

# Investigating Asthma Deaths Among Children and Young Adults: Michigan Asthma Mortality Review

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## SYNOPSIS

**Objective.** We developed a surveillance system to investigate asthma deaths in children and young adults.

**Methods.** A rapid asthma death notification and investigation system for Michigan was developed to identify interventions to prevent future deaths among people aged 2–34 years. Multidisciplinary panels to determine causal factors and recommend preventative actions reviewed information from death certificates, autopsies, next-of-kin interviews, and medical records. An annual report was disseminated to public health workers, health-care providers, insurers, and others.

**Results.** Eighty-six asthma deaths in Michigan residents, aged 2–34, occurred from 2002–2004. Sixty-one next of kin were interviewed and medical records were obtained for 84 of the deceased. Summaries were prepared on each of the deceased and were reviewed by expert panels, which reached consensus on causal factors and potential preventive action for each death. Each year an annual report, which summarized the causal factors and potential preventive activity, was prepared.

**Conclusion.** This review has informed and catalyzed interventions to improve asthma care and management in Michigan. Factors leading to the review's success and future activities are discussed.

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Mortality from asthma in the United States has increased twofold since the 1970s,<sup>1,2</sup> although recent data suggest that the asthma mortality rate has stabilized.<sup>3</sup> Over-reliance on Beta-agonists<sup>4,5</sup> and failure to appropriately prescribe and/or use inhaled corticosteroids<sup>6-8</sup> have been associated with increased asthma mortality. Smoking, drinking, substance abuse,<sup>9</sup> and family problems have been associated with increased asthma mortality, while the use of peak flow meters and a written asthma action plan have been associated with decreased asthma mortality.<sup>10</sup> Fatal asthma has also been associated with specific work exposures.<sup>11</sup>

Mortality is not evenly distributed across the population. Studies have shown high rates of asthma mortality among African Americans, low-income populations, and populations with low educational levels.<sup>12</sup> Reasons suggested for the racial disparity include differential access to care, exposure to environmental pollutants,<sup>13</sup> and crowded conditions leading to increased exposure to allergens and infections.<sup>14</sup>

The Michigan Department of Community Health (MDCH), in conjunction with Michigan State University (MSU), was funded by the Centers for Disease Control and Prevention (CDC) to develop a rapid asthma death notification and investigation system for the State of Michigan. The system was limited, at the request of CDC, to investigations of asthma deaths among children and young adults, who were 2–34 years old. This age group was chosen due to the difficulty in diagnosing asthma in children younger than the age of two and the potential for misclassification and co-morbidities in people older than the age of 34. This article discusses the system developed to investigate asthma deaths in children and young adults in Michigan.

## METHODS

### Notification of asthma deaths

Notification of asthma deaths was based on Michigan's Vital Statistics reporting system. Staff in the MDCH Division for Vital Records and Health Statistics queried the death certificate year-to-date master file on a quarterly basis. From this file, they provided MDCH Asthma Epidemiology staff with a transcript of information on all deaths for which asthma was the underlying cause (ICD-10 codes J45 or J46). The transcript contained a limited set of data from the death certificate, including name, address, date of death, date of birth, gender, county of death, county of residence, and cause(s) of death. Based on this information, MDCH Asthma Epidemiology staff identified asthma deaths that occurred among Michigan residents who were 2–34 years old.

MDCH Asthma Epidemiology staff requested an

administrative copy of the death certificates for asthma deaths meeting these criteria. Upon receipt of the death certificate, staff queried the Medicaid enrollment files in the MDCH Data Warehouse (Managed Care Production Encounters, Fee for Service, Paid Claims, Medicaid Beneficiary Files, Data Warehouse, Michigan Department of Community Health, Lansing, Michigan) to determine if decedents had ever been enrolled in a Medicaid-funded program. A copy of the death certificate was sent to MSU to begin data collection.

### Data collection

Data collection was modeled after an ongoing acute traumatic fatal workplace injury surveillance system<sup>15</sup> and MDCH Maternal Mortality Review system ([www.michigan.gov/mdch](http://www.michigan.gov/mdch)). Upon receipt of the death certificate by MSU staff, a letter was sent to the listed next of kin to explain the project and to request an interview. Interviews were conducted with the next of kin using a standardized questionnaire, which was developed after reviewing the medical literature on asthma deaths and asthma management guidelines. Modifications were made to the questionnaire periodically throughout the project period, adapting to needs identified in the field and through the review process. Interviews were coordinated and conducted by an MSU research nurse with experience and sensitivity in communicating with grieving relatives, as well as experience in locating next of kin. Additional interviews with family members or close associates identified by the next of kin were taken when appropriate and available. No financial incentives were provided for participating in next-of-kin interviews.

Simultaneously, MSU staff requested a copy of hospital records from the day of death and any medical examiner reports that may be available for the death. Based on information from the death certificate, autopsy report, and next-of-kin interviews, requests were sent to all known providers of the decedent to obtain medical records, pharmacy records, and, if applicable, emergency response records, police reports, mental health records, and correctional facility response data from the year prior to death. Data collection was a nonlinear, iterative process, using any available data to identify other providers from whom to request additional records. Beginning in 2004, Michigan Medicaid claims data were queried to document patterns of health care and pharmacy utilization and to identify facilities/providers from which to request additional medical records. This information, although not a complete record of clinical activity, was especially helpful for the deaths where next of kin were not interviewed. Recently, health-care and pharmacy utilization

data have been requested from managed-care plans and other insurers as well. Medical examiners and providers were not reimbursed for costs of supplying records or data to the project.

After the next-of-kin interview(s) was attempted or completed and records reviewed, MSU staff prepared a de-identified one- to two-page summary of the circumstances surrounding each death. In addition, a de-identified summary was prepared of each significant clinical or emergency response event. These summaries were then shared with the asthma mortality expert panels.

### Expert panel review

Two expert panels, each with approximately 10 members, were convened: one for deaths occurring among adults (aged 19–34) and one for deaths occurring among children (aged 2–18). The panels included allergists, asthma educators, school health coordinators, emergency department physicians, family practitioners, internists, nurses, pediatricians, pharmacists, pulmonologists, respiratory therapists, and social workers. Generally, panel members were selected because of their experience in asthma management in clinical and community settings, because they were known by project staff to be interested in asthma mortality, and/or because of their organizational affiliation (i.e., President of the Allergy Society or Medical Director from a health maintenance organization with a large number of Medicaid recipients). Selections were made to ensure geographic representation from the more populous areas of the state. Each panel member's interest was assessed by MDCH or MSU staff in a personal communication, followed by a formal invitation from the Chief Medical Officer or Public Health Administrator of MDCH.

Each Mortality Review Panel met two or three times per year to review summary materials from completed investigations of asthma deaths. Prior to the meeting, members were provided the de-identified summary information, and most reviewed it. Each meeting lasted approximately three hours, during which the panel collectively reviewed the summary materials available for six to eight deaths. An example of a typical write-up is shown in the Appendix. Panels were facilitated by an internist and staffed by investigators and state asthma epidemiology staff. All accumulated records and data for each death being reviewed were brought to the panel meeting for reference by the staff in case of member questions.

The panel discussed causal factors and potential prevention activities suggested by each death. Discussion was typically spirited; with facilitator guidance, the

panels focused on identifying intervention opportunities, rather than blaming people or entities for the death. The panel's interdisciplinary nature was very important in identifying intervention opportunities and developing recommendations. Although a face-to-face meeting was more time consuming, panel members stated that they preferred to meet and felt the interaction was both interesting and educational.

At the conclusion of discussion, each panel member was asked to record his/her thoughts and recommendations on a form for each death. Initially, the form consisted of two open-ended headings, "Causal Factors" and "Follow-up Activities That Are Supported by the Case." Because of difficulty reading comments on these forms and lack of written detail, these open-ended forms were modified to the form shown in the Figure. Subheadings specific to health-care providers, patients, and the health-care system were added under both causal and follow-up activity headings. In addition, common factors and interventions were offered as closed-ended options under each heading as appropriate. These options were selected from the most common responses from previous reviews. Space was provided to allow addition of new conclusions by the panel members.

If a member of the panel could not attend a meeting or if at the end of the year there were a few deaths that had been investigated after the review meetings were held, panel members were e-mailed the cases and asked to submit the completed forms via e-mail.

### Distribution of findings and recommendations

An internist reviewed all the expert panel response forms and summarized the panel's comments and recommendations. MSU staff developed an annual report from mortality statistics, investigation data, and panel findings. These reports were reviewed and approved by MDCH and published by MSU. Hard copies of the report were shared with the state's Asthma Advisory Committee; policy makers in the Michigan Department of Community Health; local asthma coalitions; local public health, professional, and advocacy organizations; quality improvement organizations; and directors of health plans. The report was also shared electronically with other state asthma programs and national agencies. Selected presentations were made to local asthma coalitions, physicians, and allied health workers through grand rounds, state-level quality improvement initiatives, and health plan meetings, national meetings, and other state asthma programs. Data were also presented to the organization representing medical examiners to discuss criteria for recording a death as being secondary to asthma. The project protocol and

**Figure. Copy of form completed by mortality review panel members**

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*Asthma Mortality Case Review*

Case number: MSU\_ \_ \_ \_ \_

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1. Causal factors (number in priority order):

*Patient-related factors*

- Compliance: trigger avoidance, pets
- Bronchodilator overuse
- Inadequate use of steroids
- Other—specify

*Physician-related factors*

- Inadequate prescription of steroids
- Needed referral for high-risk patients
- Inadequate diagnosis
- Inadequate inhaled steroids in ED
- Other—specify

*System-related factors*

- Lack of adequate adult supervision
- Psycho-social and psychiatric issues
- No regular maintenance health-care visits
- Repeated refill of bronchodilators
- Other—specify

2. Follow-up activities that are supported by the case (number in priority order):

*Educate health-care providers*

- Need for inhaled steroids
- Need for inhaled steroids in education
- Need for limitation of refills for bronchodilators without a physician visit or active approval
- Need for referrals for high-risk patients
- Other—specify

*Educate patients*

- Education of patients/family, possibly focus groups for teenagers
- Other—specify

*System level changes*

- Case manager for high-risk cases
- Pharmacy notification of excessive bronchodilator use
- School-based asthma program
- Child protective services—attention needed for foster care environment
- Other—specify

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instruments were also shared with other states and academic researchers.

One of the advisory panel members expressed an interest in examining the lung pathology results from those individuals who had been autopsied. This examination led to a spin-off research study correlating pathology results with a clinical description of how long aggravation of asthma symptoms occurred before the fatal incident. Lung pathology slides were collected from all decedents who were autopsied during the first two years of the project.<sup>16</sup>

Both the MDCH Human Subjects Committee and the MSU Committee on Research Involving Human Subjects reviewed this project. The MDCH Human Subjects Committee determined that this project was a surveillance activity and not human research. The MSU Committee on Research Involving Human Subjects approved the project as human research. To provide further assurance of confidentiality, this project was designated a Medical Research Project by the MDCH Chief Medical Executive under the provisions of Michigan Compiled Law 333;2631-2635. This designation safeguards the confidential character of studies conducted by MDCH and provides protection from release of the identifiable asthma mortality review materials for any purpose other than the research project. All medical records have been maintained in a confidential manner. Summaries shared with the advisory panels did not include personal identifiers on the individual who died, next of kin, their health-care providers, health-care systems, or insurers.

## RESULTS

The project investigated 86 asthma deaths over a three-year period from 2002–2004. The average time between the death occurring and project staff being notified to commence the investigation ranged from three to six months. An additional three deaths from this time period have recently been received and not yet investigated. Two deaths occurred to Michigan residents in 2004 when they were visiting other states, and one death certificate from 2003 was accidentally omitted during processing.

Of the 86 deaths, 24 did not have a next-of-kin interview. The major difficulty in completing the next-of-kin interviews involved locating the next of kin (the Table). We were unable to locate 15 next of kin (six for adult deaths and nine for child deaths), and nine next of kin refused to participate (five for adult deaths and four for child deaths). The participation rate improved over the three years of the project, from 60% in 2002 to 77% in 2004.

Medical records were obtained on 97% (37 of 38) of children and 98% (47 of 48) of adults. Autopsy reports were obtained on all individuals who had an autopsy. The reason we were unable to obtain medical records on two of the deceased was that neither had next-of-kin interviews, and both died at home and were not brought to the hospital. The medical records received were an incomplete history of events, as not all health-care providers(s) could be identified from a retrospective record review (the Table), particularly in the absence of a next-of-kin interview. Certain institu-

**Table. Percent of asthma mortality investigations completed, ages 2–34, Michigan, 2002–2004**

	<i>Number of children (percent)</i>	<i>Number of adults (percent)</i>	<i>Number of combined (percent)</i>
Number of deaths eligible for review	38	48	86
Unable to locate next of kin	9 (23.7)	6 (12.5)	15 (17.4)
Next of kin refused interview	4 (10.5)	5 (10.4)	9 (10.5)
Interviews completed	25 (65.8)	37 (77.1)	62 (72.1)
Medical records obtained	36 (94.7)	47 (97.9)	85 (96.5)

tions presented more barriers to data collection than others. For example, the project had extreme difficulty in obtaining information from the foster care and juvenile justice systems and mental health facilities.

The 86 deaths were reviewed by the appropriate expert panel, although for those deaths where no next-of-kin interview was conducted and there were no or limited medical records, the expert panels were unable to provide substantive comments.

## DISCUSSION

Asthma is a chronic but manageable condition. The Asthma Mortality Review project is based on the premise that the vast majority of asthma deaths are preventable with appropriate asthma management. This project demonstrated the feasibility of a timely system to identify asthma deaths, identify and interview next of kin, and obtain records in support of a detailed panel review. The approximate four months between death and next-of-kin contact was appropriate. The brief delay allowed the decedent's family time to grieve, but did not preclude our ability to locate the next of kin.

Many factors contributed to the success of this system. The partnering of an academic institution with a State Health Department provided the necessary flexibility and medical credibility with the legal authority to request information for the investigation. The commitment of the volunteer reviewers was also essential to this effort. The academic institution's experience reviewing acute traumatic workplace fatalities provided the format and knowledge to create and implement an effective system. An efficient state vital statistics system and centralized data warehouse for Medicaid information were important elements to ensure the project's feasibility. An attempt to set up a fatal asthma registry system in multiple states was not feasible.<sup>17</sup> We would attribute these difficulties to a lack of commitment at the state level to carry out a project that was not locally generated.

Investigation of patients with near-fatal asthma attacks (hospitalization and intubation) has been suggested as an alternative to fatal case investigations. In some ways, near-fatal case investigations are more attractive: the patients themselves can be interviewed, the number of people with near-fatal attacks is much higher, and the patients interviewed could potentially benefit from the investigation. We do not see near-fatal case investigations as an adequate substitute for fatal case investigations, but rather believe they complement each other. Although there is an overlap between the risk factors for fatal asthma and near-fatal asthma, there are differences.<sup>18,19</sup> One major difference previously reported is in steroid use, which is more frequent in near-fatal than in fatal asthma cases; another is in the duration of asthma, which is shorter in near-fatal than in fatal asthma cases. A program to investigate near-fatal asthma cases would generally not capture individuals at risk of fatal asthma. For example, if a history of intubation were used as the criteria to identify a near-fatal case, the system would miss 71% of the asthma deaths in Michigan. Similarly, if asthma hospitalizations in the last year were used, 48% of Michigan asthma deaths would have been missed.

There have been eight previous reports of programs set up to investigate individual asthma deaths.<sup>20–27</sup> Five of the projects have been in various parts of Great Britain,<sup>20,22–24,27</sup> one in New Zealand,<sup>21</sup> one in Victoria, Australia,<sup>26</sup> and one in the United States.<sup>25</sup> The investigations were generally for one to three years and were all conducted in the 1970s and 1980s,<sup>21–27</sup> with the exception of one in the mid–1990s.<sup>20</sup> Like our project, all used death certificates to identify the deceased. Six reviewed medical records,<sup>20–23,25,27</sup> five interviewed the deceased's primary-care physician (PCP),<sup>20,21,24–26</sup> and six interviewed the deceased's next of kin.<sup>20–22,24,26,27</sup> In three of the projects, the next of kin was interviewed only if the PCP felt it was appropriate to do so.<sup>20–22</sup>

In our project we made no attempt to interview the PCP but instead relied on the recorded information in the medical record. We also did not contact the PCP

regarding the advisability of contacting the next of kin. In our experience, next of kin were interested in talking about the death of their family member, as evidenced by high participation rates. Some families went out of their way to talk to the nurse interviewer and made repeated contacts with us. It is not possible in the three articles where the PCP was first contacted to determine what percentage of next-of-kin interviews was not conducted at the advice of the PCP. The next-of-kin interview was invaluable in providing information about the deceased and, in our experience, did not produce an adverse effect. Therefore, seeking the permission of the deceased's PCP would have been an inefficient use of resources and could have markedly reduced the information available for review. A description of the information obtained from interviewing the PCP was presented in only one of the previous reports, "Some GPs had retired or were otherwise not available; some could not remember the details."<sup>20</sup> We elected not to interview PCPs but rather to rely on the written medical record. In addition, 26% of the deceased, mostly adults, did not have a primary health-care provider. It is possible that in relying on their written medical records, we may have lost certain insights from the PCP. Almost all the deceased were unresponsive by the time they reached the hospital, and we did not find medical records from that final encounter useful in identifying preventable factors in the death. Accordingly, we did not consider it worthwhile to attempt an interview with the physician involved in that final encounter.

The true value of a surveillance system is in the usefulness of the data. Generating local data on asthma mortality is important for a number of reasons. First, both health-care providers and policy makers have a heightened interest in events that have taken place in their own areas. To initiate and sustain practice changes, one must gain the attention of health-care providers. Deaths that have occurred in a policy maker's jurisdiction or health plans are more compelling than those occurring in other geographic areas. Second, in different geographic areas, some factors may be more important than others (i.e., substance abuse was found to be more of a risk factor in Cook County asthma deaths than in all Michigan or even just Detroit deaths).<sup>9</sup>

Conducting the investigations and participating in the review panels had a substantial impact on panel members and asthma staff. Several panel members reported that they have altered their practice patterns and/or organization's procedures in direct response to the discussions held during review panel meetings. These alterations occurred not simply in reading the death summaries, but due to the discussion, problem

solving, and learning across disciplines and systems during the review meetings. Also conveyed was the importance of de-identified case summaries in raising awareness among colleagues of the similarities between the asthma management among the decedents and their current panel of patients; information gleaned from these case summaries may close gaps in current coordination of asthma care so that future deaths may be avoided. Panel members also used the cases to illustrate how common practices or systems can inadvertently contribute to severe asthma events.

MDCH asthma epidemiology and program staff experiences with the project influenced the development of the statewide strategic plan for reducing the asthma burden. Heightened awareness of asthma mortality also influenced specific projects, including development of asthma case-management services in local communities and the implementation of consistent asthma patient discharge instructions for Michigan emergency departments. The focus on these instructions is on the visit to the emergency department as a potential failure of asthma management, the importance of filling and using prescriptions for inhaled steroids provided by the Emergency Department, and follow-up by a primary health-care provider. These instructions have been supported and promoted by the Michigan College of Emergency Physicians and the American Academy of Pediatrics–Michigan Chapter, and sent to nurse managers of all emergency departments in the state.

The review activity also influenced asthma staff thinking on the best presentation of data and findings to partners and audiences, in particular the power and usefulness of the human story to convey the asthma burden in the state. This interest in the human story around asthma mortality has caught the attention of a number of audiences in Michigan in a way that traditional surveillance reporting has not. Specifically, policy makers in public health, managed care, and health systems have requested that this project be presented at conferences, grand rounds, and board meetings. For example, findings from the mortality review were presented and discussed at the Medical Directors meeting of the Michigan Association of Health Plans, and the State Advisory Board for the Michigan Child Death Review.

We are aware of the following actions being undertaken because of this project: (1) the Michigan Association of Health Plans began a policy review around the use of asthma action plans; (2) the Michigan Department of Community Health, Public Health, and Medicaid management have begun discussions around interventions and policy initiatives based on the panels'

recommendations; (3) these data were included in the Michigan Asthma Advisory Committee's recommendations to the Michigan Quality Improvement Consortium during revision of its Asthma Guideline ([www.mqic.org](http://www.mqic.org)); and (4) MDCH is considering a program to investigate sudden cardiac death in children and young adults modeled on the asthma mortality system. Due to the compelling nature of the deaths, MSU staff developed a continuing education activity around four of the deaths. These cases are posted on the MSU website and CME credits are available ([www.oem.msu.edu](http://www.oem.msu.edu)).

Although the cost of this project is fairly modest, \$50,000 per year, it is challenging to maintain the time commitment of the volunteers on the expert panels and the enthusiasm of staff investigating these emotionally draining deaths. Because of these challenges and the commonalities in causal factors and interventions identified in many of the death reviews, we have questioned whether we should continue asthma mortality investigations every year. However, the development of a rapid notification and investigation system is a significant staff, infrastructure, and partner investment that cannot be easily rebuilt after a three- to four-year hiatus. Fortunately, this system also lends itself to investigating other types of severe asthma events. Current plans are to expand the age range of deaths to be investigated and reviewed. Review of all child deaths will continue on an annual basis and other age groups of interest would be addressed in different years, depending on resources available.

It has been suggested that asthma deaths can be divided into two types: (1) slow onset, late arrival for care, and poor use of steroids because of psychological, social, and cultural factors; and (2) sudden onset of severe airway closure.<sup>28</sup> The pathology on autopsy in the first type of death shows abundant sticky mucus plugging in the airways, and in the second there are empty/dry airways suggesting sudden airway closure by a neural mechanism. The second type of asthma death, sudden onset, is harder to prevent, but review of Michigan deaths indicates that most of the asthma deaths were the slow-onset type and accordingly were preventable. Successful disease-management techniques are available to provide good control over asthma symptoms and a high quality of life. However, failure to maintain control over the disease results in a higher risk of mortality. Investigation of the reasons why people are not able to obtain and maintain good control will allow the identification of preventable risk factors for asthma mortality and recommendations to address these factors. Interventions that reduce these risk factors can prevent future deaths as well as improve

management for all people with asthma. Investigation of individual asthma deaths is comparable to widely practiced public health programs that investigate other types of death: child death review teams and maternal mortality review. Our success in implementing an asthma mortality investigation program is potentially a model for other states to follow. The ultimate evaluation of our program will be its effect on reducing both asthma morbidity and mortality in Michigan.

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## APPENDIX

A preteen African American male died from asthma in the spring. In an interview with the mother, she stated that the deceased was diagnosed with asthma as an infant. She stated the deceased had Medicaid insurance, which covered visits with no co-pay. She said the deceased went to the doctor/clinic approximately 40 times in the year before he died. His medications in the weeks before his death included Flovent "spray" prn, another "spray" every three to four hours, and a breathing machine every four hours. She could not attribute an event or exposure that triggered the fatal asthma attack.

The events surrounding the death were as follows: The mother said the deceased was at her sister's home. She said he was not feeling well. He received a breathing treatment. The deceased wanted to go to the bathroom, was thirsty, and needed air. She took the son outside and as they were going down the steps, the deceased "passed out." 911 was called but it took too long, so the deceased was taken to the hospital by car. The mother said she knew her son had died in her arms as they drove to the hospital.

The medical records from the day of death state that a preteen African American male was brought into the Emergency Department (ED) by his parents and was unresponsive and not breathing. The mother said her son had a history of asthma but had never been intubated or in an intensive care unit. His last admission for asthma was six months before his death. He had been complaining of some chest pain, wheezing,

and difficulty breathing that had continued for two to three days before his death. His last breathing treatment was at 8 a.m. on his day of death. He also had a few breathing treatments the day before his death. His medications included Albuterol prn. He was not on steroids prior to his death. The mother said that at approximately 11 p.m., the deceased complained of some difficulty in breathing and was given Albuterol nebulizer treatment with some mild relief. They were also rubbing his back during this nebulizer treatment because he was also complaining of some back pain and chest pain. After the treatment was completed, the mom stated he looked somewhat better. He was, however, continuing to complain of a little bit of difficulty in breathing, so he was taken outside to get some fresh air. When they got outside, he collapsed. This occurred between 11:15 p.m. and 11:30 p.m. EMS was called. Relatives performed CPR. They decided to transport the deceased themselves, as they live less than five minutes from the hospital. The deceased was not breathing spontaneously and there was a mild amount of vomitus in the oropharynx. There were no breath sounds with bag valve mask. He had no pulse and no heart rate. Pupils were fixed and dilated. CPR was started as soon as the deceased came into the ED. The deceased was intubated and an IV was started. The lung sounds showed extremely prolonged expiratory phase and slight expiratory wheezes heard with bagging. The medications given were Epinephrine x 3, Ketamine, Magnesium, bicarbonate, and Atropine. The deceased was pronounced dead at 12:27 a.m. The duration of CPR was approximately 20 minutes. The autopsy showed the lungs were inflated with mucus plugs. Microscopically, eosinophils were found within the lumen of the bronchi, as well as the submucosa. There was thickening of the basement membrane, and the smooth muscle was quite prominent. The toxicology report was positive for Ketamine but negative for other drugs and alcohol. The cause of death was asthma.

The mother said the deceased was admitted to the hospital for asthma six and a half months prior to his death. The medical records from the hospital stay stated the deceased had a two-day history of wheezing, sore throat, rhinorrhea, cough, and emesis x 1 on the day before his admission. He was having some asthma attacks and some wheezing episodes on the day before his hospitalization and was seen in an ED and released. These records from the ED visit were not available. He was hospitalized two years prior for asthma but had had no intubations. The medication at home was Albuterol. In the ED, the medications given to the deceased were Albuterol/Atrovent nebulizer treat-



ments q 20 minutes x 3 and Prednisone 60 mg po. In the hospital he received Prednisone 30 mg po bid and continuous Ventolin at 12.6 mg with 40% oxygen. His lung sounds were positive for wheezing bilaterally with retractions and nasal flaring. The chest X-ray showed peribronchial cuffing and streaky perihilar opacity, which was consistent with the patient's given history of asthma. There was no focal consolidation or large area of atelectasis. Radiopaque foreign body projected over the right upper quadrant of the abdomen but the exact location was uncertain. The "Asthma Service" came on the last day of the hospital stay to assess the patient. Teaching was done at length with the mother and the patient for an MDI with a spacer. The patient did improve his technique and the mother verbalized her understanding. The mother stated she would take the deceased to the primary-care physician in one week. A referral to an outpatient allergy clinic was discussed with the mother. The deceased was discharged after a three-day hospital stay.

The mother said the doctor did not want to see the deceased more frequently. She said the deceased was not referred to an allergist, lung doctor, or any other type of doctor for asthma. She stated the deceased had gone to the ED one time nine months prior to his death. The medical records for this visit were unavailable. The mother said the deceased went to the ED approximately 20 times in his lifetime for asthma.

She said he was first hospitalized for his asthma as an infant. He was hospitalized four times in his life for asthma. The mother stated the deceased had no other medical conditions including allergies. The doctor never said the deceased needed breathing tests or a peak flow meter. He did not have a written asthma plan or an asthma education course. The deceased did not smoke. The mother said the deceased had no relatives that had asthma, hay fever, or skin allergies. There were no pets in the home. She said the deceased did take antibiotics two weeks prior to death (reason unknown). Both the mother and the deceased thought the asthma was severe. The total family income for the year was <\$10,000. The deceased lived with his mother but was also watched by his aunt. The mother said the deceased missed 14 days of school because of his asthma. He had his breathing machine at school and received it every four hours. He also had a "spray pump" at school. The family was on the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) and received food stamps and family support subsidy. The deceased's body mass index was in the 80th percentile.

Classification of asthma severity per National Heart Lung Blood Institute guideline: Moderate persistent  
Classification asthma death type per autopsy: Type I