2004

Annual Report on Asthma Deaths Among Individuals Ages 2-34 in Michigan

An adult male began having increased breathing problems six months before his death after moving into a new apartment. He was seen in the ED 12 days prior to death for a breathing problem and was given antibiotics and a nebulizer. Factors considered important in his death included the over-use of bronchodilators, smoking, and the lack of attention by the deceased and his doctor to triggers in his new apartment.

A young adult male began having trouble breathing in a dance club. His friends brought him back home for a breathing treatment. He had taken 4-5 breathing treatments and an Epi-pen when 911 was called. He died in the Emergency Department (ED). The panel felt the preventable issues included bronchodilator over-use with his nebulizer, inadequate use of steroids, lack of trigger avoidance, and not carrying his inhaler with him when he went to the club.

A male child died from asthma in his sleep. He also had cerebral palsy and had been limited to a wheelchair. He had never gone to the ED for his asthma. The panel was concerned about the inadequate asthma diagnosis, inadequate prescriptions and use of steroids, need for referral for this high-risk child, and his multiple medical problems.

A male in his teens died from asthma while playing basketball. The panel believed there was bronchodilator over-use, inadequate use of steroids, and inadequate awareness of the severity of the asthma. He had no regular maintenance health care visits.

2004 Annual Report on Asthma Deaths Among Individuals Ages 2-34 Years in Michigan

A Joint Report

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Summary

This is the third Annual Report of Asthma Deaths in Michigan among 2-34 year olds. Although the 32 deaths that occurred in 2002, 27 deaths that occurred in 2003, and 30 deaths that occurred in 2004 are not a large number, the circumstances surrounding these deaths are dramatic and are indicative of potential problems with asthma diagnosis and treatment in the larger community. The deaths are particularly tragic because they are preventable. The majority of the deaths were among males (59%), and African-Americans (65%). They were most likely to occur among residents of Wayne County (43%). The deaths typically occurred prior to the deceased reaching the hospital. Case summaries of the deaths are in Appendix I.

The primary causal factor identified in the first three years of investigation was the lack of compliance by patients with good asthma management techniques including regular use of inhaled steroids rather than dependence on β-agonists and elimination of asthma triggers such as cigarette smoke and pets. Some of the deficiencies noted in asthma management were from inadequate prescription of inhaled steroids particularly in EDs. The low percentage of decedents with management plans (only 9%) would suggest that more can be done by the health care system to provide information to patients to better manage their asthma. Particular recommendations were made for:

- Case Management for high-risk patients (patients with an ED visit and/or a hospitalization for asthma). Case management for people with asthma and psychiatric conditions as well as education on asthma for psychiatric health care providers. Case management for children with asthma where lack of adequate parental supervision is a problem.
- Pharmacy notification to doctors for patients who repeatedly fill β-agonist prescriptions or possibly placing a limitation on the number of refills allowed.
- Emphasis on the chronic and potentially severe nature of asthma and the importance of prescription and use of inhaled steroids to health care providers in all sectors (primary and urgent care) and among people with asthma.
- Provision of more comprehensive asthma care in the ED setting, including prescription of inhaled steroids at discharge and a system for connecting patients with a primary care provider for follow-up.
- Education for people with asthma in self-management, emphasizing the importance of adhering to inhaled steroid medication as prescribed.
- Referral to specialists for patients with a hospitalization and/or ED visit for asthma.
- Need for health insurance for people with asthma (more of a problem in adults than children).

Plans over the coming year include the continuation of investigations into asthma deaths, dissemination of the information learned from these investigations, and promotion of suggested policy actions at the state and local level from the panel's recommendations.

Background

In response to a request for a proposal from the Centers for Disease Control and Prevention (CDC), the Michigan Department of Community Health (MDCH) in conjunction with Michigan State University (MSU) successfully competed to obtain funds to develop a rapid asthma death notification and investigation system for the State of Michigan. This system was limited, at the request of CDC, to investigations of asthma deaths among children and young adults ages 2-34. CDC selected this age group because of the increased likelihood that deaths ascribed to asthma in the ages 2-34 were truly caused by asthma. For individuals younger than the age of two or older than the age of 34 the number of other medical conditions that may present with symptoms similar to asthma increases. This report summarizes the first three years of investigations that cover asthma deaths occurring between January 1, 2002 and December 31, 2004.

Mortality from asthma in the United States has increased two-fold since the 1970's (1,2); although recent data suggest the asthma mortality rate has stabilized (3). Over-use of β-agonists (4,5) and under-use of inhaled corticosteroids (6-8) have been associated with increased asthma mortality. Smoking, drinking, substance abuse (9) 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 (10). Fatal asthma has also been associated with specific work exposures (11).

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 (12). Reasons suggested for the racial disparity include differential access to care, exposure to environmental pollutants (13), and crowded conditions leading to increased exposure to allergens and infections (14).

Asthma mortality rates in Michigan are slightly higher than the United State's rate for all age groups except among adults 65 years or older. Overall, asthma mortality rates in Michigan have declined significantly between 1999 and 2004. This decrease occurred among people ages 35 to 64 years of age. The mortality rate in Michigan for asthma in African-Americans of all ages (33.2 per million) was over three times that of Caucasians (9.7 per million) in 2004. This racial difference in asthma mortality rates was even greater in the 5-34 year old age group.

During the years 1990 to 2004 in Michigan, there were a total of 2,581 deaths where asthma was the underlying cause of death, 419 of these deaths occurred among the 2-34 year old age group. The annual number of deaths in the study age group has ranged from 5-40 per year. Asthma deaths in the 2-34 age group were almost equally distributed between males (215 deaths, 52%) and females (197 deaths or 48% of asthma deaths). Two hundred thirty-five (57%) of the deaths were among African-Americans and 172 (42%) were among Caucasians.

Asthma deaths in Michigan were not evenly distributed throughout the year. The number of deaths increased in the summer and fall for children and young adults.

Asthma deaths are 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 us to identify preventable risk factors for asthma mortality and recommend ways to address these factors. Interventions that reduce these risk factors can prevent future deaths as well as improve management for all people with asthma.

Methods

Notification of Asthma Deaths

Division of Health Statistics and Vital Records (DHSVR) staff at MDCH entered information from the death certificate into the master electronic file on a quarterly basis, at which time they provided MDCH asthma staff with a transcript of information on all deaths with asthma as the underlying cause of death. The DHSVR transcript contained a limited set of data from the death certificate, including name, address, date of death, date of birth, sex, county of death, and county of residence. Based on this information, MDCH asthma staff identified asthma deaths that met study criteria:

- Asthma as underlying cause of death (ICD-10 codes J45 or J46)
- Between the ages of 2-34 years
- Residing in Michigan at time of death

Staff requested an administrative copy of the death certificates for asthma deaths meeting these criteria.

Data Collection

Upon receipt of the copy of the death certificate, a letter was sent to the next-of-kin listed on the death certificate to explain the project and to request an interview. Interviews were conducted with the next-of-kin using a standardized questionnaire. All medical records from the year prior to death, pharmacy records, and, if applicable, emergency response records, medical examiner records and the autopsy report were requested and reviewed. In 2004 we were able to access enrollment, health care and pharmacy utilization records for decedents enrolled in Medicaid programs from MDCH Data Warehouse to help identify medical records; this was especially helpful for the deaths where next-of-kin were not available for interview. After an interview with the next-of-kin was attempted or completed and after available records were reviewed, a one to two page summary of the circumstances surrounding the death for each of the individuals was prepared. In addition to the overall summary, a one-page summary was prepared of each the medical records and autopsy reports reviewed.

Advisory Panel Review

Two expert advisory panels were convened: one for adults (reviewing deaths to individuals ages 19-34) and one for children (reviewing deaths for individuals ages 2-18). The advisory panels included allergists, asthma educators, ED physicians, family practitioners, internists, nurses, pediatricians, pharmacists, pulmonologists, respiratory therapists, and social workers. In the past year, two medical directors of medical care organizations joined the panels. Members of the two

panels are listed in Appendix II. Summaries of the data collected were shared with the appropriate advisory panels.

The Adult Mortality Review Panel met twice and the Child Mortality Review Panel met once to review completed investigations of the 2004 asthma deaths. The advisory panels reviewed the summary materials for individual deaths and were asked to list causal factors and follow-up preventive activities that were suggested by each death. These conclusions are described in the Results section.

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. Both the MDCH Human Subjects Committee and the MSU Human Subjects Review Board reviewed this project. The MDCH Human Subjects Committee determined that this project was a surveillance activity and not human research. The MSU Human Subjects Review Board 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 MCL 333-2631-2635. This designation safeguards the confidential character of research studies conducted by MDCH and provides protection from release of the identifiable asthma mortality review materials for any purpose other than the research project.

Results

During the three-year study period, there were a total of 421 deaths where asthma was the underlying cause for all ages, 152 in 2002, 133 in 2003 and 136 in 2004. Eighty-nine (21%) of these deaths were among individuals age 2-34 years. The total number of deaths per year and age group are reported in Table 1.

Table 1. Number of Asthma Deaths and Percent of All Asthma Deaths Eligible for Review in Michigan for 2002, 2003, and 2004

	2002	**2003**	**2004**	**2002-2004**
All Ages	152	133	136	421
Children 2-18	12	11	15	38
Adults 19-34	20	16	15	51
Study Total	32 (21%)	27 (20%)	30 (22%)	89 (21%)

Two asthma deaths occurred to Michigan residents who were out-of-state at the time of their deaths in 2004. These death certificates are still being obtained. No information is available on these out of state deaths at this time. Information on the two out-of-state 2004 deaths is included in Table 1 but nowhere else in the report.

Only limited information is available on one asthma death that occurred in 2003 but was just reported to MSU by MDCH asthma staff. Information on the 2003 death is included in Figure 1 and Tables 1 and 2 but not in any other tables in the report.

Table 2. Sociodemographic Characteristics of Eighty-Seven Asthma Deaths From Death Certificates, Ages 2-34 Years in Michigan for 2002, 2003, and 2004

	Children (2-18 years)	Adults (19-34 years)	Total (2-34 years)
Number of Asthma Deaths	38 (44%)	49 (56%)	87*
Average Age (years)	13.1	28.0	21.5
Sex			
Male	60.5%	57.1%	58.6%
Female	39.5%	42.9%	41.4%
Race/Ethnicity			
Caucasian, Non-Hispanic	10.5%	44.9%	29.9%
African-American	81.6%	51.0%	64.4%
Other Reported	7.9%	4.2%	5.7%
Education Completed			
College Graduate (4 year Degree)	0%	2.1%	1.2%
Some College	2.6%	32.6%	19.5%
High School Graduate	2.6%	44.9%	26.4%
Grades 6-11	68.4%	20.4%	41.4%
Grades 5 and less	26.4%	0%	11.5%
Place of Death**			
Hospital	81.5%	71.4%	75.9%
Home	18.4%	24.5%	21.8%
Vehicle	0%	4.1%	2.3%
Autopsied	74%	85.7%	80.5%

*Total number of deaths do not include the 2 out-of-state deaths

**Place of death on the death certificate is the location where the person was declared dead, not where the fatal asthma attack occurred.

Age

The average age of children who died was 13.1 years (range: 2-18 years). The average age of adults who died was 28.0 years (range: 19-34 years).

Gender

Fifty-one (58.6%) of the individuals who died were males and 36 (41.4%) were females. There were 1.4 times as many deaths among men as compared to women (1.5 times as many in children and 1.3 times as many in adults).

Race/Ethnicity

Fifty-six (64.4%) of the individuals who died were African Americans, 26 (29.9%) were Caucasian, three (3.4%) were Mexican-American, one (1.1%) was Vietnamese, and one (1.1%) was Bangladeshi as reported on the death certificate.

In 2003, 19% of Michigan's children were African American. In contrast, 82% of the children who died from asthma between 2002 and 2004 were African American – more than four times the number expected. African American women were also significantly over-represented among the asthma deaths. There were 3.1 times as many asthma deaths for African-American as for Caucasian women. For African-American men there were 1.7 times as many asthma deaths as for Caucasian men.

Education

Of the 49 adults in the study, one had completed a four-year college degree (2.1%), 16 (32.6%) had 1-3 years of college, 22 (44.9%) completed high school, and the remaining ten (20.4%) completed grades 6 to 11 of school.

Place of Death

The death certificate information on place of death listed in Table 2 reflects where the 87 people were pronounced dead. Sixty-six of the asthma deaths were pronounced dead in the hospital. However, all individuals except two were non-responsive and in code status when the individual reached the hospital. Of the 10 deaths that occurred among people with asthma admitted to the hospital, all were unresponsive and in a coma when admitted. Twenty-one were pronounced dead before reaching the hospital.

Autopsy

A high percentage of individuals, both children and adults, who died from asthma were autopsied (80.5%). Of the 70 deaths with autopsies, 58 (82.9%) showed mucus plugging in their bronchi, six (9%) had empty/dry bronchi, for five (7%) individuals the autopsy report did not address the airways and for the one death in 2003 that we were recently notified about we have not yet requested the autopsy report.

Location in State

Wayne County was the most common residence of the deceased (37) (Figure 1). There were 11 counties with two to eight residents who died of asthma in 2002-2004 (Berrien, Calhoun, Genesee, Ingham, Kent, Lapeer, Muskegon, Oakland, Ottawa, Saginaw, St. Clair). Another 10 counties each had one death (Chippewa, Huron, Iosco, Kalamazoo, Lapeer, Macomb, Montcalm, Osceola, Otsego, St Joseph).

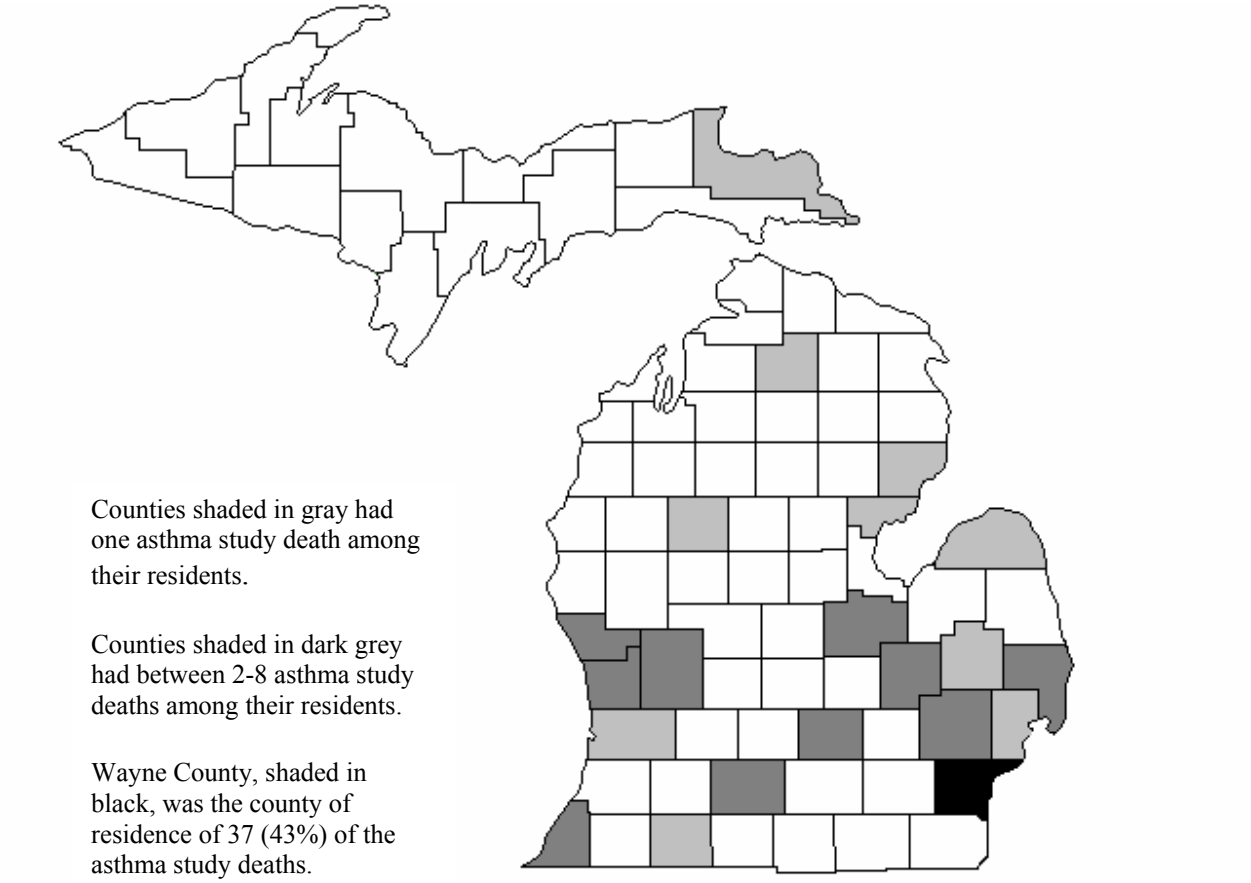
Occupation/Industry

The most common occupations listed on the death certificates of adults were homemaker/unemployed/disabled and laborer. The most common industry listed on the death certificates of the adults were automotive, retail, and medical. Other occupation and industry classifications are listed in Table 3.

Table 3. Occupation and Industry of Deceased as Listed on Death Certificate, Adults 19-34 Years, Michigan, 2002, 2003, and 2004

Number of Deaths	Occupation	Industry
8	Homemaker/unemployed/disabled	None listed
7	Laborer	
6		Automotive
4	Manager	
3	Clerk/clerical Machine operator	Retail Medical
2	Student	Manufacturing Food industry
1	Salesperson Apprentice Housekeeper Independent contractor Instructor Nurse assistant Paper carrier Presser Seat builder Stocker Truck driver Waitress Welder Unavailable	Air line Carpentry Cleaners Computer Construction Courier Dentistry Electrical Employment agency Factory Government Hotel Landscape Newspaper Pet store Pharmacy Private firm School Self-employed Unavailable Various jobs Wholesale distributing

Figure 1. County of Residence: 87Asthma Study Deaths in Michigan for 2002, 2003 and 2004



Counties shaded in gray had one asthma study death among their residents.

Counties shaded in dark grey had between 2-8 asthma study deaths among their residents.

Wayne County, shaded in black, was the county of residence of 37 (43%) of the asthma study deaths.

Investigations Completed

The average time between the death occurring in Michigan and project staff being notified to commence the investigation was 108 days in 2002, 125 days in 2003 and 200 days in 2004. The increase in time to notification in 2004 was secondary to equipment issues in Vital Statistics. The two deaths that occurred out of state are not included in investigations or findings sections of the report.

Among the 87 deaths from 2002-2004 in Michigan, the major difficulty in completing the next-of-kin interviews involved locating the next-of-kin. We were unable to locate 15 next-of-kin (six adult and nine children) and 9 next-of-kin refused (five adult and four children). This was a greater problem in 2002, where 13 next-of-kin were not interviewed, 4 in 2003 and 7 in 2004. Of the 87 deaths, 24 did not have a next-of-kin interview.

Medical records were obtained on 96% (36 of 38 of children and 47 of 48 of adults). In the absence of a next-of-kin interview, the identification of medical records received was incomplete, because the health care providers(s) for the year prior to death would be unknown (see Table 4).

Table 4. Percent of Asthma Mortality Investigations Completed Ages 2-34 in Michigan for 2002, 2003 and 2004

	Children	Adults
Number of Deaths Eligible for Review	38	48
Unable to locate next-of-kin	9 (23.7%)	6 (12.5%)
Next-of-kin refused interview	4 (10.5%)	5 (10.4%)
Interviews completed	25 (65.8%)	37 (77.1%)

Risk Factors For Asthma Mortality

The denominators for the different risk factors listed below vary due to the availability of records or whether all of the next-of-kin interviews were completed. After each percentage is the number with a positive response and the denominator for that factor. Table 5 summarizes the risk factors.

Insurance

As determined from the medical record review and next-of-kin interview, 94% (33 of 35) of children and 71% (30 of 42) of adults where insurance status was known had medical insurance. Among the twenty-eight individuals with medical insurance where information about co-payment was known, 34 of 44 (77.3%) had co-pays of $10 or less, one had $15-20 co-pay, one had a 20% co-pay, one had a $50-$75 co-pay, one had an 80% co-pay. Eight percent (4 of 49) next-of-kin or health care providers mentioned that co-pays (one had a 10% co-pay, one had a "spend down" co-pay), or cost of referrals for specialists and testing interfered with the patient's management.

As determined from querying Medicaid enrollment files, 70% (16 of 23) of children and 56% (20 of 36) of adults were enrolled in Medicaid at sometime during their life. At the time of their death, 61% (14 of 23) of children and 42% (15 of 36) of adults were enrolled in Medicaid.

Co-morbidities

Forty-five percent (20 of 44) of adults and 37% (13 of 35) of children were reported to have a co-morbid medical condition during their lives, such as Down's Syndrome, Crohn's disease, diabetes, hypertension, cerebral palsy, spinal muscular atrophy, hypoxic encephalopathy, or seizures which complicated their asthma management. Another seven had a psychiatric condition, such as major depression, bipolar disease or schizophrenia; 3.4% (1 of 29) of children and 15.4% (6 of 39) of adults.

Substance Abuse/Family Dysfunction

Seventy individuals were autopsied and sixty-five had toxicology results. Six adults tested positive for illicit drug use at autopsy. Substance abuse issues were mentioned by the next-of-kin or a health care provider in 23% (10 of 43) of the adult deaths, and 4% (1 of 28) of the child deaths. Five adults who were positive for illicit drugs also had their next-of-kin mention

substance abuse during the interview. There appeared to be a lack of parental supervision or family dysfunction that interfered with asthma management in 26% (7 of 27) of the child deaths.

Triggers

Forty-one percent (18 of 44) of the adults who died of asthma were current cigarette smokers, as compared to the general population of adults (40.8% of 18-24 year olds and 24.5% of 25-34 year olds) (15). Fifteen percent (4 of 27) of deceased children smoked and 38% (10 of 26) lived with a cigarette smoker.

Forty-eight percent (13 of 27) of children and 53% (18 of 34) of adults had dogs and/or cats living in their homes at the time of their death.

Medication Utilization

Sixty-nine percent (22 of 32) of children and 60% (26 of 43) of adults had been prescribed an inhaled or oral corticosteroid at the time of their death. One-half (11 of 22) of children and 58% of adults (15 of 26) who were taking corticosteroids were taking inhaled steroids only; 8 of 22 children and 6 of 26 adults were taking both inhaled and oral steroids and 3 of 22 children and 5 of 26 adults were taking oral steroids only.

Routine and Specialty Care

Other aspects of medical care during their lifetime were:

- Allergist Care: 55% (31 of 56) had ever seen an allergist - 64% (16 of 25) of children and 48% (15 of 31) of adults.
- Pulmonologist Care: 47% (27 of 57) had ever seen a pulmonologist - 44% (11 of 25) of children and 50% (16 of 32) of adults
- Combined Specialist Care: 34% (19 of 56) had seen both an allergist and pulmonologist 33% (20 of 60) had seen <u>neither</u> an allergist nor a pulmonologist during their lifetime. National guidelines contain recommendations for when patients should be seen by a specialist (16) – the majority of these patients met one of the criteria of these guidelines prior to their death. The remaining 33% had seen either a pulmonologist or an allergist.
- Pulmonary Function Testing: 54% of children and 55% of adults had ever had pulmonary function testing that included at least spirometry during their lifetime. It is recommended that spirometry be used to aid in the diagnosis of asthma, after treatment is initiated and symptoms have stabilized to document "normal" airway function, and at least every 1 to 2 years to assess the maintenance of air way function (16).
- Peak Flow Meter: 71% (20 of 28) of children and 55% (18 of 33) of adults had a peak flow meter (only twelve of the children and two of the adults with a peak flow meter used it regularly per next-of-kin reporting)
- Asthma Management Plan: 10% (3 of 30) of adults and 30% (8 of 27) of the children had an asthma management plan.

Intubations and Emergency Care

Twenty-nine percent (10 of 34) of adults had a history of prior intubation in their lifetime. Twenty-eight percent (8 of 29) of the children had been intubated prior to the time of their death. Seventy-nine percent (23 of 29) of children and 62% (24 of 39) of adults had been previously admitted to the hospital for asthma. Eighty-nine percent (24 of 27) of children and 91% (34 of 37) of adults had an ED visit for asthma in their life.

Obesity

At the time of their death, 52% (23 of 44) of adults were considered obese (body mass index (BMI) of 30 or greater) and 23% (10 of 44) were considered overweight (BMI of 25 to 29). Four individuals had no height and weight available, although one of the latter individuals was described as obese in their medical records. The prevalence of obesity among the deceased adults was two to four times higher than that for the general adult population of Michigan. According to the 2004 Michigan Behavioral Risk Factor Survey, 13.5% of 18-24 year olds and 22.3% of 25-34 year olds are obese (14).

The percentage of the children considered obese (BMI-for-age of 95th percentile or greater) at time of death was higher than expected from national data. Thirty-five percent (13 of 37) of the children had a BMI that was at the 95th percentile or greater for their age, 24% (9) were at the 85th to 94th percentile and 41% (15) were less than the 85th percentile. The BMI of one child was unknown. Weight status data for the general population of children in Michigan is not available. Sixteen percent of U.S. children 6-11 years and 16% of U.S. children 12-19 years have a BMI at the 95th percentile or greater for their age (17).

Weight status among the deceased children and adults did not vary significantly by race. Among African-American children, 37% (11 of 30) had a BMI that was at the 95th percentile or greater versus 40% (2 of 5) of Caucasian children. Among African-American adults, 54% (13 of 24) had a BMI of 30 or greater versus 50% (10 of 20) of Caucasian adults.

Table 5. Characteristics of Asthma Management History Based on Deaths with Information Available for Children (Ages 2-18) and Adults (Ages 19-34) in Michigan for 2002, 2003, and 2004

	Children	Adults	Total
Insurance Status			
Deceased Had Some Form of Health Insurance	94%	71%	82%
Insurance Had Co-Pays	32%	55%	43%
Co-pay Mentioned as Reason for Not Filling Medication, Seeing Specialist, or Getting Tests	9%	8%	8%
Deceased Had Co-Morbid Condition	37%	45%	42%
Deceased Had Psychological Illness	3%	15%	10%
Significant Substance Abuse Noted by Family or Health Care Provider	4%	23%	15%
Exposure to Triggers			
Current Smoker	15%	41%	31%
Smoker in the Home	38%	51%	46%
Pets in the Home	48%	53%	51%
Routine Asthma Management			
Prescribed Inhaled Steroids	34%	35%	35%
Prescribed Oral Steroids	9%	12%	11%
Taking Both Inhaled and Oral Steroids	25%	14%	19%
No Steroids	31%	40%	36%
Seen by Specialist	70%	64%	67%
Seen by Allergist	64%	48%	55%
Seen by Pulmonologist	44%	50%	47%
Ever Had Pulmonary Function Testing	54%	55%	55%
Had a Peak Flow Meter	71%	55%	62%
Regularly Used Peak Flow Meter	52%	11%	33%
Had a Nebulizer	77%	72%	74%
Asthma Management Plan	30%	10%	19%
Urgent Asthma Management			
Prior History of Intubation	28%	29%	29%
Previously Hospitalized for Asthma	79%	62%	69%
In Year Prior to Death	55%	50%	52%
Previous ED Visits in life	89%	91%	91%
Average Number of ED Visits Reported in Year Prior to Death	1.6	5.5	3.9
Family Dysfunction	26%	8%	16%

Weight			
Children		*Adults*	
$\geq$ 95 percentile	35%	Obese (BMI 30+)	52%
$\geq$ 85-94th percentile	24%	Overweight (BMI 25-29)	23%
< 85th percentile	41%	Not Overweight (BMI<25)	25%

Causal Factors

Causal factors were divided into sections based on the setting in which action is needed: patient-related factors, such as compliance issues, the need for education or trigger avoidance; physician-related factors, such as the need for education or changes in practice behavior; and system-related factors, such as lack of health care, need for changes in health care provision or foster care systems. Table 6 provides causal factors identified for the 48 reviewed adult asthma deaths. Table 7 provides causal factors for the 38 child deaths reviewed.

Adults:

The most frequent causal factors for adult deaths cited by the panel were:

1. *Compliance issues, such as following advice to eliminate asthma triggers and using prescribed steroids.*

2. *The need for a specialist referral and pulmonary function testing for high-risk patients.*

3. *The inadequate prescription of steroids by health care providers.*

4. *Lack of regular medical care with a primary care physician, many times was coupled with a lack of health insurance.*

5. *Psychiatric disease including depression.*

Children:

The most frequent causal factors for asthma deaths in children were:

1. *Inadequate use of steroids and over-use of β-agonists.*
.
2. *Compliance issues such as lack of elimination of triggers.*

3. *The need for specialist referral for high-risk patients.*

4. *The inadequate prescription of steroids by health care providers.*

5. *Lack of adequate adult supervision and regular maintenance health care visits.*

Table 6. Causal Factors for Asthma Mortality Based on 48 Deaths Reviewed for Adults Ages 19-34 in Michigan for 2002, 2003 and 2004

Factor	Number of Deaths*
Patient-Related Factors	
Compliance	26
Inadequate Use of Steroids/Over-use of β-agonists	22
Depression/Psychiatric Disorder	9
Obesity	4
Drug Abuse	3
Lack of Prior Diagnosis	2
Lack of Recognition of Severity	2
Allergic Reaction	1
Aspirin Sensitivity	1
Amount of Pain Medication	1
Physician-Related Factors	
Needed Referral or Inadequate Diagnosis for High-Risk Patients	19
Inadequate Prescription of Steroids	17
Inappropriately Discharged from ED	1
System-Related Factors	
Lack of Regular Medical Care	11
Lack of Health Insurance	6
Quality of Asthma Care Provided in Prisons/Psychiatric Hospitals	3
Work Exposure	3
Health Insurance Would Not Pay for Referral	1

*Multiple causes are possible for each death.

Table 7. Causal Factors for Asthma Mortality Based on 38 Deaths Reviewed for Children Ages 2-18 in Michigan for 2002, 2003 and 2004

Causal Factor	Number of Deaths*
Patient–Related Factors	
Inadequate use of Steroids/Over-use of β-agonists	17
Compliance: Trigger Avoidance; Pets	16
Co-Morbid Conditions	3
Aspirin Sensitivity	1
Physician-Related Factors	
Needed Referral or Inadequate Diagnosis for High-risk Patients	11
Inadequate Prescription of Steroids	8
System-Related Factors	
No Regular Maintenance Health Care Visits	6
Lack of Adequate Adult Supervision	5
Psycho Social and Psychiatric Issues	3
Repeated Refill of Bronchodilators	3
Lack of Insurance to Cover Medication	1

*Multiple causes are possible for each death.

Other Issues Raised During the Death Reviews

The ingestion of aspirin in an aspirin-sensitive individual was suspected to be the causal factor in one adult and one child death. In both cases, the deceased unknowingly used a product with aspirin in it.

The absence of deaths from certain risk factors was also an important finding. There were no asthma deaths related to care received in the hospital. There were three asthma deaths where illegal drug usage was felt to be a factor in compliance but none related to the immediate cause of death. Although peak flows meters were available but rarely used by the deceased, the lack of regular use of peak flow meters was felt by the advisory panels to be symptomatic of more important health care management deficiencies rather than a direct causal factor. Both the adult and child advisory panels felt that it was more important to put emphasis on steroid use rather than peak flow usage.

A secondary issue was the need to work with medical examiners to address whether there are changes that could be introduced to ensure that medical examiners are provided sufficient clinical information that would allow them to more accurately record the cause of death. The advisory panels questioned whether the death was caused by asthma in twelve cases.

A large percentage of the adults and children who died were obese, 52% and 35% respectively. These percentages are greater than those found in the general population, 14 - 23% for 19- to 34-year-old in adults (14) and 16% in children (17). There has been some disagreement in the

medical literature over whether obesity is a consequence of decreased physical activity among people with asthma and not a risk factor for asthma (18) and/or whether the increase in asthma symptoms reported by obese individuals is truly asthma or is a consequence of misdiagnosis of asthma among obese individuals (19).

Recommendations From Advisory Panels (see Tables 8 and 9)

Adults

Suggested interventions involved education on the prescription and use of steroids for both health care providers and patients. Emphasis was placed on educating emergency doctors on the need to prescribe inhaled steroids for chronic management in addition to oral steroids for the acute exacerbation and for educating patients about the importance of taking inhaled steroid once the acute episode is resolved. This education on changing management practice was intended for patients who had regular primary care physicians to assist them until they visited their primary health care provider as well as those who, despite referrals to primary care providers, continued to obtain their asthma care from the ED. Referral to specialists was also indicated for sixteen of the deceased.

System level changes that were suggested by the panels included the need for case managers for high-risk patients and the need for provisions to ensure regular medical care for both those individuals with or without health insurance. Some mechanism, such as notification of health care providers by pharmacies or a restriction on the refilling of β-agonist prescriptions, to reduce β-agonist over-use was favored.

Active case management for individuals with repeated ED visits and hospitalizations was a high priority. A mechanism to ensure that case managers have repeated interactions, even with difficult to manage patients such as those with psychiatric disease, is needed.

Education to improve compliance by patients on regularly using inhaled steroid and eliminating triggers were high priorities. The low percentage of asthmatics with written asthma management plans supported the review boards' conclusion that patient education needed to be improved.

Children

Like adults, education on the prescription and use of steroids for both health care providers and patients was the highest priority. Some mechanism, such as notification of health care providers by pharmacies, to monitor or restrict the refilling of β-agonist prescriptions to reduce β-agonist over-use was favored. Timely referral to a specialist was also indicated. Interventions specific to children included: setting up a focus group of teenagers with asthma to better understand how to conduct asthma education in this age group; attention to foster care environment (i.e. presence of asthma triggers); and a school-based asthma plan.

Insurance issues, either coverage or co-pays, were not noted to be a significant problem with children.

Table 8. Recommended Interventions for Asthma Mortality Based on 48 Deaths Reviewed for Adults Ages 19-34 in Michigan for 2002, 2003 and 2004

Recommendation	Number of Deaths
Educate Health Care Providers	
Need for Inhaled Steroids	17
Need to Refer High-Risk Patients to Specialists	7
Need for Pulmonary Function Tests	5
Asthma Education for Providers in Psychiatric Hospitals and Prisons	4
Need for Provision of Epinephrine Self-injection for Selected Patients	2
Guidelines to Admit versus Discharge from ED	2
Improve Management of Work-Related Asthma	1
Educate Patients	
Need to Use Steroids	13
General Asthma Education and Need for Regular Care	12
Provide Education in ED	4
Provide Aspirin Sensitivity Education	1
System Level Changes	
Need for Case Management	15
Improve Insurance Coverage	13
Pharmacy Notification of Excessive β-agonist Use	10
Raise Public Awareness of Asthma	2
Regulation of Insurance Companies on Referrals to Specialist	1
Improve Labeling of Products Containing Aspirin	1
Medical Examiners	
Develop Clear Criteria for Identifying Asthma Deaths	10

Table 9. Recommended Interventions for Asthma Mortality Based on 38 Deaths Reviewed for Children Ages 2-18 in Michigan for 2002, 2003 and 2004

Recommendation	Number of Deaths
Educate Health Care Providers	
Need for Inhaled Steroids, Include ED Doctors	9
Referrals for High-Risk Patients	9
Limitation of Refills for Bronchodilators Without a Physician Visit or Active Approval	2
Need for Pulmonary Function Test	1
Educate Patients	
Education of Patients/Family, Possibly Focus Groups for Teenagers	21
Dangers of Aspirin Sensitivity	1
System Level Changes	
Case Manager for High-Risk Cases	15
Pharmacy Notification of Excessive Bronchodilator Use	10
School Based Asthma Program	9
Child Protective Services – Attention Needed for Foster Care Environment	4
Development and Dissemination of Generic Action Plan	1
Better Labeling of Aspirin Products	1
Transportation Costs in Rural Area for High-Risk Cases	1
Inadequate Emergency Medical Response	1
Medical Examiners	
Develop Clear Criteria for Identifying Asthma Deaths	2

Discussion

Asthma is a chronic but manageable condition. This project is based on the premise that all asthma deaths are preventable with appropriate asthma management.

The 419 asthma deaths from 2002 through 2004 represent only a small percentage (0.2%) of the 173,840 deaths that occurred in Michigan during this same 3-year period. However, asthma is a treatable condition and each asthma death is a tragedy that could have been prevented.

The primary causal factor identified in the first three years of investigation was the lack of compliance by patients with good asthma management including regular use of inhaled steroids rather than dependence on β-agonists and elimination of asthma triggers such as cigarette smoke and pets. Some of the deficiencies noted in asthma management were from inadequate prescription of inhaled steroids particularly in EDs. The low percentage of people with asthma with management plans (only 9%) would suggest that more can be done by the health care system to provide information to patients to better manage their asthma. Particular recommendations were made for:

- Case Managers for high-risk patients (patients with an ED visit and/or a hospitalization for asthma).
- Case Managers for people with asthma and psychiatric conditions; education on asthma for psychiatric health care providers.
- Case Managers for children with asthma where lack of parental supervision is a problem.
- Referral to specialists for patients with a hospitalization and/or ED visit for asthma.
- Pharmacy notification to doctors for patients who repeatedly fill β-agonist prescriptions or possibly placing a limitation on the number of refills allowed.
- Emphasize the chronic and potentially severe nature of asthma and the importance of prescription and use of inhaled steroids to health care providers in all sectors (primary and urgent care) and among people with asthma.
- Provision of more comprehensive asthma care in the ED setting, including prescription of inhaled steroids at discharge and a system for connecting patients with a primary care provider for follow-up.
- Educate people with asthma in self-management, emphasizing the importance of adhering to inhaled steroid medication as prescribed.
- Need for health insurance for adults with asthma.

More specific issues identified included better labeling of aspirin products to prevent death for individuals allergic to aspirin and prescription of epinephrine self-injection for people with asthma who have asthma attacks secondary to acute allergic reactions.

It has been suggested by some researchers 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 (20). 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. Review of the 69 Michigan deaths with an autopsy indicated that most (91%) of the asthma deaths between the ages of 2-34 were the slow onset type and, accordingly, were preventable.

Next Steps

Investigation of these deaths from asthma has identified a number of avenues to reduce asthma mortality. Action needs to occur at many levels, including health care providers, patients and system-level changes. The findings from these investigations will be shared with many asthma stakeholders who have the expertise and position to institute these recommendations. Results have been disseminated in the following way:

- Annual reports were distributed: at presentations; 23 health care providers who requested a copy; Centers for Disease Control and Prevention asthma staff; asthma contacts in all 50 states; members of the Michigan Asthma Advisory Committee and its work groups; all 14 local asthma coalitions; all local public health officers in Michigan; all managed care plan medical directors and quality improvement staff in Michigan; Michigan State Library; Michigan State Medical Society; Michigan College of Emergency Physicians; Michigan Nurses Association; Michigan Surgeon General; Director of MDCH; Director of MDCH Chronic Disease Programs; Director of MDCH Maternal Child Health Programs; and the Director of MDCH Health Disparity Reduction Program.

- A presentation to staff in the Michigan Department of Community Health Medicaid and Public Health Administrations.

- Presentation to the Michigan Asthma Advisory Committee and its Quality Improvement in Asthma Care Work Group.

- Presentation to the Child Death Review State Advisory Board.

- Selected presentations to local asthma coalitions, physician and allied health workers through grand rounds, national meetings and other state asthma programs.

- Presentation of data to the Medical Director of the Michigan managed care organizations.

- Presentation of data to the organization representing Medical Examiners to discuss criteria for recording a death as being secondary to asthma.

- Contributed to development of asthma protocol for Child Death Review.

- Developed physician education activity from the blinded case studies developed for panel review.

Further work is needed to disseminate the findings and initiate changes. Plans include:

- Meet with the Michigan College of Emergency Medicine to discuss providing prescriptions for inhaled steroids and asthma education in conjunction with ED visits as well as a system to ensure follow-up by a primary health care provider.

- Disseminate quality, comprehensive asthma patient discharge instructions to all EDs in the state.

- Link local asthma coalitions with local Child Death Review Teams to share expertise and assist with implementation of recommendations that may arise for community deaths.

- Meet with Quality Improvement Directors of Michigan health plans.

- Share data with the Michigan Quality Improvement Consortium's Medical and Quality Improvement Directors to inform their revision of the Asthma Guideline.

Continued tracking of asthma deaths in Michigan is planned to identify risk factors that can be addressed to prevent such deaths. The overall number of asthma death varied from 152 in 2002, 133 in 2003, to 136 in 2004 and from 32 to 27 to 28 in the 2-34 age groups being intensely tracked. This tracking needs to be continued to see if a downward trend in asthma mortality is under way and evaluate effectiveness of interventions to reduce both asthma morbidity and mortality.

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APPENDIX I

More comprehensive case summaries are available upon request for use in educational programs for health care providers.

2004 Case Narratives

Adults

1. An adult male died from asthma after he came home from work. He had moved to Michigan six months prior to his death. He was seen in the ED three times for asthma in the last four months of his life. The panel's concerns included lack of health insurance, lack of regular medical care, inadequate use of steroids, and smoking.

2. An adult male went to the ED for an asthma attack after he used his nebulizer with albuterol and atrovent at home without relief of his symptoms. He also had run out of his prednisone. He was discharged from the ED in stable condition but later that day went into respiratory arrest and died. He was a cocaine drug abuser. The panel members discussed the deceased's drug abuse, compliance with medications and regular medical care.

3. An adult male began having increased breathing problems six months before his death after moving into a new apartment. He was seen in the ED 12 days prior to death for a breathing problem and was given antibiotics and a nebulizer. Factors considered important in his death included the over-use of bronchodilators, smoking, and the lack of seeing a specialist for the potential new allergen in his apartment.

4. An adult male died shortly after waking up in the morning. The deceased woke up at his girlfriend's house. The girlfriend did not notice any breathing problems or hear him complain of any problems. He then went to his own house, which is where he had his asthma attack. He had insurance and regular medical care. The panel felt the deceased over-used his bronchodilators, did not use steroids, had not tried to eliminate asthma triggers, and had not been referred to a specialist.

5. An adult male was found dead in his apartment after his did not show up for work for two days and did not show up for a birthday party. The panel felt that the deceased did not recognize the severity of his asthma, over-used his bronchodilators, and was under-treated by his physician.

6. An adult female was found by EMS in her bedroom unresponsive. Her kids called the grandmother and 911 after they saw the deceased having trouble breathing. Her asthma became worse after her father died two years before. The panel felt that inadequate use of steroids, over-use of bronchodilators, the need for a referral to a specialist, and depression were factors in her death.

7. A young adult female collapsed in her place of work from an asthma attack. The panel

felt the causal factors were inadequate use of steroids, over-use of bronchodilators, non-compliance with medications, exposure to second hand smoke in the bar where she worked and inadequate awareness of the severity of her asthma. She did have insurance and regular care by a doctor.

8. An adult male collapsed in his home after attempting to use his nebulizer and inhaler. He was self-employed and had a hard time keeping a job because of his breathing problems. The panel stated contributing factors to his death were non-compliance with medications, psychosocial issues, and the use of marijuana and cigarettes.

9. A young adult female died shortly after being exposed to a smoke machine being set up for a show. She was diagnosed with asthma as a toddler and had private insurance until one year before death. The factors contributing to her death were over-use of bronchodilators, inadequate use of steroids, smoking, and obesity.

10. An adult female died two days after she was seen in the ED for breathing problems. The panel questioned the diagnosis of asthma and her evaluation in the ED. She abused narcotics.

11. A young adult male began having trouble breathing in a dance club. His friends brought him back home for a breathing treatment. He had taken 4-5 breathing treatments and an Epi-pen when 911 was called. He died in the ED. The panel felt the issues included over-use of his nebulizer, inadequate use of steroids, lack of trigger avoidance, and not having the inhaler with him at the club.

12. An adult male was found dead in his bathroom. He worked at a plastics and foam plant and lived with his wife and three children. He had a history of alcohol abuse, smoking cigarettes, and marijuana. The panel felt the factors relating to the death included inadequate use of steroids, compliance with medications, and lack of a referral to a specialist.

13. An adult male died from asthma in his home. He did not have insurance and used the ED as his regular care. Factors attributing to the death include inadequate use of steroids, bronchodilator over-use, compliance with medications, smoking, and not avoiding asthma triggers.

Children

1. A male child died from asthma in his sleep. He also had cerebral palsy and had been limited to a wheelchair. He had never gone to the ED for his asthma. The panel was concerned about the inadequate asthma diagnosis, inadequate prescriptions and use of steroids, need for referral for this high-risk child, and his multiple medical problems.

2. A male child was a permanent ward of the state and in the foster care system. He was visiting his Aunt and died sometime after breakfast. Compliance with medication, asthma triggers, and bronchodilator over-use were the main issues. The panel also questioned the lack of adequate attention to asthma triggers in the foster care system.

3. A male child was playing basketball and complained that he couldn't breathe. The panel felt there was a lack of adequate insurance to cover his medications, lack of adequate steroids, and the need for more intensive care for this high-risk child.

4. A female teenager mother died from an asthma attack at home. She was never diagnosed with asthma. She was diagnosed with bronchitis at her doctor's office one week prior to death. The panel was concerned with the lack of diagnosis.

5. A female teenager was in and out of the hospital for asthma all her life. She died in the ED after the mother drove her there for a severe asthma attack. The panel attributed her death to bronchodilator over-use, inadequate use of steroids, multiple medical problems, smoking, and lack of regular medical care.

6. A male child died from asthma at his home. He had been thrown to the ground earlier in the night during a fight. The review panel felt there was inadequate steroid use and bronchodilator over-use, lack of compliance with avoidance of smoking, and pets. The child had missed approximately 20 days of school per year due to his asthma.

7. A male child died from asthma while his parents were out of town. He had quit school and had been in the juvenile court system. He used alcohol, cigarettes, and marijuana. The panel was concerned about the child's compliance with medications**,** bronchodilator over-use, inadequate use of steroids, and family dysfunction.

8. A male child in his teens died from asthma. Other medical conditions included spinal muscular atrophy and scoliosis. He was confined to a wheelchair. The panel questioned whether the cause of death was asthma. The panel attributed his death to a neurodegenerative disease.

9. A teenage female was diagnosed with asthma at age four. She was at her grandmother's house when she had an asthma attack and died. This child was seen in the ED four times in the year prior to death. The panel was concerned with compliance with medications and whether the deceased kept her appointments with her doctor. Her steroid use was inadequate and she suffered from depression. Child Protective Services was involved.

10. A male in his teens died from asthma while playing basketball. The panel believed there was bronchodilator over-use, inadequate use of steroids, and inadequate awareness of the severity of the asthma. He had no regular maintenance health care visits.

11. A preteen female had hypoxic encephalopathy and recurrent seizures from birth. She died from asthma in her sleep. The panel suggested that factors that contributed to the death were bronchodilator over-use, inadequate use of steroids along with her co-morbid conditions.

12. A preteen male had seen his physician for difficulty breathing the day before he died. He was given an inhaled steroid to take at home. His father then took him to the ED for persistent difficulty breathing. He was given breathing treatments, steroids, and oxygen. His symptoms worsened, he was intubated and died while being transported to another hospital. The panel was concerned with the inadequate use of steroids, bronchodilator over-use, and smoking by the father. He also had no regular maintenance health care visits.

13. A female in her early teens died from asthma after going to sleep with a puppy in her bed. She woke up in the night extremely short of breath. The ambulance was called after two breathing treatments were given with no improvement. She died in the hospital. The panel was concerned with bronchodilator over-use with her nebulizer, inadequate use of steroids, and the new puppy as a trigger.

14. A male teen had been ill with a cold for a few days before he died from an asthma attack. He arrived at one hospital and was transferred to a second hospital where he spent three days in the intensive care unit. He was then pronounced brain dead. The panel felt his death could be attributed to poor compliance with medical visits and referrals.

15. A preteen female died from a reaction from a drug instead of asthma as stated on the death certificate. She was never diagnosed with asthma.

APPENDIX II

Members of Adult and Child Asthma Mortality Review Panels

Adult Asthma Mortality Review Panel Members

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Child Asthma Mortality Review Panel Members

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