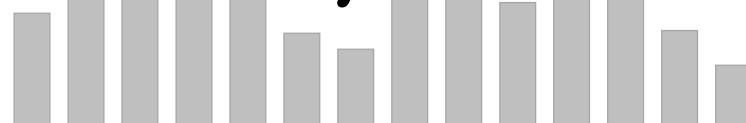


# Health by Numbers



Rhode Island Department of Health  
Patricia A. Nolan, MD, MPH, Director of Health

*Edited by Jay S. Buechner, PhD*

## Health Status, Access to Care, and Health Risk Behaviors Among Urban Rhode Islanders, 2000

*Jay S. Buechner, PhD, Colleen Ryan, MPH, Jana E. Hesser, PhD*

One of two defining goals of Healthy People 2010 is “to eliminate health disparities among segments of the population, including differences that occur by gender, race or ethnicity, education or income, disability, geographic location, or sexual orientation.”<sup>1</sup> At the national level the discussion of differences by geographic location emphasizes the elevated rates of mortality and morbidity from injury and from chronic and infectious diseases among residents of rural areas, as well as their lower utilization of preventive screening services and higher prevalence of risky behaviors.<sup>1</sup>

In a highly urbanized state such as Rhode Island, rates for many adverse health outcomes and risky behaviors are higher in core urban areas than in the surrounding suburbs, small towns, and rural areas.<sup>2</sup> The reasons for these elevations are much the same as for rural areas in other parts of the country; i.e., lack of health insurance coverage, poverty, low educational achievement, inadequate access to health care providers, and riskier occupations. Here we present data from the 2000 Behavioral Risk Factor Surveillance System (BRFSS) on the differences in behavioral health risks faced by residents of five core urban areas compared with residents of the rest of the state.

### Methods

The Rhode Island Department of Health (HEALTH), through the BRFSS, has surveyed a sample of Rhode Island adults by telephone each year since 1984 concerning key health risk behaviors, health insurance coverage, and participation in health screening. Funded by the Centers for Disease Control and Prevention (CDC), Rhode Island’s BRFSS is part of a national effort covering all 50 states, DC, and three territories that monitors these health risk factors.<sup>3</sup>

In 2000, HEALTH’s professional survey contractor for the BRFSS conducted 3,544 interviews (approximately 295 each month) of randomly selected Rhode Island residents ages 18 and older living in households with telephones. CDC defines the methodology used for the BRFSS by all BRFSS participants.<sup>3</sup>

The BRFSS asks for information on town of residence from each respondent. The five Rhode Island cities grouped as core urban were Central Falls, Newport, Pawtucket,

Providence, and Woonsocket. In the 2000 Census, they had a total population of 335,473 (32.0% of the state’s 1,048,319 residents) and 977 BRFSS respondents (28.6% of the 3,421 providing city/town of residence). The remaining 34 cities and towns had a total population of 712,846 (68.0%) and 2,444 BRFSS respondents (71.4%).

### Results

In 2000, urban residents among BRFSS respondents in Rhode Island were more likely to report their general health status as fair or poor (21%) than their suburban and rural counterparts (12%). (Figure 1) This disparity was not mirrored in the selected specific health status measures on the survey, where urban residents showed prevalence rates either similar to (asthma, diabetes) or lower than (arthritis, permanent tooth loss) other residents.

On three measures of access to health care collected by the BRFSS, urban residents were uniformly more likely to report limited access than other respondents. They were more likely to lack health insurance and less likely to have had a routine medical checkup or a dental visit during the past year. (Figure 1)

Table 1. Definitions of Health Risk Indicators

Indicator	Definition
Poor or Fair Health	Self-rated general health is fair or poor
No Routine Checkup	Has not had a routine health checkup within past year
Uninsured	Has no health care coverage (ages 18-64 years only)
Current Smoker	Smokes cigarettes regularly or occasionally
Overweight	Body mass index (BMI)* $\geq 25.0$ kg/m <sup>2</sup>
Too Few Fruits and Vegetables	Eats fewer than 5 servings of fruits and vegetables a day
Currently Has Asthma	Ever been diagnosed with asthma by a physician and currently has asthma
Ever Had Arthritis	Ever been diagnosed with arthritis by a physician
Ever Had Diabetes	Ever been diagnosed with diabetes by a physician, other than during pregnancy
No Dental Visit	Has not seen a dentist within past year
Permanent Tooth Loss	Has lost one or more permanent teeth due to decay or infection

\*BMI is defined as weight in kilograms divided by height in meters squared.

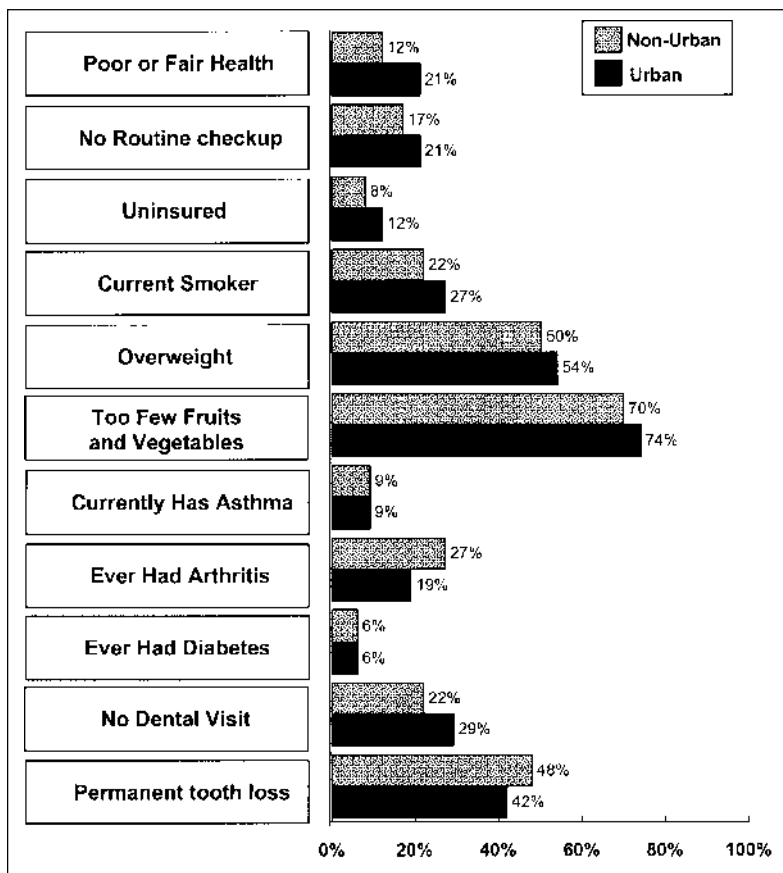


Figure 1. Health Risks among Adults Ages 18 and Older, by Urban Residence.

Urban Rhode Islanders were also more likely to participate in certain risky health behaviors than other respondents. More of the urban respondents smoked cigarettes and were overweight, and fewer reported eating five or more servings of fruits and vegetables per day. (Figure 1)

## Discussion

Residents of core urban areas in Rhode Islanders fare worse than suburban and rural residents in measures of access to health care and health risk behavior, as well as in a global measure of health status. These patterns may stem from other characteristics of urban residents that are related to health, such as low incomes, lack of access to nearby health care providers, minority race and ethnicity, and lack of health coverage. Previous analyses of HEALTH survey data have described the association of some of these underlying factors with health indicators,<sup>4, 6</sup> and the results of those studies can help illuminate the results presented here.

Currently, many of the efforts in the state to address health disparities among urban residents target population segments defined by poverty, race and ethnicity, and lack of health coverage. Examples are programs in the areas of nutrition (WIC), maternal and child health services, women's cancer screening, minority health promotion, and health care coverage (RIte Care, RIte Share). Some programs have a geographic component to their targeting, such as programs to prevent lead poisoning

among children, which target areas with high proportions of older housing, and federal programs to ameliorate differences in the supply of health care professionals. It is of note that under one such federal program, all five of the cities grouped as core urban in this study are designated as shortage areas, either for their entire populations or for residents with family incomes under 200% of the federal poverty level.<sup>7</sup> In combination, these programs are working toward the objective of eliminating the health disparities between urban and other Rhode Islanders by the year 2010.

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*Colleen Ryan, MPH, is Public Health Epidemiologist, Office of Health Statistics.*

*Jana E. Hesser, PhD, is Program Manager for Health Surveys, Office of Health Statistics, and Coordinator for Rhode Island's BRFSS.*

## References

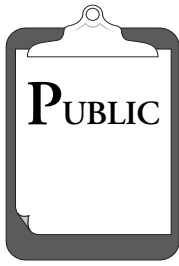
1. US Department of Health and Human Services. *Healthy People 2010: 2nd ed. Understanding and Improving Health and Objectives for Improving Health.* (2 vols.) Washington, DC: US Government Printing Office. November 2000.
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7. Lopez J, Miller MA, Ross M. The Office of Primary Care at the Rhode Island Department of Health. *Med&Health/RI* 2000;83:132-3.

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# Quick Reference Guide For Asthma Diagnosis and Treatment

The National Heart, Lung, and Blood Institute (NHLBI) first issued Guidelines for the Diagnosis and Management of Asthma in 1991.<sup>1</sup> At the time, it was considered a landmark in the management of asthma, and the publication of an updated version of the Guidelines in 1997 was considered no less important.<sup>2</sup> In community planning sessions conducted by the Rhode Island Asthma Control Program, primary care physicians, pulmonologists, allergists, and emergency medicine physicians alike have referred to the Guidelines as a major asset in the physician's armamentarium against asthma, the "gold standard" against which all approaches to asthma management should be evaluated.

Nonetheless, the Guidelines has not been widely used in front-line medical practices. Like many "gold standards," the Guidelines is comprehensive, complex, and cumbersome. The latest version is almost 150 pages long. As many physicians in Rhode Island and throughout the country have noted, the format of the Guidelines is especially ill-suited for use in hectic primary care practices.

In response, Dr. Charles Sherman and Dr. Sidney Braman of the Rhode Island Asthma Control Program have developed a Quick Reference Guide for Asthma Diagnosis and Treatment. The Guide is based on the NHLBI's Guide-

lines for the Diagnosis and Management of Asthma, and reflects the most up-to-date configuration of stepped care (step up and step down) for asthma. As they developed the Guide, Drs. Sherman and Braman discussed it with physicians from a variety of specialties, modifying it on the basis of their comments.

The practice of medicine undergoes steady, sometimes rapid change, and the medical management of asthma is no exception. For this reason, Drs. Sherman and Braman consider the Quick Reference Guide for Asthma Diagnosis and Treatment to be a working document, subject to periodic updates and continuing discussion in the medical community. As such updates occur, the Asthma Control Program will keep physicians throughout Rhode Island informed. We hope you find the present Guide to be a help in your practice.

1. National Asthma Education and Prevention Program. *Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma*. National Institutes of Health pub no 913642. Bethesda, MD, 1991.
2. National Asthma Education and Prevention Program. *Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma*. National Institutes of Health pub no. 974051. Bethesda, MD 1997.

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# Quick Reference Guide for Asthma Diagnosis and Treatment

Charles Sherman, MD

- Updated December, 2001 -

Sidney Braman, MD

## DIAGNOSIS

Subjective:  
(1 or more)

- Wheezing
- Chest tightness
- Dyspnea
- Cough ± sputum

Objective:  
(1 or more)

- Airflow obstruction ( $FEV_1 < 80\%$  predicted)
- Reversibility post-bronchodilator ( $FEV_1 > 12\%$  increase)
- Bronchoconstriction post-methacholine ( $FEV_1 > 20\%$  decrease)
- AM/PM peak flow variability ( $> 20\%$ )

## EDUCATION

- Use of peak flow meters
- Trigger avoidance
- Warning signs of exacerbations
- Medication effects and side effects
- Asthma management plan

## TREATMENT

### ***Symptoms:***

### ***Medications:***

**Step-up:**

Mild intermittent  
( $\leq 2x/week$ )

- PRN: short-acting beta agonist

**Step-up:**

Mild persistent  
( $> 2x/week$ ;  $< daily$ )

- Low dose inhaled corticosteroid
- +/- long-acting beta agonist  
or leukotriene receptor antagonist
- PRN: short-acting beta agonist

**Step-up:**

Moderate persistent  
(daily)

- Moderate dose inhaled corticosteroid  
+ long-acting beta agonist
- +/- leukotriene receptor antagonist
- PRN: short-acting beta agonist

**Step-up:**

Severe persistent  
(continuous)

- High dose inhaled corticosteroid  
+ long-acting beta agonist
- +/- leukotriene receptor antagonist
- +/- oral steroids
- PRN: short-acting beta agonist

**Step-down:**

Improved

- Slowly reduce medication as tolerated

# Point of View: Marfan Syndrome: Be Aware Of Life-Threatening Complications



Dianne N. Abuelo, MD

In April 1991 Allison Bowman, 17 years of age, collapsed and died in the yard of her North Providence home. She was 6 feet 1 inch tall and was known to have the Marfan syndrome. The following day an 11-year-old boy, also known to be affected, collapsed and died in his East Providence school cafeteria. These 2 tragic events occurring on consecutive days shocked Rhode Island and heightened awareness of this rare, but potentially lethal disorder.

Allison is just one of many individuals - primarily young adults - who had her life cut short due to Marfan syndrome and unexpected aortic dissection. A heritable disorder of connective tissue, the Marfan syndrome manifests itself in many body systems - particularly the skeletal, ocular and cardiovascular systems. Physical signs can include a tall, lanky body habitus, myopia, dislocated ocular lenses, mitral valve prolapse and dilatation of the aortic root. In about 75% of cases, the Marfan syndrome, an autosomal dominant condition, is inherited from a parent, but one quarter of cases results from a spontaneous mutation. Before the benefits of pharmaceutical treatment and surgery, the average life span was in the 40s. Now with the correct diagnosis and proper management, affected people can live into their 70s. With such an optimistic prognosis, why are people still dying early from this disorder?

One of the reasons for premature deaths is that people are still not being diagnosed early, before the situation becomes life-threatening. An accurate, early diagnosis is critical to set the management plan for a patient who, although faced with a chronic, progressive condition, could have a chance to live a normal life span with the disorder. In the emergency department, recognition of outward signs of the disorder may help to save the life of an individual who may be suffering an aortic dissection, a common complication of the Marfan syndrome.

When a parent has a positive diagnosis, it is incumbent upon the physician to ensure that all children be evaluated in the attempt to confirm or refute the diagnosis. The same holds true for patients who do not have a family history of the disorder, but present outward signs that may indicate the Marfan syndrome. Because of the high rate of spontaneous mutation, physicians must be particularly alert to the combination of findings that could indicate the Marfan syndrome or a related connective tissue disorder that shares similar life-threatening complications. Affected individuals should receive genetic counseling. Questionable cases can be referred for evaluation by a medical geneticist.

Although the gene for the disorder has been found, there is unfortunately no simple genetic test to establish the diagnosis. Instead, the evaluation must include physical examination, a slit-lamp examination to look for a dislocated lens and an echocardiogram to assess the size and function of the aorta. Many of the characteristics associated with the Marfan syndrome are common in the general population, so the clinician should combine findings and assess the overall presentation of the individual to determine if there is enough evidence to make the

diagnosis by current clinical criteria. If immediate findings are not conclusive, patients should still be followed to ensure they do not develop aortic enlargement at a later date.

Ongoing cardiology management of the Marfan patient is necessary to assure that progressive problems do not become life-threatening. Patients with the Marfan syndrome are advised to modify their lifestyles to avoid strenuous exercise, contact sports and other activities that would put undue stress on the aorta. Beta-blockade can slow aortic enlargement. When the aorta reaches a critical size (5.0-5.5 cm), surgery is recommended to replace the enlarged portion of the aorta and, if necessary, the aortic valve. Recent studies have shown that this elective aortic surgery is quite effective, with an operative mortality rate of only 1.5%.

In an emergency situation, recognizing the signs of the Marfan syndrome - which puts people at 100-fold increased risk of aortic dissection - is essential so that the proper imaging studies can be conducted and interpreted in time to institute life-saving procedures. One recent case was the death of Tony Award-winning playwright Jonathan Larson (Rent), who was seen in two New York City hospitals with incorrect diagnoses and then died shortly thereafter of an aortic dissection.

Although aortic dissection is uncommon, there are thought to be 5,000-10,000 dissections per year in the United States; but the number may be underreported because without autopsy evidence, deaths are attributed to "heart attack" or "sudden death" when the cause is actually an aortic dissection. There is a fatality rate of more than 90% associated with an acute aortic dissection originating near the heart without urgent surgical intervention.

The primary symptom of an aortic dissection is severe pain, usually in the chest, but occasionally in the abdomen when the tear begins in the lower part of the aorta. A standard chest x-ray cannot be conclusive in identifying an aortic dissection. An imaging study of the aorta (echocardiogram, MRI, CT scan or transesophageal echocardiogram) can confirm or disprove the diagnosis. Symptomatic aortic dissections or aneurysms require emergency surgery. Newer surgical techniques may allow treatment by catheterization.

For more information for physicians and families about the Marfan syndrome, contact the **National Marfan Foundation (NMF)**, 800-8-MARFAN or <http://www.marfan.org>. The NMF is offering a CME video (for two AMA Category 1 credits), *Emergency Diagnosis and Treatment of Aortic Dissection*, free of charge to physicians, emergency administrators and hospital education coordinators.

## ACKNOWLEDGEMENT

The author acknowledges the helpful input from the National Marfan Foundation.

*Dianne Abuelo, MD, is Director of the Genetic Counseling Center, Rhode Island Hospital, and Associate Professor of Pediatrics, Brown Medical School.*

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# Vital Statistics

Rhode Island Department of Health  
Patricia A. Nolan, MD, MPH, Director of Health

Edited by Roberta A. Chevoya

## Rhode Island Monthly Vital Statistics Report

Provisional Occurrence Data  
from the  
Division of Vital Records

Underlying Cause of Death	Reporting Period			
	February 2001	12 Months Ending with February 2001		
	Number (a)	Number (a)	Rates (b)	YPLL (c)
Diseases of the Heart	265	3,057	309.3	4,296.5**
Malignant Neoplasms	173	2,375	240.3	6,781.5
Cerebrovascular Diseases	41	491	49.7	745.0
Injuries (Accident/Suicide/Homicide)	29	370	37.4	6,799.5
COPD	55	487	49.3	440.0

Vital Events	Reporting Period		
	August 2001	12 Months Ending with August 2001	
	Number	Number	Rates
Live Births	1137	13,095	13.2*
Deaths	786	10,208	10.3*
Infant Deaths	(8)	(93)	7.1#
Neonatal deaths	(8)	(79)	6.0#
Marriages	917	8,550	8.6*
Divorces	362	3,424	3.5*
Induced Terminations	437	5,488	419.1#
Spontaneous Fetal Deaths	51	977	74.6#
Under 20 weeks gestation	(49)	(907)	69.3#
20+ weeks gestation	(2)	(70)	5.3#

(a) Cause of death statistics were derived from the underlying cause of death reported by physicians on death certificates.

(b) Rates per 100,000 estimated population of 1,048,319

(c) Years of Potential Life Lost (YPLL)

*Note: Totals represent vital events which occurred in Rhode Island for the reporting periods listed above. Monthly provisional totals should be analyzed with caution because the numbers may be small and subject to seasonal variation.*

\* Rates per 1,000 estimated population      # Rates per 1,000 live births  
\*\* Excludes two deaths of unknown age.

## Letter to the Editor:

On December 1, 2001, **Neighborhood Health Plan of Rhode Island (NHPRI)** made a dramatic addition to its services. It implemented a contract with employees and administrators of 19 human service agencies, offering them Neighborhood Solutions, a full-service health insurance product, made possible through their association as the **Provider Resources and Benefits (PRB)** group. These employees - many of whom may already be your patients - will now be able to access the high-quality care at a reasonable cost.

Because this extension of NHPRI's service may affect you personally, we want to keep you up-to-date about our Neighborhood Solutions product and how it works.

Neighborhood Solutions is intended to offer critical, long-term-oriented health insurance coverage in a cost-effective manner. It is designed to impart the benefits of large group purchasing, volume discounts and price stability, to collections of small groups. Most important, it helps workers get appropriate care at the appropriate time - including those who opt for supplementary, case management services.

More than 2,500 employees and 5,000

covered lives will benefit from this program. Participants include: Easter Seal of Rhode Island/ Cranston Arc, Fogarty Center, Spurwink/RI, J.Arthur Trudeau Memorial Center, Corliss Institute, the Blackstone RI Arc, West Bay Residential, Avatar, Bridges, COVE, Looking Upwards, Olean Center, Ocean State Community Resources, Perspectives Corp., Re-Focus, Gateways, LIFE, Inc., and LaPlante Center.

Neighborhood Solutions features standard care such as prescription coverage, hospitalization, and office visits. Subscribers can also opt for two supplemental programs - a waiver of co-payments for Preferred Primary Care Physicians, and another, Care Solutions, for chronic, catastrophic or complicated illnesses.

How will it work?

For Neighborhood Solutions, NHPRI is contracting with Health Care Value Management - an existing network vendor - to augment our provider network in Rhode Island and southeastern Massachusetts. Employees who select a Preferred Primary Care Physician will not have a co-pay for that physician's service. Should the member see a physician other than their Preferred

Primary Care Physician, a \$10 copay will apply. If the physician does not belong to either Health Care Value Management or NHPRI's networks, additional member co-insurances and deductibles will apply, as with in any out-of-network program.

If a patient chooses a Preferred Primary Care Physician, s/he must notify us. The system is set up to waive the office visit co-pay for such a member, and an ID card will be issued specifying it. All subscribers will have access to our case management program, "Care Solutions," for certain diagnoses, where we will further waive pharmacy co-payments, for a limited period of time.

Neighborhood Solutions has the potential to improve the health care of our citizens significantly, while improving health care access: a worthy effort, indeed.

We urge physicians to call us anytime, if they need more information, at (401) 459-6000.

- **Christopher F. Koller**  
CEO, Neighborhood Health Plan of Rhode Island

# THE RHODE ISLAND MEDICAL JOURNAL

The Official Organ of the Rhode Island Medical Society  
Issued Monthly under the direction of the Publications Committee

VOLUME 1  
NUMBER 1

PROVIDENCE, R.I., JANUARY, 1917

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## NINETY YEARS AGO

[FEBRUARY, 1912]

The October 1911 meeting, held at Rhode Island Hall [at Brown] drew 60 members and 3 guests. Drs. Frank E. Peckham and Roland Hammond presented radiographs, demonstrating the treatment of fractures. Dr. Walter L. Munro retorted that he believed "radiography is not an unmixed blessing, that often too much work is done upon cases which would do better if left alone."

At the November 1911 meeting, with 68 members and 4 guests, the total contribution subscribed toward the library was announced: \$14,890. Also, Dr. R.P. Campbell of McGill University read a paper on the diagnosis of syphilis. The discussion focused on the importance of spirochetes in early lesions, the difference between the Noguchi and Wasserman reactions {"for the most part the two give identical results"}, and the confounding influence of leprosy, tuberculosis and scarlet fever.

James L. Wheaton, Jr., MD, contributed "The Open Air School: Its Development and Purpose." He explained: "One of the greatest problems today ...should be what is the best method to be employed in the building up and in the making of a more healthful human race..." He found 60% of school-rooms "foul-smelling, sickish and contaminated with the decomposed breath of scholars," with unsterilized, uncleaned books. Inspired by the open-air treatment of tuberculosis, however, Pawtucket made one room in every new school house an open-air room, with windows open on 3 sides. Children in those rooms, moreover, washed and brushed their teeth before lunch and dinner. Absences declined, from 17% to 13% (even though children lacked clothing and had work to do at home); and children gained weight, from 4 to 12 pounds.

## FIFTY YEARS AGO

[FEBRUARY, 1952]

In "Diathermy Regulations," Charles P. Williamson, Esq., legal counsel to the Rhode Island Medical Society, clarified Federal Communications Commission rulings on the use of the equipment.

Harry Hecker, MD, and Raymond E. Stevens, MD, contributed "Nephrosis - A Long Remission after ACTH." A 14 year-old schoolboy was admitted with "swelling of his legs of 2 days duration." Seventeen days previously, he had had a head cold, which cleared, without treatment, in 3 to 4 days. He was placed on 10 mm of ACTH every 6 hours for 5 days, with no benefit. He was subsequently re-hospitalized with a swollen abdomen and chest. He was

put on 20 mm ACTH every 6 hours for 6 days, but after a weight gain (from 140 pounds to 197 pounds) and edema, therapy was discontinued. Subsequently he was put on 40 mm of ACTH qid; he felt better immediately, and returned both to school and to his job as a delivery boy.

Arthur Kern, MD, in "Dermatoses of the Newborn," reviewed conditions that could lead to death: impetigo neonatorum, epidermolysis bullosa, congenital defects of skin, sclerema neonatorum, ichthiosis congenita.

## TWENTY FIVE YEARS AGO

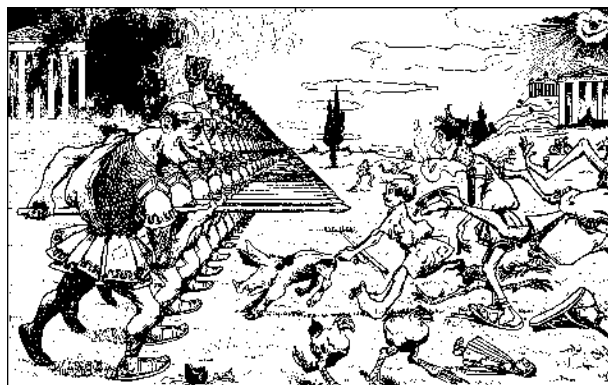
[FEBRUARY, 1977]

Stanley M. Aronson, MD, MPH, described "Brown and the State Hospitals," with details on the concrete results of the liaison: a new 32-bed teaching rehabilitation service at the Center General Hospital, supervised by Drs. Carl Granger and David Greer; a federally-subsidized study of the Institute of Mental Health and the regional Mental Health Centers, under the supervision of Dr. Sylvia Sherwood of Brown and the IMH Project Director, Stanley Oglesby; discussions of a comprehensive plan for mental retardation, with attention to the Ladd School population.

Daniel C. Wistran, MD, and Constantine Georas, MD, in "Idiopathic Hemochromatosis, Long Term Treatment and Hepatoma: A Case Report and Review of Literature," described a 48 year-old woman, the first patient with long-term follow-up developing hepatoma despite treatment.

A.A. Savastano, MD, and Louis Corvese, MD, in "Experience with the Garden Operation in Resistant Tennis Elbow," explained that in resistant cases "lengthening of the extensor carpi radialis brevis tendon is effective."

Thomas W. Pearlman, Esq., discussed, "Should a Physician Incorporate? Some Considerations in Light of the Pension Reform Act of 1974." He concluded: "Whether you incorporate or not, you should not lose the tax benefits under a pension plan."



# Bioterrorism and Physicians



Andrew W. Artenstein, MD, Marguerite A. Neill, MD, Steven M. Opal, MD

The deliberate use of microbial agents or their toxins as weapons and instruments of terror has become a focal point of our national debate due to the intentional transmission of anthrax to persons in the United States in October 2001.<sup>1</sup> While the threat of biological weaponry and bioterrorism is not novel, its imprint on the daily lives of most Americans has only become manifest with these events. These issues have been the subjects of preparatory activities and discussions for a number of years within public health, infectious diseases, military and other governmental spheres. Due to the unpredictable nature of the perceived and real threats, however, our paradigms for response and clinical management require continual reassessment.

Biological weapons have been used against both military and civilian targets throughout history. During the Cold War, both the United States and the Soviet Union maintained programs to develop these agents as offensive weapons.<sup>2</sup> The U.S. program ended by presidential decree in 1969; the Soviets continued to pursue an active program until, at least, the dissolution of their Union. The orphaned materials and the unemployed scientists from the dismantled Soviet effort still represent a significant unintended hazard of glasnost. The documentation by United Nations inspectors of the weaponization of massive quantities of anthrax and botulinum toxin by the Iraqis during the Gulf War dramatically illustrates the persistent threat posed by biological agents.<sup>3</sup>

## THREAT ASSESSMENT

Attributes contributing to the choice of pathogen as a bioterrorism agent are a high attack rate and severe clinical disease, but operational requirements are that it can be produced in adequate quantity, concentration and form and delivered in a fashion to effectively transmit infection. Aerosolization is the most likely route of bioterrorist attack due to the potential for widespread dissemination; however, large-scale release may not be necessary for a "successful" outcome from a terrorists' viewpoint. The recent transmission of anthrax in the U.S. has clearly shown that targeted deployment and delivery of biological agents using such primitive technology as mail can achieve at least some terrorist goals: anxiety, fear, and diversion of resources.

Broader terrorist aims in civilian populations, ill and dying patients, would be addressed in larger scale biological attacks.

These would likely require either state sponsorship or direct support from governments or other organizations with significant resources, contacts and infrastructure. While the development of biological agents for use in terrorism requires significant technical equipment and expertise, these weapons present a distinct economic advantage over conventional or nuclear weaponry. For these reasons they may be among the weapons of choice for developing countries.

## SENTINEL EVENTS AND DIAGNOSTIC PITFALLS

Bioterrorism is generally insidious; clinical illness will be recognized before the circumstances of a release event are known. Owing to the clinical incubation period of days to weeks for most of the potential threat agents and the geographic dispersal of Americans around metropolitan areas and other potential targets, casualties will likely be staggered in their temporal presentation for medical care and seen at diverse locations in areas surrounding a target. Early clinical recognition is further hampered by the fact that the initial symptoms and signs of many of these agents are flu-like and non-specific, and even in the later stages of illness, most physicians are inexperienced with the clinical appearance of these diseases. Additionally, as agents of bioterrorism are laboratory- and man-manipulated, their associated clinical presentations may differ from those in natural occurring disease. Nonetheless, physicians and other health care workers are likely to be the first responders in this setting and must therefore use clues obtained from patient history, exam and epidemiologic data and an active index of suspicion to guide their diagnostic and therapeutic approach.

## THREAT AGENTS

The CDC and others have classified biological threat agents into three categories based upon the feasibility of their production and deployment, transmission properties, their capacity to cause mortality and/or morbidity, and their potential to cause social disruption.<sup>4</sup> (Table

1) Category "A" agents have been successfully weaponized and tested in the past and would reliably cause high mortality, morbidity and social disruption when disseminated. Category "B" agents have also been successfully weaponized and tested in the past but have greater potential use as incapacitating agents rather than causes of high mortality. Category "C" largely represents emerging threats, and the miscellaneous group refers to some agents that have been either attempted or considered by various rogue states. Table 2 (insert) provides a syndromic differential diagnosis regarding some of these illnesses; Table 3 provides data on transmission and infection control procedures.

Anthrax is a zoonotic disease of herbivores that occurs in many geographic regions. Sporadic human infection results from contact with animal products or tissues contaminated by *Bacillus anthracis* endospores.<sup>5</sup> This agent has been successfully weaponized by nation-states as well as terrorist organizations<sup>3</sup> and has been recently used as a weapon against individuals in the U.S.<sup>6</sup> Naturally-occurring human disease is usually a cutaneous infection; less than 5% of cases are from inhalational or gastrointestinal routes of transmission. It would be anticipated that inhalational disease would be the form seen in a bioterrorist attack.<sup>7</sup> The recent inhalational cases in the U.S. have resulted from the aerosolization of spores inside letters by processing through high-speed mail sorting equipment or direct inhalation of spores on mail; cutaneous infections have resulted from handling contaminated mail.<sup>6</sup>

After the inhaled spores reach the terminal alveolar spaces of the lung, they are taken up by macrophages and transported to the mediastinal lymph nodes. There the spores germinate into vegetative, recognizable Gram-positive bacilli and subsequently disseminate hematogenously.<sup>5</sup> After an average incubation period of 2-7 days, clinical illness is manifest initially by non-specific symptoms: fever, malaise, myalgias, headache, chills, non-productive cough and abdominal pain in the majority. This symptom complex overlaps considerably with

**Table 1: Biological agents of concern for use as weapons**  
(see text) [after reference 4]

Category A	Category B	Category C	Miscellaneous
Anthrax	Q fever	Hanta viruses	HIV-1
Botulism	Viral encephalitides	Tickborne viruses	Adenoviruses
Plague	Brucellosis	Yellow fever	Influenza
Smallpox	Glanders	Drug-resistant TB	Rotaviruses
Tularemia	Staph. enterotoxin B		Hybrids
Viral hemorrhagic fevers	Ricin roxin		

**Table 3: Transmission and infection control by agent/disease**

Agent/disease	Incubation period	Person-to-person transmission	Infection control precautions
Inhalation anthrax	2-43 days	No	Standard
Botulism	12-72 hours	No	Standard
Pneumonic plague	1-6 days	Yes	Droplet
Smallpox	7-17 days	Yes	Contact + airborne
Tularemia	1-14 days	No	Standard
Viral hemorrhagic fevers	2-21 days	Yes	Contact + airborne
Viral encephalitis	2-14 days	No	Standard
Q fever	2-14 days	No	Standard
Brucellosis	5-60 days	No	Standard

influenza and other viral respiratory tract infections. Recent data suggest that nausea, vomiting, and shortness of breath appear to be significantly more commonly seen in anthrax as compared with viral respiratory tract illnesses, while rhinorrhea is common in viral respiratory tract illnesses but rarely seen in anthrax.<sup>8</sup>

Patients typically present for medical attention an average of 3.5 days into the illness, after which significant clinical deterioration occurs with dyspnea, chest pressure, hypoxemia and not infrequently, abdominal pain.<sup>6</sup> In the absence of antimicrobial therapy blood cultures are invariably positive within 24 hours. Chest roentgenography may reveal mediastinal adenopathy with or without pulmonary infiltrates and pleural effusions in most cases. Disease progresses rapidly with respiratory failure, shock, hemorrhagic meningitis (50%) and death.

Recent clinical experience in the U.S. has shown that early administration of appropriate antimicrobials and aggressive intensive care support has lowered the case fatality rate from the previously published 85%<sup>5</sup> to ~50%.<sup>6</sup> Treatment recommendations are beyond the scope of this paper and have been recently reviewed.<sup>7</sup> Combination antimicrobial therapy including a quinolone, with the addition of high-dose penicillin G for suspected CNS disease, has been advocated. Theoretical rationale exists for the addition of clindamycin due to its inhibition of protein, particularly toxin, synthesis in some bacteria. Limited cutaneous disease may be treated with a single agent. Post-exposure prophylaxis has been shown to be effective in animal studies and has been used extensively among those thought to be at risk from the recent mail exposures. The greatest difficulty with prophylaxis has been the precise determination of those at risk. The licensed inactivated anthrax vaccine is of limited availability and is not currently in use for civilians.

Botulism, an acute neurologic disease caused by *Clostridium botulinum*, occurs in sporadic outbreaks in the U.S. as a result of ingestion of foodborne toxin or the bacterium itself. The toxin, however, has been weaponized for use as an aerosolized agent of bioterrorism.<sup>3</sup> Botulinum toxin blocks the release of the neurotransmitter acetylcholine from presynaptic

vesicles thereby inhibiting muscle contraction.<sup>9</sup> The disease presents as an acute, symmetric, descending, flaccid paralysis that begins in the bulbar musculature and is associated with dilated pupils, ptosis, dry mouth, a clear sensorium and the absence of fever. Both the foodborne and the inhalation route of botulinum intoxication appear to be clinically indistinguishable.

Case fatality rates from foodborne botulism have declined to approximately 5% over the last four decades, largely as a result of improvements in supportive intensive care and mechanical ventilation. The symptoms, however, may last for weeks to months until reinnervation of paralyzed muscle fibers occurs from the generation of new motor axon twigs. Treatment with an equine antitoxin, available in limited supply from the CDC, may ameliorate symptoms if given early in the course. Clinicians should remain alert to the possibility that any single case of botulism could be the result of bioterrorism, either through intentional contamination of food or via an aerosol exposure. A large number of cases, multiple focal outbreaks, or the absence of a common dietary exposure upon detailed epidemiologic investigation may be clues to an intentional release.

Smallpox is caused by the variola virus, which although the most prolific disease killer in world history, was eradicated by an intensive global campaign by WHO in the 1960s and 1970s.<sup>10</sup> The last naturally occurring case was in Somalia in 1977. A generation of physicians and other health care providers has therefore come to medical practice without having seen a case of smallpox. The U.S. ceased routine civilian vaccination in 1972, and since variola virus does not circulate in the environment, over half of the U.S. population (those under age 30) is susceptible to smallpox. Adults who had been previously vaccinated or multiply re-vaccinated probably have some residual immunity, but the extent of protection against either infection or mortality remains unknown. It is known that the Soviets weaponized and stockpiled smallpox, and it is feared that these agents may have fallen into terrorists' hands.<sup>11</sup> These aspects, coupled with its 30% mortality rate and capacity for secondary spread among close

contacts, make the threat of bioterrorism using smallpox a potential public health catastrophe on a global scale.

Smallpox is spread from person-to-person by close contact via respiratory droplets and, in certain instances, by fine particle aerosols. Following an incubation period of 7-17 days, the patient develops fevers, chills and prostration. Within one or two days, a maculopapular rash erupts on the face, distal extremities, and mucous membranes of the mouth and oropharynx and spreads in a centrifugal distribution.<sup>12</sup> These lesions subsequently evolve to papules, vesicles and pustules over about 8 days in synchronous fashion, i.e. they are all in the same stage of development. After about three weeks, the lesions scab over and separate. The patient with smallpox is infectious from the onset of rash until all of the scabs have separated. Classically, varicella accounts for most of the diagnostic confusion; however, the rash of chickenpox is centripetal (i.e. begins on the trunk and spreads outward), the lesions are in varying stages of development (i.e. asynchronous) and do not involve the palms or soles.

The treatment for smallpox is largely supportive. Strict isolation with airborne precautions is necessary for cases. Tracing and vaccination of household and close personal contacts (i.e. face-to-face contacts) and vaccination of health care workers caring for cases is crucial to limiting the spread of infection. It is known that vaccination within four days of infection can either ameliorate the course or prevent disease altogether.<sup>12</sup> Only limited supplies of the vaccine exist in the U.S., but there is a current national plan to acquire adequate vaccine supplies to immunize the entire U.S. population if necessary. While there are no antiviral drugs of proven efficacy in the treatment of smallpox, this is an area of active investigation and some available agents have shown promise in animal models of related poxviruses.

Bacterial pathogens that cause primarily pneumonic disease are considered to be prime candidates for use as agents of bioterrorism. Aerosolized preparations of *Yersinia pestis*, *Francisella tularensis* and *Coxiella burnetii* could result in human and animal cases of pneumonic plague, tularemia, and Q fever, respectively. Plague is perhaps the most feared of these agents due to its propensity for person-to-person spread via respiratory droplets.<sup>13</sup>

In its naturally occurring form primary pneumonic plague is rarely transmitted to humans from respiratory secretions of infected animals, such as domestic cats.<sup>13</sup> After a one to six day incubation period, prominent systemic and respiratory symptoms ensue, typically with multilobar pulmonary infiltrates on chest roentgenogram. Cough productive of purulent sputum and/or hemoptysis are classically described, although the frequency of the latter is not clear. In the absence of effective treatment patients rapidly progress to multiorgan system failure

**Table 4: Useful Websites, Phone Numbers**

*www.bt.cdc.gov	CDC, Bioterrorism and Response
*www.hopkins-biodefense.org	Johns Hopkins Center for Civilian Biodefense Studies
*www.usamriid.army.mil	U.S. Army Medical Research Center for Infectious Diseases
*www.usamriid.army.mil/education/bluebook.html	USAMRIID Medical Management of Biological Casualties handbook
*www.health.state.ri.us/biot/home.htm	Rhode Island Dept. of Health BT site
RI DOH disease reporting: (401) 222-2577/after hours, weekends: (401) 272-5952	

with cardiovascular collapse and disseminated intravascular coagulation. The diagnosis can be made by identification of the characteristic small Gram-negative coccobacillary forms with "safety pin" (bipolar staining) appearance on Gram stain.<sup>13</sup> The organism is readily identified in sputum and may be found in the peripheral blood of patients dying of septicemic plague. The microbiology lab should be notified in advance if this agent is suspected. Recommendations for treatment and prophylaxis have been recently reviewed.<sup>14</sup>

Pneumonic plague can be transmitted via respiratory droplet nuclei from person-to-person, usually after close contact (<2 meters) with the index case.<sup>13,14</sup> This puts healthcare workers, hospital employees and other patients at risk in a hospital environment and raises the specter of secondary and tertiary spread, especially in poorly ventilated indoor settings. Prompt recognition of pneumonic plague and adherence to strict respiratory isolation precautions can prevent secondary cases; early initiation of appropriate antimicrobials may render the patient non-infectious and avert a lethal outcome.

Naturally occurring tularemia has several discrete clinical forms, but the intentional release of *F. tularensis* would likely cause a pulmonary syndrome at low inocula. After an incubation period of one to fourteen days, patients experience the abrupt onset of a febrile illness with upper respiratory symptoms, pleuritic chest pain and variable progression to pneumonia with or without hilar adenopathy.<sup>15</sup> The mortality rate exceeds 30% without appropriate antimicrobial treatment. Diagnosis is usually based upon clinical features and accomplished after ruling out other agents; the organism is an extreme biohazard in the laboratory, and therefore lab personnel should be notified in advance when isolation is attempted in clinical specimens. The antimicrobial approach to tularemia is similar to that of plague.<sup>15</sup> This illness is not spread person-to-person via respiratory secretions.

Q fever is a respiratory illness caused by a rickettsial organism that, although not generally fatal, can result in debilitating symptoms that may persist for many weeks.<sup>16</sup> Approximately 50% of affected individuals will have frank pneumonia following a non-specific febrile illness. The diagnosis is generally retrospective and therefore treatment should be based on clinical presentation.

Viral hemorrhagic fever agents are considered potential weapons of terror as they are

generally highly infectious in aerosol form, transmissible in healthcare settings, and lethal. Many of these agents, including Ebola, Marburg, Lassa fever, Rift Valley fever and Bolivian hemorrhagic fever viruses have been extensively studied by the government of the former Soviet Union.<sup>11</sup> These viruses have similar clinical presentations and overlapping clinical syndromes: fever, conjunctival injection, myalgias, prostration, increased vascular permeability and microvascular damage manifest by diffuse petechial hemorrhages.<sup>16</sup> Full-blown hemorrhagic fever evolves into shock with diffuse hemorrhaging and multi-organ system dysfunction. Blood and other bodily fluids from these patients are extremely infectious necessitating strict contact and airborne precautions. Treatment is largely supportive and should include the early use of vasopressors if needed. Ribavirin has been shown to be useful in some patients with Lassa fever, Rift Valley fever and Congo-Crimean hemorrhagic fever.<sup>17</sup>

**Venezuelan equine encephalitis (VEE)** is highly infectious in aerosol form and is a potential threat agent. Although uncommonly fatal, VEE may cause a disabling neurologic syndrome with sequelae in some.<sup>16</sup> The disease is not transmitted person-to-person, and therapy is largely supportive.

## CONCLUSION

As first responders to the threat of bioterrorism, physicians must be forward-thinkers, professionally prepared and personally ready for proactive roles within our local communities and our hospitals. A variety of resources are available to guide this effort. (Table 4) As physicians we must not only recognize and accept our responsibilities to the patients in our care, but we must fulfill our responsibilities as caretakers of the public health by working in tandem with public health authorities to optimize public safety.

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