Special Issue on Yog
Why tap your savings when you can draw on $15,000 to $40,000 from a personal unsecured line of credit.

- An instant line of credit.
- Pay no interest until you use it.

Plus, your Bankoh Professional Banking Package includes -- free or without annual fees (fees waived):

- Bankoh Visa® Gold Card*
- Bank of Hawaii Access Card®
- Bankoh Personal Checking Account
- Bankoh Collection Series Checks
- Cashier’s Checks and Money Orders

Get pre-approved overdraft protection:

- Bankoh CoverCheck

Along with other features and the 24-hour banking convenience you expect from Bank of Hawaii.

Please visit your nearest Bank of Hawaii branch and ask for more information.

MEMBER FDIC

* The Annual Percentage Rate for purchases on a Visa Gold is 12.30%. This rate is effective as of 1/1/96, and is subject to change. The Visa Gold has a variable rate, and the annual percentage rate may vary. The Visa Gold rate is determined quarterly by adding a “margin” of 7% to the average auction rate of 91 day U.S. Treasury Bills during the prior three-month period ending on the 15th day of each March, June, September and December.
Contents

Editorial
Norman Goldstein MD ................................................................. 41

Guest Editor
Frederick C. Holschuh MD ......................................................... 41

HMA President's Message
Carl W. Lehman MD .................................................................. 43

Alliance
Susan L. Foo, Alliance Vice-President, Health Projects ...................... 43

Abstracts from the Vog Symposium
Vog Overview and Background
Bruce S. Anderson PhD .............................................................. 44

Airflow Over the Island of Hawaii
Yi-Leng Chen PhD .................................................................. 44

Atmospheric Structure Around the Big Island and How it Affects Vog Flow
Russ Schnell PhD .................................................................. 45

VOG Concentration from Satellite
John N. Porter ........................................................................ 45

Vog Size Distribution, Optical Effects, and Spatial Variability
Antony D. Clarke and John Porter ............................................... 45

Volcanic Emissions from Kilauea and Their Effect on Air Quality
Jeff Sutton PhD and Tamar Elias ................................................ 46

Emergency Department Visits and Hospitalizations for Respiratory Disease on the Island of Hawaii, 1981 to 1991
David M. Mannino MD, Samuel Ruben MD, MPH, Fred C. Holschuh MD, Timothy C. Holschuh, Michael D. Wilson, Tami Holschuh ........................................... 48

News and Notes
Henry N. Yokoyama MD .............................................................. 55

Classified Notices .................................................................. 56

Council Highlights
Roger T. Kimura MD, Secretary .................................................. 57

The Weathervane
Russell T. Stodd MD ................................................................ 58

Plume from Puu Oo vent.
Front cover sponsored by Hawaii Emergency Physicians Associated, Inc. (HEPA).
Special thanks to Jane Takahashi of the U.S. Geological Survey at the Hawaiian Volcano Observatory.
Hawaii Emergency Physicians Associated, Inc.
HEPA

Established: 1971

Serving:
Hilo Medical Center
Castle Medical Center
Lucy Henriques Medical Center
Wahiawa General Hospital

Congratulations!

Sam Gingrich, M.D., F.A.C.E.P.
Director, EMSS, Island of Hawaii - Since 1978
Immediate Past Director, Emergency Department,
Hilo Medical Center
Director, Emergency Department, Lucy Henriques Medical Center
Specialist, Diving and Hyperbaric Medicine
Director, Hawaii Emergency Physicians Associated, Inc.

HEPA is a participating provider with:

HMSA—continuous since 1971
Kaiser—continuous since 1971
PGMA
CHAMPUS
Medicare
HDS

Aloha Care
HMSA
QUEST—
Kaiser
Queen's
Straub

P.O. Box 1266 • Kailua, HI 96734 • (808) 261-3326 • Fax: (808) 262-0514
This issue of the *Journal* focuses on a major problem on the Big Island of Hawaii—on all our islands and for our neighbors in the Pacific.


And Dr Nathan Burbane, professor of environmental health at the UH School of Public Health noted in 1969 the concentration of vog (volcano-induced fog) is not enough at the moment to even cause minor irritation. "It may be that two or three very young children with other allergies may have some respiratory discomfort, but the chance of that happening with the present concentration would be very rare, I would say. Meanwhile, it sure is depressing isn’t it?"

It is more than depressing! It is dangerous! Hawaii has the highest asthma death rate in the United States (*J Allergy Clin Immunol.*, 84:421-34). The problem of chronic obstructive pulmonary disease (COPD) and asthma has been exhaustively studied by Mannino, Ruben, the Holschuhs, and Wilson and is reported in this issue of the *Journal*.

This study represents a record for our *Journal*. It took three years of reviews, revisions and especially perseverance by David Mannino MD and his co-workers to obtain acceptance to publish this excellent report.

We also present some abstracts of a vog symposium on September 12, 1995 sponsored by the Department of Health.

Dr Bruce Anderson, Deputy Director for Environmental Health, Department of Health, and Dr Kenneth Olden, Director of the National Institute for Environmental Health Science and National Toxicology Program, will continue the studies of the health effects of vog.

In the latter part of the 1980s, when the eruption of Kilauea Volcano had been continuous for more than five years, Hawaii County Council Chair Russell Kokubun and Civil Defense Chief Harry Kim called together a task force on the eruption’s effects on the people of our island. I was privileged to be asked to serve on this committee which became known as the Hawaii County Vog Authority. During the years that the Vog group met to discuss and study the effects of vog, we received reports on types of volcanoes, geophysics, air quality, weather patterns, acid rain, agriculture, and human health. Many national and international experts on volcanoes, and local authorities on pulmonary disease assisted the group.

I began to report patient encounters in the Hilo Medical Center Emergency Department where I had noticed increased respiratory tract problems and upper respiratory complaints during “bad vog days.” I often heard people with asthma and COPD tell me they would sometimes sit in air conditioned shopping malls for relief.

Dr Sam Ruben, then Hawaii County district health officer, and I planned a study of ER visits around the island to include two years prior to the eruption and then annually until the study ended. ER visits at the five community hospitals are logged manually in log books. More than 200,000 patient encounters were received by the student investigators who were supported by grants and assisted by the Lung Association’s Big Island office. The culmination of this investigation is summarized in our article in this issue of the *Journal*.

I still practice in the Hilo Medical Center Emergency Department and continue to see the effects of vog on human health. Some years ago, Dr Bob Arnott of the “CBS Morning News” came to Hilo to interview me about vog. A nationally aired segment mentioned vog effects although my comments were not as sensational as he would have liked. What I told him, and continue to tell anyone who will listen, including all asthma and COPD patients I see is, “We can do little about vog, but we can do everything about smoking cessation.”

Two interesting bits of information from the meetings of the Vog Authority. An expert on volcanic eruptions, when asked how long we could expect this eruption to continue, said, “In my estimation, it could be three days to 300 years.” Another person when asked what the ancient Hawaiians did during prolonged eruptions answered, “They moved.”

With some exceptions, we generally can’t expect people to move, but we can do things to help. We can assist with a “vog index” type daily air quality report (the Department of Health is working on this). We can determine if schools in heavy vog areas should be air conditioned, and do everything we can to control tobacco use.
We have what it takes to keep your business healthy.

As your practice grows, so will your financial needs. At B of A, we have the products and the expertise to help manage your business efficiently. You can rely on quick loan decisions, simplified loan application procedures and flexible rates that work for you. For smart ideas that keep your business in good shape, call 545-6841 or visit the Bank of Choice.

The Bank of Choice

Bank of America
The problem of vog exposure is of special interest to me. As an allergist, I have been interested in the effects of various types of smoke on the allergic patient, especially the asthmatic patient who is often allergic or hyperreactive to exposure to many chemicals. I studied the effects and skin sensitivity of patients exposed to sugarcane smoke and also to firecracker smoke and published articles in the June and November 1976 issues of the HMJ. At that time, I wondered why an extract of sugarcane smoke could produce positive skin-test reactions, but the firecracker smoke extract did not. Yet, most severe allergy patients dread exposure to firecracker smoke. Subsequently the study of metasulfites, sulfur dioxide, and related compounds revealed that 10% to 15% of asthmatics are highly sensitive to sulfites, often not an allergic reaction but probably due to a deficiency of sulfite oxidase. They further showed that administering vitamin C or cyanocobalamine (Vitamin B12) decreased the patient’s sensitivity. I surmise that firecracker smoke and vog have a high concentration of sulfur dioxide.

I have consulted in Hilo one or two days every month for more than 20 years. Aggravation of allergic symptoms and asthma from exposure to vog have been perceived by many of these patients. Based on the above information, I often have prescribed vitamin C 2000 mg to 3000 mg per day for patients exposed to vog. I have never studied the results, but I believe a good double-blind study should be done to further evaluate this premise.

In last month’s HMJ, Dr. Yokoyama’s column included a reprint of my comments about the Medicare-Medicaid Entitlement Programs in the Honolulu Star Bulletin. That article evolved as a consequence of a presentation I had made in November 1995 at a half-day session organized by Representative Suzanne Chun-Oakland. I was asked for any proposed solutions to keep the Medicare and Medicaid Programs viable with governmental cutbacks in funding.

I believe there are multiple components that make the welfare program unaffordable. Many speakers at that conference have continued to meet regularly to further discuss the problems with Dr. Susan Chandler. We keep addressing the theme of budgetary cutbacks. I say, help welfare recipients become self-sufficient as well as individually responsible. They no longer need welfare assistance. We are likely to pay more in criminal costs than we save by dropping welfare recipients from the program without first training them to be self-sufficient. A dependency on the system has been created by giving monetary assistance without providing training and assistance in character development. These changes could not be readily implemented, but in the long run, I believe are necessary. We need a mechanism within our capitalistic society to deal with individuals who depend on the welfare program, which also includes Medicaid. The Medicaid system simply cannot provide the ever-increasing demands with concomitant decreased funding. I reported that physicians in Hawaii are treating these patients at or near operating costs, that further reduction of reimbursements to physicians is likely to force more physicians to stop participating with Medicaid and create a real access to care problem.

I recommend that programs be developed that require a welfare recipient to agree to work and/or be job trained in order to become self-sufficient.

Our society should neither allow nor support illicit drug use and unhealthy lifestyles by welfare recipients. In my opinion, such recipients must be willing to accept the responsibility of complying with rules or receive no benefits.

This year marks the 48th anniversary of the Hawaii Medical Association Alliance. Through the dedication and public service commitment of the spouses and medical friends of the HMA Alliance, a positive impact has been made in our community. I am delighted to report that the following 1995 Health Projects have been completed or are ongoing for 1996.

- Fundraising for the Cancer Society and Hospice Hawaii.
- Letter-writing campaign to President Clinton to ban the nuclear testing by France in the South Pacific has been met with a great deal of support by our school children and our community at large.
- The MADD Red Ribbon Campaign to prevent needless injuries and deaths due to drunk drivers was most successful, with thousands of red ribbons distributed to doctor’s offices for their patients and staff.
- The collection of usable toys and clothing for the Aloha Medical Mission to be sent to the needy families who suffered severely from the recent typhoon in the Philippines.

HMAA is dedicated to the SAVE campaign (Stop America’s Violence Everywhere) to make physicians and their spouses prominent advocates of domestic peace. Please contribute to the HMAA fund for domestic violence awareness programs. The children and families in our community need our help.

Mahalo nui loa for your continued support.

HAWAII MEDICAL JOURNAL, VOL 55, MARCH 1996
Abstracts from the Vog Symposium
September 12, 1995
Sponsored by the Hawaii Department of Health

Vog Overview and Background

Volcanic emissions from the Kilauea East Rift Zone are causing the most obvious air pollution problem in Hawaii today. On Kona wind days, volcanic haze is clearly visible hundreds of miles away on Oahu. The characteristics and dispersion patterns of volcanic emissions have been well-defined; however, studies on possible health effects are inconclusive.

Kilauea East Rift Zone has been erupting almost continually since January, 1983. Everyday the volcano produces more than 1,000 tons of sulfur dioxide. In fact, the U.S. Environmental Protection Agency reports the only recent violations of air quality standards for sulfur dioxide in the region were the result of naturally occurring volcanic emissions at the Hawaii Volcanoes National Park (“Breathing Easier: a Report by EPA on Air Quality in California, Arizona, Nevada and Hawaii”).

Air quality monitoring data from other areas on the Big Island are very limited; however, data collected by the Department of Health suggest that state and federal ambient air quality standards are not being exceeded in Kona or other areas of the Big Island even under the worst conditions. Nevertheless, sulfur dioxide, fine particles in the air, and various pollutant mixtures, such as sulfates and acid aerosols may individually or in combination present a significant risk.

Of special interest is the possibility that sulfur dioxide and other sulfur compounds are combining with oxygen and water to form sulfuric acid mists. These acid mists can irritate the respiratory tracts of humans and animals. At present, there are no air quality standards to judge the degree of health risks posed by these pollutant mixtures.

Since 1983, the Department of Health has received hundreds of calls from residents and visitors concerned about respiratory problems associated with exposure to volcanic emissions (vog). Anecdotal reports by doctors also support the contention that these pollutants may affect breathing and aggravate existing chronic respiratory and cardiovascular diseases. Sensitive individuals may include asthmatics, individuals with bronchitis or emphysema, possibly children, and the elderly. Unfortunately, existing records have been found to be incomplete and inadequate to characterize health risks. Thus, studies completed to date have been largely inconclusive.

This special issue of the Hawaii Medical Journal includes abstracts of recent air quality and health studies conducted on vog, and they represent the current state of understanding of the subject. Although studies on health risks to date are inconclusive, all involved in the symposium agreed that further work is needed to better characterize health risks.

Obviously, nothing practical can be done to mitigate the source; however, it is important that the Department of Health and other agencies further define current risks so that appropriate intervention strategies can be developed. With a firm scientific foundation, we will be in a much better position to address public health concerns associated with vog.

Bruce S. Anderson PhD
Deputy Director for Environmental Health
Hawaii Department of Health

Airflow Over the Island of Hawaii

Perturbations induced by the airflow past single isolated mountains include a variety of phenomena: flow splitting and flow deceleration on the windward side, mountain wakes in the lee side, etc. In addition, the airflow is affected by the diurnal heating cycle. From July 11 to August 24, 1990, the Hawaiian Rainband Project (HaRP) was conducted over the island of Hawaii to study the mesoscale airflow around the island, and the dynamics of early morning rainbands offshore of Hilo. The mesoscale airflow over the island summarized in this report is based on the data collected from surface stations and aircraft observations during HaRP.

Island blocking as revealed by the mean surface airflow

The mean trade-wind sounding taken by aircraft over the ocean east of Hilo during HaRP exhibits east-northeast trade winds on the order of 6 to 9 meters per second. Along the windward coast, flow splitting occurs in the Hilo Bay area. The airflow moves around the island with northeasterlies along the northeastern coast and southeasterlies along the northeastern coast. In addition to northern and southern tips of the island, strong surface winds also are found in the Humuula Saddle between Mauna Loa and Mauna Kea and in the Waimea Saddle between the Kohala Mountains and Mauna Kea. In both regions, the airflow moves around the mountains and channels through the saddle. On the windward slope, the incoming flow is decelerated significantly as it approaches the island. In the lee side, the trade winds are completely blocked by Mauna Kea and Mauna Loa with calm winds.

Nighttime and daytime flow regimes

The surface airflow is strongly modulated by the diurnal heating cycle. At night, much of the island has a downslope wind component except in the high wind regions: northern tip, southern tip, Waimea Saddle, and Humuula Saddle. The flow direction along the northeasterly and northeastern coasts shows that the trade winds are being forced to move around the island.

On the windward slopes west of Hilo, on the Kona coast and along the Waikoloa coast downstream of the Waimea Saddle, the wind direction of the daytime flow regime is about 180° out of phase with...
the nighttime flow regime. In these regions, the wind flow has a large upslope component during the day. Pronounced upslope flow also is observed at Mauna Loa Observatory, on the southeastern flank of Mauna Loa, and along the Kona coast as a result of solar heating.

Wake vortices

The wake consists of two elongated counterrotating quasi-steady eddies that give rise to a wide region of strong reverse flow along the wake axis. The reverse flow extends westward from the west coast of Hawaii a distance of about 200 km. A cloud line extends along the wake axis and sometime broadens considerably farther downstream. Aerosol concentration in the southerly eddy is elevated due to the entertainment of Kilauea plume. Strong shear zones, trailing westward from the northern and southern tips of the island delineate the accelerated trade winds and air trapped in the recirculating wake.

References


Dr Yi-Long Chen
Department of Meteorology
University of Hawaii

Atmospheric Structure Around the Big Island and How It Affects Vog Flow

Relative to the size of the Earth, the thickness of the atmosphere is comparable to a sheet of Handiwrap covering a one foot diameter globe. Half of the Earth’s atmospheric mass exists below 16,000 ft altitude. In short, the atmosphere is thin.

This thin layer of air is naturally divided into a number of discrete vertical regions like successive floors in a four-story building. The equivalent of the first floor within the atmosphere is called the boundary layer. In the atmosphere, air normally gets colder with height, but there are situations where the reverse is true, these regions are called temperature inversion layers. In Hawaii, the base of the boundary layer is at sea level and the top is generally in the region of 6,000 ft (~1 mile) above sea level at a strong (up to 6° C) temperature inversion. This inversion produces the top of the lowest cloud layer observed around the islands and separates the boundary layer from the free troposphere.

The free troposphere extends from the top of the boundary layer to another temperature inversion called the tropopause. The tropopause is usually observed at around 50,000 ft over Hawaii. Above the tropopause is the stratosphere.

The vog experienced in Hawaii is injected into the boundary layer and is for the most part trapped there. Vog, the same as clouds, is generally unable to penetrate the inversion layer; thus, the vog is carried along by the prevailing low-level trade winds from the northeast when blowing in strength. In the lee of Mauna Loa, eddies in the trade-wind flow are capable of carrying the vog along the Kona and Kohala coasts. Occasionally the vog is carried to Neighbor Islands when the boundary layer flow is other than the normal trades.

Under upslope conditions, whereby a thin layer of warm, moist boundary layer air flows up the side of Mauna Loa due to daytime heating of the dark lava, vog may be drawn into the free troposphere and carried up to Mauna Loa Observatory (11,400 ft). In so doing, the vog is pulled up the slopes from near sea level and drawn across areas not normally exposed to vog.

Dr Russ Schnell
Director
Mauna Loa Observatory
NOAA

VOG Concentrations from Satellite

An AVHRR image (2/95) processed to obtain the aerosol optical concentration. In this image, island downslope nighttime winds have pushed some of the plume to the east while the majority is being carried to the southwest by the trades which are beginning to set in. The Kilauea Volcano plume is frequent but not always present in processed satellite images suggesting emissions are somewhat episodic. This image was collected by Pierre Flament and processed by John Porter (School of Ocean and Earth Science, University of Hawaii at Manoa).

Over the past few years we have developed algorithms that can derive aerosol optical depths from AVHRR satellites. These aerosol optical depths correctly show the Kilauea vog plume as it drifts downwind from the island of Hawaii. While the AVHRR satellite is useful for case studies, it is limited by the fact that it passes Hawaii only twice a day and often sun-glint conditions prevent the retrieval of the aerosol optical depth (particularly in the summer).

In the near future, the new GOES8 satellite will come on-line. This satellite will be improved (compared to previous GOES satellites) and will have sensor digitization similar to the AVHRR satellites (10 bits over 0 to 100% albedo). Therefore, this satellite will be useful for deriving the aerosol optical depth. A particular advantage of this satellite is the fact that it is geostationary, which means it will always be looking down on the Hawaiian Islands at the same viewing angle. Instead of taking images once or twice a day, it will provide images every hour and more frequently on occasion. If successful in obtaining funding, we will be providing aerosol optical depth images from an anonymous ftp (file transfer protocol) site where users could access the images freely.

by John N. Porter
Hawaii Institute of Geophysics
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa
Vog Size Distributions, Optical Effects, and Spatial Variability

Vog is primarily a sulfate aerosol with a significant amount of associated water that varies with ambient relative humidity. It is usually mixed into the background aerosol and has a submicrometer size distribution with a mass peak near 0.35 μm. This size is particularly effective for scattering visible light, making light scattering measurements a rapid and reasonable surrogate for inferring the mass concentration of the vog aerosol. Light scattering measurements made every few seconds reveal marked variability in the vog structure over both horizontal and vertical scales. Factor of 10 changes in concentration were observed over time periods of less than one hour at the coastal site of Cape Kumukahi on the Big Island. Measurements from light aircraft reveal vertical gradients that can also increase by a factor of 10 between the surface and the trade-wind inversion. Under appropriate meteorological conditions, these high concentrations aloft also can mix down to the surface. Temperature changes during the day vary relative humidity in ways that can result in changes in visibility for the same sulfate concentration. These factors must be considered when designing a sampling strategy or interpreting the results. In relation to potential health effects, during normal inhalation the hygroscopic growth of this vog, aerosol will grow in response to the near 100% humidity in the airways. Deposition determinations suggests that about one-third of the observed vog aerosol will be retained in the airways and lungs.

Volcanic Emissions from Kilauea and Their Effect on Air Quality

Kilauea Volcano currently releases between 350 metric tonnes per day (T/D) of sulfur dioxide (SO2) during eruptive pauses, and 1850 T/D during active eruption. Metric tonnes equal one metric ton or 1000 kilograms. Of this, between 90 T/D and 260 T/D are emitted from the summit and the balance from the East Rift Zone eruptive area. The volcano also directly releases water vapor, small particles, metals, and lesser amounts of other gases, including hydrogen sulfide, hydrogen chloride, hydrogen fluoride. This gas and particle mixture combines with air and sunlight to produce the hazy atmospheric condition known as vog: a combination of gases, sulfate aerosols including among others, sulfuric acid, ammonium sulfate, and ammonium hydrogen sulfate. Gas release of another form occurs at locations where lava enters the ocean. Molten lava (110°C) violently boils sea water to dryness and decomposes it, leading to a series of chemical reactions that produce a voluminous plume cloud containing a mixture of hydrochloric acid and concentrated seawater. This condition produces a localized atmospheric hazard known as lava haze or laze which can contain as much as 10 to 15 parts per million of hydrochloric acid. The geographic fate of this pollution is primarily a function of meteorology, especially wind speed and wind direction. Typically, northeasterly trade winds transport vog and to some extent laze plumes to the southern tip of the island where wind patterns wrap around, sending vog up the Kona coast. Here, vog becomes trapped by onshore/offshore winds, affecting populations in west Hawaii. During periods of Kona winds, primarily winter months, the eastern half of the island receives more of the vog.
HEPA is pleased and proud to honor Hawaii County Civil Defense administrator Harry Kim. Mr. Kim was presented a special award by the Hawaii Medical Association at its 1994 annual meeting during the installation of the HMA President, HEPA co-founder Dr. Fred Holschuh. Because of a longstanding association with Mr. Kim and his friendship and affection for him, Dr. Holschuh asked that he be allowed to write some comments in this recognition of Harry Kim. Here are his comments:

It is fitting that Harry Kim be honored in this issue of the Hawaii Medical Journal featuring the results of a study on the health effects of vog. I have known Harry Kim for many years and was privileged to serve with him and others on the Hawaii County Vog Authority. His concerns for the people of our island and our state have led to many positive approaches in dealing not only with vog and the destruction of Kalapana, but the consequences of all potential disasters affecting human safety. Whether it is a storm, flood, fire, earthquake, drought, or other disaster, we all rest easier knowing Harry is on top of these situations. We all have heard Harry’s calming voice on Big Island radio with his Civil Defense announcements.

Harry Kim was aware of the potential health effects of vog and laze (hydrochloric acid vapor emitted when the lava enters the ocean) and said it was the duty of public health officials to evaluate and warn people of problems. He was constantly on the scene at the command post at Kalapana Beach Park during the heart-wrenching destruction of Kalapana. My wife Diane and I saw Kalapana burn, saw the Painted Church moved away, flew over the flow, watched with sadness as the people’s lives were forever altered, and above all, were aware that Harry was always there. I can still envision him standing with fire officials, talking to the press, conferring with his staff, speaking with federal and state officials, and praying during religious ceremonies. The most vivid memory I have of Harry, however, is of him standing, with his arm around a young woman’s shoulders, sharing her grief when her home vanished under the lava’s march to the sea.

Harry Kim was misty eyed, as we all were, when the Hawaiian musical group that played at the HMA Annual Meeting dedicated the song “Kalapana” to him. He shed tears for the people of Kalapana and opened his heart to them. The whole state opened their hearts to Harry Kim.

Harry, my friend, it is with great pride and humility that HEPA is pleased to join the people of the Big Island in saluting you and thanking you for all you do for all of us.
Emergency Department Visits and Hospitalizations for Respiratory Disease on the Island of Hawaii, 1981 to 1991

David M. Mannino MD,* Samuel Ruben MD, MPH,** Fred C. Holschuh MD,† Timothy C. Holschuh, Michael D. Wilson, Tami Holschuh

This study examined trends in and patterns of emergency department visits and hospitalizations for respiratory disease on the island of Hawaii from 1981 to 1991. We found that emergency department visit rates and hospitalization rates for both asthma and COPD for 1987 to 1991 increased in all regions of the island in comparison with such rates for 1981 to 1986. Rates of emergency department visits and hospitalizations for chronic obstructive pulmonary disease or COPD, but not asthma, were significantly higher in the high-exposure Kona side of the island than in the intermittent-exposure Hilo side of the island during 1983 and 1988 to 1990. We also found that during the weeks that winds were from the west, blowing volcanic air pollution toward Hilo, emergency department visits for asthma increased 15%. Some of the results of our study support the hypothesis that volcanic air pollution affects respiratory health on the island of Hawaii, while other results do not. Any future studies should include measurements of air pollutant levels.

Introduction

Morbidity and mortality among people with asthma or COPD continue to increase in the United States.1,2 Hawaii has one of the highest asthma death rates in the United States.3 Many factors may contribute to this problem, including lack of access to medical care, inappropriate use of medications, exposure to allergens, and poor air quality.4 We undertook this study of emergency department visits and hospitalizations for exacerbations of asthma and COPD among persons living on the island of Hawaii to determine the possible effect of the change in air quality that occurred in 1986 as a result of the eruption of Hawaii’s Kilauea Volcano.

Kilauea Volcano has been active intermittently since 1983 and continuously since 1986. The main volcano and its vents produce about 1200 tons of sulfur dioxide gas daily. Prevailing winds blow most of this gas, along with its oxidation products, to the western side of the island where Kona is located. The island’s main population center, Hilo, is located about 40 miles east of the Kilauea Volcano. Occasionally the winds reverse and blow from the west to the east, toward Hilo. During 1989 to 1990 mean levels of particulates with an aerodynamic diameter of less than 10 µm on the Kona and Hilo sides of the island were similar (11.5 µg/m³ and 10.7 µg/m³, respectively), whereas sulfate levels (which are thought to be related to volcano-generated air pollution) were higher on the Kona side (4.7 µg/m³) than on the Hilo side (1.8 µg/m³) of the island.5

In the first part of this study we examined trends in the rates of emergency department visits and hospitalizations from the emergency department for asthma and COPD that occurred on the island of Hawaii from 1981 to 1991. In the second part of this study we examined weekly variations in emergency department visits for asthma that occurred at Hilo Hospital from 1981 to 1991. For the years 1986 to 1991, the years for which we have meteorologic data available, we examined how wind speed, wind direction, and temperature affected emergency department visits for asthma at Hilo Hospital.

Methods Part I

Researchers extracted records from emergency department log books in four of five hospitals (Hilo, Kau, Kohala) on the island of Hawaii for the period from January 1, 1981 to September 30, 1991. The fifth hospital at Honokaa did not maintain an emergency department log. We extracted data on all patients listed in the emergency department log book and whose discharge diagnosis mentioned either asthma, chronic bronchitis, or emphysema. The data extracted included diagnoses, age, sex, town of residence, hospital visited, date and time of visit, and disposition. Because we did not extract personal identifiers, it is possible that the same person could have been counted on several different occasions. People who were not residents of the island of Hawaii were coded as either being from other islands in the Hawaiian archipelago, from the mainland United States, or from other countries.

We recorded all of the data entries to make the diagnoses uniform and to make the town recorded conform to a standard census district. The diagnoses were coded as either a primary or secondary diagnosis of asthma, or a primary or secondary diagnosis of COPD. Each entry had only one diagnosis, and in those cases where both asthma and COPD were listed in the discharge diagnoses, we used the diagnosis that appeared first. We then entered the recorded data into a computerized data set and verified the data manually using the data-entry sheets.

We used census data from both the 1980 and 1990 U.S. Census.
We determined annual intercensal population estimates for each of the 12 census districts on the island by linear interpolation, using 1980 and 1990 age-distribution breakdowns for each census district to estimate the population size for each age group from 1980 to 1991. We used the population estimates to calculate annual age-adjusted and population-adjusted rates.

We divided the island into three regions on the basis of presumed exposure of the population of each area to volcanic air pollution (high, intermittent, or low), along census tract lines (Fig 1). This classification was made on the basis of the consensus of two clinicians who treat patients on the island. Population-based air-pollution data were not available for the years 1981 to 1991.

We calculated annual rates of emergency department visits for asthma (as either the primary or secondary diagnosis) and COPD (as either the primary or secondary diagnosis) for seven age groups in each of these regions. We then calculated the age-adjusted annual rate for each region and the rate ratio (RR) and its 95% confidence intervals (CIs), comparing the period from 1987 to 1991 with the period 1981 to 1986, for each age group in each region and then for each region, using an age adjustment. We used the statistical program SAS (SAS Institute, Cary, NC) for these analyses. Additionally, we calculated annual rate ratios between the high-exposure region and the intermittent-exposure region using a weighted Mantel-Haenszel stratified analysis available in Epi-Info 5.01 (Centers for Disease Control and Prevention, Atlanta, Ga). We did not calculate annual rate ratios between the low-exposure region and either of the other regions because we did not have data from one hospital that was located in the low-exposure region.

Methods Part II

We used the same emergency room database described above in this part of the study, but limited our analysis to patients who were treated at the Hilo Hospital emergency department and had a diagnosis of asthma, reactive airways disease or related conditions.

Data on volcanic activity over the study period were obtained from researchers at the U.S. Geologic Survey (Terry Gerlach, U.S. Geologic Survey, August 1993).

Meteorologic data were obtained from Hawaii Volcanoes National Park. A weather station has been operational from September 1986 to the present at a site near Kilauea Volcano. This weather station, which is at an elevation of approximately 4,000 feet, is not influenced by daily variations in wind direction (oceanward in the evening and landward during the day) that affects weather stations close to the coast of an island. We used hourly wind direction, hourly wind speed, and hourly temperature. For each hour, we classified the wind direction as blowing from the west (compass direction between 170° and 340°), blowing from the east (compass direction between 0° and 170°), or neither. We classified an hourly wind speed as low if it was less than the 25th percentile of all the hourly wind speeds (3.9 miles per hour) and classified an hourly temperature as low if it was less than the 25th percentile of all the hourly temperatures (13.5° centigrade). We then summed wind direction from the west and east, low wind speed, and low temperature for each day.

We summed both emergency department visits and meteorologic factors over a 7-day period (Saturday to Friday) to determine weekly counts. For the meteorologic factors, we then divided the sum by the total number of hours that week that the variable was measured to determine a proportion. To calculate categorical variables for meteorologic factors, we determined the highest quartile for wind direction from the west (greater than 10.8% of total hours per week), and the median for low wind speed (15.0% of total hours per week) and low temperature (17.8% of total hours per week) and classified each week accordingly. We also determined quartiles of the wind speed and temperature factors, which we used in the linear regressions.

We determined monthly and annual emergency department visits for asthma. We used 1980 and 1990 census data to estimate annual populations for the region that Hilo Hospital serves, and used these estimates to adjust the visits in the years 1982 to 1991 to the 1981 population.

Statistical analyses were done using the statistical programs SAS and SPIDA (Statistical Computing Laboratory, New South Wales, Australia). We calculated the correlation coefficients between weekly emergency department visits and the meteorologic factors as either continuous or categorical variables. Because meteorologic factors are related to month of the year, we divided each year into three 4-month seasons, and used these divisions, rather than months, as a seasonal indicator. We included this seasonal indicator in our multiple linear regression analyses, using the SAS procedure REGRESS. Wind direction from the west was the main variable of interest. We also assessed interaction between this variable and other meteorologic factors. Additionally, we stratified the data into weeks with low and high wind speeds and temperatures. We then did t-tests, using emergency department visits as the dependent variable, between weeks with and without western winds (as a categorical, independent variable) present.

We used the generalized estimating equation analytic program from SPIDA to repeat regression analyses while controlling for autoregression in our model. We did this by grouping the data into four-month seasons and treating these groups as independent. We used independent and exchangeable correlation structures in this analysis, and controlled for wind speed and temperature.

Results Part I

During the study period, there were 12,539 visits (6,242 females and 6,297 males) for asthma or COPD to the four emergency departments. The diagnoses varied by age, with asthma more prevalent among younger people (younger than age 45 years) and COPD more prevalent among older people (older than age 45 years, data not shown). Similarly, the disposition of each patient visit also varied by age, with a higher percentage of older patients admitted to either the hospital or the intensive care unit than were younger patients (data not shown). Of the 12,539 patients who sought treatment for asthma or COPD, 10,078 (80.4%) were discharged to their home, 1,961 (15.6%) were admitted to the hospital, 455 (3.6%) were admitted to the intensive care unit, 5 (0.1%) died, and 40 (0.3%) were transferred to another facility.
whereas emergency department visits for asthma were consistently higher among people living in the intermittent-exposure area than among those living in the high-exposure area (p < 0.05 for every year). Annual age-adjusted rates of emergency department visits and hospitalizations for COPD showed a different pattern (Fig 3). The high-exposure area consistently had the highest rates, and these rates were significantly higher in some years when volcanic activity was increased (1983 and 1988 to 1990, p < 0.05).

The overall age-adjusted and population-adjusted rate ratios for emergency department visits by people with asthma and COPD and hospitalizations for asthma and COPD, when we compared data for 1987 to 1991 with data for 1981 to 1986, were similar in all three regions of the island (Table 3). Both the emergency department visit rates and the hospitalization rates had increased in all three regions.

Results Part II

During the study period there were 7,993 emergency department visits for asthma to Hilo Hospital. Females made slightly more visits than males (4,032 vs 3,959). Children younger than age 16 made 3,895 (48.7%) visits. Most of the patients were discharged home (6,888, 86.2%).

Mean weekly visits increased from 11.4 in 1981 to 18.2 in 1991 (Table 4). After adjusting the population to the 1981 baseline population, we found that the mean weekly visits increased from 11.4 to 15.2. Figure 4 illustrates the weekly emergency department visits for asthma at Hilo Hospital, along with the

Both the distribution of patient age and the disposition of the patient varied by hospital (Table 1, Table 2). Hilo Hospital had a higher percentage of visits by patients younger than age 15 years than did Kona Hospital (45% vs 34%, p < 0.001) and had a lower percentage of visits by patients older than age 45 than did Kona Hospital (27% vs 38%, p < 0.001) (Table 1). As one would expect, Kona Hospital had a higher proportion of patients whose diagnosis was COPD (data not shown) and admitted a higher proportion of patients than did Hilo Hospital (p = 0.005). We found that the two smaller hospitals in Kau and Kohala had distributions of patient ages that were similar to those found at Hilo Hospital. We also calculated what percentage of patients received care at the hospital close to them. Of the 8,353 patients included in this part of the study who lived close to Hilo Hospital (as determined by census district) 8,272 (99.0%) received their care at the Hilo Hospital emergency department, whereas of the 2,474 patients who lived close to the Kona Hospital, 2,385 (96.4%) received their care at the Kona Hospital emergency department.

Annual age-adjusted and population-adjusted rates of emergency department visits and hospitalizations for asthma did not show a consistent pattern over the study period (Fig 2). Hospitalization rates for asthma were similar among people living in the high-exposure and intermittent-exposure areas (p > 0.05 for every year), whereas emergency department visits for asthma were consistently higher among people living in the intermittent-exposure area than among those living in the high-exposure area (p < 0.05 for every year). Annual age-adjusted rates of emergency department visits and hospitalizations for COPD showed a different pattern (Fig 3). The high-exposure area consistently had the highest rates, and these rates were significantly higher in some years when volcanic activity was increased (1983 and 1988 to 1990, p < 0.05).

The overall age-adjusted and population-adjusted rate ratios for emergency department visits by people with asthma and COPD and hospitalizations for asthma and COPD, when we compared data for 1987 to 1991 with data for 1981 to 1986, were similar in all three regions of the island (Table 3). Both the emergency department visit rates and the hospitalization rates had increased in all three regions.

Results Part II

During the study period there were 7,993 emergency department visits for asthma to Hilo Hospital. Females made slightly more visits than males (4,032 vs 3,959). Children younger than age 16 made 3,895 (48.7%) visits. Most of the patients were discharged home (6,888, 86.2%).

Mean weekly visits increased from 11.4 in 1981 to 18.2 in 1991 (Table 4). After adjusting the population to the 1981 baseline population, we found that the mean weekly visits increased from 11.4 to 15.2. Figure 4 illustrates the weekly emergency department visits for asthma at Hilo Hospital, along with the

Both the distribution of patient age and the disposition of the patient varied by hospital (Table 1, Table 2). Hilo Hospital had a higher percentage of visits by patients younger than age 15 years than did Kona Hospital (45% vs 34%, p < 0.001) and had a lower percentage of visits by patients older than age 45 than did Kona Hospital (27% vs 38%, p < 0.001) (Table 1). As one would expect, Kona Hospital had a higher proportion of patients whose diagnosis was COPD (data not shown) and admitted a higher proportion of patients than did Hilo Hospital (p = 0.005). We found that the two smaller hospitals in Kau and Kohala had distributions of patient ages that were similar to those found at Hilo Hospital. We also calculated what percentage of patients received care at the hospital close to them. Of the 8,353 patients included in this part of the study who lived close to Hilo Hospital (as determined by census district) 8,272 (99.0%) received their care at the Hilo Hospital emergency department, whereas of the 2,474 patients who lived close to the Kona Hospital, 2,385 (96.4%) received their care at the Kona Hospital emergency department.

Annual age-adjusted and population-adjusted rates of emergency department visits and hospitalizations for asthma did not show a consistent pattern over the study period (Fig 2). Hospitalization rates for asthma were similar among people living in the high-exposure and intermittent-exposure areas (p > 0.05 for every year), whereas emergency department visits for asthma were consistently higher among people living in the intermittent-exposure area than among those living in the high-exposure area (p < 0.05 for every year). Annual age-adjusted rates of emergency department visits and hospitalizations for COPD showed a different pattern (Fig 3). The high-exposure area consistently had the highest rates, and these rates were significantly higher in some years when volcanic activity was increased (1983 and 1988 to 1990, p < 0.05).

The overall age-adjusted and population-adjusted rate ratios for emergency department visits by people with asthma and COPD and hospitalizations for asthma and COPD, when we compared data for 1987 to 1991 with data for 1981 to 1986, were similar in all three regions of the island (Table 3). Both the emergency department visit rates and the hospitalization rates had increased in all three regions.

Results Part II

During the study period there were 7,993 emergency department visits for asthma to Hilo Hospital. Females made slightly more visits than males (4,032 vs 3,959). Children younger than age 16 made 3,895 (48.7%) visits. Most of the patients were discharged home (6,888, 86.2%).

Mean weekly visits increased from 11.4 in 1981 to 18.2 in 1991 (Table 4). After adjusting the population to the 1981 baseline population, we found that the mean weekly visits increased from 11.4 to 15.2. Figure 4 illustrates the weekly emergency department visits for asthma at Hilo Hospital, along with the

Both the distribution of patient age and the disposition of the patient varied by hospital (Table 1, Table 2). Hilo Hospital had a higher percentage of visits by patients younger than age 15 years than did Kona Hospital (45% vs 34%, p < 0.001) and had a lower percentage of visits by patients older than age 45 than did Kona Hospital (27% vs 38%, p < 0.001) (Table 1). As one would expect, Kona Hospital had a higher proportion of patients whose diagnosis was COPD (data not shown) and admitted a higher proportion of patients than did Hilo Hospital (p = 0.005). We found that the two smaller hospitals in Kau and Kohala had distributions of patient ages that were similar to those found at Hilo Hospital. We also calculated what percentage of patients received care at the hospital close to them. Of the 8,353 patients included in this part of the study who lived close to Hilo Hospital (as determined by census district) 8,272 (99.0%) received their care at the Hilo Hospital emergency department, whereas of the 2,474 patients who lived close to the Kona Hospital, 2,385 (96.4%) received their care at the Kona Hospital emergency department.

Annual age-adjusted and population-adjusted rates of emergency department visits and hospitalizations for asthma did not show a consistent pattern over the study period (Fig 2). Hospitalization rates for asthma were similar among people living in the high-exposure and intermittent-exposure areas (p > 0.05 for every year), whereas emergency department visits for asthma were consistently higher among people living in the intermittent-exposure area than among those living in the high-exposure area (p < 0.05 for every year). Annual age-adjusted rates of emergency department visits and hospitalizations for COPD showed a different pattern (Fig 3). The high-exposure area consistently had the highest rates, and these rates were significantly higher in some years when volcanic activity was increased (1983 and 1988 to 1990, p < 0.05).

The overall age-adjusted and population-adjusted rate ratios for emergency department visits by people with asthma and COPD and hospitalizations for asthma and COPD, when we compared data for 1987 to 1991 with data for 1981 to 1986, were similar in all three regions of the island (Table 3). Both the emergency department visit rates and the hospitalization rates had increased in all three regions.
Table 3.—Age-Adjusted Rate Ratios, by Region, for Visits to Hospital Emergency Departments and Hospitalizations for Asthma and Chronic Obstructive Pulmonary Disease (COPD), Island of Hawaii, 1981 to 1991.

<table>
<thead>
<tr>
<th>Region</th>
<th>High-Exposure Area</th>
<th>Intermittent-Exposure Area</th>
<th>Low-Exposure Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td>RR (95% CI)</td>
<td></td>
</tr>
<tr>
<td>Emergency Department Visits for Asthma</td>
<td>1.17 (1.07, 1.27)</td>
<td>1.21 (1.15, 1.26)</td>
<td>1.26 (1.03, 1.53)</td>
</tr>
<tr>
<td>Hospitalization for Asthma</td>
<td>1.24 (1.03, 1.48)</td>
<td>1.17 (1.04, 1.32)</td>
<td>1.70 (0.98, 3.01)</td>
</tr>
<tr>
<td>Emergency Department Visits for COPD</td>
<td>1.87 (1.52, 2.29)</td>
<td>1.66 (1.43, 1.92)</td>
<td>2.35 (1.18, 4.66)</td>
</tr>
<tr>
<td>Hospitalizations for COPD</td>
<td>1.76 (1.38, 2.24)</td>
<td>1.54 (1.25, 1.90)</td>
<td>2.39 (1.03, 5.53)</td>
</tr>
</tbody>
</table>

* Rate Ratio (RR) and 95% Confidence Intervals (CI), comparing age-adjusted rates in 1987 to 1991 to 1981 to 1986.

We tested for, and did not detect, interactions between wind direction and wind speed or temperature in our multiple regression model. In the final model (Table 7), western winds accounted for a 16% increase in emergency department visits for asthma at Hilo Hospital, after we adjusted for other low wind speed, low temperature, year and season.

In the linear generalized estimating equations, where we grouped the data by year and season to control for autocorrelation, wind direction from the west accounted for a 15% increase in emergency department visits after controlling for wind speed and temperature (p = 0.005).

**Discussion**

The first part of this study examined the trends in emergency department visits for asthma and COPD on the island of Hawaii from 1981 to 1991. We were interested in determining whether there was any change in this trend after Kilauea Volcano began erupting intermittently in 1983 and continuously in 1986.

We did not have air quality data available to validate our high-exposure, intermittent-exposure, and low-exposure regions; instead, we used the consensus of two physicians who treat patients living on the island to determine these regions. Although these divisions seem reasonable, they may not accurately reflect actual exposures to volcano-generated air pollution.

We evaluated an 11-year period in which people had visited emergency departments for the treatment of asthma or COPD. We were able to demonstrate a difference in emergency department utilization between the two largest hospitals: Kona and Hilo. Hilo Hospital tended to treat a greater number of younger patients (younger than age 15 years) and to admit fewer of them, whereas Kona Hospital tended to treat a greater number of older patients.
(older than age 45 years) and to admit more of them. The reasons for the difference in utilization patterns are unclear but may be related to the differences in the communities that surround these two hospitals. This difference may have affected the outcome of the study, especially if children in the Kona area, which is thought to have high exposure to volcanic air pollution, were more likely to receive care for their asthma exacerbations at physician’s offices than at the hospital’s emergency department. We were not able to obtain data from the Hilo Hospital, where emergency department logs were not maintained during 1981 to 1991. This small hospital is located in a low-exposure region from which it draws its patients. The absence of data from this hospital would cause the estimates of asthma and COPD rates among people living in the low-exposure region to be falsely low, but this absence would not be expected to affect these rates among people living in the high-exposure or intermittent-exposure regions of the island.

Annual age-adjusted rates for both emergency department visits and hospital admissions for asthma varied by the region of the island. Although people living in the intermittent-exposure area had a higher rate of emergency department visits than did people living in the high-exposure area, the hospitalization rates for people living in either area were similar in all years of the study. This finding suggests that the people with asthma who were treated at the hospital in the intermittent-exposure region (Hilo) had less severe illness than those who sought treatment at the hospital in the high-exposure area (Kona). Other possibilities include a diagnostic bias at Hilo Hospital (physicians may have been more likely to list a discharge diagnosis as asthma), a difference in emergency department utilization between Hilo and Kona Hospitals, or a difference in access to primary care physicians between the Hilo and Kona communities. Conversely, in 1983 and 1988 to 1990, age-adjusted rates for both emergency department visits and hospitalizations for COPD were higher in the high-exposure region than they were in the intermittent-exposure region.

Age-adjusted and population-adjusted rates of emergency department visits for both asthma and COPD were higher in 1987 to 1991 than in 1981 to 1986; the same was true for hospitalizations for asthma and COPD. This relationship was detectable in areas of the island thought to have high, intermittent, and low exposures to volcanic air pollution. The reasons for these higher rates are unclear. One possibility is that the increase we observed was unrelated to the volcanic eruption. Another possibility is that, because people travel to all areas of the island, their residence may not accurately reflect their exposure to volcanic air pollution. Yet another possibility is that volcanic air pollution affects the entire island to some degree.

National estimates of hospital discharge rates for asthma increased 4% from 1980 to 1990. In this study, we found that hospitalization rates for asthma, after adjusting for age and population, increased 20% and varied by region. The increasing morbidity and mortality of asthma nationally is thought to be related to several factors, including allergen exposure, lack of access to care, inappropriate medication use, and poor air quality. We do not have any data on allergens that are present on the island or how their levels may have changed over the study period. More than 98% of Hawaii residents have medical insurance, so most would have access to either a primary care provider or to the emergency department. We do not have data on medication use by residents, but would not expect this to vary dramatically from such use by people in the rest of the country. We did not collect data on emergency department visits for bronchitis or pneumonia for this 11-year period. These conditions would be expected to affect a larger portion of the population than asthma or COPD and might be more sensitive indicators of the effects of volcanic air pollution.

The results of the second part of the study suggest that, after controlling for other meteorologic factors such as wind speed and temperature, winds from the west are associated with an increase in emergency department visits for asthma at Hilo Hospital. There is a strong, independent, seasonal component to both emergency department visits for asthma and the other meteorologic factors that were measured. Unfortunately, we do not have meteorologic data prior to 1986 to determine whether this pattern was similar when there was less volcanic activity.

Other researchers have demonstrated a relationship between meteorologic factors and hospitalizations for asthma exacerbations. Results of a study on Oahu demonstrated a relationship similar to that seen in our study between unusual wind directions and emergency department visits for children with wheezing. In that study, the magnitude of the effect of wind direction was about 20% of the effect of temperature, whereas in our study, the magnitude of the effect of wind direction was greater than that of temperature.

Air quality factors, including levels of sulfur dioxide, ozone, acid aerosols, and organic dusts have been linked to respiratory morbidity and mortality in some studies. Sulfur dioxide is the main...
pollutant generated at Kilauea Volcano (Terry Gerlach, U.S. Geological Survey, August 1993), in amounts that far exceed those generated by coal-burning power plants. Additionally, hydrochloric acid aerosols are generated when hot lava enters the ocean. We did not have population-based air quality data available to us. The meteorologic station, located near the Kilauea Volcano’s summit, documented high levels of sulfur dioxide when the wind was blowing toward the monitor (data not shown). Although tourists visit this area, few people live near this monitoring station, and the air pollutant levels measured there would likely not be correlated with population exposures in Hilo. Additionally, the largest source of sulfur dioxide is the Puu Oo vent (Fig 5), located eight miles closer to Hilo than the summit.

We used the meteorologic data from the summit of Kilauea Volcano, believing that these data would best reflect the general meteorologic conditions on the eastern side of the island, without being affected by the daily wind variations that affect the more coastal monitors. The overwhelming majority of the winds measured at this weather station were the typical eastern trade winds. The weekly percentage of western winds varied by month, with June, July, and August having the lowest percentage, and October, December, and February having the highest percentage. Even in the months with the highest percentages, however, western winds accounted for only 25% of the total weekly winds.

We used different methods to determine the relationship between wind direction and emergency department visits. All methods demonstrated an increase in weekly visits of approximately 15% associated with western winds when we controlled for other factors. This finding may be related to air quality factors and volcano-generated air pollution. Another cause for this finding might be allergens or molds blown into the area from the east central part of the island. Other factors, such as respiratory infections or influenza epidemics, also may be important.

Limitations of both parts of this study include a possible self-selection process, diagnostic bias, and lack of environmental or personal exposure data. Some physicians have reported that some of their patients who thought that the volcanic air pollution was adversely affecting their health either moved to a different part of the island or moved off the island altogether. If this observation is true, those residents who remained behind in the high-exposure areas would be a healthier subgroup, people who were possibly less affected by the effects of volcanic air pollution. Our extraction method was dependent on the diagnosis listed in the emergency department log book. Different physicians might give a similar disease process different diagnoses, which might have affected our results if these alternative diagnoses were not included in data extraction. A final limitation is that we did not have regional or personal exposure data. This limitation makes this study an ecologic one, which can be used to generate but not prove hypotheses.

Some of the results of our study support the hypothesis that volcanic air pollution affects respiratory health on the island of Hawaii, while other results do not. We found that emergency department visit rates and hospitalization rates for both asthma and COPD increased in all regions of the island of Hawaii during the period 1987 to 1991, including those areas that presumably have less exposure to volcanic air pollution. Conversely, we detected a higher rate of both emergency department visits and hospitalizations for COPD on the high-exposure, western side of the island during 1983 and 1988 to 1990 than on the intermediate-exposure, eastern side of the island during those years. We did not see, however, a similar effect in asthma hospitalizations, and we found that the rates of emergency department visits for asthma were much higher on the intermittent exposure side of the island. On the other hand, during weeks when winds were blowing towards the Hilo side of the island, 15% more people went to the emergency room in Hilo because of asthma. We do not have air quality data and cannot determine whether these findings are related to volcano-generated air pollutants or other factors. Further investigations of asthma and other respiratory disease on this island should include population-based air-quality monitoring, that measures levels of sulfur dioxide, fine respirable particulates, and acid aerosols.

Use of trade names is for identification only and does not constitute endorsement by the U.S. Public Health Service or the U.S. Department of Health and Human Services.

Acknowledgments
The authors would like to thank Jack Lewin MD, Bruce Anderson PhD, Richard Vogt MD, and Robert Worth MD, of the Hawaii Department of Health, Honolulu; Terry Gerlach, of the U.S. Geological Survey, Vancouver, Washington; Amy Hamane of the American Lung Association of Hawaii, Hilo; and Mary Boyd, Ruth Etzel MD, Henry Falk MD, and Dana Flanders MD, of the Centers for Disease Control and Prevention, Atlanta, Georgia, for their assistance with this research. This study was supported in part by the Shippers’ Wharf Grant, established in 1904, and by the American Lung Association of Hawaii.
References


Table 6.—Mean number of emergency department (ED) visits to Hilo Hospital, Hilo, Hawaii, for asthma by weeks, with western winds, stratified by weeks of high and low wind speeds and weeks of high and low temperatures.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>ED Visits</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winds from West</td>
<td>No</td>
<td>57</td>
<td>15.4</td>
</tr>
<tr>
<td>Wind Speed</td>
<td>Yes</td>
<td>55</td>
<td>17.8</td>
</tr>
<tr>
<td>Winds from West</td>
<td>No</td>
<td>111</td>
<td>15.5</td>
</tr>
<tr>
<td>High Wind Speed</td>
<td>Yes</td>
<td>2</td>
<td>23.0</td>
</tr>
<tr>
<td>Winds from West</td>
<td>No</td>
<td>71</td>
<td>17.1</td>
</tr>
<tr>
<td>Low Temperature</td>
<td>Yes</td>
<td>41</td>
<td>17.9</td>
</tr>
<tr>
<td>Winds from West</td>
<td>No</td>
<td>95</td>
<td>14.1</td>
</tr>
<tr>
<td>Low Temperature</td>
<td>Yes</td>
<td>16</td>
<td>18.1</td>
</tr>
</tbody>
</table>

Table 7.—Multiple linear regression results of variables in the final regression model for mean emergency department visits to Hilo Hospital for asthma, 1986 to 1991.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekss with Western Wind</td>
<td>2.50</td>
<td>2.41</td>
<td>.017</td>
</tr>
<tr>
<td>Weeks with Low Wind Speed (Quartiles)</td>
<td>-0.93</td>
<td>2.06</td>
<td>.041</td>
</tr>
<tr>
<td>Weeks with Low Temperature</td>
<td>1.01</td>
<td>2.35</td>
<td>.019</td>
</tr>
<tr>
<td>Year*</td>
<td>1.30</td>
<td>1.37</td>
<td>.172</td>
</tr>
<tr>
<td>1988</td>
<td>3.84</td>
<td>3.75</td>
<td>&lt;.000</td>
</tr>
<tr>
<td>1990</td>
<td>2.96</td>
<td>2.45</td>
<td>.015</td>
</tr>
<tr>
<td>1991</td>
<td>4.17</td>
<td>3.44</td>
<td>.001</td>
</tr>
<tr>
<td>Season**</td>
<td>1.99</td>
<td>1.58</td>
<td>.115</td>
</tr>
<tr>
<td>Spring (January - April)</td>
<td>4.79</td>
<td>5.17</td>
<td>&lt;.000</td>
</tr>
<tr>
<td>Fall (September - December)</td>
<td>-0.93</td>
<td>2.06</td>
<td>.041</td>
</tr>
</tbody>
</table>

Fig. 6.—Weekly emergency department visits for asthma to Hilo Hospital, Hilo, Hawaii, and weekly percentage of hours with winds from the west, measured at the Kilauea summit, for the years 1987 through 1991.

Fig. 7.—Weekly percentage of low temperature hours, low wind speed hours, and hours with winds from the west, by month over the time period 1987 through 1991, Hilo, Hawaii.

R²=0.22; F=6.63
* 1986 to 87 were the control years
** Summer (May to August) was the control season
Lecture by Laurie Tom MD, an endocrinologist at QMC-UH. July 29, 1995

The thyroid gland produces T3 and T4 which affect multiple organ systems including the reproductive system.

**Hypothyroidism (most common)**
- 4 to 8 times more common in women than men
- More likely with autoimmune family hx
- Occurs in 10% to 21% of women over age 50; and symptoms often attributed to menopause.
- High T4, T3 cause hyperthyroidism
- Low T4, T3 cause hypothyroidism

**Hypothyroidism**
- Masks coronary artery disease (CAD)
- A/C lipid abnormalities
- With CAD can be exacerbated by hypertension, anemia, etc.
- Affects reproductive system

**Thyroid Function Studies**
TSH: $60 reduced to $34; free T4: $34

**TSH Values:**
- Low: <0.5
- Normal: 0.5 - 5.0
- High: >5.0

TSH changes before T3 and T4 in early subclinical hypothyroidism and hyperthyroidism.

**Subclinical hypothyroidism progresses to clinical dis. Initially 13.2% had normal T4, high TSH.** Four years later, 33% had low T4 and high TSH. Once patient diagnosed, treatment begins. High titer of anti-TPO microsomal antibodies are predictive of those that progress to overt hypothyroidism—estimated at a rate of 5% to 8% per year.

**Hypothyroidism may mask CAD symptoms by:**
- Bradycardia, decreased contractility leading to reduced O₂ demand
- Physical inactivity so angina less likely
- Altered mental status so symptoms not reported

**CAD symptoms can be exacerbated in hypothyroidism by:**
- Hypertension leading to increased O₂ demand
- CHF with depressed ventricular function
- Anemia so less O₂ available to myocardial tissue

**Lipoprotein changes in hypothyroidism:**
- Increased total cholesterol, LDL, HDL, and VLDL, but the degree of increased HDL less than LDL, so still an unfavorable ratio.

**Effects on reproductive system**
- Anovulation
- Increased frequency of periods
- Heavier menses
- Fertility difficult
- Increased rate of miscarriages

Appropriate population for thyroid screening:
Patients with family history of autoimmune thyroid disease; Hashimoto’s or Graves’ non-thyroid autoimmune diseases; diabetes mellitus type 1; pernicious anemia; SLE; myasthenia gravis.

**Hyperthyroidism**
- Incidence: Women more than men
- Graves’ disease: most common; autoimmune disease
- TMG (Toxic multinodular goiter): Dx: TSH and T4 (TSH producing tumors)

**Preferred treatment**
- Graves’ disease: 1³¹
  - Anti thyroid Rx Surgery
- TMG: Surgery
  - ¹³¹
- Painful thyroiditis: Symptomatic (anti-inflammatory drugs)
- Non-painful thyroiditis: Symptomatic (watch for eventual hypothyroidism)
- Hashimoto’s thyroiditis: Symptomatic (watch for eventual hypothyroidism)

Anti-thyroid drugs: Graves’ disease pretreated with ATD leads to reduced efficiency of ¹³¹ therapy

**Thyroid Nodules**
Five percent incidence of cancer. Nodules are common (10% to 15% in adults undergoing PE). Up to 15% of nodules have suspicious features clinically. Dx: thyroid scanning; “cold” and “hot” nodules, biopsy “cold” nodules. Dx: thyroid nodules: Adenoma, carcinoma, cyst, other Malignancies usually “cold,” but most nodules are cold.

**Continued on next page**
Continued from page 55

**Initial evaluation: TSH**

If TSH low, then scan; hot nodule almost never malignant.

Normal TSH, then FNA (need cytology)

Ultrasound and RAI scan add to costs and not helpful in ruling out malignancy

Nondiagnostic biopsies (no cells to examine) are not “negative”

Indeterminate biopsies, if suspicious clinically may require surgery.

FNA (fine-needle aspiration) is simple, cost-effective and accurate in the hands of a good endocrinologist along with a good cytopathologist.

Clinical approach:

- **TSH**
- **RAI scan**
- **FNA biopsy**

**Benign**

**Intermediate**

**Malignant**

**Observation**

**Surgery**

---

**Classified Notices**

**To place a classified notice:**

**HMA members**—Please send a signed and typewritten ad to the HMA office. As a benefit of membership, HMA members may place a complimentary one-time classified ad in HMJ as space is available.

**Nonmembers**—Please call 536-7702 for a nonmember form. Rates are $1.50 a word with a minimum of 20 words or $30. Not commissionable. Payment must accompany written order.

**Locum Tenens**

**Radiologist**—Available on short notice for locum tenens. Full or part time, any island. (808) 875-9794.

**Locum tenens available**—Board-certified family practice, 12 years’ clinical experience in Hawaii. Deborah C. Love MD; Home phone on Oahu: (808) 637-8611; cellular phone Maui: (808) 281-4713.

**Office Space**

**Pearl City Business Plaza**—Long leases; 680+ sq ft; 24 hr security; free tenant/customer pkg; available now; call 531-3526 Gifford.

**Medical Arts Bldg.**—250 sq ft to 997 sq ft office space avail. Pharmacy, x-ray lab; Clinical Laboratories of Hawaii on-site. Call Chrissy Young (S), 524-2666.

**Space to Share**—Physician practice has space to share with flexible arrangements for individual practice needs. Near QMC ground floor, free parking. Call Deborah at 532-0517 for more information.

**For Rent**—100 sq ft office space Kapiolani Medical Center, phone 949-3677

**Looking for an MD**—Opportunity to share office space with alternative health care providers. Low overhead. Space available in town. Tuesday, Thursday, Saturday, Sunday. Four treatment rooms, reception area. Call Dr. Bryan Luke or Susan at 591-2400.

---

**Honolulu Has 250 Hotels. Only One Is In Downtown.**

Executive Centre Hotel is Honolulu’s only true business hotel, situated in the heart of the business and financial district. Our guests enjoy all-suite accommodations, appointed with three telephones, private voice mail, in-suite fax machine, refrigerator, and kitchenettes.

Restaurant Row, Aloha Tower Marketplace and Chinatown are just a short walk away, and the hotel is convenient to both the courts and health-care facilities.

For frequent travelers, ask about our exclusive Corporate Program, Executive Pass. You and your clients can enjoy our competitive rates on suites, upgrade options, and an impressive array of amenities.

---

**EXECUTIVE CENTRE HOTEL**

**We Mean Business In Downtown Honolulu**

Call 539-3000 for reservations

1088 Bishop Street • Honolulu Hawaii 96813

---

*Based on availability*
Council Highlights

February 2, 1996
Roger T. Kimura MD, Secretary

The HMA Council was called to order by HMA President Carl Lehman MD at 5:32 p.m.


HMA Staff: J. Asato, J. Estioko, P. Kawamoto, B. Kendro, J. Won, A. Rogness, recording secretary.

Minutes: The minutes of the January 5 meeting were approved as circulated.

- Dr Lehman reported the Finance and Pension Committees will be meeting together this year, and it might become a combined committee; a bylaws change would be necessary. He attended a Governor’s luncheon with two Mayo Clinic physicians. The Hawaii Health Council met on January 22 and each Council member is working on issues they consider to be most important. He will be attending a Hawaii Bar Association meeting on dispute resolutions. He received a thank-you letter from Thomas Reppun MD, who requested a copy of the memorial resolution presented at the HMA House of Delegates for his father, Fred Reppun MD.

- The HMA Alliance reported: They have been working on the issue of domestic violence and a banner is almost completed. Doctors’ Day is on March 30, a proclamation will be signed by the Governor and the annual gift of first-aid kits will be delivered to the legislators. The Alliance will work together with HMA staff on the Distinguished Medical Reporting Awards banquet on Saturday, April 13 to create a gala, black-tie optional event.

For Action

- Council approved the following actions: the HMA Alliance’s request to be registered as a non-profit organization with the Department of Commerce and Consumers Affairs, which enables them to utilize bulk mail rate postage.

- Appointed Drs David Fitz-Patrick and Eugene Magnier to the HMA Employees’ Pension Committee and elected the HMA Finance Committee and their terms of office as follows: Drs A Kunimoto (4), M. Shirasu (3), S. Hundahl (2), P. Blanchette (1).

- Deferred action regarding any decision on the IPA venture between HMA and PMA until March 1 after information is received from meetings.

- Supported a physician-driven management service organization (MSO). Recommended that the Legislative Committee discuss a Patient Protection Act for the 1997 legislative session with appropriate consultants.

- Approved the list of HAMPAC Board members, to include HMAA members Scott Carrothers, Shirley Robinson, and Cherlita Gutteling.

- Appointed Dr Lehman’s nomination of Dr Reginald Ho to serve on the HMA Cancer Commission as HMA’s representative for a 3-year term.

- Approved a plan whereby the Honolulu County Medical Society would contribute $7,000 and HMA would assume the balance of the cost to combine the HCMS Bulletin and HMA Newsletter into one newsletter.

Component Society Reports

Kauai.—Dr T. Crane, President, reported a medical society meeting will be held on February 9 and Drs C. Lehman and T. Au have been invited to attend. The meeting will be a combined Valentine’s Day celebration and Legislative Update and Information Seminar.

Honolulu.—Dr P. Blanchette, President, reported that the HCMS is looking at streamlining the organization and eliminating potential redundancies. The Board members have begun to look at the AMA Federation recommendations on restructuring. The HCMS is already proposing focus groups of physicians who are in growing areas such as Mililani, Ewa Beach, Wahiawa and the Windward areas. Dr Scott Hundahl resigned as HCMS Councilor and Dr Blanchette has appointed Chiyoue Fukino MD as his replacement.

East Hawaii.—Dr L. Sonoda-Fogel reported for President E. Bade that their county will be planning a meeting in March. The summer program that the county used to have will now be coordinated by the East Hawaii IPA.

West Hawaii.—Dr T. Smith, President, reported that the North Hawaii Community Hospital will be open in about a month and a half. Their society will set up a meeting with Dr Lehman, Mr Won, and others to discuss the IPA and restructuring. Their society will be holding meetings on legislative issues to address the many bills.

For Information

Definition of Emergency Services.—At the last Council meeting an issue was discussed regarding retroactive denials for non-emergent care other than an evaluation fee and directed the ER to refer patients to the primary care physician. The implementation of such a plan has been deferred. An ad hoc committee of ER physicians has been appointed by the insurer to examine the dangers of triaging people out of the ER to a lower level of care without adequate work-up. Dr Holshuh will keep Council informed.

Medicaid Cutbacks Group.—Dr Holshuh reported he has been meeting with a group to look at cutbacks in Medicaid and block grants. They are also discussing the concept of eliminating individual physician disability determinations for the general assistance category and instead using a state panel of physicians to do the determinations.

SHPDA.—Dr Holshuh served on the task force established by the Legislature to evaluate the functions of the State Health Planning and Development Agency. A copy of his report was distributed at the Council meeting. Dr Holshuh supported and presented the AMA’s position to the Task Force of voluntary community health planning with no mandate. Twenty of the 23 member task force wanted to keep SHPDA in its current form or with some streamlining, and it will sunset in 5 years.

DEA.—At the last Council meeting there was discussion on the inappropriate use of DEA numbers. Dr Holshuh wrote a letter to the AMA regarding the concern and Mike Vitek, Medical Director of OMS of the AMA responded. The concern went through the AMA channels and the AMA has asked for another hearing with the DEA to discuss the issue.

MADD.—Dr Holshuh is serving on the MADD Committee which met at the HMA. The committee wants to work on the definition of probable cause.

Restructure Activities.—The AMA’s Report of the Study of the Federation was sent to all the county society presidents. Some of the ideas may be used on the local level. Comments on the report will be sent to the Long-Range Planning Committee.

Distinguished Medical Reporting Awards Banquet.—The banquet is planned for Saturday, April 13 at The Ilikai Hotel. The HMA and HMA Alliance will work together on the gala event.

Medical Claims Conciliation Panel.—Dr Lehman reported there was concern about the panel not being active. Rodney Marie, Senior Hearings Officer sent HMA a letter confirming that the panel is functioning as usual. They are seeking physician volunteers to serve on the panel. This request will be placed in the next newsletter.

The meeting was adjourned at 7:50 pm.
Comment on Murphy's Law—Murphy was an optimist.

An experienced CRNA (certified registered nurse anesthetist) performed peribulbar anesthesia for a radial keratotomy operation. She perforated the globe resulting in vitreous hemorrhage, retinal detachment, and additional surgery. Experts for the plaintiff contended the event was negligence *per se* and that no CRNA was qualified to perform a peribulbar block. However, the CRNA had performed the block on hundreds of patients over a ten-year period, and presented a video demonstrating her technique. Experts who viewed the tape found nothing wrong, and stated it did not violate the standard of care. The jury recognized the perforation as an unfortunate event and found in favor of the defendant.

Television—a medium. So-called because it is neither rare nor well done.

You have never heard of the *nocebo*? It is the opposite of the placebo, a pill that makes you feel better, although it contains only sugar. The nocebo makes you feel bad when physiologically it shouldn’t be able to do so. Example—for two years after the Gulf War no complaints were received from war vets, but after a doctor suggested a *syndrome* and the media and attorneys got into the picture, now thousands have developed classic psychosomatic complaints such as aching joints and headaches. The unusual ailment involved only American soldiers, until the British press picked up on it, and then British soldiers became ill. Similarly, for 30 years women were satisfied with breast implants, but when the media and the attorneys got into the act, stories such as toxic breasts and ticking *time bombs*, produced all kinds of strange illnesses. Curiously, silicone makes only American women sick; foreign women apparently are immune. One wonders when some attorney will discover that *deadly* silicone is actually being placed in human eyes.

Confidence is simply that quiet, assured feeling you have before you fall flat on your face.

Gordon Miller MD, an ophthalmologist in Salem, Oregon, has prepared a “Capitation Initiative” aimed at the November ballot. His contention is that capitation contracts cause physicians to withhold care because of financial self-interest. His bill would provide that doctors could be paid in only five ways: for work performed (fee for service), by an hourly wage, by prearranged salary and benefits, by bonuses based on work performed, and by reimbursement for expenses. Dr Miller claims that the petition will exclude physicians who are paid for not doing work. As you might guess, the state’s HMOs are seriously opposed and claim that the initiative would hamper their successful attempts to hold down health care costs. Yes, and it would surely impact the fantastic incomes of some managers and investors.

There is no cure for birth or death save to enjoy the interval.

For a few dreamers who fail to understand why the Medicare program is in financial trouble, please consider the following: at the beginning of the 20th century, life expectancy in the United States was believed to be about 49 years. Today that number has increased to an estimated 75.7 years. Beyond question, it will expand further as research produces treatment for chronic illnesses, such as diabetes, heart disease, and cancer. Then consider the advances in control of infections such as polio, smallpox, measles, influenza, among others. Not only are people living longer, resulting in more degenerative conditions, requiring more surgery, more medications, and more extended institutional care, but the arrival of the baby boom generation will greatly enlarge the population of eligible citizens. Obviously, expenditures for the growing Medicare population are greatly challenged now and soon will exceed all available income. Superficial, Band-aid mechanisms, such as squeezing reimbursement to doctors and hospitals, make no significant impact. Congress must establish fundamental changes in such factors as eligible age, financial need, and health behavior patterns. The currently silly and arrogant posturing by Congress and the President over cosmetic changes in the Medicare budget appear inane after examining the overall social challenge.

Make a point of trying everything once—except incest and folk dancing.

It seems incredible on the surface, but the Red Cross may lose blood donors in the southern region because of a cookie shortage. It isn’t just any cookie, but the *Nutter Butter*, a 65-calorie peanut-shaped and peanut-butter-flavored morsel. Since 1970, the cookie has been part of the post-donation treats, but the regional Red Cross in its wisdom (?) reallocated funds, and discontinued the cookie. Calls and letters of complaint have been pouring in, some including threats of no more blood donations. It appears that some believe the cookie has medicinal qualities, others just like the taste, and a few say it is the only time they get to enjoy that treat.

There’s no safety in numbers—or in anything else.

The recent AAO meeting in Atlanta, Georgia, yielded a very interesting picture of expenditures for eye care by the Department of Veterans Affairs. A survey conducted by the Subcommittee on Eye Care determined that optometry clinics require 44% more full-time-equivalent employees (FTEE) than ophthalmology clinics to handle the same number of visits. On a per-visit basis, optometry services cost as much as or slightly more than ophthalmology services. Ophthalmology-led services give the most productivity per FTEE, the lowest cost per visit, and shorter waits for a new appointment. The summarizing statement: “A strong argument for the ophthalmologist-led team of eye care providers can be made based on efficiency and quality at the lowest cost.”

Addenda

- Latest study—mydriatics cannot diagnose Alzheimer’s disease!
- Meetings are indispensable when you don’t want to do anything.
- Lorena Bobbitt was acquitted because the evidence would not stand up in court.

Aloha and keep the faith—rts
Physician owned and directed
Physicians started MIEC in 1975 when commercial carriers refused to insure professional liability or prohibitively raised rates.

No sales and marketing staff
MIEC doesn't pay sales commissions. We don't have a marketing staff. Our operating expenses are lower. Our full attention and financial obligation is to our policyholders: to defend them, to advise them about preventing claims, and to answer their questions on practice liabilities, including managed care.

Lower premiums, dividends
MIEC has maintained the same rates for Hawaii physicians for the past five years. When claims experience is better than expected, MIEC also grants dividend credits. In 1996, these credits will once again reduce out-of-pocket malpractice insurance costs of renewing Hawaii policyholders an average of 40%.

MIEC, your best long-term answer to malpractice insurance.

Medical Insurance Exchange of California
6250 Claremont Avenue, Oakland, CA 94618
1-800-227-4527
Sponsored by the Hawaii Medical Association
The Future Horizons 401(k) of Hawaiian Trust was developed specially to meet the retirement needs of Hawaii’s people. It’s flexible to fit your business, offers a variety of quality investments, and it’s designed to take care of the details so you can take care of business. Find out how Future Horizons 401(k) is geared more to Hawaii business than possibly any other 401(k) plan in the state. Call the Retirement Experts, at Hawaiian Trust, (808) 538-4400. Or toll-free from the Neighbor Islands, 1-800-272-7262.

Any investments in stocks and bonds are subject to risks that may result in loss of principal, and are not deposits or obligations of, or endorsed or guaranteed by Bank of Hawaii or Hawaiian Trust Company, and are not insured by the FDIC, the Federal Reserve Board or any other government agency.