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Asthma-Related Chemicals in Massachusetts: an Analysis of Toxics Use Reduction Act Data

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This report was produced by the Lowell Center for Sustainable Production's Environmental Health Initiative (EHI). The Lowell Center established EHI in 2004 to help people better understand links between environmental conditions and human health, and to find sustainable solutions in policy and practice that improve health. EHI is grounded in the evidence that environmental and social conditions – driven by political choices – are primary determinants of health. EHI provides tools to government and non-governmental organizations seeking effective action on these conditions, conducts research and analysis, and provides leadership and vision.

The Massachusetts Toxics Use Reduction Institute

Funding for this project was provided by a grant from the Sustainability Research Fellows Program at the Toxic Use Reduction Institute (TURI). The Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education and training programs, and provides technical support to promote the reduction in the use of toxic chemicals or the generation of toxic chemical byproducts in industry and commerce.

The recommendations that the researchers present in this document are based on the research funded through the project, and represent their judgment on appropriate and innovative policy actions. These recommendations do not necessarily reflect the policies and perspectives of TURI or the Toxic Use Reduction Program as a whole.

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EXECUTIVE SUMMARY

Massachusetts has one of the highest rates of asthma in the nation, causing a substantial societal burden of human suffering, lost capacity and productivity as well as fiscal costs. Nearly 150,000 children and 500,000 adults currently have asthma in Massachusetts. Increasingly, health payers, providers, and government programs emphasize the use of effective chronic disease management programs that can substantially improve the quality of life for people living with asthma. Despite these efforts, asthma in many people remains out of control, requiring frequent use of rescue medications and often—particularly for low income people living in challenging social circumstances and substandard home and community environments—trips to the emergency room, hospitalizations, and infrequently, death. Only a small percentage of health care expenditures is devoted to disease prevention—particularly primary prevention, or preventing disease processes before they start in the first place—despite the potential to lower rates of disease and reduce costs.

The scientific literature clearly distinguishes between causes of the initial onset of asthma in people previously free of the disease, and causes of asthma attacks in people who already have a diagnosis of asthma. As is true of most diseases, both genetic and environmental factors contribute to asthma onset. Evidence suggests that hundreds of chemicals are among those environmental factors contributing to the initial development of asthma. These chemicals along with others can also trigger exacerbations in people who already have the disease. Much of this evidence comes from workers exposed in the workplace. Yet individuals may also be at risk from chemical exposures at home, from consumer products, building materials, and outdoor air pollution. With the exception of occupational health professionals, clinicians and decision-makers in government and the private sector tend to overlook strategies for minimizing exposure to asthma-related chemicals as they work to reduce the burden of asthma. Moreover, efforts to promote research and the adoption of safer substitutes for chemicals associated with asthma are often not a component of comprehensive asthma prevention and control agendas.

The purpose of this project was to understand the extent to which chemicals that can cause the initial onset of asthma or trigger subsequent asthma attacks are being used by Massachusetts industries who report under the Toxics Use Reduction Act (TURA) program. TURA is a Massachusetts law passed in 1989 to encourage the reduction in amounts of toxics and toxic byproduct used or generated by Massachusetts industries. Examining TURA data can help identify opportunities for reducing exposure to asthma-related chemicals in the workplace and in the community, which may, in turn, help prevent new cases of asthma and/or exacerbations in people who already have the disease. The project involved: (a) assembling a master list of agents that cause the initial onset of asthma or exacerbate existing asthma; (b) researching trends in the use of asthma-related chemicals in Massachusetts using TURA data; and (c) exploring the associations between the TURA data and asthma surveillance data gathered by the Massachusetts Department of Public Health (MDPH) to help generate hypotheses to explain such trends and point to opportunities for interventions. This report first provides background on asthma to highlight why this disease is a public health priority in Massachusetts. We then detail the methods and findings of our data analyses.

This project yielded the following results and policy/research recommendations:

I. TURA Reportable Chemicals that Cause or Exacerbate Asthma

▪ Findings:

1. Approximately 335 substances are known or suspected of causing or exacerbating asthma based on evidence from a variety of sources.¹ These substances include chemicals, as well as biological agents, such as molds, animal proteins, insect proteins and plant proteins. Of these 335 substances:
 - 68 chemicals are reportable under TURA and 41 have been reported to TURA at some point in the program's history.
 - Of the 41 chemicals that have been reported to TURA, 15 have been characterized as "more hazardous" (based on endpoints other than asthma) by the TURA program's Science Advisory Board.
 - TURA does not mandate reporting for approximately 100 chemicals known to be capable of causing and/or exacerbating asthma.

▪ Recommendations:

1. TURA decision-makers should consider adding to the "list of reportable chemicals" those chemicals known or suspected of causing or exacerbating asthma that are not currently on the list.
2. The Science Advisory Board should also include asthma as an endpoint as it evaluates chemicals for its "more hazardous" list. Although over a dozen asthma-related chemicals reported to TURA are on the TURA program's Science Advisory Board's "more hazardous" list because of other health concerns, asthma is not a health outcome considered in the development of this list.
3. The Science Advisory Board should consider including "capacity to cause and/or exacerbate asthma" among the criteria for recommending that a chemical from the "more hazardous" list be reviewed for a "higher hazard" designation, which carries with it a lower reporting threshold.

II. Trends in Asthma-Related Chemicals Reported to TURA

▪ Findings:

1. Between 1990 and 2005, the total cumulative use of asthma-related chemicals in Massachusetts declined by 27%, but uses of some individual asthma-related chemicals increased.
 - The chemicals driving the total cumulative use of asthma-related chemicals in Massachusetts from 1990-2005 include: styrene monomer, sulfuric acid, zinc and zinc compounds, diisocyanates (when all reported diisocyanates are combined), and chromium and chromium compounds. Of these chemicals, ammonia, zinc and zinc compounds, and diisocyanates showed an increase in total cumulative use from 1990-2005. Toluene diisocyanate was the main diisocyanate driving the increased use for diisocyanates.

¹ Sources include (1) the Association of Occupational and Environmental Clinics, (2) the Collaborative on Health and Environment, (3) a 2006 comprehensive review of the literature by Malo and Chan-Yeung, and (4) the Institute of Medicine's 2000 report, "Clearing the Air."

2. Total cumulative fugitive and point source air emissions² of asthma-related chemicals from 1990-2005 also declined, 82% and 71% respectively.
 - Specific asthma-related chemicals that were the primary contributors of the total cumulative fugitive releases include: ammonia, sulfuric acid, acetic acid, styrene monomer, and nitrogen dioxide. Fugitive emissions for all five chemicals showed dramatic declines from 1990-2005
 - Specific asthma-related chemicals contributing the most to the total cumulative point source air emissions from 1990-2005 include: sulfuric acid, ammonia, formaldehyde, acetic acid, and styrene monomer. Of the five chemicals, ammonia and sulfuric acid showed overall increases in point source air emissions over this fifteen year period (since 1991, sulfuric acid emissions have been declining).

▪ Recommendations:

1. The Commonwealth should increase support for the Office of Technical Assistance (OTA) and the Toxic Use Reduction Institute (TURI) to provide technical assistance and to support innovation among Massachusetts industries thus enabling them to further reduce their use and release of asthma-related chemicals.
 - Among industries reporting to TURA, millions of pounds of chemicals associated with asthma continue to be used and released as (1) fugitive emissions, which may impact workers, and (2) point-source air emissions which may impact communities. The results of toxics use reduction planning and technical support to businesses—provided by the state Office of Technology Assistance and the Toxic Use Reduction Institute are impressive: 40% reduction in use, 71% reduction in waste, and 91% reduction of on-site releases since the program's inception in 1989. With sufficient resources, further reductions in uses and releases of chemicals known to cause and/or exacerbate asthma could be expected.
2. The Massachusetts Department of Public Health should increase asthma surveillance activities among individuals and workers at risk from exposure to toluene diisocyanate (TDI). In addition, the TURA program should also support research and technical assistance to identify safer alternative to TDI.
 - Given the increasing use of TDI in Massachusetts and emerging evidence about the role of isocyanate skin exposure in the development of asthma, occupational asthma prevention efforts should be strengthened, and resources should be allocated for research and technical support to identify safer alternatives.

III: Exploring Associations between TURA Chemicals Data and Massachusetts Asthma Surveillance Data

▪ Findings:

- Work-related asthma surveillance data: The Massachusetts Department of Public Health's (MDPH) sentinel work-related asthma surveillance system documents that asthma-related chemicals, including those reported under TURA, have caused or aggravated existing asthma among Massachusetts workers. These

² Fugitive air emissions are releases not captured by emission control technologies, such as leaks through pipe fittings, loading/unloading operations, or evaporative losses. Point source air emissions are those releases that occur through confined air streams such as stacks, vents, ducts, or pipes.

- surveillance data also show that the highest numbers of work-related asthma cases are in industries not required to report to TURA, including the health care industry. Workers in these sectors are exposed to asthma-related chemicals on TURA's list of reportable chemicals, some of which are also on the TURA program Science Advisory Board's "more hazardous" list (e.g. formaldehyde and ethylene oxide).
- School-based asthma surveillance data: According to MDPH's school-based surveillance data, the prevalence of asthma among schoolchildren is higher in some communities where high amounts of asthma-related chemicals are used and released by industries that report under TURA. Preliminary analysis was insufficient to document or to rule out an association between the higher rates of the disease and higher use or point air releases of asthma-related chemicals.
 - Recommendations:
 - Work-related asthma surveillance data: Based on substantial numbers of work-related asthma cases reported from industries other than those that report under TURA, consideration should be given to require additional industries—in particular health care—to report .
 - School-based asthma surveillance data: Given the high prevalence of asthma among Massachusetts children, the TURA data are an important data source to further explore constituents of both indoor and outdoor air pollution and their connection with pediatric asthma. Priority analyses for future work include examining the association between prevalence rates in particular schools, as reported to MDPH, and the use and release of specific asthma-related chemicals, such as nitrogen dioxide, sulfuric acid and formaldehyde, in those locations. These more refined ecological analyses could help generate hypotheses for further testing using more rigorous study designs.

Though the development of asthma is complex and varies individual to individual, exposure to chemicals is a risk factor for many people. Researching and promoting safer alternatives has the potential to make an important contribution to reducing exposure to asthma-related chemicals and thereby reducing the burden of the disease. Toxic Use Reduction programs in the public and private sectors are an important prevention strategy and should be included in any comprehensive asthma prevention and control agenda. The declines in use and air releases of asthma-related chemicals observed in this analysis are good news, yet there remains ample opportunity for further reductions via technical and planning support provided through TURA as well as including asthma in the Science Advisory Board's evaluation process for chemicals listing and classification. The increase in use of isocyanates is of particular concern, and deserves attention by public health officials and the TURA program.