17 communities located either fully or partially within the five-mile radius of the airport include Boston, Brookline, Cambridge, Chelsea, Everett, Hull, Lynn, Malden, Medford, Melrose, Milton, Nahant, Quincy, Revere, Saugus, Somerville, and Winthrop. Based upon this directive the Massachusetts Department of Public Health, Bureau of Environmental Health (MDPH/BEH) designed and conducted the Logan Airport Health Study (LAHS).

In the early stages of design of the LAHS, the MDPH/BEH formed a Community Advisory Committee (CAC) composed of area residents, local health officials and technical experts in the areas of epidemiology, biostatistics, survey design and administration, and air modeling. With input from the CAC, the MDPH/BEH designed and implemented a cross-sectional disease and symptom prevalence study that investigated the associations between opportunities for exposure to airport emissions and adverse health outcomes. Environmental exposure data included noise and air emissions. Air pollution emissions are primarily from aircraft operations, ground service equipment, transportation vehicles on airport property, and the airport power plant. The primary source of noise from the airport is that of aircraft takeoff and landing operations. Three categories of health outcomes were evaluated: respiratory, cardiovascular, and auditory effects.

SURVEYED POPULATION AND HEALTH QUESTIONNAIRE

Following a pilot study aimed to test survey methods initiated in 2002, interviews for the LAHS commenced in 2005. A total of 6,072 eligible residents representing households from the 17 communities that make up the study area were interviewed. These adult respondents also provided information for 2,215 children living in those respective households. Therefore, the results of the LAHS represent information for 8,287 individuals living within five miles of Logan Airport. The telephone interviews, conducted in English and Spanish, collected information on the prevalence of targeted health outcomes as well as relevant demographic and risk factor information. Information was collected for one adult in each of the interviewed households and for any children aged 3-17 years.

Study participants were selected randomly so that the survey results could be considered representative of the study area. A strategy was also employed to oversample residents living closest to the airport to ensure an adequate sample size representing those with the highest potential exposure. Statistical weighting methods were then employed to account for the oversampling.

Modeled after nationally and internationally recognized health surveys, including the Behavioral Risk Factor Surveillance System (BRFSS) and the International Study of Asthma and Allergies in Childhood (ISAAC), the LAHS survey contained questions designed to assess the following categories of asthma and respiratory disease: lifetime asthma, current asthma, current asthma with medication use, probable asthma, asthma hospitalizations, and chronic obstructive pulmonary disease (COPD). Cardiovascular outcomes included non-fatal heart attack, angina, and coronary heart disease. Auditory effects included adult-onset hearing impairment and tinnitus. In addition to assessing the presence of health outcomes, the survey also included questions on risk factors associated with the targeted health outcomes, on potential exposures inside the home and at work, and questions reflecting demographic and socio-economic status. A ten-year residential history was also

taken in order to provide some measure of each respondent's length of residency in the area.

EXPOSURE ASSESSMENT: AIR POLLUTANTS

Air pollutant emissions typically associated with airport operations are largely due to incomplete combustion of fuel from aircraft, ground service equipment, and passenger automobiles on airport property. To estimate potential air pollution exposure specifically from airport-related operations (and thereby exclude possible exposure from non-airport related sources), advanced high-resolution air dispersion modeling (US FAA EDMS model version 5.1.3) was applied to predict ambient concentrations across the study area of five primary air pollutants (CO, NOx, $PM_{2.5}$, SOx, VOCs). The air dispersion modeling was based on 2005 emissions data, meteorological inputs, and aircraft takeoff and landing information for over 350,000 aircraft operations (94% of total 2005 operations). The modeling analysis also estimated emissions along flight paths up to an altitude of 3000 feet for takeoffs and landings. Data on emissions and airport operations were provided by Massport.

Using ArcGIS to map the 6,072 households included in the study, air pollutant concentrations were assigned to each respondent based on inverse-distance weighting of concentrations predicted from the air dispersion modeling. Given the very high correlation of estimated concentrations of the five pollutants across the study area, a combined exposure variable was developed that encompassed all pollutants. Annual average pollutant concentrations were selected for developing cut-points for the creation of three exposure areas estimating lower, medium, and higher potentials for exposure to airport-related air pollution.

EXPOSURE ASSESSMENT: NOISE

MDPH/BEH also evaluated noise exposure across the study area using noise contours from aircraft operations provided by Massport. Using US FAA's Integrated Noise Model (INM),

Massport models noise by considering the number of operations, types of aircraft operating during the day and night, use of runway configurations, and location and frequency of flight paths to and from the runways. Massport produces annual Day-Night Sound Level (DNL) contours that range from 60-75 dBA at five dB increments. The WHO health-based guideline to protect against hearing impairment is 70 dBA. This guideline value indicates that the risk for hearing impairment would be negligible for a cumulative noise exposure below 70 dBA on a daily basis over a lifetime. Review of the 2005 INM noise contours indicated that the 70 dBA contour did not include a sufficient number of respondents to assign as the high noise exposure category. As a result, the 65 dBA contour was selected as the high noise exposure area. The medium noise exposure area was defined by households located in the 60-64 dBA noise contour and the low noise exposure area was defined by households located outside the 60dBA noise contour.

STATISTICAL ANALYSIS

All analyses were conducted using SUDAAN, a statistical package designed for use with complex sampling methodologies, which incorporates weighting and variance calculations associated with the complex random digit dialing (RDD) sample design. Descriptive analyses were conducted separately for adults and children to assess the frequencies (percent of the population) with various socio-demographic characteristics. The prevalence of other potential factors (covariates) that may be associated with each specific outcome among adults and children were also estimated. The prevalence of each health outcome of interest was examined in the total population and among those living in each category of estimated airport-related air pollution or noise exposure.

Multivariate analysis (multiple logistic regression) was used to assess the association between the prevalence of targeted health outcomes and residence in low, medium, or high exposure areas while accounting for the impact of other potentially influential factors (confounders). Controlling for other factors known to be strong predictors of the health outcome being investigated is a statistical method to evaluate the association of interest,

while adjusting for differences across exposure areas for other risk factors such as age, race, smoking status, family history of heart disease, or residential proximity to major roadways.

RESULTS / CONCLUSIONS

The major conclusions of the Logan Airport Health Study are as follows:

- Air dispersion modeling of airport related emissions using a state-of-the-art model indicates that the highest predicted pollutant concentrations associated with airport-related operations are near the perimeter of Logan Airport and fall off rapidly with increased distance. This is a characteristic of the impact of sources that are primarily located near the ground surface.

- Consistent with findings of other airport studies, modeled concentrations of air pollutants are low relative to measured background air pollution concentrations.

- Evaluation of associations between airport-related pollutant concentrations and targeted health outcomes among the study area population detected some elevations in respiratory health outcomes in the high exposure area.

  Specifically:

- Among children, study results identified some respiratory effects indicative of undiagnosed asthma (i.e., probable asthma); children in the high exposure area were estimated to have three to four times the likelihood of this respiratory outcome compared with children in the low exposure area.

- Among adult residents, individuals diagnosed with chronic obstructive pulmonary disease (COPD) were statistically significantly more likely to have lived in the high exposure area for three or more years.

- There were no statistically significant differences in cardiovascular outcomes in the study population across the high, medium, and low exposure areas.

- There were no statistically significant differences with respect to hearing loss in either adults or children for those living in the high exposure area compared to the lowest exposure area.

RECOMMENDATIONS

- The results of this study should be reviewed by Massport and others to determine mitigating steps that can be taken across the study area.

- Massport has undertaken initiatives to reduce air pollution impacts within their control (e.g., providing infrastructure for compressed natural gas (CNG) fuels and electricity charging stations, Alternative Fuel Vehicle Program). Similar initiatives could be considered in consultation with local communities that would serve to further reduce the burden of indoor and outdoor sources of air pollution on residents in closest proximity to the airport.

- Massport has also been working with the East Boston Neighborhood Health Center (EBNHC) to address workforce issues among Massport employees. Massport could expand these efforts with the EBNHC as well as other community health centers to better address respiratory health notably among children in closest proximity to the airport.

- While air dispersion modeling indicates that the contribution from Logan Airport operations across the study area is relatively small, air pollution levels are higher in urban areas. Predicted pollutant concentrations were higher near the perimeter of the airport; thus, any methods that can be implemented to continue to reduce airport-related air pollution should be explored.

- MDPH/BEH should work with communities within the high exposure area (in whole or in part) on initiatives that would serve to further reduce exacerbation of pre-existing respiratory diseases (e.g., asthma and COPD) among residents.

  Specifically:

  - MDPH/BEH will continue to support MassDEP's efforts to reduce motor vehicle emissions including implementation of the Low Emissions Vehicle program and diesel engine retrofit initiatives;

- Upon request MDPH/BEH's Indoor Air Quality (IAQ) Program staff will work with local municipalities to conduct IAQ assessments in schools and public buildings;

- Upon request MDPH will work with local officials to address concerns that may be associated with local development initiatives;

- MDPH/BEH will collaborate with the MDPH Bureau of Community Health and Prevention's Tobacco Cessation and Prevention Program on their efforts to work with local boards of health and tobacco-free community partnerships. These efforts enforce youth access and secondhand smoking laws and provide educational/outreach resources to support smoke-free workplace and housing programs.