

Health Hazard Appraisal Counseling— Continuing Evaluation

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A program of annual health examinations was expanded to include counseling based on a computerized appraisal of individual patients' specific health risk factors. Data obtained from a specially designed questionnaire, laboratory tests and a physical examination yielded a health hazard appraisal showing a number of weighted risk factors and their relation to ten leading causes of death as determined for that patient. From all of this information, a "risk age" was developed which could then be compared with the patient's "true age." The results were reviewed with each patient, and methods of correcting health hazards were stressed. The first annual retesting of a group of 107 examinees showed a net risk age reduction of 1.4 years (formerly reported in this journal). The longer term follow-up reported in this paper showed a net risk reduction of 2.38 years in a group of 26 examinees. The net risk age reduction in the two groups represented 32 and 40 percent, respectively, of the achievable risk age reduction when patients comply with suggestions made during risk reduction counseling. These findings indicate that health hazard appraisal counseling is an effective method of altering priorities of health practices.

MANY PROPONENTS of preventive medicine contend that the appraisal of health risk factors and the counseling of patients concerning those risks constitute an important part of health care.¹⁻⁵ The health hazard appraisal concept is based on the fact that each person faces certain health risks because of age, sex, race, heredity and lifestyle. When these factors are combined with information from a patient's medical history, physical examination, x-ray studies and laboratory tests, a physician is able to determine the health risk hazards of each patient. When the physician knows the prognostic characteristics of his patient

and compares them with the experience of others having the same characteristics, he can quantitatively assess the health risks that the patient faces and counsel him accordingly. If the patient responds in an affirmative manner, his health risk factors can be reduced significantly.^{6,7}

In health hazard appraisal, the degree of risk that an individual person faces is established from tables of mortality data on the United States population as a whole, by specific cause. These tables were developed by Harvey Geller of the United States Public Health Service.^{8,9} For the health hazard appraisal, data from these tables are entered into a computer and combined with information on each patient's prognostic characteristics and medical condition. The combined data are then analyzed, and a computer printout

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TABLE 1.—Ten-Year Mortality (Geller) Table for 45-Year-Old White Men

Cause of Death	Chances in 100,000 of the Person Dying from This Cause		
	1960	1968	1974
Arteriosclerotic heart disease . .	3,507	3,539	2,973
Cancer of the lung	486	586	681
Cirrhosis	370	453	471
Vascular lesions of the central nervous system	428	385	299
Suicide	313	290	281
Motor vehicle accidents	313	360	260
Cancer of the large intestine and rectum	185	165	172
Pneumonia	185	193	113
Homicide	*	*	109
Bronchitis and emphysema	*	134	88
Other causes	3,473	2,875	2,158
Total causes of death	9,260	8,980	7,605

*Data not available.

is produced of the health hazard appraisal including a set of weighted factors that may positively or negatively alter the risk of death.

Factors of primary importance are blood pressure, presence of heart disease, overweight, smoking habits, use of alcohol and other aspects of lifestyle, as well as safety factors such as number of miles driven annually and use of seat belts. With the results of the computer printout, a physician can evaluate the outlook for his patient over the coming ten years, taking into account the "average" risk for the general population and the characteristics of his patient, which may alter the risk to be above or below the average.

Risk characteristics have been developed using data from the Framingham study,¹⁰ the cigarette use and lung cancer study of Hammond and Horn,¹¹ and numerous studies conducted by the insurance industry, medical schools, hospitals and government agencies.^{12,13} With this information, a risk factors manual has been developed to aid in health hazard appraisal.*

The Geller tables are critical input to the appraisal process. Table 1 shows the Geller data on an average 45-year-old white male American compiled for the years 1960, 1968 and 1974. According to these data, he has 7,605 chances in 100,000 of dying within the next ten years from heart disease, lung cancer, cerebrovascular accident, cirrhosis, suicide and a number of other causes. The following illustration shows how risk factors are applied to individual patients. A 45-

year-old man smokes one package of cigarettes a day, but does not consume alcohol. His smoking, however, increases his ten-year risk of death to nearly 10,000 chances in 100,000. As a result, his risk becomes that of a 47-year-old man rather than his actual age of 45; he has a ten-year risk almost 2,000 chances in 100,000 greater than the average person of his age, race and sex who does not smoke. If he also used alcohol or smoked more than one package per day or both, his ten-year risk of death would increase greatly. If he were to stop smoking, however, he would reduce his risk by 26 percent, therefore giving him the risk factor of a 44-year-old man. With such quantitative information, the physician can counsel his patient on the benefits of affirmatively changing his lifestyle.

Four years ago, the NASA-Ames Research Center at Moffett Field, California, initiated a program of health hazard appraisal and counseling for its 1,600 employees, which was reported in 1975 in THE WESTERN JOURNAL OF MEDICINE.¹⁴ The authors of the present paper reported the results of health hazard appraisal counseling of 488 employees of the National Aeronautics and Space Administration (NASA). Of those employees, 107 were randomly reappraised about a year later, with the finding that the net risk age among them was reduced by 1.4 years. This significant finding indicated that appraisal-based counseling is an effective method of altering priorities of health practices. The authors also evaluated patient acceptance of the health hazard appraisal. Their findings in this regard showed that 80 percent fully accepted the program and expressed the desire to be tested annually. Of the subjects, 50 percent interpreted their test results as indicating that they should change their health practices, and 80 percent indicated that they intended to make some or all of the recommended changes to lessen the risk of death in the next ten years.

The present paper assesses the results of later health hazard appraisals conducted in the NASA-Ames Research Center counseling program.

Methods

Most NASA-Ames employees participate in the program at the Ames Health Unit. Participants are given both a periodic health examination and a health hazard appraisal. The health examination includes x-ray study of the chest, spirometry, resting electrocardiography, submaximal stress electrocardiography, laboratory profiles, and a

*Available to physicians from the Methodist Hospital of Indiana, 1604 North Capital Avenue, Indianapolis, Indiana 46202, or as a computer-processed report from Interhealth, 2970 Fifth Avenue, San Diego, California 92103.

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complete history and physical examination. The health hazard appraisal consists of a computer analysis of the answers to a six-page questionnaire concerning the patient's lifestyle, known diseases, family history, health habits, emotional status and racial background. Physical data are inserted into the questionnaire by the health unit personnel. To provide patient privacy, the questionnaires are identified only by the initials of the respondent and an identifying number.

Two weeks after the examination, the patient returns for health hazard appraisal counseling. A physician explains the results of the various tests and discusses any health risk factors that vary significantly from the population as a whole and thus constitute significant risks. In summarizing the data, the physician compares the patient's *true age* with his *risk age* as determined by the appraisal. The patient is then advised of the importance of changing his lifestyle and habits—for example, smoking, use of alcohol, or weight—and referred to his personal physician for any required treatment. The discussion focuses on the *achievable age*, the lowest possible risk age that the patient could achieve if, for example, he stopped smoking, modified his alcohol intake or reduced his weight. With lifestyle modification, the patient's risk age could become lower than his true age, and with total compliance, could reach his achievable age.

A sample health hazard appraisal printout is shown in Figure 1. The subject of this printout is a 40-year-old white man. For his age, race and sex the average risk of death in the next ten years is 5,490 chances in 100,000, based on the Geller tables. This patient's risk is considerably reduced, however, because of his favorable medical history and health practices. His present risk is 2,936 chances in 100,000 according to his health hazard appraisal, and his risk age is four years younger than his actual age. His risk factors include being slightly overweight, driving a motorcycle as an avocation and frequently not using seat belts when driving an automobile. If he complies with the recommendations shown in the right-hand column of the printout, his risk would be further reduced to 2,652 chances in 100,000, giving him a potential age of 33 years as compared with his actual age of 40 years. Information such as the foregoing was used to develop the Ames Health Unit program for patient counseling for risk reduction.

At the time of the present writing 1,225 Ames employees have participated in the physical examination/health hazard appraisal program. A group of 608 employees underwent a second examination/appraisal somewhat more than two years after the first. Slightly more than two years later, a small group (38) returned for a third examination/appraisal. The groups were not selected on any basis. They represent employees

AVERAGE	Risk/100,000	5,490	PRESENT AGE	40
PRESENT	Risk/100,000	2,936	RISK AGE	36
ACHIEVABLE	Risk/100,000	2,652	ACHIEVABLE AGE	33
<hr/>				
CAUSE: Accidents, Motor Vehicles			AVERAGE RISK	339 (1.0)
			PRESENT RISK	305 (.9×Avg)
			ACHIEVABLE RISK	108 (.3×Avg)
CONTRIBUTING FACTORS			ACHIEVABLE RISK WITH TREATMENT	
	<i>Present</i>	<i>Risk</i>	None before driving	
Alcohol: 1-2 drinks/week		1.0	Always use seat belts	
Mileage—10,000 miles or more8	.5	
Seat Belts: less than 10 percent usage ...		1.1	.8	
<hr/>				
CAUSE: Arteriosclerotic Heart Disease			AVERAGE RISK	1,861 (1.0)
			PRESENT RISK	130 (.1×Avg)
			ACHIEVABLE RISK	74 (.1×Avg)
CONTRIBUTING FACTORS			ACHIEVABLE RISK WITH TREATMENT	
	<i>Present</i>	<i>Risk</i>	Exercise as directed	
Exercise: some activity		1.0	.5	
<hr/>				
CAUSE: Cirrhosis of Liver			AVERAGE RISK	304 (1.0)
			PRESENT RISK	61 (.2×Avg)
			ACHIEVABLE RISK	30 (.1×Avg)
CONTRIBUTING FACTORS			ACHIEVABLE RISK WITH TREATMENT	
	<i>Present</i>	<i>Risk</i>	Stop drinking	
Alcohol 1-2 drinks/week2	.1	

Figure 1.—Health hazard appraisal computer printout for a 40-year-old white man.

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participating in the voluntary annual health examination program. Of this group, 26 have been studied to evaluate compliance with the health hazard appraisal counseling. Computer records of their former health hazard appraisals were located for comparative purposes to allow analysis of the same risk factors on all examinations. The remaining 12 patient records were not available for recomputation because of routine transfer of files.

Results

Statistics on the risk rate of the Ames personnel are presented in Table 2. The true death rate

TABLE 2.—Average of Health Hazard Appraisal (HHA) Death Rate Results for the Ames Research Center Population (per 100,000)

	True Death Rate	Risk Death Rate	Difference (between true and risk death rates)	Risk Death Rate Reduction
Initial HHA (N=1,225)	8,336	8,503	+ 167	..
Second HHA (N=608)	11,334	10,668	- 666	833
Third HHA (N=26)	11,809	9,526	-2,283	2,450

—that is, the likelihood of death per 100,000 in the upcoming ten years—has been calculated from national statistics based on age, race and sex. The risk death rate is based on those statistics as modified, positively or negatively, by the health hazard appraisal. The risk death rate reflects the employee's family history, health practices, and lifestyle. A significant reduction in the risk death rate occurred between the first and second evaluations. This reduction is evidenced by the 833 fewer chances of death per 100,000 shown in the table. The change between the second and third appraisals was even more substantial—with the risk of death reduced by 2,450 chances per 100,000.

The difference in subject age was 2.37 years between appraisals one and two and 1.1 years between appraisals two and three. It should be noted that time is a critical factor in such appraisals because the mortality curve steepens with each added year and, consequently, it becomes increasingly difficult to reduce the death risk (see Figure 2). The aging differential between the last two appraisals was only half as great as that between the first two. This factor probably explains the greater decrease in the death risk rate between

The risk of death is not constant. The graph below indicates the number of deaths per 100,000 population at various ages. Death rates go up very slowly until about age 30 and much more rapidly thereafter. Thus, a decrease in the death rate—say 650 deaths—as we get older represents the difference between the rate for people age 41 (point D) and that for people age 40 (point C). However, at the lower or younger end of the scale, a difference in deaths of that same number—650—represents the difference between people age 30 (point B) and those of age 14 (point A). Thus, when one is younger, his achievable age could go from 30 to 14 by reducing his risk of death by 650, whereas at age 41, a similar size risk reduction will have much less effect—only 1 year—reducing the age to 40.

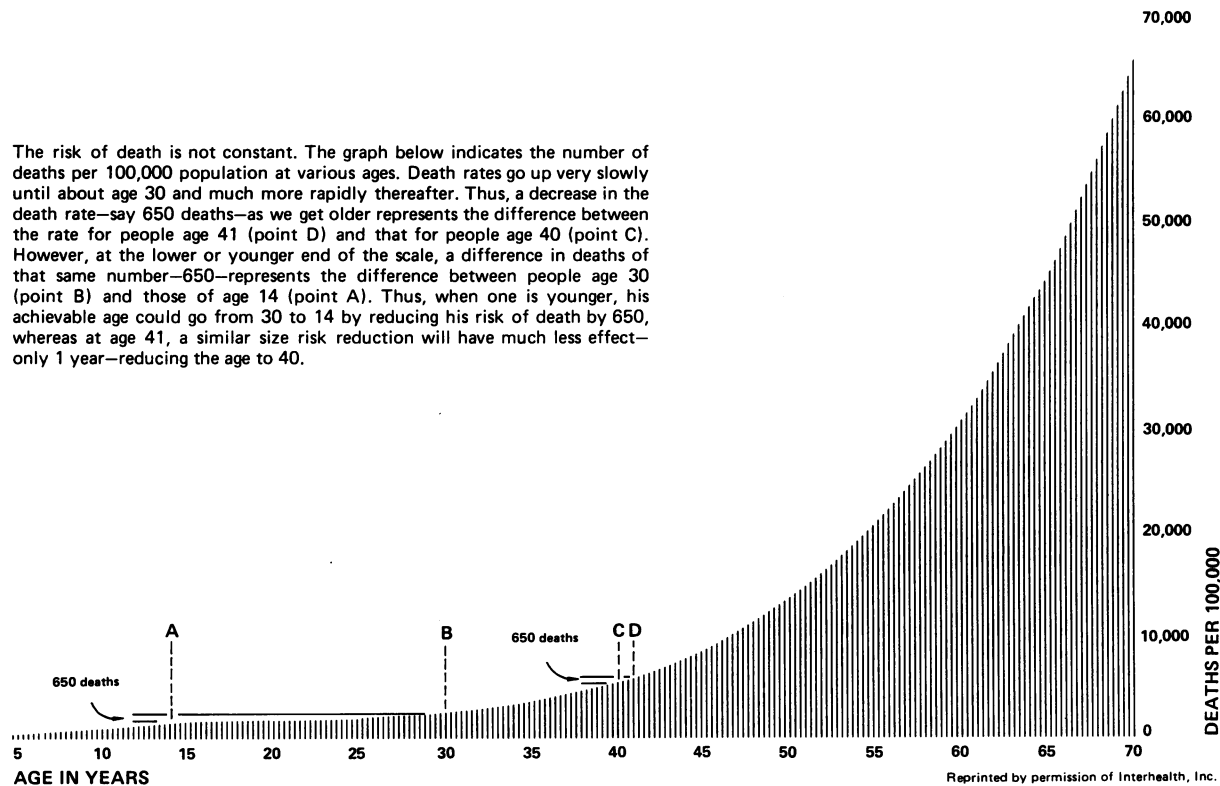


Figure 2.—Mortality curve for the American population.

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the second and third appraisals than that occurring between the first and second appraisals.

Shortly after the authors began to test this group, the health hazard appraisal computer programs were revised, having been updated on the basis of new research on risk factors prevalent in the American population. The data on the Ames group being studied at that time would not have been comparable unless the original appraisals were rerun using the new health hazard criteria. Unfortunately, the records of only 26 of the subjects were available for computer re-evaluation with updated programs.

With the new data, the authors found that this group of employees had a reduction in risk age of 2.38 years as compared with the 1.4 years previously noted¹⁶ (see Table 3). The findings, however, represent similar reductions of the difference between risk age and achievable age for the groups studied. A reduction in the first study of 1.4 years represented 32 percent of the achievable risk age reduction. In the current study, the reduction of 2.38 years represents 40 percent of the achievable risk age reduction.

The present study also sought to assess patient acceptance of the health hazard appraisal. A random sampling of patients—some participating in

the program for the first time and others undergoing their second and third evaluations—were asked to complete a questionnaire to determine their impressions of this form of patient counseling. The responses indicated that most patients felt that their first appraisal provided them with significant information about their health (see Table 4). Over the four years of counseling the number who felt that they received important information declined slightly from 94 percent to 82 percent. On initial appraisal, 91 percent felt that they should change their lifestyles; after the third appraisal 87 percent still felt that way.

Patient confidence in the health hazard appraisal remained relatively stable over four years of the study although patients increasingly disagreed with the conclusions regarding their health. The authors observed that patients frequently became confused when new risk factors emerged in their appraisals after they had reduced earlier risk factors by changing their lifestyles. This reaction may account for the growing patient disagreement with appraisal recommendations. Table 1 shows the additional problem of the shift in numerical values of certain risk factors as the Geller tables are updated periodically. Some examinees find it unsettling to be presented with changes in risk factor counseling that are beyond their control.

The number of patients who intended to make changes in their lifestyles as a result of health hazard appraisal counseling declined from 94 percent on initial appraisal to 70 percent on the third appraisal. This degree of change may have resulted from the decreasing number of possible

TABLE 3.—Average of Health Hazard Appraisal (HHA) Results on Third Periodic Examination (converted to age of employee in years)

	True Age	Risk Age	Achievable Age	Risk Age Reduction
Initial HHA ..	48.04	47.96	43.92	...
Third HHA .. (N=26)	49.88	47.42	43.88	2.38

TABLE 4.—Health Hazard Appraisal (HHA) Acceptance Obtained Through the Use of Questionnaire (percent)

Question	First HHA (N=33) (Percent)	Second HHA (N=45) (Percent)	Third HHA (N=23) (Percent)
The results of the HHA showed me a <i>great deal</i> about the status of my health.	61	44	30
	33	47	52
The results of the HHA showed me a <i>great need</i> for change in my lifestyle.	0	13	9
	55	56	39
	36	24	39
I <i>agree</i> with the conclusions in the HHA results	91	78	65
I <i>disagree</i> with some of the conclusions.	9	13	35
I <i>intend to</i> change my lifestyle accordingly.	24	20	22
	15	9	4
	55	56	44
I would like to take the HHA <i>every year</i> .	73	67	70
	21	27	17

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lifestyle changes available to the respondents as risk ages were reduced with subsequent health hazard appraisals. However, 70 percent expressed interest in continuing with annual counseling after the third health hazard appraisal. This interest offers promise that further reductions may be made in risk factors among the subject population as the program enters its fifth year.

Comments

Mortality statistics, at first glance, would appear to be unlikely data on which to base patient counseling concerning health practices. But these statistics provide the basis for a ten-year forecast of the death risk of individual patients and the substance for physicians to counsel their patients about improving their health habits. With the aid of mortality data and a health hazard appraisal, physicians can place various risk factors in an order of priority that patients can understand. Some factors that are included do not appear to be within the realm of the usual practice of medicine. But such factors as the use of seat belts and hazardous avocations can have an important bearing on the health hazard appraisal. And an important benefit of health hazard appraisal is that it concerns more than just the physiological aspects of a person's life.

As risk factors are further expanded and quan-

tified, health hazard appraisal will become an increasingly important aspect of preventive medicine. With new data in new areas—such as personality typing and the impact of social changes on future health—the effectiveness of health hazard appraisal counseling will be enhanced.

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