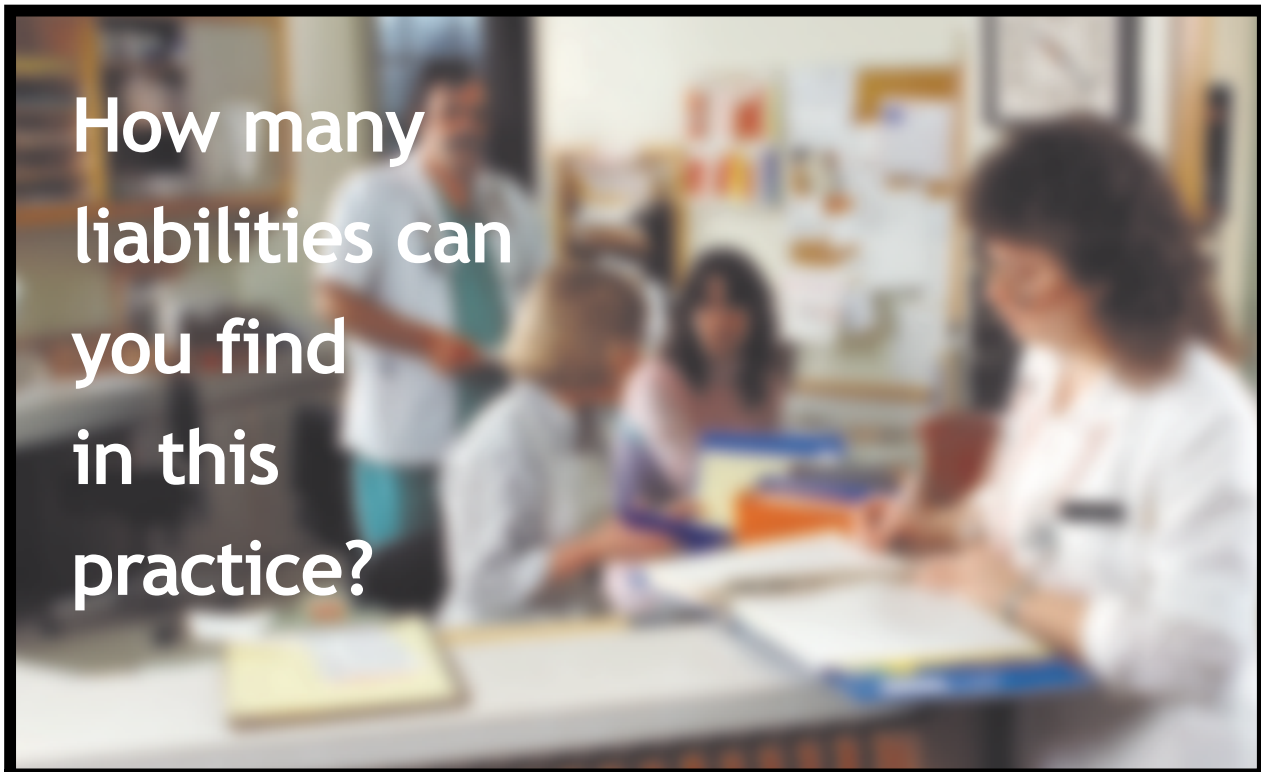


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Medicine Health RHODE ISLAND

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Medicine Health RHODE ISLAND

VOLUME 84, No. 11 NOVEMBER, 2001

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Medicine and Health/Rhode Island (USPS 464-820), a monthly publication, is owned and published by the Rhode Island Medical Society, 106 Francis Street, Providence, RI 02903. Phone: 401-331-3207. Single copies \$5.00, individual subscriptions \$50.00 per year, and \$100 per year for institutional subscriptions. Published articles represent opinions of the authors and do not necessarily reflect the official policy of the Rhode Island Medical Society, unless clearly specified. Advertisements do not imply sponsorship or endorsement by the Rhode Island Medical Society. Periodicals postage paid at Providence, Rhode Island. ISSN 1086-5462. POSTMASTER: Send address changes to *Medicine and Health/Rhode Island*, 106 Francis Street, Providence, RI 02903. Classified Information: RI Medical Journal Marketing Department, 175 Mathewson Street, Providence, RI 02903, phone: (401) 331-4637, fax: (401) 331-3594

Putting On Shoes – Acts of Humility



Most of my patients are scared when they first meet me. Seeing a neurologist is usually more stressful than seeing a urologist, cardiologist, or even an oncologist. When a patient sees an oncologist it is usually because cancer is an established fact and the oncologist becomes the master planner, the strategist who will hopefully save the day. Of course there is the other side to it, the lost cause, the painful referrals to hospice for terminal care, and the terrible, often devastating battles that take place on the road to failure or success. When other organ systems go wrong we view them, more or less, as mechanical failures. “My heart’s not right.” Either there’s ischemia requiring a procedure to increase blood flow, or the rhythm of the pump is unreliable, in which case medicine or an electrical device is used, or the pump is weak, requiring medicines to improve mechanical efficiency. Kidneys are replaceable or can be bypassed. Lung, endocrine and digestive system diseases are commonly limiting but not commonly fatal. And the disorders are often non-progressive.

None of these diseases changes one’s “essence,” one’s inner being like a neurologic disorder. Behavior is what defines a person. “I think therefore am.” How humbling it is then to evaluate a patient for a disease that may in fact become depersonalizing, to pass a diagnosis, hence a sentence, without a diagnostic test other than exclusionary studies. “The brain MRI, the spinal fluid and all the blood tests are normal, so I think you have disease X.” “And this means that in a few years you will need help doing these routine activities..” “And although there are ads aplenty for medications, none alter the disease course; none cure the disease; and their benefits on symptoms are small.” “The promise of stem cells is only a hope and that lies years ahead.”

Humility. Who should be more humble than a doctor? I hold someone’s

hope in my hands. I don’t usually hold their life in my hands, which may be more humbling still. How does a doctor display humility, or should one? Doctors on TV and in movies often fall into two discrete categories. One is humble and humane, the other is arrogant but brilliant. There are the occasional arrogant bumbler who are typically straw men, pompous balloons asking to be punctured. But I am accustomed to seeing humility paired with humanity, while intelligence and competence are not necessarily part of the package.

Humility is important for doctors (if not for everyone). There is so much we cannot do. Hopes in our omnipotence are so often dashed. The patient who is referred to the specialist and then to the super-specialist, the so-called tertiary care center, who hears the same bad news each time, needs the kind of sensitivity that accompanies humility.

What humility I have, I learned from my parents and my patients. “I’ve done pretty well considering I’ve had this condition five years, don’t you think?” “If it wasn’t for you, doc, I can’t imagine how bad off I’d be,” (said honestly by a person in a wheelchair).

Humility may be conveyed in small, symbolic acts. Sometimes these acts are not necessarily intended as sensitive, well meaning acts either. Early in the course of my practice, dealing largely with elderly and impaired people, I learned that helping them on with their shoes and socks saved a lot of time. It has never been my practice to have patients undress in examination rooms since I don’t often evaluate my patients undressed. They all have primary care providers who do this. But I do need to check their feet for the Babinski reflex. So they have to take their shoes and socks off. And then they can’t leave until they’re back on, plus, one can’t have a serious conversation with a patient who

is not fully dressed. Getting socks on is not usually much of a problem, even with edematous feet and large toenails, but shoes are a whole other ball game. By late afternoon, some patients’ feet are overflowing the shoe, which is now two sizes too small. The obvious solution is a shoehorn. I bought a metal shoehorn, which sits in my doctor’s bag, next to the ophthalmoscope, reflex hammer and optokinetic nystagmus tape. It’s an efficient device, which is why I use it. It saves aggravation and patient embarrassment, for not being able to get their shoes back on. The “shoeing” process has become a joint venture. The patient and I team up to overcome the obstacles of edema and Parkinson’s disease, to surmount one of life’s very small hurdles in the “ADL” (activities of daily living) course.

Using a shoehorn is perhaps the thing I do that gets the most feedback. When I take out the metal shoehorn (metal is important because it doesn’t break. Breaking a shoehorn will mortify a patient) there is always a smile and occasionally a laugh. “Boy, you really are prepared.” And as the shoes are laced, “Do you sell shoes too?” Well-meaning jokes from the patient and families help defuse the atmosphere and create a bond. We’re all in this together. “Mrs. Jones told me about you. She said you even put on her shoes.” Sure, why not? It’s a small act and it’s efficient. Yet the symbolic value apparently is higher.

I can’t tell how often I’m not humble with my patients. I didn’t buy a shoehorn to be humble in the first place. I did learn from my patients, however, that a shoehorn can be a more powerful tool than a reflex hammer.

– Joseph H. Friedman, MD

Those Adorable Little Bunny Rabbits

Rabbits, and their cousins the hares, have gotten mixed reviews. In some cultures they are revered as beguiling creatures; in others they are venerated as symbols of fertility; while in still others they are feared as surrogates of wandering witches and evil spirits. And the Scriptures mentions them only as unclean creatures unfit to eat [Leviticus 11:5].

Biologists say that the animal kingdom is composed of numberless species ceaselessly struggling to survive. But then Walt Disney and colleagues created a new world, free of mortal competition and filled with adorable vegetarian creatures all abiding by Isaiah's injunction that the lamb shall safely dwell with the wolf. Disney had transformed the wild rabbit into a tender creature, with neither gender nor guile, capable of producing large numbers of bunny rabbits by some obscure, non-copulative means. In the benevolent world of children's cartoons, to impute evil to a rabbit was tantamount to declaring that the bald eagle was little more than a remorseless carnivore.

Rabbits and hares have populated, some say overpopulated, the realm of mythology and folklore where their most consistent features have been innocence and timidity. But Aesop also found traces of arrogance in his hares, especially when they deigned to race the tortoise.

In the Algonquin culture, rabbits were never hunted since they were guardians of life's elemental secrets and might harbor the afterlife spirits of hero-ancestors. In pre-pharaonic Egypt the god Menebuch, disguised as a rabbit, taught humans manual skills, and after the great deluge, helped to restore the world while fulfilling his role as mediator between mortals and the otherworld. In general, the rabbit became the archetype of gentility, inoffensiveness, martyrdom, timidity and immense fertility. The Easter bunny has become a seasonal symbol of fecundity and renewal. The rabbit was never the warrior; and while it was said to hold the secrets of immortality, it nonetheless frequently died in behalf of others.

But then there was the darker side. The pre-Christian Celts saw only evil incarnate in the living rabbit; and in midsummer rituals they consigned captured hares and rabbits to crude wicker cages which they burned so as to destroy the souls of the witches harbored within the rabbits.

Animal parts have been used in many cultures to capture whatever attribute was thought to be embodied within the living animal. The teeth of tigers and sharks, the furs of leopards, the horns of rams, the gallstones of bears, the talons of chickens all became talismans used by those who believed in their power. But the most popular of animal parts providing magical protection from evil was the rabbit's foot. In pagan Wales, the newborn baby was rubbed over with a rabbit's foot to insure a life of abundant health, riches - and good luck. [The amputated foot, though, did not bring much luck to the rabbit.]

Two historic events served to lessen the public image of the rabbit as a model of timidity and benevolence.

In 1910, following the devastating San Francisco earthquake, public health physicians surveyed the California countryside seeking infectious disease outbreaks as an aftermath of the disrupting tremors. Dr. George McCoy encountered a curious disease in Tulare County, involving local squirrels and rab-

bits but affecting humans as well. By 1912 a causative bacterial organism was isolated from those afflicted and subsequently named *Francisella tularensis* to honor Dr. Edward Francis, who had supervised much of the early research and who named the disease, tularemia, after the county where it had first been identified. Actually, the disease had been noted before but was not recognized as an infectious process. Late in the 19th Century a Japanese physician named Ohara had described a disorder affecting those who hunted for or ate rabbit meat. The Japanese called it *yatobyō*, meaning rabbit fever. Ohara was convinced that the disease represented some kind of poisoning. He then took some blood from an affected rabbit and rubbed it upon his wife's skin. Within days, according to Ohara's report, a large ulcer appeared. [There is no mention as to why he selected his wife for this potentially dangerous experiment.]

Dr. Francis noted the following concerning tularemia: It is a highly infectious disease affecting vast numbers of cottontail rabbits, beaver, muskrat and other rodents. Hunters, trappers and those who skin or eat rabbits or are exposed to rabbit blood are the most vulnerable. The disease is also transmitted to humans by ticks and deerflies as well as by direct contact with infected rabbit blood. The disease in humans takes many forms depending upon the route by which the organism enters the human body. It may produce skin ulcers first, if transmitted by a tick bite or by contact with rabbit blood. Or it may cause a pneumonia if the organism is inhaled.

After the description of the disease was published, it became apparent that it had a distribution far broader than California. In Russia, for example, there have been at least 100,000 cases per year. The infection responds readily to certain antibiotics and tularemia is no longer a major public health threat.

The rabbit, however, continues to act as a major reservoir for other infectious diseases of humans. These include tapeworm disease, California encephalitis, Crimean hemorrhagic fever and various forms of typhus.

A second event destroyed any likelihood that the rabbit would continue to be the adorable and cherished symbol of innocence - at least in Australia. In 1859 Thomas Austin, an Australian farmer, imported 24 rabbits for his ranch, releasing them for hunting purposes. Because rabbits have no natural enemies in Australia, they reproduced without restraint and numbered over a million within a year. Since 1860, a major segment of the Australian budget and energy is annually invested in trying to control this plague of rabbits.

There are the pastoral creatures called Flopsy, Mopsy, Cottontail and Peter in Beatrix Potter's innocent world; but then there are the billions of nameless rabbits which have overrun the Australian countryside; and still further billions throughout the globe carrying a spectrum of infectious organisms as reservoirs of human illnesses such as tularemia. Given the two conflicting images of the rabbit, perhaps the brief reference in the Book of Leviticus is the more accurate.

— Stanley M. Aronson, MD, MPH

Introduction

Fred J. Schiffman, MD, FACP

The Annual Spring Meeting of the Rhode Island Chapter of the American College of Physicians-American Society of Internal Medicine was held at the Radisson Airport Hotel on April 17 and 18, 2001.

Once again, participation was outstanding. Abstracts selected for poster exhibition included 18 from the Roger Williams Medical Center (Boston University School of Medicine). From Memorial Hospital of Rhode Island, The Miriam Hospital, The Providence VA Medical Center and Rhode Island Hospital (Brown Medical School), 83 abstracts were presented. They were displayed the evening of April 17th and during the day of April 18th.

The subject matter was varied and the enthusiasm of presenters uniformly great. The subjects ranged from topics such as "An Anaphylactic-like Re-

action to Drano" to "Endogenous Bacterial Endophthalmitis." The quality of the posters has increased every year to the point where with the aid of computer-generated banners and graphics, our local meeting rivals the best international events.

There were oral presentations on the morning and afternoon of April 18th. Once again, the professionalism of the speakers and the graphics were simply outstanding. It was clear that they had worked hard with faculty members at their respective institutions. Their talks were polished and easily understood by all in the audience.

As with poster presentations, subjects varied from "Prevalence of Asthma in a Rural Guatemalan Community" to the "Impact of Diabetes on Coronary Angiographic Findings in the

Acute Coronary Syndrome."

Many of the presentations at previous meetings have been expanded and published in peer-reviewed journals. The quality of this year's presentations surely indicates that this will occur once again with this group's scientific efforts.

Fred J. Schiffman, MD, FACP, the Governor of the Rhode Island chapter, ACP-ASIM, is Professor of Medicine, Brown Medical School.

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The Occurrence and Characteristics of Inadvertent Lithium Intoxication: Cases and Review of the Literature

Kathryn A. Tuohy, MD, and Douglas Shemin, MD

THE MIRIAM HOSPITAL

Background: There are recommendations that lithium doses should be adjusted during episodes of illness that predispose patients to volume depletion, which increase the risk of lithium toxicity. We postulate that although many patients become lithium-toxic as a result of an acute overdose, a significant number of patients become lithium toxic inadvertently in association with intercurrent illness while continuing to take the prescribed dose. The portion of patients in each group and the characteristics of lithium intoxication in these two groups are not well defined.

Methods: The medical records of patients with lithium toxicity over a ten-year period were reviewed to determine the per-

cent of these patients who developed lithium toxicity inadvertently in association with intercurrent illness, and to compare the severity of the intoxication in these patients to those who had intentionally overdosed on the drug.

Results: Of the 53 patients studied, 41 (77%) had intentionally overdosed and 12 (23%) had become toxic inadvertently in association with an intercurrent illness. The patients who intentionally overdosed presented with a mean serum lithium level of 2.4 mEq/L and reached a peak serum lithium level of 2.9 mEq/L as compared to the patients who inadvertently became lithium toxic, who presented with a mean serum lithium level of 3.4 mEq/L, which also was the peak serum lithium level in this

group. Only 59% of the patients who intentionally overdosed developed signs or symptoms associated with lithium toxicity, while 100% of patient who inadvertently became lithium toxic developed signs or symptoms. Further, only 4 (9%) of the patients who intentionally overdosed required hemodialysis as compared to 5 (42%) of the patients who became toxic inadvertently.

Conclusions: A significant portion of patients become lithium toxic inadvertently in association with intercurrent illness while trying to take their medication properly. In these patients, the intoxication tends to be more severe than that occurring in those patients who take an overdose intentionally, despite the fact that the patients who overdose generally ingest a much larger dose.



The Prevalence of Asthma in a Rural Guatemalan Community

John Koff, MD, Eileen Gilbert, MD, Charles Sherman, MD, MPH

RHODE ISLAND HOSPITAL; METROHEALTH
MEDICAL CENTER, CASE WESTERN RESERVE
UNIVERSITY

Background: Asthma, defined as a reversible airway disease, is known to have an increased prevalence in urban centers with an increased incidence among minority groups - specifically African-Americans and Hispanics. It has been speculated that asthma is a multifactorial disease associated with risk factors encountered in an urban environment - pollution, increasing crowding, dust, etc. Therefore it might be hypothesized that the incidence and prevalence of asthma may be decreased in a third world country such as Guatemala. However, anecdotal reports from healthcare workers traveling to rural Guatemala have observed a high incidence of "respiratory illnesses."

Methods: A door-to-door random consecutive sampling of two villages in the Guatemalan Highlands was performed during March 2000. The **Asthma Quality of Life Questionnaire (AQLQ)** was incorporated into a survey to elicit the frequency

and severity of patient symptoms. In addition, spirometry was used to assess the presence of reversible airway disease.

Results: Preliminary data show that 37% (n=76) of the patients surveyed reported symptoms consistent with moderate or severe persistent by the NIH criteria. However, only 19.7% described their symptoms as moderate or severe. 78% believed that dust, and 89% thought illness were triggers of their symptoms, while only 54% thought burning fires contributed.

Conclusions: Internationally, the prevalence of asthma varies between countries, with the highest seen in Australia and New Zealand at an estimated 12% and 17% (in children), while in the United States the estimate is 3.1-8.6%. This study shows that symptoms consistent with asthma are present in the rural Guatemalan communities. Reversible risk factors may include dust and open cooking fires. The triggers, identified in this study, provide a focus for local community efforts and international aid. Further intervention should include efforts to modify these environmental risk factors, combined with education and treatment programs.

A Two-Week Low Iodine Diet is Necessary for Adequate Preparation for I-131 Scanning

Joel T. Park, MD, James V. Hennessey, MD, FACP

RHODE ISLAND HOSPITAL; HASBRO CHILDREN'S
HOSPITAL

Low-iodine (I) diets (LID) have been used to prepare thyroid cancer patients for radiiodine uptake studies. We sought to evaluate the utility of a self-managed LID designed for outpatients in a one-week versus a two-week LID period in patients being prepared for 4mCi **recombinant human thyrotropin (rhTSH)** stimulated and 2mCi thyroprivic I-131 scans. **Urinary (Ur) I to creatinine ratios (I/CR)** were assessed in 22 consecutive patients undergoing a rhTSH4mCi I-131 scan prepared with a one-week LID (50 ug/day). Of the 22 patients, 15 had undergone one or more previous thyroprivic 2mCi I-131 scans. UrI content obtained following the same diet for a two-week period preceding each thyroprivic study was compared to results from the rhTSH studies. URI content following each diet period and scan event was considered individually. The LID adequately prepared a significant proportion of the patients (I/CR<100ug/g). After one week of LID, the I/CR was $193 \geq 68 \pm 167.98$ (mean \pm s.d.,

n=22), in contrast to 67.01 ± 84.59 (n=28) after two weeks of LID. Following the one-week LID preparation, no patients attained the desired I/CR target of <50ug/g, but 41% of the patients (n=9) reached adequate UrI content of <100ug/g. I/CR were inadequate (100-250ug/g) in 32% (n=7). The desired UrI content was poorly achieved in 27% (n=6) with I/CR>250ug/g. After two weeks of LID, 75% of the patients attained the goal I/CR of <50ug/g (n=21), and 4% (n=1) had UrI content in the adequate range (50-100ug/g). 18% (n=5) had inadequate results (100-250ug/g), but only 4% (n=1) demonstrated a poor UrI outcome with I/CR<250ug/g. Furthermore, 67% of patients who had previously undergone the two-week diet preparation were less successful in attaining similar low UrI content in the subsequent one-week LID. No patient obtained a clinically significant lower I/CR with the one-week LID. In conclusion, a simple, self-managed LID used in an outpatient setting adequately prepares patients for I-131 scanning. However, a LID of 2 weeks seems necessary to attain desirable urinary iodine content in preparation for scanning.

Impact of Diabetes on Coronary Angiographic Findings in Acute Coronary Syndrome

Mark C. Heckel, MD, Barry L. Sharaf, MD, Nicholas J. Miele, MD, David O. Williams, MD

RHODE ISLAND HOSPITAL

Background: Differences in the nature and extent of coronary artery disease (CAD) between **diabetics (DM)** and **non-diabetics (n-DM)** have been described in stable coronary disease. Whether such differences, particularly those involving culprit lesions, exist among DM patients with **acute coronary syndromes (ACS)** is unknown.

Methods: We characterized and compared the coronary

angiographic findings in patients who had acute angiography for symptomatic rest ischemia with and without ST segment elevation according to history of DM. TIMI IIIB and TIMI V clinical and angiographic core lab databases were used for this analysis.

Results: Of 623 ACS patients, 84 (13%) had DM while 539 (87%) did not. Compared to n-DM patients, DM patients were more likely to be older (60.5 years vs. 57.6 years,

p=.014), female (44.0% vs. 27.6%, p=.002), and have a history of hypertension (52.4% vs. 33.5%, p=.001). Also, DM more often had multi-vessel lesions identified as possible culprits (14.5% vs. 5.8%), p=.02). No differences (p>.05) were noted in ability to identify a culprit lesion (84.5% vs. 78.5%), LAD as culprit site (50.8% vs. 42.3%), culprit stenosis severity (82.8% vs. 82.4%), presence of thrombus (14.9% vs.

24.0%), plaque ulcer (24.5% vs. 25.7%) or TIMI 3 flow (57.1% vs. 62.3%).

Conclusions: DM patients with ACS differ from those without DM. DM patients have more extensive CAD upon presentation. Features of the culprit lesion, however, are similar regardless of the presence of DM.

A Case of Domestic Violence

Arielle Adrien, MD, Fred Schiffman, MD, FACP

MIRIAM HOSPITAL

This is a case of a 76 year-old woman with a past medical history of abdominal mesothelioma for 18 months. She was managed conservatively with frequent follow-up appointments with her oncologist. She was not on any medication. She was admitted to the hospital with a complaint of dyspnea for 2 weeks and increased abdominal girth. She was noted to have a depressed affect and reported that her husband of 54 years died of a heart attack 3 weeks prior to her admission. The patient underwent an abdominal paracentesis with a total of 1.2 liters of peritoneal fluid removed. After the fluid quickly reaccumulated, causing abdominal distention, an abdominal **computed tomography (CT)** was ordered to assess the size of the mesothelioma and the plan was discussed with the patient. Later during that night, transport services came to take the patient to CT. She adamantly refused to go and despite much convincing of the intern nightfloat, the patient stated that she had no interest in getting the abdominal CT. The next morning during pre-round, the patient was very apologetic about her refusal and felt proud of her decision. With tears in her eyes, she stated "this is the first decision that I have ever made in 54 years." When asked to elaborate, she reported to have been in a marriage where she was totally controlled by her husband. She was only allowed to go out for a certain amount of time and would be subject to physical abuse if she was a few

minutes late. She was not allowed to have any friends. Everything that she liked was taken away from her including her cherished piano. She also reported many years of sexual abuse "too cruel to detail" as well as physical abuse such as attempted strangulation and other bodily injuries that forced her to seek care from her primary care provider accompanied by her husband. When asked if she was ever asked about domestic violence during her medical visits, she answered "no." Would she have told her story if her provider had raised the issue? She said "yes."

Elder abuse can take many forms, such as physical abuse, sexual abuse, emotional abuse, financial exploitation and neglect. It is reported that 10% of elders are victims of abuse. Between 1986 and 1996, there was a 150% increase in reports of violence against elders. Out of all elder abuse, 14-15% is reported to have been inflicted by spouses. Often patients present with depression, anxiety, chronic pain, fatigue, gynecological and gastrointestinal symptoms as well as direct physical injuries such as fractures, bruises, body aches. There are studies that have linked 14-23% of females seen in the primary clinics and 20% of emergency visits to physical abuse. These statistics clearly point out that physicians have the unique opportunity to greatly improve the health of their patients by addressing the issue of domestic violence regardless of the patient's age or socioeconomic status.

A Case of Esophageal Crohn's Disease

Dmitriy Leongardt, MD, Alan Epstein, MD

ROGER WILLIAMS MEDICAL CENTER

Case: A 41 year-old white female presented with a two-week history of dysphagia and odynophagia. The patient had had ileocolonic Crohn's disease for the last 20 years. For the past several years the patient had done well on sulfasalazine treatment. The patient had surveillance colonoscopy one year prior to this admission that did not reveal any colonic dysplasia and showed quiescent Crohn's disease. A week prior to admission the patient had **endoscopic gastro-duodenoscopy EGD** done for the complaint of dysphagia and was found to have multiple aphthous appearing ulcers throughout her esophagus, consistent with Crohn's disease. Patient continued to suffer from dysphagia to the point where she could not tolerate any significant p.o. intake. Patient was seen as an outpatient 3 days after the EGD and was found to be fatigued and markedly dehydrated. Pathology findings were consistent with erosive esophagitis with granulomas, negative for HSV and CMV. She was given infliximab (Remicade®) i.v. therapy as well as normal saline rehydration, and then sent for hospitalization. The

patient's condition markedly improved after infliximab treatment; she tolerated clear liquids within 12 hours. After a two-day hospital stay, the patient was discharged to home in stable condition, tolerating a full house diet.

Discussion: Crohn's disease, or regional enteritis, is a chronic inflammatory condition involving all layers of the intestinal wall. The condition affects small bowel alone in 30-40% of cases, small and large intestine in 40-55%, and large intestine alone in 15-25%. Disease may also occur in other areas of the alimentary tract, such as the mouth (6-9%), esophagus (<1%), stomach and duodenum (0.5-5%). Conventional therapy includes 5-aminosalicylic acid derivatives, corticosteroids and immunomodulating agents. Recent studies showed that a new class agent - anti-TNF antibody (infliximab) - is highly effective in treatment of Crohn's disease. Infliximab is also effective in treatment of severe esophageal Crohn's disease. In this case, the infliximab therapy produced a remarkably rapid clinical recovery. Follow-up EGD two weeks post-therapy showed a normal endoscopic appearance of the esophagus.

What Medications Do Physicians Give to HIV/AIDS Patients and Why?

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MEMORIAL HOSPITAL OF RHODE ISLAND

Background: Treatment of HIV/AIDS patients is with combination antiretroviral (ART) regimens with the goal of reducing viral load to undetectable levels. Initially, these regimens contained **protease inhibitors (PI)**. However, some PIs have been reported to have long-term complications, such as lipodystrophy. **PI regimens (PIR)** also contain many pills, making adherence difficult. Increasingly, non-nucleoside reverse transcriptase inhibitor (NNRTI)-based and other **protease sparing regimens (PSR)** are being used, while PIR use is decreasing.

Objective: To examine when infectious disease physicians would begin ART in an asymptomatic HIV patient, whether they would treat with PIR or PSR, and what would influence their choice regarding PI vs PS regimen.

Methods: A survey was mailed to all infectious disease physicians in New York and California. Three cases of asymptomatic HIV-infected patients who met DHHS guidelines for ART, each with differing levels of CD4 cell counts and HIV viral RNA, were presented. Physicians chose ART that they would begin for each case. Choices were categorized as PIR or PSR, based on whether the regimen contained PI or not. For each regimen, a series of questions regarding potential outcomes such as adherence to medication, development of adverse reactions, improvement or worsening of the patient's quality of life and change in

HIV viral RNA with treatment were asked.

Results: A total of 127 surveys have been analyzed. Most respondents (89.9%) would begin ART in Case #1, a patient with a CD4 count of 410 and HIV RNA 50,000; 62.1% would treat with a PSR, and 34.1% with a PIR. Factors that influenced physicians' ART choices were perceptions of poorer adherence, higher likelihood of adverse reactions, and worsening quality of life with PIRs compared to PSRs, but a higher likelihood of an undetectable viral load with PIR. Most (93.3%) would begin ART for Case #2, a patient with a CD4 count of 300 and viral load of 50,000; 58.1% would treat with a PSR and 37.2% with a PIR. They gave similar perceptions of influencing factors. In contrast, most (95.3%) would treat Case #3, a patient with a CD4 count 300 and viral load of 150,000; but 32.5% would treat with a PSR, and 62.7% with a PIR. Influencing factors were perception of higher likelihood of an undetectable viral load, but higher likelihood of side effects and worsening quality of life with PIR.

Conclusion: These data provide insight into the influence of CD4 cell count and HIV RNA viral load, and perceptions of benefits and risks of PIR vs. PSR ART on the choice of treatment for HIV patients. It appears that the perception of higher risk of adverse events and decreased quality of life with PI based regimens is felt to be of less importance when the patient has a higher viral load and lower CD4 count.

Email Feedback to Preclinical Medical Students in a Problem Based Learning Discussion Group

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THE MEMORIAL HOSPITAL OF RHODE ISLAND

The provision of constructive feedback, both formative and summative, is a vital component of the learning process. Unfortunately, despite the importance assigned to such feedback by medical educators and students, it is often abbreviated, omitted or delayed due to competing time demands present in academic medicine. In recent years we observed an increasing reliance upon email as a form of communication between students and teachers in our small group **problem based learning (PBL)** discussion sessions. Based upon this, we hypothesized that email communication may be a satisfactory vehicle to convey constructive feedback to predoctoral students. As a feedback medium it is direct, personal and also offers the additional advantage of being in a "hard copy" form that can be reviewed and referred to throughout the learning process. This study examines the attitudes of second-year medical students at the Brown Medical School regarding the use of verbal versus electronic mail feedback within a small group PBL pulmonary pathophysiology session.

Methods: Eighty predoctoral students were divided into ten discussion groups of eight students as a required component of their three week duration, second year course in pulmonary pathophysiology. Faculty group facilitators were instructed to provide students with mid-course feedback. Instructors were asked to do this either verbally, via email or both. At the completion of the course students were asked to complete a written survey instrument designed to assess feedback satisfaction and preference. The

instrument included queries as to whether or not students received feedback, the mode of feedback conveyance, and their level of satisfaction according to a five-point Likert scale (1 = unsatisfactory, 5 = most satisfactory). Results are expressed as mean, SD.

Results: Of 80 total, 62 students (78%) responded; 39 students (63%) reported that they did receive feedback. Of those that received feedback 23 (37%) received it verbally, 16 (26%) via email and one student received both. Of 37% that received verbal feedback, there was an overall satisfaction rating of 3.9 SD 0.9; 83% of these students thought that verbal feedback should continue; 75% of the students preferred verbal feedback over email. Of 26% who received email feedback the overall satisfaction rating of 3.9 SD=0.7. 93% of these students felt that email feedback should be continued. Of the 23 students who did not receive formal feedback, 90% preferred verbal feedback.

Discussion: Although second-year students who did not receive feedback in our study appear biased against email as feedback, those who received email feedback reported a similar level of satisfaction with this method when compared to those receiving verbal feedback. The perception that email is less personal was not borne out in practice. We therefore offer email as a reasonable alternative to verbal feedback when time constraints act counter to the provision of timely and complete verbal feedback. It also has likely applicability to medical students in other settings, both preclinical and clinical.

An Approach to Measuring and Comparing Performance and Improvement in Hospitals

John S. Coldiron, MD, MPH

Monitoring, measuring and assessing performance as well as the success of planned performance improvements is vital to the decision-making and resource-allocation processes of any organization. Hospitals are given specific guidance regarding these activities through the **Joint Commission on Accreditation of Healthcare Organizations (JCAHO)** standards established for leadership and for improving organizational performance. These standards obligate leadership to identify and select priorities and to improve organizational performance¹ and they confer the responsibility for collecting and analyzing data and for demonstrating performance improvement when necessary.² To accomplish the mandated monitoring and improve performance, a hospital must have an

infrastructure which provides the appropriate organizational framework, supporting policies and procedures, and a data collection and reporting system. This article will focus on data collection and reporting.

To accomplish the collection and reporting functions in the most efficient manner with the addition of a minimum of resources requires steps that lead to the following:

- * Consolidation of all organizational indicators into a single database.
- * Simplification of reporting of indicators by providing for direct, one-time, on-line data entry by the responsible person in a standardized format.
- * Production of user-friendly reports

that are specific to the various functional entities, e.g. departments, committees, teams, governing bodies, professional groupings, managers and external agencies, in a summary format that highlights the most useful data for that specific group. These reports should illustrate trends over time and, as appropriate, allow production of control charts so that performance variations are identified.

A schema for the overall design of the data collection and reporting system required to do these critical functions is illustrated in Diagram 1.

Central to the data support system are the **performance evaluation and improvement (PE&I)** databases. As illustrated in Diagram 1, the sources of data are numerous, varying from organization to organization in both content and data-collection software. This PE&I reporting system summarizes key data elements from the selected sources. Also, this data can produce a variety of reports, uniquely targeted for various internal and external audiences.

An indicator module can be used to produce a dashboard of indicators specific to the areas of interest of any given sub-unit within the organization. Table 1 and Table 2 are examples of administrative and clinical "report cards" using the monitoring indicators selected by the organizational unit tracking the processes or outcomes.

Likewise a report can be developed that displays the progress for those indicators tracking improvement. (Table 3)

The same data sources can be used to provide case-specific data in provider profile formats. For example, a physician profile that would be useful in the medical staff reappointment process³ can be displayed. (Table 4)

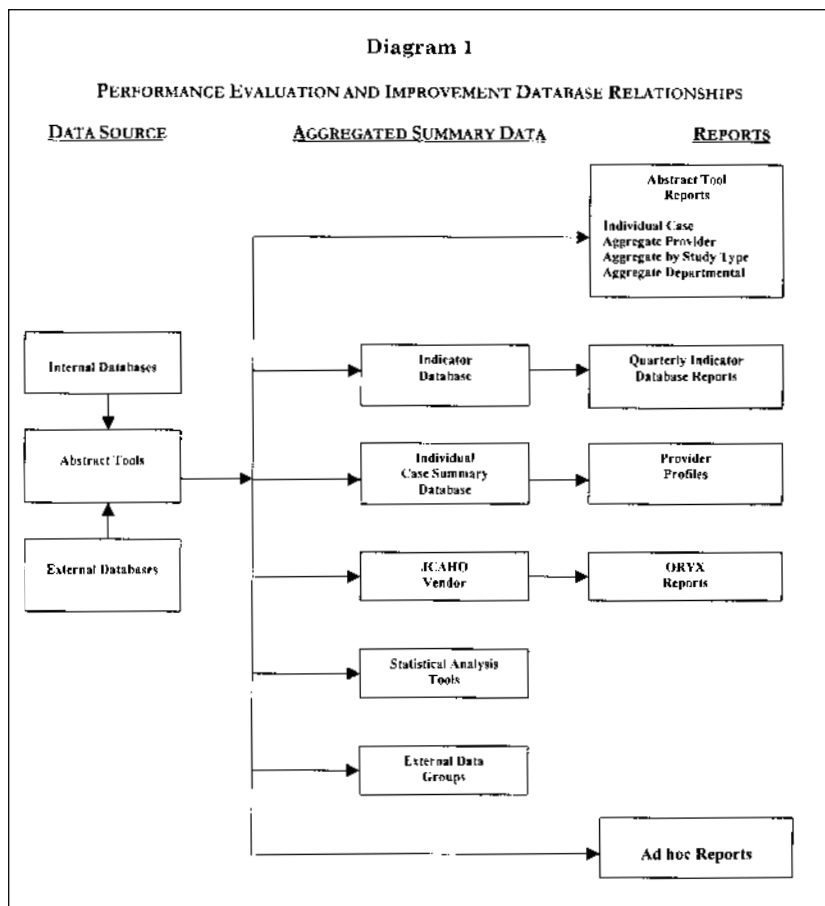


Table 1

Summary Report of Department Indicators

Administrative Services (Satisfaction Surveys)

ID	Indicator	Target/ %	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Lst Qtr %	Y Avg %
0101	Inpt Overall Composite Quality	87	QR	QR	88	QR	QR	91	QR	QR	88	QR	QR	90	90	90
0102	Inpatient Staff Courtesy	86	QR	QR	88	QR	QR	90	QR	QR	89	QR	QR	91	91	90
0103	Outpt Surg-Overall Quality	88	BR	BR	90	BR	BR	BR	BR	BR	90	BR	BR	BR	BR	90
0156	ED Registration	88	QR	QR	91	QR	QR	87	QR	QR	90	QR	QR	87	87	89
0157	ED Waiting Time	81	QR	QR	85	QR	QR	81	QR	QR	76	QR	QR	76	76	79
0164	Inpt. Comfort/Cleanliness	83	QR	QR	83	QR	QR	88	QR	QR	86	QR	QR	87	87	86
0165	Inpatient Food Service	76	QR	QR	78	QR	QR	81	QR	QR	80	QR	QR	81	81	80
0166	Inpatient Admitting	89	QR	QR	90	QR	NQD	92	QR	QR	89	QR	QR	92	92	91
0457	Outpt Surg-Preadm. & Reg.	86	BR	BR	90	BR	BR	BR	BR	BR	90	BR	BR	BR	BR	90
0458	Outpt Surg-Facility Subscale	79	BR	BR	81	BR	BR	BR	BR	BR	79	BR	BR	BR	BR	80
0459	Outpt Surg-Wait Time	96	BR	BR	96	BR	BR	BR	BR	BR	97	BR	BR	BR	BR	97

QR = Quarterly Report
 BR = Biannual Report
 NQD = No Qualifying Data

Table 2

Summary Report of Department Indicators

Clinical Services (General Surgery)

ID	Indicator	Target/ %	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Lst Qtr %	Y Avg %
0101	Appropriate PreOp Antibiotics Bowel Procedure	100	100	100	100	100	89	83	90	83	100	100	73	100	91	93
0102	Class II Surg Site Inf. Rate	<=1.5	2	3	0	0.8	1	1	1	1	NDA	2	1	0	1	1
0103	Inpatient Med. Rec. Complete	90	68	67	80	NDA	NDA	NDA	60	66	66	NDA	75	70	72	69
0104	Prophylaxis Hip Arthroplast	100	100	80	100	100	100	100	100	100	100	100	83	NQD	92	97
0105	Unsched. Returns to OR	2	0	7	5	8	1	4	2	3	1	2	0	1	1	3
0161	Inpt. Medical Outcome	89	QR	QR	91	QR	QR	92	QR	QR	90	QR	QR	93	93	91
0162	Inpt. Physician Care	90	QR	QR	91	QR	QR	94	QR	QR	90	QR	QR	93	93	92
0455	Outpt Surg-Surgeons	88	BR	BR	91	BR	BR	BR	BR	BR	91	BR	BR	BR	BR	91
0456	Outpt Surg-Medical Outcome	91	BR	BR	92	BR	BR	BR	BR	BR	91	BR	BR	BR	BR	91

NDA - No Data Available

Table 3

Progress Toward Target
 Jan 2000 - Dec 2000

	Indicator	Start Date	Target	Baseline	Last	Previous	2 nd Previous	3 rd Previous	Percent* Progress
0501	Medication Error Reporting	01/01/00	>30	15	25	23	18	16	67
0502	Mammo Patient Follow-up Tracking	01/01/00	100%	94	96	95	95	94	22
0503	Fall Prevention Prog. Documentation	07/01/00	100%	88	92	88	---	---	32
0504	Employee Sharps/Injury Reduction	04/01/00	>1	1.7	1.2	1.7	1.3	---	71

*Percent progress toward the "Target" value since implementation of a planned improvement of the process as measured by the most recent ("Last") value in relationship to the "Baseline" (pre-intervention) value. Prior to start date shown as....

TABLE 4: SAMPLE PEER REVIEW SUMMARY SECTION OF A PHYSICIAN PERFORMANCE PROFILE

Review Type	INDIVIDUAL			DEPARTMENT			ENTIRE MEDICAL STAFF		
	Total Cases	# Significant Exceptions*	% SE	Total Cases	# Significant Exceptions*	% SE	Total Cases	# Significant Exceptions*	% SE
Blood Use	34	0	0	1,160	3	.3	1,547	3	.2
Criteria-based review	18	1	5.5	773	39	5	1,127	68	6
Drug Use	3	1	33	109	9	8	129	9	7
Mortality	19	0	0	452	13	3	503	14	3
PRO Quality	6	0	0	153	2	1.3	192	2	1
Record review	17	1	6	485	53	11	1,032	83	8
Surgical case	23	0	0	3,146	39	1	7,412	40	.5
Clinical occurrences	6	0	0	151	3	2	187	4	2
Totals	126	3	2%	6,429	161	2.5%	12,129	223	2%

*Number of significant exceptions (SE) found after second-level review. Significant exception means a deviation from the Standard of Care which impacts on patient outcome or resource expenditure.

INDEX TREND CHART

INDEX TYPE	1 ST QTR 2000	2 ND QTR 2000	3 RD QTR 2000	4 TH QTR 2000
Monitor	0%	3%	3%	3%
Improvement Progress	14%	5%	30%	50%

Monitor Index: = The mean (average) variation of the actual value of the quarterly average from the target value for each indicator included in the study population.

Improvement Index: = The average percent improvement [(difference between baseline value and current value) divided by (target value minus baseline value)] for all improvement indicators initiated in the previous year.

Finally, by measuring the variation from the mean for monitoring indicators and calculating the mean variation of all indicators from their individual targets, an overall institutional measure of performance is developed. As well, the percent progress of the improvement projects toward the target can be calculated. (Index Trend Chart).

These indices give a “one number” measurement of quality for the stable processes of the institution (monitoring indicators) as well as the relative success of the selected improvement efforts (improvement indicators). If truly representative of the scope of the institution’s services and if validated properly, *infra vida*, these indices not only provide the measure of quality in the subject organization but can be used for comparison to others.

The starting point for implementation of a system to measure performance through indicator profiles is insistence on institution-wide standardized input of data elements into each indicator. (Indicator Description)

In developing the indicator description, one must specify why the target is appropriate, and also, clearly describe the methodology for collection of data. The rationale for any adjustment for case mix needs to be described and applied to both the indicator and data used to establish the performance target. Finally, the indicators selected must truly reflect important aspects of the scope of services provided by the departments within the institution.

If steps are taken to assure that the indicators in the PE& I

database(s) truly reflect the characteristics of key process variables and outcomes of the components of the scope of services of the institution, if it is validated that the targets established are suitable, if the methodology used to collect the data is verified as correct and if the reporting of the results is validated, then comparisons can be made from institution to institution. The issue of validation of the accuracy of the data is of great importance. Within the organization the quality improvement staff can serve as internal auditors; and, for external comparisons, validators sponsored by trade organizations, customer associations or government agencies, can perform the role.

Most institutions have a large number of indicators they generate for

INDICATOR DESCRIPTION		
Affiliate:	Newport Hospital	Responsible Person: Manager, Performance Evaluation & Improvement
Dept:	4089	Phone: 846-6400
Indicator ID:	0582	JCAHO Indicator: Yes
Indicator Name: Acute Myocardial Infarction - Aspirin at Discharge		
Start Date		Target
10/01/2000		100%
JCAHO Functions		JCAHO Dimensions of Performance:
Care of Patients		Effectiveness
System / Affiliate (S / A)	Project Team / Dept (P / D)	Monitor / Improvement (M / I)
S	P	I
If P selected for Project Team indicator, name the Coordinating Team:		
Team 1: Continuously Improve Quality of Care and Clinical Outcomes		
Opportunity Statement:		
An opportunity exists to improve the clinical care of the patient with Acute Myocardial Infarction (AMI) beginning with Admission and ending with Discharge. This effort should improve medication management for the AMI patient. This process is important to work on now because we need to improve and validate the quality of care provided to this patient population.		
Indicator Description:		
Refer to "JCAHO Pilot Project Specification for Hospitals"		
Numerator = Number of eligible AMI patients who are prescribed aspirin at discharge Denominator = Number of qualified AMI cases as defined by JCAHO specifications		
Identify why indicator has been selected:		
To lower the one-year mortality rate for Medicare beneficiaries following hospital admission for AMI. This has also been selected as part of the HCFA 6 th Scope of Work and Rhode Island JCAHO pilot project.		
Standard / Benchmark:		
Comparative Data with other hospitals in Rhode Island and across the nation.		
How is data collected:		
Retrospectively by abstractor. Medical Record is identified by JCAHO specifications and downloaded on a monthly basis into Medquest software for abstraction. Once completed, it is submitted to JCAHO and HCFA.		

their own internal use or to meet requirements of an external licensing or certifying agency. Consolidating the indicator database does not mean these indicators should be abandoned, but rather just standardized in terms of their format and aggregated into one database that can be summarized in flexible, user-defined formats. The use of control charts to track trends and the statistical process control approach to the analysis of variation of performance over time provides the basis for focused review and possible

action.⁴ This process can be facilitated by software such as QualaCare,⁵ which allows desktop entry of values by designated individuals throughout the organization. This approach to monitoring performance has proven successful in over three years of institution-wide use in an acute general community hospital, which includes psychiatric, rehabilitation and sub-acute services (Newport Hospital, Newport, RI).

In summary, it is possible, practical and desirable to evaluate and mea-

sure improvement of the functions and dimensions of performance within an organization through the use of an indicator reporting tool. The ability to aggregate, summarize and report data in user-defined formats allows identification of areas for focus and further investigation. It also produces an overall index of the stability of the organization's performance and the progress being made on improvement projects that can be compared to other organizations using the same methodology.

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Senescence, Frailty and Mortality: Mathematical Models of Aging

Mary E. Sehl, MD, MMS

With a rapidly growing old-old (age greater than 85 years) segment of the population in the United States and most developed countries, the question of how we age and how best to care for aging patients has become of increasing importance. Biological theories and mathematical models of aging are needed in order to understand the dynamic processes involved in aging, to identify who is at risk for frailty and death, to develop interventions to maintain functional status, and to detect the costs and benefits of such interventions.

The terms "aging" and "frailty" remain ill-defined. A distinction must be drawn between "aging" and "senescence." Aging refers merely to changes occurring with the passage of time. These changes can be malignant, indifferent or benign, as in the effects of time on wine and cheese. In contrast, the term senescence implies a loss of integration and resilience. Senescence can be defined as a progressive physiological degeneration with age that leads to a decline in survival and reproduction. It is also important to separate normal, healthy senescence from age-related illnesses, such as osteoarthritis, cardiovascular disease, certain types of cancer (e.g., prostate), and Alzheimer's disease.

The technical definition of "frailty" used by demographers is "a set of susceptibilities and risk factors that allow for individual differences in mortality

rates."¹ However, in medicine, "frailty" is often used to denote "a condition or syndrome which results from a multi-system reduction in reserve capacity to the extent that a number of physiological systems are close to, or past, the threshold of symptomatic clinical failure. As a consequence the frail person is at increased risk of disability and death from minor external stresses."²

There are at least 300 different theories about what underlies the senescence process,³ classified into: theories based on age changes, theories related to primary damage, genetic program theories, evolutionary theories, tissue-specific theories, physical-mathematical and unified theories.³ The focus of this article shall be on mathematical theories of aging, and the use of theoretical data-based modeling both to analyze longitudinal data collected from aging subjects and to test theories of the mechanisms underlying senescence.

Historically, work done by actuaries such as Gompertz⁴ and Makeham⁵ on the laws of mortality was based on the search for the mechanism of human aging and death, whereas the focus of subsequent biomedical research was on specific age-related and age-dependent diseases frequently encountered. Recently, with a growing amount of collected experimental data and basic science research into the biological mechanisms underlying human senescence

(e.g. heat shock proteins, hormesis, "aging genes," including age-1, clk-1, daf-2, daf-16, and eat-2), and with the survival of greater proportions of the human population to advanced ages, there is renewed interest in the development of general models of human senescence and mortality.

LINEAR MODELS OF DECLINE

Death "from old age," independent of specific accident or major illness, has been shown to occur as a result of a linear decline of organ reserve with age.⁶⁻⁹ Shock⁶⁻⁸ examined many important physiological functions, such as nerve conduction velocity, basal metabolic rate, cardiac output, blood flow to the kidney, and maximum breathing capacity. Strehler and Mildvan⁹ later studied linear decline by plotting reserve capacity against age, using similar physiologic variables (cellular water, blood flow to the kidney, maximum breathing capacity, nerve conduction velocity, and cardiac output), and showed close slopes of loss among the variables, with values ranging from 0.9% to 1.4% of maximal reserve per year. Bortz and Bortz¹⁰ presented a global rate of senescence in healthy, active athletes (0.5% per year) for exercise-related performance variables, in contrast to rates of decline in sedentary individuals (up to 2% per year loss).

A distributional form for senes-

cence loss rates has been characterized¹¹ in which many functional and structural variables were examined using data from multiple studies of healthy human aging subjects. Both cross-sectional and longitudinal studies were included, and subjects who smoked or had chronic illnesses were excluded. The frequency distribution of linear loss rates for diverse physiological variables from different organ systems was shown to have a unimodal, right-skewed shape, with mean and median values of 0.65% and 0.5% per year, respectively. This partial Gaussian shape suggests that there may be some variables that get better with age (such as experience or wisdom) to complete the left hand side of the distribution, making it symmetrical.

In linear models of senescence, the mortality risk is related to functional decline by the concept of a threshold of failure. When the physiologic capacity reaches a threshold value (e.g. 30% of maximal functioning), the system fails. Mortality can then be calculated as a function of system failure at the point when this threshold is crossed. Forbes and Brown¹² proposed a simple model with two mathematical parameters, R and S, that depend on physiological processes, and a cut-off level that relates the amount of deterioration to the probability of dying. The application of this model to mortality data allows for the estimation of the values of R and S, in order to be able to predict mortality and calculate life tables.

LOSS OF COMPLEXITY WITH AGE

Normal aging is associated with a progressive impairment in physiological control systems that interact to maintain adaptive capacity. One can examine not only the average value of a given physiological measure with age, but also the variability of the measure over time (e.g. heart rate beat-to-beat variability). Decreased variability is hypothesized to be a measure of pathology of a physiological system, and can be analyzed to study the functional decline of a physiological control system with age. The degree of complexity within this variability has been shown to be a useful physiological marker of aging: a healthy physiologic control system produces an

irregular, highly complex variability in dynamics; with age, this variability becomes dampened, more regular and less complex.^{13,14}

An elegant new statistical method, called "Approximate Entropy (ApEn)," originating from nonlinear dynamics, chaos theory and probability theory, is used to analytically or numerically quantify the degree of regularity of physiological fluctuation.¹⁵ In studies in which this analysis has been applied to various physiological systems, there has been shown a loss of complexity with age in cardiovascular control (i.e. heart rate beat-to-beat variability, BP variability), pulsatile hormone release, and electroencephalographic potentials.¹³ These methods can be used to identify individuals who are most at risk for morbidity and mortality, and can aid in the optimization of interventions (such as the delivery of hormone replacement therapy), based on an understanding of the temporal patterns of certain physiological variables in a healthy individual vs. a frail individual.

DECELERATION OF MORTALITY RISK AT ADVANCED AGES

A major mystery in aging research is the observed leveling off at advanced ages of the exponential growth of mortality with age. The relation of mortality risk to age, for most age groups, has been shown to fit the traditional Gompertz-Makeham equation:

$$\mu_x = ae^{Gx} + b,$$

where a, b, and G (the Gompertz parameter of a given population), are constants, and μ_x is the force of mortality of the population. However, this equation does not hold for mortality rates observed in the oldest age groups, in which the mortality has been shown to decelerate, level off or even decline. A deceleration of mortality rates at advanced ages has been shown to occur in Mediterranean fruit flies,¹⁶ *Drosophila melanogaster*,¹⁷ *Caenorhabditis elegans*,¹⁸ and humans.¹⁹

What underlies this deceleration? It may be a change in the rate of the senescence process in an individual. However, because death changes the composition of a cohort by differentially removing the frail, the question of popu-

lational heterogeneity as a cause of the mortality deceleration has been investigated.²⁰ The mechanisms that underlie these observed dynamics can be explored using various (e.g. demographic, evolutionary) models of aging, frailty and mortality.

GENERAL MODELS LINKING FUNCTIONAL DECLINE TO MORTALITY

For thorough descriptions of several of the mathematical models of aging and frailty developed in the past and currently being studied, please refer to an excellent recent review of mortality modeling.²¹ Some early models linking the linear decline in organ reserve to the nonlinear shape of observed mortality curves were formulated by Strehler and Mildvan⁹ and Sacher and Trucco.²² The Strehler-Mildvan model is based on the assumptions that (1) the death rate at a given age is proportional to the frequency of stresses that surpass the ability of a subsystem to restore the initial conditions at that age, and (2) the magnitude of responses required to overcome a challenge follows a Maxwell-Boltzmann distribution, similar to that of intermolecular energies (small challenges are much more common than large ones). Vitality, $V(x)$, is defined as the capacity of an individual organism to stay alive at age x, and declines linearly with age. According to the model, mortality rate is proportional to the frequency of environmental challenges, which depends on the vitality of the organism, $V(x)$, and the deleteriousness of the environment, D, as described by the following equation:

$$\mu(x) = ke^{-\frac{V(x)}{\epsilon D}}$$

where k and ϵ are constants. In this way, if the challenge size has an exponential frequency distribution, a linear decline in organ reserve leads to an exponential probability of death with age.

In Sacher and Trucco's mathematical theory of aging,²² mean physiologic state declines at a constant rate with time, while Gaussian displacements occur about this mean at all times, regulated by random fluctuations of internal and external origin. From his postu-

lates, an expression is derived in which the rate at which members are removed from the population is a function (an exponential decay $\sim e^{-x^2}$) of the difference between their mean physiologic state and the limiting physiologic state.

Reliability theory, using component analyses, has been used in mortality modeling.²³ Death is attributed to a failure of multiple components connected in series. Risk of failure for non-identical components is examined by dividing each component into subsets (e.g. the myocardium is composed individual muscle cells), and calculating when a system “wears out” based on the loss of a critical mass of its constituent cells.

DEMOGRAPHIC MODELS

Demography can be used to examine the frailty, or heterogeneity, of a population in order to explain the shape of the mortality curves observed for the population. Demographic models provide better fit to data than the traditional Gompertz model, because they consider frailty of subcohorts of the population. A demographic model in which frailty is fixed for a given subset of the population^{1,24} uses a joint probability distribution of two random variables: survival time (T) and a heterogeneity variable (Z). Z is considered the frailty of the population, characterizing individual susceptibility to disease and death. It is a gamma distributed random variable, with value greater than 0 with probability 1, and is fixed, unidimensional and continuously distributed. Mortality for individuals of frailty Z is described by the following equation:

$$\mu_z = Zae^{Gx} + b$$

where a, b and G are constants. The gamma-Makeham model²⁴ provides better fit to mortality data than the Gompertz model. These models can be extended to include the concept of changing frailty, useful in the analysis of data from longitudinal studies of aging.

EVOLUTIONARY MODELS

Evolutionary approaches to explaining senescence are based on the idea that the forces of natural selection

decline with age. In these models, the mortality and fertility of a population are considered in conjunction with one another. The increase in age-specific mortality during the reproductive age interval and simultaneous decline in evolutionary pressure can be mathematically illustrated using Lotka's equation for a stable population. The discrete-time model is described by the following equation:

$$\sum_{x=a}^b e^{-rx} l_x m_x = 1,$$

where a and b are the ages of the beginning and end, respectively, of the reproductive interval, $p_i = 1 - e^{-\mu_i}$ is the probability of death between ages i-1 and i, $l_x = \prod_{i=1}^x (1 - p_i)$ is survival, m_x is age-specific fertility rate, and r is the growth rate of the population. The sensitivity of the growth rate of the population, r, to the mortality rate at age k (μ_k):

$$\frac{\partial r}{\partial \mu_k} = \frac{-\sum_{x=k}^b e^{-rx} l_x m_x}{\sum_{x=a}^b e^{-rx} x l_x m_x},$$

is negative, implying that the sensitivity of fitness to changes in mortality rates declines with age.²⁵

STATE-SPACE MODELS

Woodbury and Manton²⁶ proposed a state-space model of aging which includes four types of dynamic forces that influence the distribution of individual states over time: drift (shifts with age in mean physiological characteristics of the population), regression (return of an individual to more normal ranges), diffusion (stochastic divergence of an individual's physiological values), and mortality selection (removal of persons because of death as a probabilistic function of physiological state). These four dynamics operate simultaneously and influence each other. Combining the four dynamics with a cumulative measure of risk exposure, a set of tractable, computational equations are derived, based on the rigorous statistical model.

From the application of this model to data from the Duke University Lon-

gitudinal Study of Aging population, estimates for both the mortality and dynamic (physiological) coefficients have been calculated. These estimates reveal characteristics of population aging dynamics and selection of robust individuals. In particular, by applying this model to an analysis of circulatory disease risk, the effects of risk factors (and how they change with age) can be separated from the aging dynamics of circulatory disease.²⁷ These results can be used to describe the future course of these processes.

MODELS ACCOUNTING FOR DECELERATION

There have been some models of aging constructed with the intent to explain the deceleration of mortality at advanced age. The aim of these models is to factor out which components and which mechanisms allow for mortality to decelerate. In an extension of the demographic fixed frailty model, the Gamma-mixed Gompertz model, average mortality increases as a logistic function of age.¹ Another model makes use of Markov chain theory.¹⁹ A time-homogeneous Markov chain is constructed in which there are n transient states, with state n+1 being an absorbing state, and a matrix (of order n), A, of transition intensities. The survival function is represented by a series of probabilities of the individual being in one of the live states. As the age of the individual increases, the hazard (negative natural logarithm of survival function) approaches a constant, the dominant eigenvalue of the transition matrix. Thus, the mortality always levels off eventually. In applying these (and more) models of mortality to longitudinal aging data, it becomes possible to investigate possible causes of the observed slowing of mortality at advanced ages.

APPLICATION OF MODELS: LONGITUDINAL STUDIES OF AGING

What exactly can we learn from these models and how can they be applied to experimental data? Mortality models have been used for many different purposes: to smooth mortality data, to construct life tables, to aid inferences

from incomplete data, to facilitate comparisons of mortality, and to aid in forecasting.²⁸ Mortality modeling can show the relative contributions of previous mortality rates and current morbidity and deprivation to future mortality curves. Mathematical models that deal with the effects of observable covariates on mortality can be applied to longitudinal data collected for a set of observed variables (e.g. blood glucose, vital capacity index, hematocrit, body mass index), in order to assess the contribution of the different covariates to morbidity and mortality.

Longitudinal data from many physiological variables are currently being collected in studies of various experimental insects and mammals, as well as in human aging studies, e.g. the Baltimore Longitudinal Study of Aging (National Institute of Aging), the Framingham Heart Study (National Heart, Lung and Blood Institute), the Duke Longitudinal Study of Aging (Duke University Center for Aging) and the Danish Twin Study (Danish Twin Register). Longitudinal data allow one to view trajectories of physiological processes over time, and to separate population phenomena from the events of an individual.

The well-known age-period-cohort problem arises in clinical aging studies when chronological age, location in cohort and time of measurement become confounded. Age effects are characterized by biological and physiological changes; period effects are due to changes in environment, measurements and practice effects associated with repeated measures; and cohort effects are characterized by the interaction of specific historical situations affecting cohorts at specific ages.²⁹ Cross-sectional studies have as variables age and cohort, whereas longitudinal studies have age and period. The ideal study is the cross-sequential study in which the same age groups are sampled at consecutive times.³⁰ Here the age effect is isolated by contrasting the age-cohort confound of cross-sectional design with the age-period confound of longitudinal design.

As only a limited amount of information can be gathered over time for a given individual or population, hazard

models that represent the effects of observed, partially observed, and unobserved stochastically changing variables are becoming extremely useful. A mathematical model used to study longitudinal data recently developed is the quadratic hazard model.³¹ Inherent in the quadratic hazard model is the use of a U- or J-shaped curve for the relation of risk to risk factors, as is observed empirically. This relation is consistent with the hypothesis of homeostatic mechanisms that maintain physiological variables within a desirable range. Furthermore, because of covariate interactions conditional on location parameters, the lowest levels of risk in the quadratic hazard model occur at positive low levels of stress, fitting with the idea of hormesis (low exposures to stress increase "fitness," i.e. the ability to resist environmental stress).

Using models with stochastic changes allows one to see whether there is better fit to observed data when these deviations are included. Thus one can answer the question whether frailty is fixed, potentially via homeostatic mechanisms. Adding a stochastic component has shown that debilitations causes a stochastic change which leads to selection that counterbalances the effects of debilitations.³²

The usefulness of the multidimensional model lies in the ability to study contributions of different factors to mortality, independently. One can consider the independent effects of several coexisting physiological variables (which could be measured for an individual), and by selectively altering these parameters, view the relative contributions of each parameter to overall risk of mortality. In addition, the multidimensional model can be used to determine the complex relationship between physiological function and observed differences in mortality for different groups, e.g. different sex cohorts.³³

A multidimensional model developed by Manton, Stallard, Woodbury and Dowd³⁴ has been applied to longitudinal data on risk factors (such as cholesterol, hematocrit levels) and mortality and another longitudinal study of function and mortality. The application of this model to these data allows for the

determination of the relative contributions of certain risk factors and functional status to the risk of mortality. In this work, risk factors explained 70% of the age-dependence of mortality, and the relation of risk factors to mortality changed over age and differed by gender. Functional scores are also strongly related to mortality. Using a rich state-space model, the adjustment of the model for unobserved heterogeneity can better describe the relation of mortality to functional status.

Application of the model to the Framingham Heart study data showed that functional capacity, defined as a multidimensional index of physiological reserves, in which 9 physiological factors were considered, is strongly related to mortality until age 95, after which physiological and functional changes deteriorate more slowly. When a given set of risk factors, or functional measures, is considered for a mortality model, the degree of success of those factors in explaining the age-related increase in mortality can be estimated by a parameter inherent in the state-space models. This parameter can be calculated for different sets of risk factors to determine which factors are most important in predicting mortality patterns.

Eventually, if factors (the different dimensions in the model) can be identified that most influence mortality, one can in principle measure these functions and be able to predict survival, prognose level of dependence, and level of care needed, etc. If one is able to identify who is "frail," and which functions contribute most to frailty, these populations and functions can be targeted for medical care. Further modeling could examine what repair and treatment could do for an individual and predict gains in decreased mortality or increased functional status from a given intervention.

MODERN METHODS

Mathematical models in biological data analysis have traditionally included survival curve analysis as a tool to investigate aging and mortality. In recent years, it has become apparent that the addition of data-based modeling of lifespan trajectories, using programmed computer simulations, can serve as a

new approach to understanding the biology of senescence and its underlying mechanisms. Results obtained from modeling can be compared to experimental results, and parameters can be altered to identify which components of the model are the most stable and which are the most sensitive to change. These methods have been greatly enhanced by the accumulation of longitudinal data about changes of physiological parameters in the aging process from different animal and human populations. Thus, it has become possible not only to study fundamental ideas and formulate hypotheses about senescence, but also to produce results that can be compared with experimental data. Furthermore, one can effectively simulate new experiments, which can aid in the planning of future potentially expensive, time-consuming experimental studies.

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Contributions report on an issue of interest to clinicians in Rhode Island: new research, treatment options, collaborative interventions, review of controversies. Maximum length: 2500 words. Maximum number of references: 15. Tables, charts and figures should be camera-ready. Photographs should be black and white. Slides are not accepted.

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Clinicians are invited to describe cases that defy textbook analysis. Maximum length: 1200 words. Maximum number of references: 6. Photographs, charts and figures may accompany the case.

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Readers share their perspective on any issue facing clinicians (e.g., ethics, health care policy, relationships with patients). Maximum length: 1200 words.

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Authors discuss a new laboratory technique. Maximum length: 1200 words.

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Authors present an iconoclastic, research-based analysis of long-held tenets. Maximum length: 1200 words.

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We encourage submissions from all medical disciplines. Image(s) should capture the essence of how a diagnosis is established, and include a brief discussion of the disease process. Maximum length: 250 words. The submission should include one reference. Please submit the manuscript and one or two cropped 5 by 7 inch prints with the author's name, degree, institution and e-mail address to: John Pezzullo, MD, Department of Radiology, Rhode Island Hospital, 593 Eddy St., Providence, RI 02903. Please send an electronic version of the text to: JPezzullo@lifespan.org.

The Rhode Island Public and the Mental-Health Parity Debate

David A. Rochefort, PhD

The expansion of insurance for mental health problems has emerged as a controversial public policy question in recent years. Rhode Island's first "parity" statute, enacted in 1994, was amended during the 2001 legislative session to include several additional benefits, although lawmakers stopped short of abolishing all inequities between mental health and general health care coverage. A majority of other states, as well as the federal government, have also adopted their own mental-health parity laws.¹ Little consistency marks the design and scope of benefits under these measures, however, resulting in a patchwork of financial protections for mental health treatment across the country, and even from state to state within particular regions.

In Rhode Island as elsewhere, parity proposals have often stimulated vigorous behind-the-scenes debate among organized stakeholders such as insurers, employers, professional groups, and mental health advocates. Typically, this process has led to negotiated compromises over the types of services and disorders to be covered. Neither comparative statistical analyses of parity actions across the states,² nor the findings of various legislative case studies,³ would suggest that public opinion has had a substantial impact on policymaking in this area.

However, it would be wrong to assume that the public is indifferent on matters of mental health insurance coverage.

This article, which reports the results of an original survey of Rhode Islanders, documents the existence of a number of strong preferences and value positions that could help to guide future parity deliberations in the state. It also presents information as to which groups among the Rhode Island public place the highest priority on expanding insurance for mental health problems and say they are willing to pay more for this form of coverage.

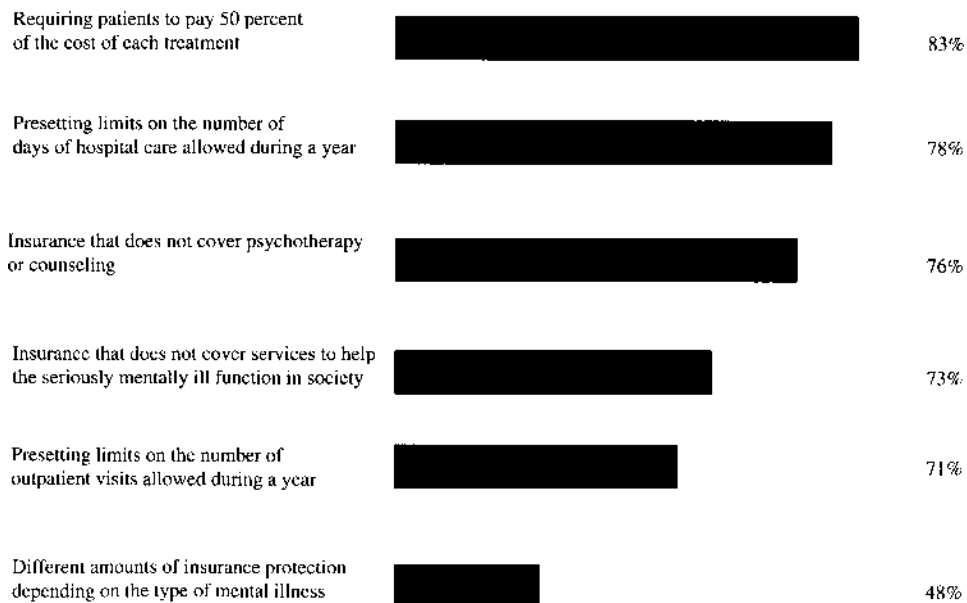
PARITY MENTAL HEALTH INSURANCE: ISSUE BACKGROUND

Due to "moral hazard" concerns about the potential overutilization of services and a desire not to supplant the role of public psychiatric facilities, insurers traditionally have relied on myriad benefit restrictions in the mental health area. These include special annual limits on days of inpatient care, lower lifetime spending limits for mental health services, maximum numbers

of outpatient visits per year, and higher patient cost-sharing. According to the U.S. Surgeon-General's Report on Mental Health, the spread of managed care has tended to increase service restrictions and cost constraints for mental health care.⁴ The call for mental-health parity arose in response to the philosophical equity issue created by differential insurance treatment of people with mental health problems, as well as the risks of underservice and financial loss that occur when such problems develop.

Rhode Island took its first cautious step in addressing this type of insurance discrimination in 1994, when the Legislature amended Title 27 of the General Laws on "Insurance." A new Chapter 38.2 focusing on "mental illness coverage" mandated that all private health insurers in the state pay for treatment of mental illnesses with the same service limits, dollar limits, and cost-sharing as for other medical con-

Figure 1
Percentage of Survey Respondents "Opposed" or "Strongly Opposed" to Mental Health Insurance Control Practices



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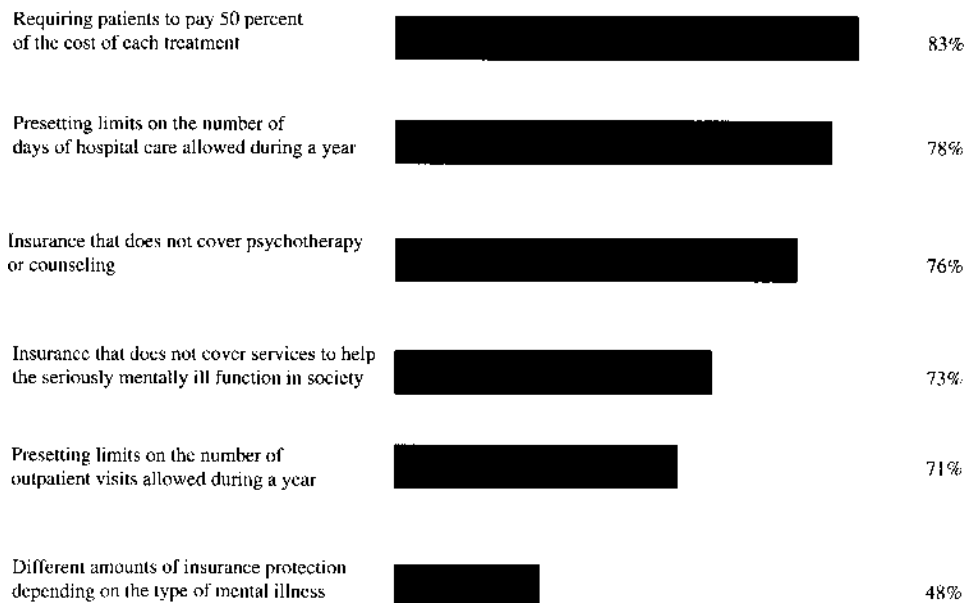
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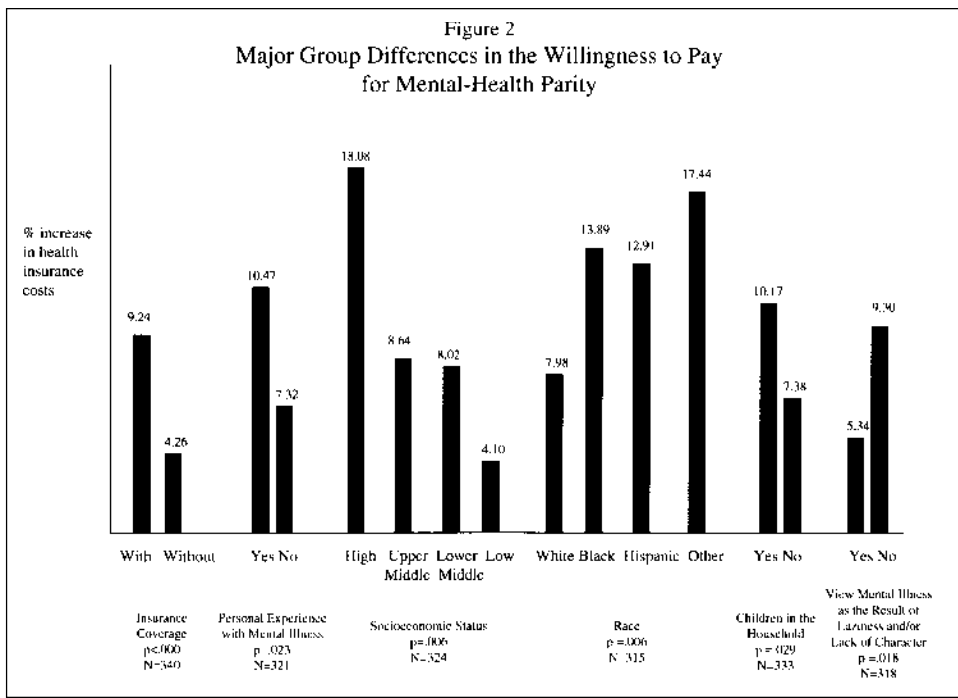
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ditions, but with several qualifications. It applied only to “biological disorders”; it did not include outpatient psychotherapy, only inpatient care and outpatient medication visits; and it omitted substance abuse disorders. According to data reported by the National Advisory Mental Health Council, the law was followed by a moderate increase in the number of inpatient admissions per 1,000 insurance plan members, a moderate reduction in the average length of inpatient stays, and a 19% overall increase in the number of inpatient days per 1,000. Total health plan costs rose only 1/3 of 1%.⁵

The push for general health care reform on the state and national levels during the early and mid-1990s increased interest in the improvement of mental-health coverage. When that broad attempt at reform collapsed, advocates continued to argue for parity laws as a modest and worthwhile intervention not dependent on a complicated overhaul of the health system. In states like Rhode Island, the issue has also gained momentum from periodic news reports of people with mental illnesses having been cut off from or denied needed mental health treatment by insurers, often in seemingly arbitrary fashion.⁶

One useful indicator of support for parity lies in the willingness of people to pay more for health insurance that includes extensive mental health benefits.



Since 1994, a series of proposals have been submitted with the intent of liberalizing Rhode Island’s parity statute. However, aside from legislation in 1999 that relocated enforcement authority for the law from the Division of Business Regulation to the Health Department, no major changes were adopted until this current year. “An Act Relating to Insurance Coverage for Mental Illness,” signed by the governor on July 10, 2001, revises the original parity law in a number of important respects, as follows:

- * Addition of substance abuse problems for coverage under the law
- * Broadening of the concept of mental illness by removing the requirement that disorders must be of a

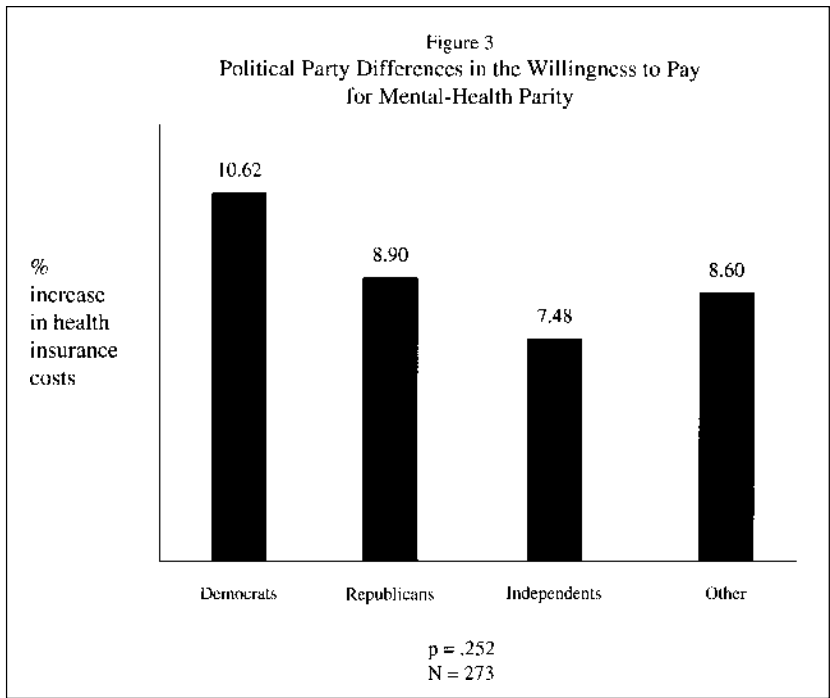
biological nature
* Elimination of a 90-consecutive-day limit for inpatient hospitalization

Significant limitations remaining under the bill are thirty outpatient mental health visits per calendar year; the exclusion of community residential care for mental illnesses; and thirty hours of outpatient treatment for substance abuse problems per year.

So it is that Rhode Island has adopted a comprehensive - albeit not “full” - parity statute. Yet the law’s actual impact may hinge on how it is implemented. Researchers have identified several problems related to

compliance, enforcement, and loopholes in parity laws around the country.⁷ Another concern is that insurance plan members need to gain sufficient awareness and understanding of the new parity law to make use of its rights and benefits. Finally, although parity statutes expand access to mental health treatments in theory, an individual’s ability to receive services in practice will remain a function of managed care gatekeeping procedures.

Currently, the parity issue is again in the news as the U.S. Congress revisits the Mental Health Parity Act of 1996, due to lapse at the end of September, 2001.⁸ This federal law provides only a weak legal framework for parity, but it covers over 100 million Americans in Rhode Island and other states who are enrolled in “self-insured” health plans (arrangements in which the employer rather than the insurer funds the risk of paying claims) that are immune from state regulation. The achievement of mental-health parity also is linked to the continuing problem of uninsurance since parity statutes can do nothing to improve access to mental health care among those lacking health insurance. Finally, parity promises to be a live issue for the foreseeable future in a state like Rhode Island where officials have identified



the mental health system as in need of augmented financing and reorganization.⁹

METHODOLOGY OF THE RHODE ISLAND SURVEY

The survey described in this study was carried out by the Public Opinion Laboratory at Brown University between September 14 and October 15, 1999. A procedure of random digit dialing was used to select a sample of 482 adults ages 18 years and above, yielding findings with a margin of error of approximately five percentage points, plus or minus. (Actual numbers of valid responses vary with the question asked.) The author developed the questionnaire using a combination of original survey items and, for comparative purposes, questions taken from other published opinion studies. Included on the survey was a total of nearly seventy questions focusing on mental-health parity as well as the areas of managed health care, managed mental health care, and performance of the mental health system in Rhode Island. The gender, age, race, education, socioeconomic level, and political party identification of respondents were also recorded. The survey project received joint funding from Northeastern University and the Mental Health Association of Rhode Island, where the

author is professor of political science and a board member respectively. (The survey instrument is available on request from the author. A summary of the overall survey findings has been published by the Mental Health Association of Rhode Island.¹⁰)

GENERAL FINDINGS

The demographic characteristics of the sample proved to match quite well the overall demographics of the state's population. The percentage of respondents in this survey with health insurance coverage was 87.5%, a number that closely approximates statistics from the Rhode Island Department of Health near the time of the study. Among these insured Rhode Islanders, only 34% said they would rate their coverage for mental health care as "good" or "very good." The biggest group of respondents, 47%, said they were unsure about how to rate their insurance coverage within this area.

All survey respondents were asked to give their views on common practices used by insurers to control the usage of mental health services. The results (Figure 1) demonstrate that most Rhode Islanders are generally against such measures. In only the last case did fewer than a majority "oppose" or "strongly oppose" the stated insurance control practice, yet even here

those opposing (48%) clearly outnumbered those supporting (36%), with 17% unsure.

Similarly, two-thirds of survey respondents felt that it was "very important" for mental health care to be covered in health insurance plans. When asked what increase in health insurance costs it would be worth paying "to have mental health and physical health problems covered to the same extent," the average response was 8.55% with a range from 90 to 0%; 33.5% of those answering the survey question said 0%.

PATTERNS OF GROUP SUPPORT

The previous section summarized general survey findings regarding the idea of parity mental health insurance coverage. Equally of interest, however, are patterns of group support among Rhode Islanders that are obscured in the aggregate. Using as our dependent variable the question about how much respondents would be willing to pay for mental-health parity, a number of independent variables were selected from the survey - demographic factors, existing insurance coverage, personal experience with mental illness, and attitudes toward mental illness. Tests of statistical significance were conducted to assess the extent of differences among groups of respondents as defined by these variables.

The results pinpoint six variables as important in explaining support for parity. Those willing to pay the most for increased mental health insurance coverage included respondents who:

- * already possess insurance coverage
- * say they or a family member or friend ever had a mental illness
- * describe themselves as high socioeconomic status
- * are nonwhite
- * have children in the household
- * do not view mental illness as "the result of laziness and lack of character".

Specific numerical differences between groups, level of significance, and the number of valid responses for each questionnaire item are given in Figure 2.

Finally, in keeping with parity's status as a public policy issue, it is worth exploring the possibility of variations in support among respondents who identify with different political parties. (Figure 3) There was no significant relationship in this survey between political party and the willingness to bear increased insurance costs, if needed, for the sake of parity.

DISCUSSION AND CONCLUSION

Recently, Rhode Island lawmakers took another major step in requiring the equal treatment of mental and physical illnesses under private health insurance plans. However, certain discrepancies in coverage between the two areas persist, and the evidence is that parity legislation will be ineffective without active monitoring in the post-legislative phases of implementation. How high a priority should mental-health parity matters continue to be in Rhode Island?

The findings of this survey suggest strong popular backing for the concept of mental-health parity, as well as resistance to the practices that have been commonly employed by insurers to limit the utilization of mental health services. One useful indicator of support for parity lies in the willingness of people to pay more for health insurance that includes extensive mental health benefits. According to this survey, most Rhode Islanders who have an opinion on this question not only say they are willing to pay such an increase, but to do so at a level exceeding even the predicted cost estimates of most parity opponents.

Based on this same willingness-to-pay survey item, parity is more important for some Rhode Islanders than others. Some of these patterns, such as greater support for parity among those already possessing health insurance coverage, who have had some direct experience with mental illness, or who have children in the household, seem readily understandable. Also unsurprising is the fact that people who do not hold a stigmatizing view of mental illness find greater favor with parity. By contrast, the strong pro-parity stances of nonwhites and high so-

cioeconomic status respondents defy easy explanation and may be related to general support for social welfare legislation among these groups.

From a public-policy perspective, what is most crucial are not such differences, but the broad constituency behind parity that crosses diverse social groups. If public opinion so far has played little role in the parity policymaking process, one cannot attribute this to the lack of a clear position.

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Forthcoming

Craniofacial Abnormalities: A CME Issue

The December 2001 *Medicine & Health/Rhode Island* will feature Craniofacial Abnormalities, an issue guest-edited by Patrick Sullivan, MD.

Brown Medical School is accredited by the Accreditation Council for Community Medical Education (ACCME) to provide Continuing Medical Education for physicians.

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"The practice of medicine is an art, not a trade; a calling, not a business ..." – WILLIAM OSLER, Aequanimitas

Respiratory System Mechanics In a Patient With Massive Subcutaneous Emphysema

Annie Lin Parker, MD, and F. Dennis McCool, MD

Massive subcutaneous emphysema most commonly arises from airway trauma due to positive pressure ventilation, esophageal disruptions, or post-operative and post-traumatic bronchopleural fistulae.^{1,2} Usually, the concern is merely cosmetic; however, respiratory failure and difficulty providing mechanical ventilatory support have been associated with massive subcutaneous emphysema.³⁻⁵ Possible mechanisms underlying respiratory failure include 1) an increased elastic load imposed on the respiratory system

due to pneumatic compression of the chest wall or 2) a heightened resistive load due to airway compression by mediastinal air.^{4,5} Although previous reports have documented that the pressure needed to deliver a tidal volume is increased in these individuals³⁻⁵, there are no reported measurements of respiratory system compliance, airways resistance, or their changes following chest wall decompression. We present a case of massive subcutaneous emphysema and report the elastic and resistive properties of the respiratory system and their response to chest wall decompression. In addition, baseline measurements of respiratory muscle strength obtained prior to developing massive subcutaneous emphysema allowed us to assess the degree to which the infiltration of massive amounts of subcutaneous air affected the balance between the force reserve of the inspiratory muscles and the pressure load imposed upon them.

Table 1
Baseline Pulmonary Function Test

TLC	2.51 L	54% predicted
FVC	1.09 L	33% predicted
FEV1	0.95 L	34% predicted
Plmax	50 cmH2O	59% predicted

Definition of abbreviations: TLC = total lung capacity; FVC = forced vital capacity; FEV1 = forced expiratory volume in 1 second; Plmax = maximal static inspiratory pressure.

CASE REPORT

A 41-year old woman with a history of restrictive lung disease from kyphoscoliosis had been followed in our Division for 12 years. Pulmonary function tests were routinely performed; those obtained one year prior to hospitalization are shown in Table 1. At the time of this admission, she presented to our institution with right lower lobe pneumonia and respiratory distress. She was intubated and placed on mechanical ventilation for hypercapnic and hypoxemic respiratory failure. The initial ventilatory settings were Assist-control (AC) with a rate of 12, tidal volume (V_T) of 500 ml, fraction of inspiratory oxygen (F_iO_2) of 100% and positive end-expiratory pressure (PEEP) of 5 cmH2O. Arterial blood gas (ABG) with these ventilator settings revealed a pH of 7.55, PCO_2 of 30 torr and a PO_2 of 293 torr. Venous access was poor and multiple attempts were needed to place an intravenous line in the right subclavian vein. Several hours later, she became tachypneic, hypotensive, and developed swelling of the subcutaneous tissues of her

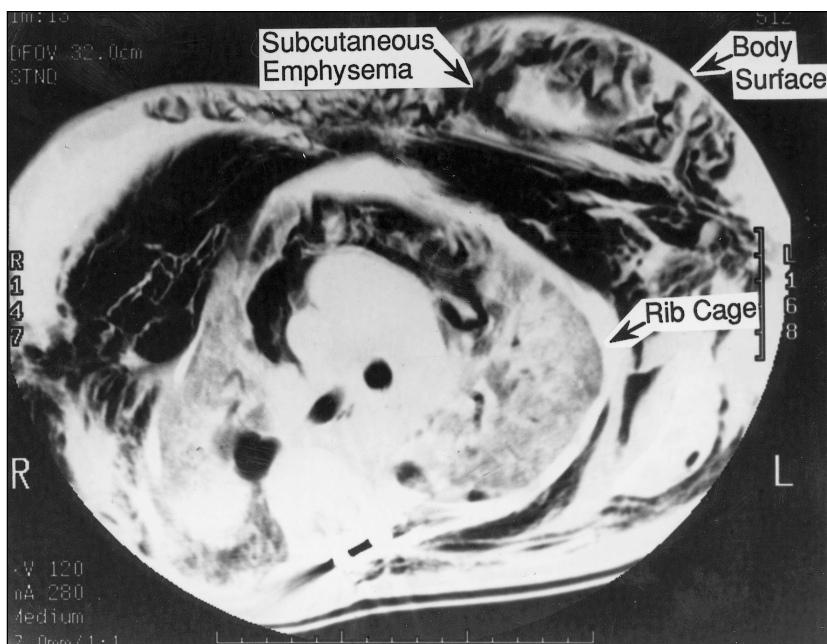


Figure 1: CT scan of the chest showing massive subcutaneous emphysema.

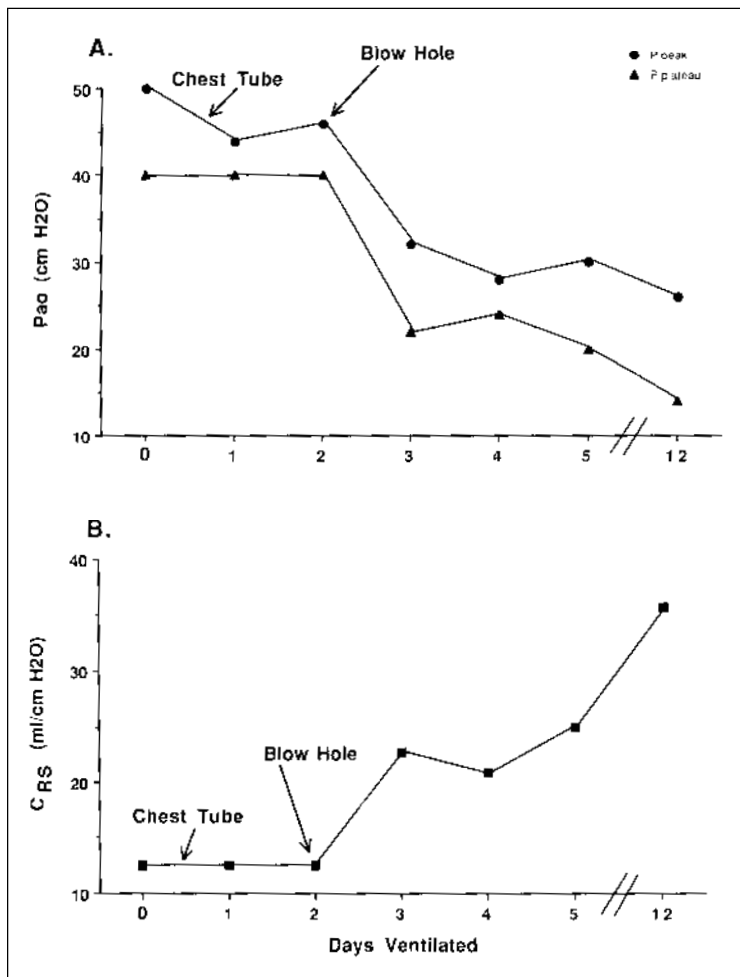


Figure 2: Changes in peak and plateau pressures measured at airway opening (A) and respiratory system compliance (B) while paralyzed and sedated.

face, neck and anterior chest wall. Her oxygenation and ventilation worsened with repeat ABG showing a pH of 7.25, PCO₂ of 52 torr and a PO₂ of 64 torr despite an increase in the respiratory rate to 25. A chest tube was then placed in the fifth intercostal space of the right rib cage for presumed pneumothorax. The subcutaneous emphysema extended over the next 48 hours to involve her entire body. While paralyzed, sedated, and ventilated with settings of AC of 20, V_T of 400 ml, flow rate of 1 L/sec and PEEP of 10 cm H₂O, peak inspiratory airway pressures ranged between 44 and 50 cmH₂O and the static end-inspiratory respiratory system pressure, "plateau pressure", was 40 cmH₂O. The corresponding **respiratory system compliance (C_{RS})** was 13 ml/cmH₂O.

Chest roentgenograms did not reveal a persistent pneumothorax, but the extensive subcutaneous emphysema limited these evaluations. To better define the relevant anatomy, a **computed tomography (CT)** scan of the chest was obtained (Figure 1). This revealed massive subcutaneous emphysema, pneumomediastinum, pneumopericardium, and diffuse bilateral air space densities. A second chest tube was placed in the right second intercostal space; however, there was no change in the subcutaneous emphysema and no decrease in either the peak or plateau airway pressures

(Figure 2). To promote better venting of the subcutaneous air, bilateral infraclavicular incisions with dissection to the fascia of the pectoralis muscles ("blow holes"⁶) were made, one in the second intercostal space on the right and another one in the same location on the left side. A rush of air was noted with each incision and over the next 12 hours the subcutaneous tissue became less tense. Coinciding with the resolution of the subcutaneous air, there was a decrease in the peak and static end-inspiratory pressures as well as an increase in respiratory system compliance from 13 to 22 ml/cmH₂O (Figure 2). The respiratory mechanics continued to improve and she was successfully extubated 10 days later. C_{RS} prior to extubation was 36 ml/cmH₂O.

DISCUSSION

Massive subcutaneous emphysema occurs when alveolar rupture introduces air into the interstitial space around the pulmonary vasculature. The air dissects toward the hilum of the lung leading to pneumomediastinum and then along the fascial planes to the soft tissues of the face, neck, torso, and extremities causing subcutaneous emphysema. Reported complications include compression of the upper airway, tension mediastinum, and acute respiratory failure. Previous reports have suggested that respiratory failure in this context is due to an increased resistive load from compression of the intrathoracic airways by mediastinal air or to an increased elastic load from the infiltration of air into the subcutaneous tissues of the chest wall. This report distinguishes between these two mechanisms.

Heightened elastic or resistive loads will increase peak airway pressures during mechanical ventilation. The difference between the peak and plateau pressure reflects the inspiratory resistive pressure drop across the airways and endotracheal tube. A difference less than or equal to 10 cm H₂O at a typical ventilator flow rate of 1 L/sec reflects a normal airways resistance.^{7,8} In our patient, this difference ranged between 4 and 10 cm H₂O and did not change following decompression of the subcutaneous emphysema indicating that the mediastinal emphysema had not substantially compressed the larger airways.

By contrast, there was a profound elastic load on the respiratory system with a reduction of C_{RS} to 13 ml/cm H₂O. This value is roughly 1/8th of that of a healthy individual. This pronounced reduction in CRS could be attributed either to a reduction in **lung compliance (C_L)** due to alveolar filling from pneumonia or to a reduction of **chest wall compliance (C_{cw})** due to restriction of the chest wall by subcutaneous air. Neither C_L nor C_{cw} were directly measured at the time of mechanical ventilation. However, the rapid increase in C_{RS} (13 to 22 ml/cm H₂O) following chest wall decompression is most likely due to changes in

chest wall compliance as the alveolar infiltrates that were noted on radiographs took more than 10 days to resolve. If true, the 1.7 fold increase in C_{RS} would reflect nearly a four fold increase in C_{CW} following decompression of the chest wall.

The pronounced elastic load imposed by the subcutaneous emphysema on the **inspiratory muscles (IM)** may have been sufficient to limit IM endurance. Inspiratory muscle fatigue can be induced in healthy individuals when the ratio of the pressure needed to inhale (P_{breath}) is greater than half of the maximal static inspiratory pressure (PI_{max}).⁹ With our patient, this balance between the demands placed on the IM and their reserve can be assessed by comparing P_{breath} with baseline measurements of PI_{max} . Prior to chest wall decompression, the pressure needed to deliver a breath of only 400 ml was 44 cm H₂O whereas PI_{max} was 50 cmH₂O at her baseline. Accordingly, the balance between IM demand and reserve would be altered such that the ratio of P_{breath} to PI_{max} (0.88) would be sufficient to promote IM fatigue. Such pressure requirements per breath may have contributed to respiratory failure in our patient. If untreated, these loads also may be of sufficient magnitude to impair liberation from mechanical ventilation even in individuals with normal respiratory muscle strength.

Management of massive subcutaneous emphysema usually involves identifying and remedying the offending cause such as a tear in the tracheobronchial tree. In patients with a compromised respiratory status, chest wall decompression should also be considered and may be a simple life-saving maneuver. The incision needed for chest tube placement may in itself be sufficient to decompress the chest wall, but, as with our patient, it may be insufficient to release the majority of subcutaneous air. The placement of bilateral infraclavicular incisions, "blow holes", however, may allow for more effective chest wall decompression. In our patient C_{RS} nearly doubled after the procedure. The major therapeutic benefit was an immediate reduction of the pressures needed to ventilate this patient. A second benefit is that adequate decompression of the chest wall would reverse a significant elastic load and avert IM fatigue during weaning attempts.

We conclude that massive subcutaneous emphysema can impose an enormous but potentially reversible elastic load on the respiratory system. It may be of such a magnitude that patients with otherwise normal respiratory muscle strength are predisposed to developing respiratory failure. By contrast, the resistive load due to compression of large airways within the mediastinum by mediastinal air was not an important mechanism contributing to the elevated peak inspiratory pressures in this patient. Decompressing the chest wall with "blow holes" was an important therapeutic maneuver as it nearly doubled C_{RS} , allowed us to ventilate the patient using conventional methods, and facilitated the weaning process.

... massive subcutaneous emphysema can impose an enormous but potentially reversible elastic load on the respiratory system



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Stroke Update

As part of Rhode Island Quality Partners' continued effort to provide Rhode Island physicians with current clinical evidence helpful to their practice, the following article summarizes recent publications related to the treatment and prevention of stroke.

TPA FOR ISCHEMIC STROKE

Randomized trials have demonstrated the effectiveness of intravenous **tissue plasminogen activator (TPA)** to improve outcomes following acute stroke.^{1,2,3} However, in order to be effective TPA must be administered soon after symptoms develop (i.e. within 3 hours). This requires that individuals seek medical attention immediately, and that medical personnel recognize the symptoms of stroke and rapidly evaluate the indications for TPA. This includes immediate neuroimaging to differentiate ischemic from hemorrhagic strokes. A summary of three recent publications that focus on TPA usage are discussed below.

Using a prospective registry of stroke patients, Barber et al. examined the availability of IV TPA therapy to patients with ischemic stroke and the reasons why patients with ischemic stroke did not receive it.⁴ Of 2,165 stroke patients presenting to a university hospital, 1,168 (53.9%) were diagnosed with ischemic stroke, 31.8 percent with intracranial hemorrhage (intracerebral, subarachnoid, or subdural), and 13.9% with TIA. Delay in presentation to an emergency department beyond three hours excluded 73.1% (854/1168) of patients. Twenty-seven percent of patients with ischemic stroke (314/1168) were admitted within three hours of symptom onset and of these 84 (26.7%) patients received TPA. A further 31% were excluded because their symptoms were either considered too mild or were rapidly improving. Of that 31%, a third either expired or were left dependent, bringing into question the initial decision not to treat. The authors concluded that the majority of patients are unable to receive TPA for acute ischemic stroke because they do not reach the hospital soon enough. This study underscored the importance of educating the public and patients at risk for stroke to seek medical attention as soon as they experience any TIA or stroke symptom.

In a separate cohort study, Johnston et al measured the overall rate of usage of TPA for ischemic stroke at academic medical centers and evaluated the association between ethnicity and TPA usage.⁵ Between June and December 1999, 42 academic medical centers in the United States each identified 30 consecutive ischemic stroke cases. Complete information was available for 1,195 ischemic stroke patients (788 whites, 285 African-Americans and 122 Other Group). Of the 189 pa-

tients eligible to receive TPA (e.g., without a documented contraindication to therapy), 39 (20.6%) received TPA. Ten (20%) of all the patients receiving TPA had a documented contraindication to TPA. African-Americans were one fifth as likely to receive TPA as whites (1.1% versus 5.3%), and the difference persisted after adjustment. The study showed that TPA is used infrequently for ischemic stroke at academic medical centers in the United States, even among qualifying candidates, and contraindications to treatment do not appear to account for the difference. In addition, African-Americans are significantly less likely to receive TPA for ischemic stroke.

Wang et al evaluated physicians' attitudes toward treating stroke as a medical emergency and the use of **carotid endarterectomy (CEA)** to prevent strokes.⁶ They mailed a questionnaire on stroke and the treatment of carotid stenosis to resident physicians in Los Angeles who had already completed their first year of training. A total of 76% of the respondents had heard of the "brain attack" campaign, 22% did not identify dysarthria as a symptom of stroke, and 21% did not identify obtundation as a presentation of stroke. Twenty-eight percent chose not to use tissue plasminogen activator for acute ischemic stroke, and 60% recognized the need to begin treatment within three hours. A total of 56% responded that they would not advocate operating on patients with asymptomatic severe stenosis (>70%) until stenosis reached a critical value (85%). Conversely, 45% would recommend operative treatment for symptomatic patients who had less than 60% stenosis. This study indicated that the recognition of stroke as a medical emergency and the use of TPA needs to be more widespread. The authors conclude that enhanced physician education about criteria for TPA and CEA could promote improved treatment for strokes.

CAROTID ENDARTERECTOMY

CEA has been shown to be effective in reducing the risk of stroke for individuals with carotid artery atherosclerotic disease. Of the many indications for CEA, two key measures that relate to its effectiveness include the degree of carotid stenosis and the experience of the surgeon.¹³ Several recent publications underscore the need for accurately assessing the degree of stenosis and that old age should not be a contraindication for CEA.

Barnett et al summarized the literature about therapeutic decisions for patients with carotid stenosis.¹⁰ Physicians should consider the degree of stenosis, presence of symptoms, skill of the surgeon and the time frame since the last ischemic event when considering carotid endarterectomy. Patients with severe stenosis (>70% by angiogram) should receive carotid endarter-

ectomy, provided the estimated operative risk of mortality and stroke is less than 6% and symptoms have recurred within the previous six months. With moderate stenosis (50-69% by angiogram), and with similar low operative risk and symptom levels, males with hemispheric and nondisabling stroke will benefit from carotid endarterectomy. Patients with TIA only, retinal symptoms alone and who are women do not benefit in this range of stenosis. The authors conclude that while symptomatic patients respond well to carotid endarterectomy, regardless of age, those patients with serious cardiac disorders and with organ failure should not be included.

Johnston et al. evaluated how often intra-arterial contrast angiography alters a CEA decision as compared to noninvasive vascular imaging (duplex ultrasound, magnetic resonance angiography, CT angiography).⁷ Reports of all noninvasive vascular imaging studies in 569 consecutive patients undergoing angiography at an academic medical center (n = 360) and a community hospital (n = 209) were reviewed over a three year period. Patients were classified as to whether CEA was indicated based on each study. The misclassification rate for duplex ultrasound alone was 28%, and for magnetic resonance angiography alone was 18%. Both duplex ultrasound and magnetic resonance angiography were completed in 11% of patients, with a misclassification rate of 7.9%. The authors concluded that surgical decisions based on the results of noninvasive studies only should be made with caution, particularly if duplex ultrasound is performed alone.

Alamowitch reviews the results of a follow-up study of the **North American Symptomatic Carotid Endarterectomy Trial (NASCET)**.¹¹ Patients aged 75 years or older from the NASCET were compared with those aged 65 to 74 years and less than 65 years. Baseline characteristics and risk of ipsilateral ischemic stroke at two years by degree of stenosis and surgical vs. medical were reviewed. Among patients with 70 to 99% stenosis, the absolute risk reduction of ipsilateral ischemic stroke with CEA was 28.9% for patients aged 75 years or older, 15.1% for those aged 65 to 74 years and 9.7% for those less than 65 years of age. The perioperative risk of stroke and death at any degree of stenosis was 5.2% for the oldest group, 5.5% for 65 to 74 years and 7.9% for less than 65 years. The authors concluded that in the prevention of ipsilateral ischemic stroke, elderly patients with 50 to 99% symptomatic carotid stenosis benefited more from CEA than did younger patients.

In a commentary on the above article, Rothwell discusses the results of two large randomized controlled trials, the **European Carotid Surgery Trial (ECST)** and **NASCET**.¹² These trials have shown that surgery reduces the risk of stroke in patients with severe carotid stenosis. Because of these results, middle-aged and young elderly (less than 75 years) patients with carotid disease are actively investigated and treated. Although neither trial had an upper age limit nor has reported a reduced benefit in the elderly, carotid disease is often neglected in the older elderly according to the author. Endarterectomy in routine clinical practice is therefore likely to benefit reasonably fit patients over age 75. The author concludes that because the trial evidence suggests that elderly patients are likely to benefit and the operative risks reported are acceptable, it is difficult not to justify the further investigation of carotid dis-

ease in otherwise fit elderly patients willing to consider surgery.

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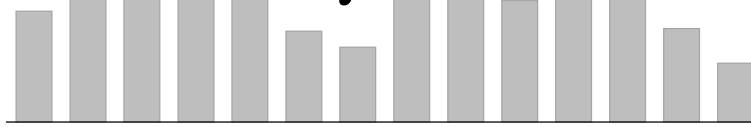
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The analyses upon which this publication is based were performed under Contract Number 500-99-RI02, entitled "Utilization and Quality Control Peer Review Organization for the State of Rhode Island," sponsored by the Health Care Financing Administration, Department of Health and Human Services. The content of this publication does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

The author assumes full responsibility for the accuracy and completeness of the ideas presented. This article is a direct result of the Health Care Quality Improvement Program initiated by the Health Care Financing Administration, which has encouraged identification of quality improvement projects derived from analysis of patterns of care, and therefore required no special funding on the part of this Contractor. Ideas and contributions to the author concerning experience in engaging with issues presented are welcomed.

Health by Numbers



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

Edited by Jay S. Buechner, PhD

Reductions in Premature Mortality, Rhode Island, 1989-1998

Jay S. Buechner, PhD

Healthy People 2010 sets health objectives for the nation based on two broad goals:¹

Increase quality and years of healthy life.

Eliminate health disparities

The goals for 2010 are similar to those underlying the process used to set health objectives for the immediate past decade.² This analysis presents information on the reductions in premature mortality achieved by Rhode Island during the ten-year period 1989-1998 and documents the state's progress toward achieving the goal of increased lifespan.

Table 1. Leading Causes of Years of Potential Life Lost (YPLL), Rhode Island, 1995-1997

Cause of Death	Percent of YPLL
Malignant neoplasms	21.5
Injuries	19.3
Unintentional injuries	10.5
Suicide	5.5
Homicide	3.3
Diseases of heart	13.0
Perinatal conditions	7.5
HIV infection	5.2
Congenital anomalies	4.2
Chronic liver disease, cirrhosis	2.5
Cerebrovascular disease	2.2
All other causes	24.6

The analysis employs the measure of "years of potential life lost" (YPLL) developed by the Centers for Disease Control and Prevention (CDC), in which deaths before the age of 65 are weighted according to the difference between the decedent's age at death and the refer-

ence age of 65 years.³ Such weighting adjusts raw counts of deaths to include information on when deaths occurred relative to a reference lifespan.

Methods

Mortality data for state residents were selected from the Rhode Island Vital Records death files for the years 1989-1998 and analyzed by age group, gender, and underlying cause of death. As the cause of death codes are not yet assigned for 430 resident deaths that occurred in other states during 1998, cause of death information for that year is not included. Years of potential life lost were calculated as follows:

For deaths ages 65 and older, YPLL = 0.

For deaths ages 0 - 64 years, YPLL = (65 - age at death).

Rates of YPLL per 100,000 population were calculated using annual state population estimates by age and sex from the Bureau of the Census.⁴ When necessitated by small numbers of cases annually, the analysis was based on aggregates of consecutive years.

Results

Over the ten-year period examined, there was a total of 95,772 deaths among Rhode Island residents, of whom 19,970, or 20.9% were persons under age 65. By year, the proportion of deaths occurring before age 65 fell from 23.1% in 1989 to 19.1% in 1998. During that same period, the state's population ages 0 - 64 years fell by just 2.4%.

The annual number of YPLL recorded also fell during this period, from 40,664 in 1989 to 31,995 in 1998, a decline of 21.4%. The rate of YPLL per 100,000 population ages 0 - 64 declined similarly, by 19.4% overall, with year-to-year decreases observed in eight of the ten years. (Figure 1)

The primary contributions to YPLL by underlying cause of death reflect both those causes that are

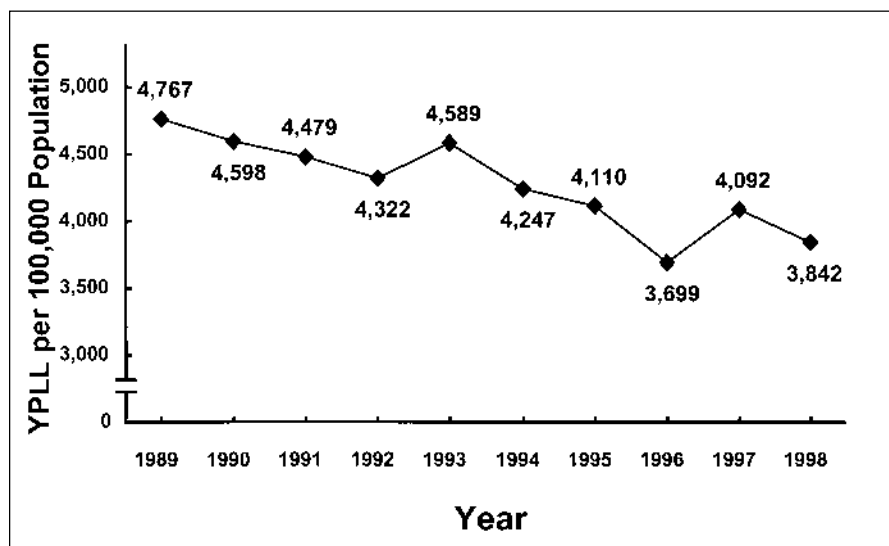


Figure 1. Years of Potential Life Lost (YPLL) per 100,000 Population Ages 0 - 64 Years, Rhode Island, 1989-1998.

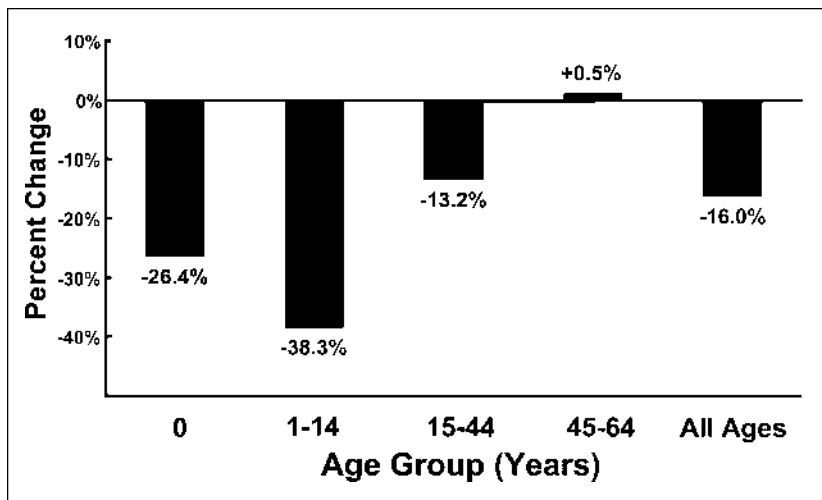


Figure 2. Percentage Change in Years of Potential Life Lost (YPLL) per 100,000 Population Ages 0 - 64 Years, 1989-1991 to 1996-1998, by Age Group, Rhode Island.

prominent in simple mortality counts and those that are most common among young children, adolescents, and young adults. (Table 1) Although the major chronic diseases are represented among the ten leading contributors to YPLL, including cancer, heart disease, stroke, and cirrhosis of the liver, together they comprise less than 40% of YPLL during 1995-1997. The remaining 60% is accounted for by causes of death that occur predominantly among the very young (perinatal conditions, congenital anomalies) or among children and young adults (suicide, homicide, unintentional injuries, and AIDS).

By gender, premature mortality as measured by YPLL is greater among males than among females. Over 1989-1998, just under two-thirds (64.8%) of YPLL were accounted for by mortality among males. However, males experienced slightly greater reductions (down 17.6%) than females (down 12.9%) in YPLL per 100,000 between 1989-1991 and 1996-1998, tending to reduce the disparity.

The reduction in YPLL was concentrated in specific age groups within the age range 0-64 years. (Figure 2) The largest decreases, as measured from the period 1989-1991 to 1996-1998, have been observed among young children ages 1-15 years, where the YPLL rate has declined by 38%, and among infants during the first year of life, where the decline has been nearly as high (26%). Adolescents and young adults have also experienced significant declines in premature deaths, as the YPLL rate for that group has fallen by 13%. Only the middle-aged have not benefited greatly, as their rate has actually increased slightly.

Conclusions

The period from 1989 to 1998 was one where the rate of mortality, as measured by YPLL, among those under age 65 declined rapidly in Rhode Island. The improvement was most evident among the very young, those affected by perinatal conditions and by congenital anomalies, and among children, adolescents, and young adults, those af-

ected primarily by injuries and HIV infection. Older adults, among whom the impact of chronic diseases associated with aging is greater, did not experience the same level of mortality reductions as younger residents.

Placed in the context of the Healthy People 2010 goal of increasing the lifespan of Rhode Islanders, the observed rapid changes in mortality during the last decade give promise of further reductions in premature mortality. An evident continuing challenge is reducing mortality from chronic diseases among middle-aged adults. Whether we can achieve reductions in these deaths will depend greatly on whether our population achieves healthier lifestyles in the areas of exercise, diet, tobacco use, and alcohol use.

It remains a formidable task for public health to induce such changes on the scale needed to improve on the results presented here.

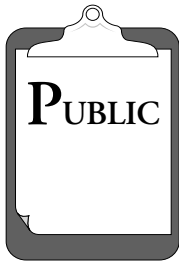
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Adult Asthma Prevalence in Rhode Island

John P. Fulton, PhD, Jana Hesser, PhD, Colleen Ryan, MPH

The increase in asthma prevalence that has occurred in the United States since 1980 is nothing short of an epidemic. Between 1980 and 1993-1994, for example, the prevalence of asthma among people of all ages in the United States increased from 3.1% to 5.4%, with higher prevalence among children and teens ages 5-14.¹

In 2000, the Centers for Disease Control and Prevention (CDC) used its Behavioral Risk Factor Surveillance System (BRFSS)² to estimate adult asthma prevalence (current self-reported asthma among persons ages 18 and over) in the United States as a whole and in each of the 50 states, the District of Columbia, and Puerto Rico. At that time, adult asthma prevalence was higher in Rhode Island, 8.5%, than in the nation as a whole (7.2%). In fact, Rhode Island tied three other jurisdictions for the fifth highest adult asthma prevalence among the 50 states, Puerto Rico, and the District of Columbia.³

In addition to estimating the overall prevalence of adult asthma in the state, the Rhode Island BRFSS may be used to profile the typical adult Rhode Islander with asthma, and to locate disparities in asthma prevalence among socio-demographic groups. Doing so helps us to set priorities for asthma control in the state.

METHODS

Population data on asthma and basic socio-demographic variables were obtained from the 2000 Rhode Island BRFSS. The BRFSS is a national telephone survey of randomly selected adults (ages 18 and older) who live in households with telephones. It asks respondents questions about a variety of health-related behaviors and conditions, including asthma. Fifty states and four territories perform the BRFSS each year with funding and methodological standards provided by the CDC.² A professional survey contractor has conducted the BRFSS in Rhode Island since 1990. During 2000, 3,544 Rhode Island adults were interviewed, about 295 per month. Of these, 3523 (99.4%) answered either the two questions:

“Have you ever been told by a doctor that you have asthma?”

“Do you still have asthma?”

The prevalence of adult asthma was determined from these two questions. Anyone who answered yes to both

questions was considered to be a prevalent (or current) case.

In calculating the proportion of adults with current asthma, BRFSS data are weighted to reflect the true socio-demographic make-up of the state. These weighted proportions may be used to estimate the number of Rhode Islanders with current asthma (number of prevalent cases) and the percent of Rhode Island adults with current asthma (prevalence rate). These estimates were derived and listed in Table 1 for various population sub-groups, along with the number of actual respondents upon which the estimates are based.

Because the BRFSS results are based on a sample of Rhode Island adults, each asthma prevalence estimate has an associated standard error that may be used to calculate 95% confidence intervals to bracket the estimate. With regard to the prevalence estimates in Table 1, confidence intervals vary from plus or minus 1% to plus or minus 5%. To conserve space for other statistics, confidence intervals have not been listed, but must be kept in mind as prevalence estimates are compared from one socio-economic subgroup to another. In short, small (from 1-5%) differences between prevalence estimates may not be statistically significant.

RESULTS

Profile

An estimated 64,420 adult Rhode Islanders currently have asthma. Of these, a large majority are white and not Hispanic (85%), with a high school or college diploma (86%), health care coverage (94%), and a health checkup within the past year (86%). A majority are female (67%) and employed (65%) with an income exceeding \$25,000 per year (69%).

Disparities

Adult asthma prevalence, estimated to be 8.5% among all Rhode Island adults, varies little among socio-demographic groups. Nonetheless, there are a few notable disparities in asthma prevalence. Females have a higher self-reported prevalence (10.8%) than males (5.9%). People over 65 years of age have a lower self-reported prevalence (5.4%) than other adults, despite the higher proportion of females in this age group. People in the lowest income bracket (11.9%), people who are unemployed (12.8%), and people who are unable to work (17.2%) have higher than average asthma prevalences, but people in one of the high income

Table 1. Estimated current asthma prevalence (a) -- Behavioral Risk Factor Surveillance System, Rhode Island, 2000, persons age 18 and over, by socio-demographic group

Group (b)	% Rhode Islanders With Current Asthma (b) (Estimated)		No. Rhode Islanders With Current Asthma (b) (Estimated)	No. Rhode Islanders Total in Group (b) (Estimated)	No. Respondents Total in sample (b) (Actual "n")
	%	± 95% C.I.	Number	Number	Number
All persons	8.5	± 1.0	64420	759539	3523
Race and Ethnicity					
White non-Hispanic	8.4	± 1.1	52394	624186	2988
Black non-Hispanic	7.1	± 4.8	2070	28987	129
Hispanic	9.2	± 4.1	7094	76869	290
Other	8.8	± 6.3	1888	21540	80
Gender *					
Male	5.9	± 1.4	21375	359717	1370
Female	10.8	± 1.5	43045	399822	2153
Age in Years *					
18-24	7.0	± 3.4	6898	99053	295
25-34	10.3	± 2.8	13491	131346	587
35-44	9.8	± 2.2	15519	159212	846
45-54	8.7	± 2.3	11229	128673	665
55-64	10.4	± 3.2	9141	87879	428
65+	5.4	± 1.8	8046	148241	671
Education					
Less than h.s. graduate	8.4	± 2.9	9139	108690	446
H.s. graduate	7.1	± 1.7	15706	222730	1014
Some post-h.s.	10.2	± 2.2	19872	195606	927
College graduate	8.6	± 1.8	19703	230446	1127
Marital Status					
Married	8.5	± 1.4	35505	419427	1789
Separated	5.4	± 3.8	940	17501	102
Divorced	10.7	± 3.1	7864	73799	481
Widowed	7.4	± 2.9	4345	58380	344
Never married/ unmarried couple	8.3	± 2.2	15627	188169	792
Income (c)					
< \$14,999	11.9	± 3.9	7233	60814	331
\$15,000 - \$24,999	8.6	± 2.5	10041	116976	546
\$25,000 - \$34,999	7.3	± 2.8	6969	95625	435
\$35,000 - \$49,999	7.6	± 2.3	8428	111398	518
\$50,000 - \$74,999	11.9	± 3.1	13591	113980	529
≥ \$75,000	7.0	± 2.2	8647	124238	584
Employment *					
Work for wages	8.7	± 1.4	37977	436459	2001
Self employed	7.3	± 4.0	3578	48710	238
Homemaker	8.3	± 4.0	3324	40082	202
Student	6.5	± 5.4	1713	26405	92
Retired	6.0	± 1.8	8846	147345	671
Unemployed	12.8	± 5.5	3924	30639	150
Unable to work	17.2	± 7.1	5057	29350	167
Core City Status (d)					
Core city	8.6	± 1.9	20378	236962	974
Non-core	8.6	± 1.2	42807	498930	2436
Health Care Coverage					
Yes	8.6	± 1.1	60449	702778	3299
No	7.0	± 3.1	3901	55610	218
Last Health Checkup					
< 1 year	9.1	± 1.2	55214	610019	2892
> 1 year / < 2 years	6.9	± 3.1	4885	70895	310
≥ 2 years	5.9	± 2.8	4202	70626	295

a - Answering "yes" to "Have you ever been told by a doctor that you have asthma?" and "Do you still have asthma?"

b - Excludes respondents who answered "I don't know" or who refused to answer the relevant questions

c - 16.2% of respondents did not answer the question on income.

d - Core city: Providence + Pawtucket + Central Falls + Woonsocket + Newport; non-core: remainder of the state

* - Chi-square test statistically significant with P-value < 0.05

brackets (\$50,000-\$74,999) also have a higher than average asthma prevalence (11.9%).

DISCUSSION

Rhode Island has one of the highest adult asthma prevalence rates in the United States, as estimated from BRFSS data collected in 2000.³ Asthma is ubiquitous in Rhode Island. It seems to afflict adult Rhode Islanders across the

socio-demographic spectrum, with expected concentrations in women and in people of especially low income, some of whom are unemployed or who may be unable to work.⁴

Nationally, African Americans have slightly higher self-reported asthma prevalence than whites for all age groups combined (5.8% versus 5.1%, respectively, in 1993-4).¹ This disparity was not observed among Rhode Island adults who responded to the 2000 BRFSS, but may exist among Rhode

Islanders of all ages. This possibility will be tested when the results of Rhode Island's 2001 Health Interview Survey are in. Responses to this household survey may be used to compute disease prevalence among children as well as adults.

The small disparities observed in Rhode Island's adult asthma prevalence do not reflect all the disparities in asthma morbidity experienced in the state. National data reveal much greater disparities in asthma-related emergency room visits, hospitalizations, and death rates than in asthma prevalence.^{1,4} Only by observing all these data together may one get an overall sense of disparities in the disease burden of asthma across socio-demographic groups. Nonetheless, knowing who has asthma is an important piece of the overall puzzle, and in Rhode Island, no single group seems to be especially immune to this condition.

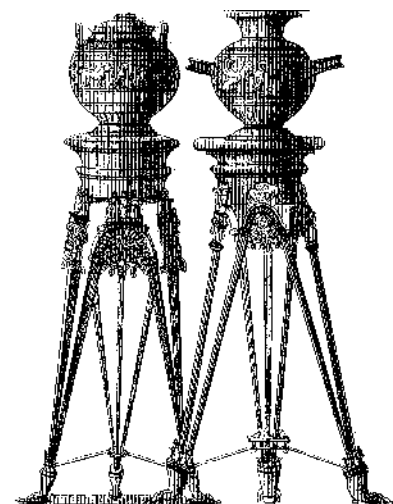
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Vital Statistics

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			
	November 2000	12 Months Ending with November 2000		
	Number (a)	Number (a)	Rates (b)	YPLL (c)
Diseases of the Heart	255	3,144	318.1	3,952.0
Malignant Neoplasms	218	2,460	248.9	6,865.0
Cerebrovascular Diseases	41	506	51.2	787.5
Injuries (Accident/Suicide/Homicide)	28	342	34.6	6,158.5
COPD	41	506	51.2	382.5

Vital Events	Reporting Period		
	May 2001	12 Months Ending with May 2001	
	Number	Number	Rates
Live Births	1373	13,342	13.5*
Deaths	864	10,183	10.3*
Infant Deaths	(10)	(97)	7.3#
Neonatal deaths	(7)	(81)	6.1#
Marriages	717	8,532	8.6*
Divorces	241	3,280	3.3*
Induced Terminations	458	5,442	407.9#
Spontaneous Fetal Deaths	86	996	74.7#
Under 20 weeks gestation	(75)	(922)	69.1#
20+ weeks gestation	(11)	(74)	5.5#

(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 988,480

(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

Point of View: From Machiavelli to Mad Cow Disease: 20th Century Ecological Changes and the Inevitable Role of Medicine in Disease Prevention

Robert A. Saritelli, RPh

“It happens then as it does to physicians in the treatment of consumption, which in its commencement is easy to cure and difficult to understand; but when it has neither been discovered in time nor treated. . . it becomes easy to understand and difficult to cure. The same thing happens in state affairs; by foreseeing them at a distance, which is only done by men of talents, evils which might arise from them are soon cured; but when, from want of foresight, they are suffered to increase to such a height that they are perceptible to everyone, there is no longer any remedy.” Machiavelli, *The Prince*, 1513

PROLOGUE

What Machiavelli said of state affairs is also true of human disease prevention, the natural world and global ecology. In the struggles for power and survival, in the constant seeking of material wealth and comfort, few people and fewer leaders in the 20th century managed much thought for the ecological impact of their actions, or the far-reaching effects of their economic policies. The economic growth imperative and the unrelated but equally intense desire for national security overshadowed the subtle and gradual concerns about the world environment. Despite increased environmental awareness after 1970, many environmental outcomes continued to be unintended consequences of more pressing human pursuits. Policy makers locally, nationally and internationally responded more readily to clear and present opportunities and dangers that affected economic expansion and military superiority than to the more gradual deterioration of the world ecology. Worldwide environmental policies were an afterthought to conventional business and politics.

PUBLIC HEALTH

Nature, the environment, societal trends, population growth, infectious disease, and human health and welfare are interrelated. In the 19th century, rapid industrialization and urbanization created dense populations of malnourished people, among whom contagious disease easily spread. Also, after 1880 the expansion of European colonialism in Africa and Asia put European soldiers in contact with malaria, yellow fever and other exotic infections. Cholera, for instance, had long existed in India, but the migration of soldiers spread it beyond parochial habitats, killing millions worldwide. In 1832 the cholera epidemics that raged through European and many North American cities galvanized efforts to organize public health authorities. By 1850 public health measures designed to alter human ecology and control infectious dis-

ease became widespread and systematic, organized first in northwestern Europe. The pioneers were physicians, social reformers, and philanthropists whose efforts encouraged governments and their armies to sponsor programs to combat the spread of infectious disease. People had sought to prevent and cure infectious disease for millennia but before 1880 successful interventions were minimal. Louis Pasteur (1822-1895), Robert Koch (1843-1910) and others illuminated the role of microbes and insects in disease transmission, to provide enough basic knowledge to counteract infectious pathogens. Armed with increased scientific knowledge, medical and health communities attacked disease on many fronts. Urban sanitation, personal hygiene, insect and varmint control, cleaner water, improved sewage disposal, and better housing made the human environment less hospitable to microbial pathogens. Public health measures coupled with the upcoming discoveries of antibiotics, viral vaccines and advances in immunology did much to decrease the human disease burden. From 1880 through

*Of the 30 or more
infections that emerged
after 1975 none were
new to the world; they
were new only to
humans.*



1963, the continual progress against infectious microbial and viral pathogens fundamentally altered the previous balance between people and pathogens, encouraging the rapid population growth of humans throughout the 20th century. A typhoid vaccine first developed in 1897 was routinely administered in the British army during World War I. An effective diphtheria vaccine appeared in 1923; the tetanus vaccine became an effective agent by the 1930s. The invention of the electron microscope in the same decade facilitated viral-related studies. Vaccines against yellow fever (1937), influenza (1945), polio (1954), and measles (1963) helped these scourges disappear as serious life threats in vaccinated areas. In the United States the increased pace of vaccination between 1945 and 1963 safeguarded the post-World War II babies. Between 1920 and 1980 worldwide life expectancy increased by 20 years; and the leading causes of death shifted from infectious diseases to non-communicable illnesses like cancer and heart disease.

CONSEQUENCES OF CHANGES IN ANIMAL-HUMAN CONTACT

Many human diseases originate from animal infections. For several thousand years people-animal contact shaped the dynamics of human disease history. In recent centuries the prevalence of influenza in China is thought to be caused by the increasing populations of people, ducks, and pigs living closely together. Most influenza outbreaks originated from China. In the 20th century there were many more people and more

avenues of contact with animal populations. The wave of humans who entered the tropics to exploit its natural resources also put more people in contact with more animal species - and their potential pathogens. Beyond this were the increased numbers of non-domesticated creatures (rats, cockroaches, sparrows, seagulls - known collectively as *synanthropes*). A byproduct of recent human progress has been an unintentional but expansive shelter for rodents. Rats eat about 20% of the world's grain harvest. In 1997, New York City provided a home for 28 million of them. By building urban areas (that double as rodent warrens) and removing rodent-eaters like foxes, we have bolstered the population of rats, mice and related species - and thereby made a more hospitable world for rodent viruses. Several of the major emergent viruses after 1970 that were communicable to humans were derived from rodents, including Hantavirus, Argentine hemorrhagic fever and Lassa fever.

AIDS apparently also derived from increased human activities in tropical forests and subsequent disruptions of ecology. Many experts trace the virus to central African chimpanzees, then spreading to human hosts by 1959. In the 1970s it broke out of central Africa, aided by Angolan warfare, refugee movements and labor migrations. By the 1980s, AIDS appeared in the United States; however, its focal center remained Africa where by 1998 two-thirds of the 47 million HIV+ people lived. Between 1978 and 1998 the majority of the 14 million victims who succumbed to AIDS were Africans.

HUMANS AND SPECIES BIODIVERSITY

Most species that ever lived are now extinct. Extinction rates suggest on average one mammal will go extinct every 200 years. Human exploration, settlement in new lands, forest clearance, and hunting accelerated the pace. Since the 17th century 484 animals and 654 plants have vanished. The 20th century's extinction rate for mammals was 40 times the expected rate and for birds about 1000 times background estimates. Most modern extinctions result from habitat loss, although some derived from hunting or fierce predation by introduced species. This century's human assault on the equatorial tropical forest is noteworthy in heightening extinction rates because almost half of terrestrial species live in them.

While decreasing the number of species remaining on Earth, human dominance improved the prospects of both *synanthropes* and domesticated plants and animals. Roughly 40 animals and 100 plants have hugely expanded their population growth and geographic ranges through domestication. Except for the horse, which declined in use after being replaced in the 1920s by the internal combustion engine, all the important domesticates like cattle, sheep, goats, hogs, and poultry species increased dramatically. From 1890 to 1990, the global population of goats increased by 1,130%. Cattle populations increased by 406%, sheep by 342%, poultry by 1,525% and pigs by 950%. Of course most were destined for slaughter. In addition, human activity focused on remaking

landscapes and ecosystems to maximize the efficient production of these chosen domesticates. Worldwide today we share the Earth with over 16 billion domesticated animals.

In the 20th century human cultural evolution and growth dominated and controlled the biological evolution of many other species. The domesticated use of animals at times wrought havoc with the animals, sometimes with human consequences. In 1889, in Somalia, the campaigning Italian army introduced cattle bearing the rinderpest virus, a new, highly contagious disease for Africa. Millions of cattle, wild buffalo, giraffe, antelope, and other ruminants died. It caused the worst epizootic (outbreak of an animal disease) in recorded history: 90% of grazing animals died south of the Zambeze River and the pastoral economies of eastern and southeastern Africa collapsed. The Masai tribe lost two-thirds of its people. With these shifts in animal-human dynamics the risk for ecological disasters and species-jumping infections increased.

ANTIBIOTIC MISUSE-RESISTANT MICROBES

After the early 1950s, American pigs and cattle were fed mass quantities of antibiotics to promote growth in the overcrowded feedlots of the livestock industry. Oral antibiotics were zealously prescribed to many patients. In 1992, 20% of all antibiotics prescribed in the world were inappropriate treatments for viral infections, predominately colds. The overuse of antibiotics in animals and humans hastened and abetted the natural selection of resistant

Global warming after 1980 increased the range of mosquitoes and other insect vectors carrying disease.



microbial strains. Before 1970, newer and more effective antibiotics killed strains that grew resistant to older antibiotics, like penicillin and tetracycline. Thereafter, incurable strains of numerous infections threatened human health. Evolution made the emergence of **multiple-drug-resistant (MDR)** bacteria inevitable, but human folly with antibiotic use enabled the process of microbial resistance. Worldwide by 1995 MDR tuberculosis killed 3 million people a year, mostly from poor countries. Resurgent malaria (chloroquine-resistant strains) killed 2 million per year in the 1990s, half of them in Africa. Resistant strains developed to pneumonia treatment by the late 1980s and cholera evolved an MDR form in 1992, which originated from Bangladesh coastal waters. The evolution of resistant infections and disease vectors stalled the extraordinary success achieved by public health in limiting infections in human affairs, started in 1880. It ended a golden age of infectious disease control and challenged pharmaceutical researchers to develop new antibiotics just to stay one step ahead of virulent microbes.

DEVIATIONS FROM THE NATURAL ORDER

Changes in the way we live with animals affected the disease experience of both animals and people in the 20th century. Of the 30 or more infections that emerged after 1975 none were new to the world; they were new only to humans. The growing contact with animals, the human invasion into the tropics, worldwide migration, irrigation projects, warfare, urbanization-all enlarged the spectrum of microbial traffic that

passed through human bodies. Global warming after 1980 increased the range of mosquitoes and other insect vectors carrying disease. Soil bacteria evolved in response to heavy fertilizer and pesticide use on farms. Pollution of clean water forced bacteria and viruses to blaze new evolutionary pathways to survive. The ecological systems of humans, animals, plants, microbes and vectors continued their complicated co-evolution; ecological changes and shifts of balance among these competitors remained beyond human control and it would have been odd if no surprises resulted. Human population increased 4 fold during the 20th century to 6 billion by year 2000 - producing deviations from the natural order of world ecosystems.

MAD COW DISEASE

More surprises resulted from these deviations. In the **United Kingdom (UK)** in 1986 the first case of **Bovine Spongiform Encephalopathy (BSE)** (Mad Cow Disease) was documented. BSE is a progressive, lethal neurological disease of cattle. The neurons in the brain of affected cattle become riddled with vacuoles, holes and spaces that make the brain tissue resemble a sponge. Epidemiological research has led scientist to suspect that the BSE agent originated from the scrapie agent seen in British sheep for the past 200 years. It may well have jumped species when sheep offal was included as a protein supplement fed to beef and dairy cattle. More than 160, 000 cattle have been diagnosed with BSE, involving in excess of half of all the dairy farms in the UK. After cattle started to die from BSE, their carcasses and offal were included in the same protein enriched feed. This seems to have magnified the epidemic, so that in 1993, 1000 new cases per week were being reported. In 1988, the British government banned the inclusion of sheep and cattle offal in feed supplements, but the ban was not adequately enforced until 1991-1992. Even by 1990 Britons suspected a health risk from BSE. UK government officials assured the British public that there was no risk. Such advice haunted the officials 6 years later when in March, 1996, 10 cases of **Creutzfeldt-Jakob Disease (CJD)** were reported. The CJD victims were much younger (27 yr. vs. 63 yr.) than the norm for the usually sporadic cases that occur worldwide at a baseline rate of 1:1,000,000 population per year. Moreover, the British press reported that the pathological findings in the brains of the 1996 CJD victims were different than those in the more typical older CJD victims.

FOOT AND MOUTH DISEASE IN UK

In the winter and early spring of 2001 an epidemic of foot and mouth disease in domesticates rocked the rural countryside of Great Britain. The British Ministry of Agriculture on April 2, 2001, reported 875 documented cases during the as-yet 6-week epidemic. An additional, 940, 000 animals were marked for prophylactic culling. Funeral pyres of dead animal carcasses and mass burial sites were painfully obvious to all Britons. There are so many unanswered questions. Who made the decision to feed animal meat to strict herbivores? Who decided to feed BSE-infected cattle carcasses to their living brethren in a form of animal cannibalism? Even to lay

persons such decisions appear as absolute heresy to wise animal husbandry and perhaps the laws of nature. In retrospect, such decisions were made with concern for profit with no regard to the possible natural consequences.

RECOMMENDATIONS

At the century's end momentous changes were underfoot in information technology and genetic manipulation. Plant geneticists select or bioengineer high-yielding strains of crops, designed to resist pests and disease, or maximize growth by responding vigorously to fertilizer or irrigated water. Scientists can select and propagate genes. Tiny, bioengineered creatures appear set to alter such environmental-related realms as pest control, mining, fertilizers, sewage treatment and waste recycling. In Scotland sheep have been cloned while cattle were cloned in Japan.

The range of possible outcomes from such change is wide; such outcomes may prove modest or may loom large. The future history of the 21st century will make such matters clearer. The evolving and inevitable role of future medicine will be to recognize early on environmental changes and bioengineering outcomes that might radically affect human health before they become cataclysmic health problems. In the 21st century the most effective medicine will proactively identify human actions that circumvent the natural order and expose mankind to the ravages of now unknown infectious disease. Medicine must add its voice to other scientific disciplines to set rules and standards for future genetic manipulation. Human decisions and choices in environmental and genetic manipulation must conform to the fundamental laws of nature to minimize disease risk and inadvertent disruptive consequences to the global ecosystem and human health. True genius will lie in seeing and interpreting the future in the first seeds of discernible information.

“Nature, to be commanded, must be obeyed.”1620, Sir Francis Bacon, *Novum Organum*, 1620

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– A Physician's Lexicon –



Certified Male

Words rarely stay with their assigned definitions for extended periods of time, particularly when they are moved from one language to another. There is, of course, some limited logic to the rules of etymology; but words, like the people who use or misuse them, will tend to wander endlessly over the centuries, stretching their meaning, sometimes offering nuances never dreamed of when the word had first been fashioned, and at times even assuming meanings which contradict the original definition.

Take, for example, the Greek root, *andro-*, meaning male, found in such medically related words as androgen, andrology and androgynous [bearing both male and female characteristics]. Various classical names, both of males and females, carry the *andro-* root including Alexander, Andrew, Androcles, Andromeda [literally, mindful of her husband] and the wife of Hector the warrior, and Andromache [literally, whose husband excels in war].

Classical Greek contains a very closely related root, *anthropo-*, also meaning male, but is currently used in many English words to signify mankind in the broader sense of both males and females. Thus, there are words such as anthropology, anthropoid [human-like primates], and anthropophagy [cannibalism].

The two closely related roots [*andro-* and *anthropo-*] have their own verbal domains; but when each one combines with another Greek root, *philo-*, [meaning love of, as in the word philosophy], widely and wildly divergent meanings then emerge. Philanthropy, literally the love of mankind, generally defines

noble acts of charity. Philandering, on the other hand, while originally defined as a lover of many, now defines, in current usage, a scoundrel who dallies, flirts and trifles with the love of another.

One of the stranger applications of the root, *andro-*, is found in the science of paleontology. In August of 1856, in a valley neighboring upon the German city of Dusseldorf, quarry workers entered a gorge and happened upon a concealed cave. In it they discovered numerous human bones. The bones were eventually taken to a local naturalist, J.D. Fuhlrott, who immediately recognized them as morphologically distinguishable from *Homo sapiens* bones, but yet human. This was corroborated by other scientists and they then sought a name for this race of not-quite-humans represented in these ancient bones. The valley had been named for a local teacher, Joachim Neumann [German for new man] and the scientists, feeling the need to revert to a classical language, translated Neumann to Greek, rendering it as *neo-ander*, shorted to *neander*; and since it was a valley they appended the German word for valley [*thal*], thus producing the memorable word, Neanderthal.

The word, meander, defines anything [usually a river] taking an aimless, winding, rambling course. The word was taken, in ancient times, from the name of a meandering river [now called the Menderes River] in Turkey. But, it has been suggested, the river's name had designated a place solely for bathing males.

– Stanley M. Aronson, MD, MPH

Statement of Ownership, Management, and Circulation		Indicates whether checked	
		Average for Calendar Year During Preceding 12 Months	For Year of Publication
1. Name of Publication: <u>Medicine and Health / Rhode Island</u>			
2. Issue Date: <u>4/6/01 - 6/30/01</u>			
3. Issue Frequency: <u>IR</u>			
4. Issue Mails: <u>12</u>			
5. Number of Copies: <u>1000</u>			
6. Total Number of Copies: <u>1000</u>			
7. Total Distribution: <u>1000</u>			
8. Total Paid Circulation: <u>1000</u>			
9. Total Free Circulation: <u>0</u>			
10. Total Paid and Free Circulation: <u>1000</u>			
11. Total Copies Not Distributed: <u>0</u>			
12. Total Copies (Sum of 10 and 11): <u>1000</u>			
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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

PER YEAR \$2.00
SINGLE COPY, 25 CENTS

NINETY YEARS AGO

[NOVEMBER, 1911]

An Editorial, "Prolonged Pregnancy," argued for induction of labor at term "as a matter of routine." Estimating that 15% of labors were protracted beyond the due date, the Editorial cited the practice of Dr. Erasmus Miller, published 30 years earlier in the *Boston and Medical Surgical Journal*: "He would now and then attend an old patient, stipulating that he would make the engagement if he might set the day of the labor. . . and induce it... He would arrive in the evening, pass a gum catheter between the membranes and the uterine wall, coil the free end in the vagina and go to bed, to be called in a few hours to complete the labor."

Dr. Herbert Terry and Dr. Wm McDonald, Jr., contributed "Primary Chancre: Two intravenous injections of Ehrlich's Salvarsan: Prompt recurrence of symptoms showing involvement of brain and nervous system: A Case Report." In 1911 Prof Ehrlich and Mr. McDonagh had written: "Mercurial inunctions or injections are unnecessary to supplement the treatment of syphilis by '606' as a routine measure, because mercury can be relied on...should '606' fail to cure the patient, and such a failure is extremely rare..." In this case a 40 year-old man with chancre was treated with mercury, by inunctions, and then by potassium iodide. His symptoms continued. Later, the physician injected 0.6 grams of '606,' followed by another dose in 1 week. Four months later, the patient came to Dr. McDonald with a right-sided facial paralysis, dizziness, loss of appetite, headaches, decreasing vision. His Wasserman test was positive. The treatment was more mercurial inunctions with increased doses of potassium iodide. One month later, the patient had improved. The authors stressed, first, "the danger of omitting frequent Wasserman or Niguchi tests subsequent to use of Salvarsan," and, second, that "even after use of Salvarsan one may fall back on KI and mercury."

In "Health of Providence, June - September 1911," Charles V. Chapin, MD, reported that the summer death rate was the lowest on record - a fact he attributed to the decline in diarrheal diseases. Ten years earlier, even with a smaller population, the number of diarrheal deaths was double that in 1911. The reason: "improvements in milk supply, and particularly the systematic effects...to teach mothers how to care for their infants."

FIFTY YEARS AGO

[NOVEMBER, 1951]

In "Common conditions of the feet often confused with fungus infection," Malcolm A. Winkler, MD, described the four most common fungi attacking the feet: *Monilia Albicans*, *Epidermophyton Inguinale*, *Trychophyton Gypseum*, and *Trychophyton Purpureum*. Fungi-linked conditions were often misdiagnosed as dermatophytosis, contact dermatitis, hyperidrosis with symmetric lividities.

C.D. Selby, MD, Resident Lecturer in Industrial Health, University of Michigan, presented "Physical examination in industry as a cancer-finding procedure" at the Fourth Annual Cancer Conference of Physicians, under the auspices of the Rhode Island Medical Society. The Journal reprinted his talk. He argued that although the physical exam "cannot give sufficient attention to the areas most frequently involved in cancer - the stomach and prostate in men, and the breast and cervix in women," the

exam could still promote cancer-detection. Specifically, the exam could allow the physician, who sees the patient regularly, to spot repeat complaints that need follow-up; the exam could be adapted along the lines of the Hillsdale Plan for cancer detection (where patients would ask for full exams); and the exam could promote health education.

The UAW (United Automobile, Aircraft and Agricultural Implement Workers of America - CIO) had charged that the American Medical Association was wrong to spend members' dues on political lobbying. The Editorial countered that members' dues contributed only 7% of the AMA's budget (the rest came from periodicals and advertising revenue) - a small contribution in the campaign "... against socialism in this country, particularly the socialization of medicine."

The previous year the College of Surgeons had ceded to the American Hospital Association the sole responsibility for accrediting hospitals. The Editorial praised the newly-formed Joint Commission: "With pleasure...we note the recent announcement of the AMA that a plan for a joint commission has finally been established, composed of 18 members, 6 approved by the AMA, 6 by the AHA, and 3 each by the American College of Surgeons and the American College of Physicians."

TWENTY FIVE YEARS AGO

[OCTOBER, 1976]

A Message from the Dean on "The Indebtedness of Students Currently Attending Medical School" voiced two fears: 1) that increasing indebtedness "may soon modify the characteristics of medical school applicants and, by a self-selection process, diminish within the applicant pool the representation of rural, low income and minority populations," and 2) ". . . may shape career directions of graduates." A recent AMA study showed that 35% of all medical students had incurred debt before medical school; the average debt was \$2,923. Of current medical students, 67% had incurred debt; the average post-graduation debt was \$11,573. Brown showed the same trends: 60% of 247 medical students received assistance; 12% were enrolled in the Armed Services or Public Health subsidy programs. The debt did not skew career choices.

The issue focused on Mental Health.

Joseph M. Zucker, MD, in "Problems in Mental Health Care in Rhode Island," described the panel on the development of a comprehensive mental health network in Rhode Island.

Robert J. Westlake, MD, in "The Non-Profit Voluntary Psychiatric Hospital and the Delivery of Mental Health Services in Rhode Island: Past and Future," stated that "...current developments promise increased potential for rehabilitation versus long-term custodial care."

Joseph J. Bevilacqua, PhD, in "Organizing the Mental Health Network in Rhode Island - The State Role," discussed the "partnership of the state system" with the communities.

Michael A. Ingall, MD, in "Community Mental Health in Rhode Island," suggested that "Cooperation and coordination with government and the private sector will deliver more services."

Joseph E. Cannon, MD, in "A Reallocation Model for Limited Health Resources," discussed the need to share services "to reduce duplication and underutilization."

An Editorial praised the establishment of the State Mental Health Network and Day Hospital at Butler, as well as the reduced length of stay in acute psychiatric facilities and the lower census at the Institute of Mental Health - all marking the trend to keep people in the community.