Health Expectancy

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Abstract

This paper presents a different approach to measuring Health Expectancy, especially as it relates to the elderly population. This new actuarial approach is described and numerous examples are given. Three health status levels are envisioned: (1) healthy, (2) needs assisted living and (3) needs skilled care. Comparisons are given with external sources. As a separate but adjunct matter, actual mortality results are given at ages 90 and over. Beneficial aspects of health expectancy are discussed, including survival to and beyond age 100.

1. Introduction

More than 100 years ago, the actuarial profession introduced the concept of "expectation of life," a measure of the average future lifetime of a group of people generally the same age and sex. Over the ensuing years, people in academic circles and others, primarily in countries other than the United States, began to write about a different measure of future lifetime, the average future **healthy** lifetime of such a group. Most of this research has focused on health expectancy as a macro or aggregate measure for comparison of different population groups around the globe. Such research is noted in the "References" section of this paper.

Over the past 20 years, the authors became interested in expanding the literature about health expectancy in two important ways:

1. By concentrating on truly homogeneous groups of people with the same age, sex, smoking status **and medical impairment profile**. In this manner, we have made a valuable contribution to people dealing with questions of personal risk management as they face an uncertain future. For seniors in particular, health expectancy provides insights into survival to very advanced ages.
2. By assessing the impact of known impairments using actuarial science as opposed to medical science or underwriting art.

The balance of this paper explores these two new aspects in great detail.

2. How is Health Expectancy Determined?

Fundamentally, the method determines the probability that a person will be alive and healthy (or unhealthy) at any time in the future. Using this information, it is readily possible to split life expectancy into "healthy" and "unhealthy" periods. Furthermore, if there are several definitions of "unhealthy" the split can be in more than two health status levels. This paper actually splits life expectancy into three health status levels.

3. Definitions of "Unhealthy"

There are many possible definitions of the term "unhealthy." These include:

(a) inability to qualify for standard life insurance

(b) suffering from a defined list of critical illnesses

(c) totally and permanently disabled, as defined by eligibility for Social Security disability benefits

(d) Nagi limitation, which is defined as inability to perform any of the following five Nagi activities: (1) stooping, crouching or kneeling; (2) lifting or carrying objects weighing up to 6 kg (10 lb); (3) extending the arms above the shoulder; (4) grasping small objects; and (5) walking two to three blocks

(e) Limitation in "Instrumental Activities of Daily Living" is defined in the National Long Term Care Surveys as inability to complete at least one of the following eight tasks: (1) light housework, (2) laundry, (3) meal preparation, (4) grocery shopping, (5) outside mobility, (6) travel, (7) money management and (8) telephoning.

(f) in need of assisted living

(g) in need of skilled nursing care

Need for assisted living means inability to perform two or more of the following activities of daily living: (1) bathing, (2) dressing, (3) toilet use, (4) transferring from bed to chair, (5) eating and (6) continence. Suffering from Alzheimer's disease automatically qualifies. "Need of assisted living" does not necessarily mean residence in an assisted care community; nor are all residents necessarily qualified as "unhealthy." Skilled nursing care means a person is so incapacitated as to require the regular attention and care of a registered nurse or a licensed practical nurse. Need for skilled nursing care does not necessarily mean residence in a skilled nursing home.

Health Expectancy examples shown in this paper make use of both the assisted living and skilled nursing definitions. This approach is meaningful to the public, and is in accord with long-term care insurance currently on the market.

4. The Need for Proper Basic Tables and Mortality Ratios

Accurate life and health expectancy (and associated probabilities) can be determined only on the basis of (1) current basic mortality at all ages; and (2) appropriate mortality ratios for ailments that are present and not contemplated in the basic mortality. There is a large body of mortality ratio theory dealing with specific causes (including multiple causes), variations by age, nature of the basic table, etc. Mortality ratios "less than 1" are also contemplated, especially for preferred socio-economic groups. For the subject matter of this conference, it is especially necessary to get correct measurements of all the elements, at advanced ages.

Unless otherwise indicated the basic mortality tables used for this study are the 2002 Bragg Life Tables (BLT), Ultimate. The mortality ratios are from the Bragg Associates' Report: "Mortality Ratios, Underwriting Rules, and Socio-Economic Adjustments (MRUSA)." These tables were constructed from a large body of insured life mortality data, including information on health status and underwriting.

The assignment of a "mortality ratio" to an individual is not just a means of predicting mortality; it is also recognition that certain types and levels of ailments exist, over and above those already contemplated by the basic mortality table itself.

The use of a correct basic mortality table (which projects survival and death patterns) implies the existence of certain morbidity patterns, which are embedded into the fabric of the table, and typically intensify with age.

The science of health expectancy discovers these embedded morbidity patterns. The results (male versus female, old versus young, with and without disabilities, etc.) almost invariably turn out to be logical, and can be verified by external comparisons. As mentioned earlier, the authors have chosen to define unhealthy using the assisted living and skilled nursing definitions common to the long-term care industry. It is possible to estimate the mortality ratios for people in each of these two states from a study of the ailments commonly found and the associated mortality. In so doing, the authors have determined a set of mortality ratios by age and

sex for each of the unhealthy states selected. It is important to keep in mind that there is no separate estimate of disability incidence rates or levels, or recovery rates, in this study. The mathematics are such that recoveries have no effect on health expectancies at all. They are offset by new incidences. It is only the net of the two that is meaningful. A person is found to be unhealthy based on his or her anticipated mortality level. The mortality ratio determined for a person based on his or her health factors is compared to the mortality ratios for persons who have been judged to require assisted living or skilled nursing care. Since the mortality for a particular type of impairment is considered in relation to the mortality without that impairment for a person at the same age, the authors do not believe the use of insured mortality instead of that for the entire population will impact the results.

With these mortality ratios for unhealthy people in hand together with the appropriate basic mortality tables, it is possible to construct survivorship tables, using mortality ratios for the individual being evaluated. In this manner, the "total alive" each year can be tracked in the healthy and unhealthy groups. Using this general procedure, the authors have been able to produce the examples shown in this paper and to develop incidence rates for each of the assisted living and skilled nursing states. These have been compared to known external sources and found to correlate very reasonably, as shown in Section 5.

5. Comparison with External Sources

The authors are providing four tables (5.1 through 5.4) which compare the results of this study (based on health expectancy methodology and data) with external sources. These verify that the mortality ratio approach used in this paper to incorporate healthy and unhealthy life expectations produces comparable results to those in common usage as reported in U.S. studies. The sources are:

(NLTCS) National Long Term Care Surveys, 1982 and 1984

(Healthy Medicare Elderly) Medicare Beneficiaries with no limitations (1992-1998)

(85 NNHS) 1985 National Nursing Home Survey

TABLE 5.1

Two-Year Probability of Remaining Healthy

	MALE		FEMALE	
Age	NLTCS	This Study	NLTCS	This Study
75	77.6%	71.6%	79.0%	67.1%
80	70.5%	67.5%	70.9%	63.5%
85	59.3%	62.0%	58.3%	58.2%
90	48.1%	50.6%	45.7%	48.1%
95	36.9%	39.3%	33.1%	37.0%

The National Long Term Care Surveys (NLTCS) are nationally representative surveys of Medicare beneficiaries aged 65 and over with chronic functional disabilities (sometimes referred to as the “frail elderly”). These surveys are the major source of nationally representative information on changes in the health and functioning of the elderly population.

A fundamental advantage of the NLTCS is that it is based on a list sample drawn from Medicare eligibility files. This makes it practical to draw supplementary samples of certain subgroups, e.g., extremely old persons (aged 95+) and elderly populations by race or ethnicity (e.g., African Americans, Hispanics). The NLTCS is a unique resource for a variety of analytical purposes. For example, the very old (persons aged 85+) is the fastest growing group within the elderly population.

TABLE 5.2

One Year Probability of Remaining Healthy

	Healthy Medicare Elderly	This Study	
Age	M & F Combined	M	F
75	80.4%	73.7%	68.7%
85	66.9%	66.2%	61.5%

The healthy group in this study includes all who do not need assisted living; this would include moderately sick people who are probably not included in the healthy group for U.S. Sources NLTCS and Healthy Medicare Elderly.

TABLE 5.3

Incidence Rates to Skilled Nursing Care

	MALE			FEMALE		
Age	85 NNHS	This Study		85 NNHS	This Study	
		Non Smoking	Smoking		Non Smoking	Smoking
82	.0785	.0382	.0708	.0950	.0353	.0694
87	.1209	.0731	.1072	.1408	.0603	.1026
92	.1690	.1790	.2286	.1953	.1419	.1661
97	.2867	.2799	.3663	.2089	.2547	.2952

85 NNHS Incidence Rates are high because of frequent discharges and readmissions; this study on the other hand deals with permanent change in health status and should produce lower incidence rates (as it does).

85 NNHS Average Stays are for “single bouts of illness”; this study on the other hand deals with all future bouts of illness and should therefore show larger average stays (as it does). The proper comparison is the product of the incidence rate and average stay, or “claim cost.”

Once these differences are considered in determining the claim costs from the two sources, the results of these two studies are consistent. This is shown in the following table.

TABLE 5.4

Incidence Rates, Average Stay and Claim Cost

		[85 NNHS		**] [**	**This Study (Nonsmokers)]**		
	Age	A Incidence	B Average Stay (Yrs)	Claim Cost = A x B	C Incidence	D Average Stay (Yrs)	Claim Cost = C x D
Male	82	.0785	.731	.0574	.0382	1.37	.0523
	92	.1690	.679	.1148	.1790	1.094	.1958
Female	82	.0950	.971	.0922	.0353	2.19	.0773
	92	.1953	.943	.1842	.1419	1.236	.1754
Av. Cl Cost				.1122			.1252

6. Health Expectancy Examples

Health expectancy technology is such that meaningful calculations can be done for any combination of age, sex and ailment. This is a very valuable resource for counseling seniors, and especially to encourage them to be in charge of their own destinies.

Numerous examples follow some general observations.

(1) For males ages 75-85, none of the individual ailments considered has as great an adverse impact as that of smoking. The adverse impact of smoking is approximately the same as the combined impact of heart disease and prostate disorder.

(2) For males, the adverse impact of prostate cancer (not shown in the chart) is the same as that of heart disease.

(3) For females ages 75-85, the adverse impact of diabetes is about the same as that of smoking. The adverse impact of the combination of osteoporosis and diabetes is more severe than that of smoking at these ages.

(4) It is interesting to note the effect of diabetes and heart disease for both sexes. For females, it is surprising that these ailments each have a greater adverse impact on health expectancy than breast cancer.

(5) The chart comparing health expectancies in 1967—40 years ago—to those for today is revealing. In this chart, the authors have applied their current methods for determining health expectancy to the 1965-70 Basic Tables and the 2002 Bragg Life Tables to obtain the results for 1967 and 2007, respectively. For males, healthy periods have improved 65 percent to 70 percent at ages 75-85 and 45 percent and 35 percent, respectively, at ages 90 and 95. For females, the improvement is not as great—around 50 percent at ages 75-85 and 40 percent and 25 percent, respectively, at ages 90 and 95. These significant improvements are reflective of both the improvement in overall mortality and morbidity levels at these ages.

(6) It is instructive to consider the question, "What is the best possible health expectancy profile for an individual today?" The authors have just introduced 2007 Bragg Life Tables for Preferred Non-smokers (07 BLT) and these are further divided into Class I (Super-Preferred) and Class II (Other Preferred). The chart comparing health expectancy on the 2002 Bragg Life Tables Ultimate to health expectancy on the 2007 Bragg Life Tables Preferred Class I Select and Ultimate answers the question posed for individual non-smokers with no ailments. For each sex, healthy periods are 30 percent to 45 percent longer on the 07 BLT. Careful consideration must be given to both the medical and socio-economic profile of an individual before deciding he or she is indeed "Super-Preferred!"

The following general comments are also relevant:

- Healthy periods are generally far longer than expected by the subjects, even where ailments exist.
- Healthy periods are generally about the same for males and females.
- The two unhealthy periods are longer for females than for males.
- The examples at ages 90 and 95 continue to be very favorable for those seniors.
- Even at 95, the healthy period ahead is 2.50 years for males and 2.42 years for females.

TABLE 6.1

Health Expectancy Examples				
	Males			
Ailments		**Age 75**	**Age 80**	**Age 85**
None	Healthy Yrs.	10.52	7.93	5.59
	Needs AL	2.72	2.11	1.45
	Needs SN	1.60	1.43	1.28
	Total LE	14.84	11.47	8.32
Prostate disorder	Healthy Yrs.	9.85	7.41	5.26
	Needs AL	2.86	2.20	1.49
	Needs SN	1.63	1.45	1.28
	Total LE	14.34	11.06	8.03
Arthritis	Healthy Yrs.	9.72	7.30	5.16
	Needs AL	2.89	2.22	1.51
	Needs SN	1.64	1.45	1.28
	Total LE	14.25	10.97	7.95
Obesity	Healthy Yrs.	9.22	6.93	4.86
	Needs AL	3.00	2.29	1.55
	Needs SN	1.66	1.46	1.28
	Total LE	13.88	10.68	7.69
Treated hypertension	Healthy Yrs.	8.35	6.29	4.42
	Needs AL	3.19	2.42	1.61
	Needs SN	1.71	1.48	1.29
	Total LE	13.25	10.19	7.32
Diabetes	Healthy Yrs.	7.92	5.92	4.16
	Needs AL	3.28	2.49	1.65
	Needs SN	1.73	1.49	1.29
	Total LE	12.93	9.90	7.10
Heart disease	Healthy Yrs.	7.02	5.29	3.69
	Needs AL	3.49	2.62	1.72
	Needs SN	1.77	1.51	1.29
	Total LE	12.28	9.42	6.70
Heart disease and	Healthy Yrs.	6.55	4.94	3.47
prostate disorder	Needs AL	3.60	2.69	1.75
	Needs SN	1.80	1.53	1.29
	Total LE	11.95	9.16	6.51
Smoker	Healthy Yrs.	6.79	5.25	3.80
	Needs AL	2.97	2.39	1.73
	Needs SN	1.64	1.47	1.28
	Total LE	11.40	9.11	6.81

TABLE 6.2

Health Expectancy Examples				
	Females			
Ailments		**Age 75**	**Age 80**	**Age 85**
None	Healthy Yrs.	10.55	7.97	5.59
	Needs AL	2.80	2.24	1.66
	Needs SN	2.89	2.40	1.87
	Total LE	16.24	12.61	9.12
Arthritis	Healthy Yrs.	9.70	7.30	5.14
	Needs AL	2.95	2.34	1.71
	Needs SN	3.03	2.49	1.91
	Total LE	15.68	12.13	8.76
Breast cancer	Healthy Yrs.	9.30	7.02	4.91
	Needs AL	3.02	2.39	1.74
	Needs SN	3.09	2.53	1.93
	Total LE	15.41	11.94	8.58
Treated hypertension	Healthy Yrs.	8.22	6.21	4.34
	Needs AL	3.22	2.51	1.80
	Needs SN	3.26	2.64	1.98
	Total LE	14.70	11.36	8.12
Osteoporosis without	Healthy Yrs.	8.16	6.16	4.30
fractures	Needs AL	3.23	2.52	1.81
	Needs SN	3.27	2.65	1.99
	Total LE	14.66	11.33	8.10
Heart disease	Healthy Yrs.	6.75	5.11	3.54
	Needs AL	3.50	2.69	1.90
	Needs SN	3.51	2.80	2.06
	Total LE	13.76	10.60	7.50
Diabetes	Healthy Yrs.	6.28	4.72	3.30
	Needs AL	3.59	2.76	1.92
	Needs SN	3.59	2.86	2.08
	Total LE	13.46	10.34	7.30
Osteoporosis without	Healthy Yrs.	4.59	3.47	2.44
fractures & diabetes	Needs AL	3.92	2.97	2.03
	Needs SN	3.88	3.05	2.17
	Total LE	12.39	9.49	6.64
Smoker	Healthy Yrs.	6.40	4.89	3.58
	Needs AL	2.69	2.14	1.63
	Needs SN	3.63	3.05	2.46
	Total LE	12.72	10.08	7.67

TABLE 6.3

Health Expectancy Examples Ages 90+

Nonsmoker with No Ailments

Age		MALES	FEMALES
90	Healthy Yrs	3.64	3.62
	Needs AL	0.79	1.12
	Needs SN	1.15	1.36
	Total LE	5.58	6.10
95	Healthy Yrs	2.50	2.42
	Needs AL	0.46	0.75
	Needs SN	1.01	1.05
	Total LE	3.97	4.22

TABLE 6.4

			Non-Smoker Examples Compared==No Ailments							
		2002 BLT Ultimate vs. 2007 BLT Preferred Class I Select & Ultimate								
Males	**7**	**5**	**8**	**0**	**8**	**5**	**9**	**0**	**9**	**5**
	02 BLT	**07 BLT**	**02 BLT**	**07 BLT**	**02 BLT**	**07 BLT**	**02 BLT**	**07 BLT**	**02 BLT**	**07 BLT**
Healthy Yrs.	10.52	14.30	7.93	10.98	5.59	8.02	3.64	5.19	2.50	3.59
Needs AL	2.72	3.89	2.11	3.28	1.45	2.62	0.79	1.86	0.46	1.31
Needs SN	1.60	1.88	1.43	1.67	1.28	1.45	1.15	1.18	1.01	1.05
Total LE	14.84	20.07	11.47	15.93	8.32	12.09	5.58	8.23	3.97	5.95
Females	**7**	**5**	**8**	**0**	**8**	**5**	**9**	**0**	**9**	**5**
	02 BLT	**07 BLT**	**02 BLT**	**07 BLT**	**02 BLT**	**07 BLT**	**02 BLT**	**07 BLT**	**02 BLT**	**07 BLT**
Healthy Yrs.	10.55	13.83	7.97	10.74	5.59	7.89	3.62	5.24	2.42	3.52
Needs AL	2.80	4.77	2.24	3.16	1.66	2.52	1.12	1.80	0.75	1.29
Needs SN	2.89	3.00	2.40	3.45	1.87	2.87	1.36	2.20	1.05	1.70
Total LE	16.24	21.60	12.61	17.35	9.12	13.28	6.10	9.24	4.22	6.51

TABLE 6.5

			Health Expectancy in 2007 compared to 1967							
				Standard Risks, No Ailments						
Males	**7**	**5**	**8**	**0**	**8**	**5**	**9**	**0**	**9**	**5**
	2007	**1967**	**2007**	**1967**	**2007**	**1967**	**2007**	**1967**	**2007**	**1967**
Healthy Yrs.	10.52	6.27	7.93	4.64	5.59	3.39	3.64	2.53	2.50	1.88
Needs AL	2.72	0.93	2.11	0.56	1.45	0.29	0.79	0.16	0.46	0.07
Needs SN	1.60	1.45	1.43	1.33	1.28	1.20	1.15	1.06	1.01	0.92
Total LE	14.84	8.65	11.47	6.53	8.32	4.88	5.58	3.76	3.97	2.87
Females	**7**	**5**	**8**	**0**	**8**	**5**	**9**	**0**	**9**	**5**
	2007	**1967**	**2007**	**1967**	**2007**	**1967**	**2007**	**1967**	**2007**	**1967**
Healthy Yrs.	10.55	7.11	7.97	5.20	5.59	3.69	3.62	2.55	2.42	1.92
Needs AL	2.80	1.69	2.24	1.25	1.66	0.85	1.12	0.46	0.75	0.33
Needs SN	2.89	1.85	2.40	1.52	1.87	1.27	1.36	1.11	1.05	0.96
Total LE	16.24	10.65	12.61	7.97	9.12	5.80	6.10	4.13	4.22	3.21
Notes: 1. 2007 based on 2002 Bragg Life Tables Ultimate										
2. 1967 based on 1965-1970 Basic Tables Ultimate										

7. Probabilities of Being Healthy in the Future

The authors are including a very interesting table showing the probability of being healthy in the future—meaning alive and not needing assisted living or skilled nursing care. This shows that for a person age 95 the probability of remaining alive and healthy at age 100 is 17.48 percent for males and 17.33 percent for females.

TABLE 7.1

Probabilities of Being Healthy in the Future
Standard Nonsmokers

			MALES		
End of Yr	Age 75	Age 80	Age 85	Age 90	Age 95
1	73.7%	70.5%	66.2%	58.4%	49.6%
2	71.6%	67.5%	62.0%	50.6%	39.3%
3	69.4%	64.4%	57.4%	43.1%	30.5%
4	67.1%	61.3%	52.4%	36.0%	23.3%
5	64.7%	58.1%	47.1%	29.6%	17.5%
6	62.2%	54.8%	41.6%	23.8%	12.9%
7	59.6%	51.3%	36.1%	18.8%	9.3%
8	56.9%	47.5%	30.7%	14.6%	6.5%
9	54.1%	43.4%	25.7%	11.2%	4.4%
10	51.3%	39.0%	21.1%	8.4%	2.8%
11	48.4%	34.4%	17.0%	6.2%	1.7%
12	45.3%	29.9%	13.4%	4.4%	1.0%
13	41.9%	25.4%	10.4%	3.1%	0.5%
14	38.3%	21.2%	8.0%	2.1%	0.3%
15	34.4%	17.4%	6.0%	1.4%	0.1%
16	30.4%	14.0%	4.4%	0.8%	0.1%
17	26.4%	11.1%	3.2%	0.5%	0.0%
18	22.4%	8.6%	2.2%	0.3%	0.0%
19	18.7%	6.6%	1.5%	0.1%	0.0%
20	15.4%	4.9%	1.0%	0.1%	
21	12.4%	3.6%	0.6%	0.0%	
22	9.8%	2.6%	0.3%	0.0%	
23	7.6%	1.8%	0.2%	0.0%	
24	5.8%	1.2%	0.1%		
25	4.4%	0.8%	0.0%		
26	3.2%	0.5%	0.0%		
27	2.3%	0.3%	0.0%		
28	1.6%	0.2%	0.0%		
29	1.1%	0.1%			
30	0.7%	0.0%			
31	0.4%	0.0%			
32	0.2%	0.0%			
33	0.1%	0.0%			
34	0.1%				
35	0.0%				
36	0.0%				
37	0.0%				
38	0.0%				

TABLE 7.2

Probabilities of Being Healthy in the Future
Standard Nonsmokers

	FEMALES				
End of Yr	Age 75	Age 80	Age 85	Age 90	Age 95
1	68.7%	65.7%	61.5%	54.4%	45.9%
2	67.0%	63.5%	58.2%	48.0%	37.0%
3	65.3%	61.1%	54.5%	41.7%	29.3%
4	63.5%	58.6%	50.5%	35.6%	22.7%
5	61.7%	56.1%	46.1%	29.8%	17.3%
6	59.7%	53.4%	41.5%	24.5%	12.9%
7	57.7%	50.5%	36.6%	19.8%	9.4%
8	55.5%	47.4%	31.8%	15.6%	6.7%
9	53.3%	43.9%	27.1%	12.1%	4.5%
10	51.0%	40.1%	22.7%	9.3%	2.9%
11	48.6%	36.0%	18.7%	6.9%	1.8%
12	45.9%	31.8%	15.1%	5.0%	1.0%
13	43.1%	27.6%	11.9%	3.6%	0.5%
14	39.9%	23.6%	9.2%	2.4%	0.3%
15	36.4%	19.7%	7.1%	1.5%	0.1%
16	32.8%	16.2%	5.3%	0.9%	0.1%
17	28.9%	13.1%	3.8%	0.5%	0.0%
18	25.1%	10.4%	2.7%	0.3%	0.0%
19	21.4%	8.0%	1.8%	0.1%	0.0%
20	18.0%	6.1%	1.2%	0.1%	
21	14.8%	4.6%	0.7%	0.0%	
22	11.9%	3.3%	0.4%	0.0%	
23	9.4%	2.4%	0.2%	0.0%	
24	7.3%	1.6%	0.1%		
25	5.6%	1.0%	0.0%		
26	4.2%	0.6%	0.0%		
27	3.0%	0.4%	0.0%		
28	2.1%	0.2%	0.0%		
29	1.5%	0.1%			
30	0.9%	0.0%			
31	0.6%	0.0%			
32	0.3%	0.0%			
33	0.2%	0.0%			
34	0.1%				
35	0.0%				
36	0.0%				
37	0.0%				
38	0.0%				

8. HALYs, DALYs & QALYs

There have been others interested in relating morbidity to mortality who have done different research into the connection. Organizations such as the World Health Organization have used such research to develop alternative approaches to more gross measures.
For example, health-adjusted life years (HALYs) are population health measures which allow morbidity and mortality to be described together with a single number. They are used for estimating the burden of disease, comparing the relative impact of specific illnesses and conditions in communities, and in economic analyses. Quality-adjusted life years (QALYs) and disability-adjusted life years (DALYs) are types of HALYs, but they were devised for different purposes.

The health-related component of HALYs is referred to as health-related quality of life (HRQL) and uses a scale of 0 to 1.0, representing the extremes of death and full health. The HRQL associated with different levels of health and disease is multiplied by life expectancy. This is used to produce associated DALYs or QALYs.

Healthy life expectancy, sometimes called health-adjusted life expectancy (HALE), is an indicator that extends measures of life expectancy to the distribution of health states in the population. HALE does not take a specific disease or health impairment into account, but provides a view of the overall morbidity and mortality burden of a population. Summation of prevalent years lived with disability (PYLD) across all causes overestimates the severity of the average population health state because of co-morbidity between conditions. The World Health Organization has estimated healthy expectancy for 192 WHO Member States using information from health interview surveys and from the Global Burden of Disease Study. HALE appears to be primarily used in distinguishing the health of populations in different countries, especially between developed and non-developed countries.

Summary measures of health that combine mortality and morbidity into a single indicator are being estimated using a workbook tool developed in Canada. To date work has been primarily for the Canadian population and different types of cancer. The Population Health

Impact of Disease in Canada research program will continue to model other diseases and expand the PHI workbook system.

The authors have included the above discussion because these approaches are in the same general range as the health expectancy concepts of this paper. However, the methodologies are entirely different. Furthermore, these approaches do not directly involve the concept (as does this paper) of moving through the three health status levels: healthy, needs assisted living and needs skilled care.

HALYs appear to be derived by multiplying a standard life expectancy by Health Related Quality of Life (HRQL).

Attempting to correlate the two approaches, the authors point out that HRQL could be approximated by dividing this paper's life expectancy for cases with ailments by life expectancy with no ailments. Some examples are as follows:

TABLE 8.1

Estimated Health Related Quality of Life Ratios

	Life Expectancy (No ailments) (A)	Life Expectancy (With ailment) (B)	Estimated HRQL = (B)/(A)
Male, aged 85			
Prostate Disorder	8.32	8.03	.97
Heart Disease	8.32	6.70	.81
Female, aged 85			
Diabetes	9.12	7.30	.80
Heart Disease	9.12	7.50	.82

9. Data at Ages 90 & Over

Inasmuch as this symposium is about living to age 100, the authors are including actual mortality data on Ordinary Life policyholders who reached ages 90 or over in the period 1989-2003. The number of policy years exposed was 56,152; 640 of those were at ages 100 or over.

TABLE 9.1

Mortality Rates at Age 90 and Over (1000q)

(Exposure Years 1989-2003—Ordinary Life Policyholders)

The total number of deaths involved in this table is 8,368. Every cell is based on at least 35 deaths, except the 3 cells shown in parentheses.

	MALE	FEMALE	COMBINED
90	137	103	126
91	145	115	136
92	148	95	131
93	168	136	157
94	230	193	218
95	205	267	223
96	190	215	199
97	257	239	249
98	179	(98)	159
99	272	190	241
100	197	(153)	192
101-105	145	(0)	140

Source: Data Base of Bragg Associates, Atlanta

10. Comments Re: Data at Ages 90 and Over

The following information is subsidiary to the health expectancy topic, but is of great interest.

The authors are providing (in Table 9-1) actual insured life mortality data for attained ages 90 and up. These data, which cover exposed years 1989-2003, were submitted to the Bragg Associates data base by life insurance companies in the United States. The data are by amounts of insurance, but the number of death claims has been estimated; total death claims are estimated at 8,368; this means that the sample is very credible.

Such data are rarely available, and are very interesting and instructive.

The authors are showing crude 1000q for each attained age. The data are shown for male, female and combined.

The authors present the following comments:

(1) At age 90, mortality is lower for females than males (as expected). By age 96, however, the two mortalities appear to have become similar.

(2) 96 also appears to be the peak age for mortality—at around 224 per 1000 if the results at 95, 96 and 97 are averaged. Thereafter, mortality seems to stay level, until age 101. After that, mortality seems to decline, but the data are very sparse.

(3) The mortality rate at ages 101–105 is a surprisingly low 140. Data are sparse, but there are 49 deaths, meaning that this result is "credible."

(4) Even at the peak age (96), 776 per thousand are survivors; this corroborates the main thrust of this paper: survival comes from staying in the healthy group.

(5) At age 105, the data show exposure of 11, three of whom die. An exposure of eight reached age 106, but were then lost to the study, presumably because of non-reporting.

(6) The experience 1000qs shown in this study (for age 90 and up) are generally far lower then those found in publicly available "basic" <u>life insurance</u> tables. The actual to expected ratios to the <u>Annuity</u> 2000 Basic Tables are 108.8 percent male, 94.3 percent female, and 104.4 percent overall. (The mean exposure point for the data is 1996.)

11. Comments about Healthy and Unhealthy Groups

- Males are far more likely than females to be in the less severe "assisted living but not skilled care" category (and vice versa for the skilled category).
- Females are always more likely than males to be in the unhealthy groups.
- Unhealthy population ratios are a lot higher for smokers than for nonsmokers.
- The healthy "immortal group" declines by age, but is still remarkably high at age 95 (62 percent for nonsmoker males and 56 percent for nonsmoker females).
- The "skilled care" group increases uniformly by age.
- The "assisted living but not skilled care" group increases by age until age 85 (male) and 95 (female). Thereafter it declines, presumably because skilled care becomes needed.

12. Uses of Health Expectancy for the Elderly

The health expectancy tool is proving to be valuable in the elderly environment. Some instances:

(1) The results are really always surprising and optimistic. The senior learns about himself/herself. The senior is encouraged to take charge of his/her destiny.

(2) Decisions can be reached about housing, etc.

(3) Is the senior healthy enough to drive?

(4) Is the senior healthy enough to continue to work at a beneficial level?

(5) Have the ultimate "assisted living" and "skilled care" periods been adequately addressed?

(6) Alternate calculations showing effects of (a) losing weight, (b) quitting smoking, (c) medical treatments, (d) improving socio-economic conditions, etc.

Health expectancy appears to be a valuable potential resource for doctors and other health care professionals in providing useful information to patients. Ideas are very welcome! How to bring this about is a subject for future study.

13. Surviving to 100

There have been tremendous improvements in mortality in the 70s and 80s, resulting in far more people reaching age 90.

This section focuses on the 90s, with effort to see the "survival to 100" probabilities. The authors believe that these probabilities are very reassuring!

TABLE 13.1

Probability of Survival to 100

	Alive (Based on 02 BLT)	Alive and Healthy (by Health Expectancy Methodology)
Males from Age		
90	14.83%	8.39%
95	30.90%	17.48%
Females from Age		
90	18.34%	9.25%
95	34.39%	17.33%

14. Staying in the Immortal Group

The authors informally use the term "immortal group" to describe those who succeed in staying in the healthy group. There are incidence rates for moving out of this group into the unhealthy group and (very importantly) there are recovery rates from the unhealthy group back into the healthy group. Recovery is very common. Even at age 95, the immortal group is estimated at 62 percent of the population for nonsmoking males, and 56 percent for nonsmoking females. (This means "does not need assisted living.")

Table 14.1 concerns "Survival after 90." The Annual Survival Rates are derived from Table 9.1. The percentages not needing assisted living are derived from the health expectancy procedures used for this study.

Staying in the immortal group involves all of the wellness activities we are familiar with, such as weight control, nonsmoking, and attention to medical advice. It also involves the psychological aspects of being in charge of one's own destiny.

The provision of health expectancy runs to seniors, based on the ailments which they have, has proved very beneficial. Generally speaking, a lengthy healthy period is predicted, even where typical ailments exist. Despondency is overcome; the senior now sees a way to be in charge of his or her own destiny.

The authors sincerely hope that the provision and proper use of the health expectancy tool will significantly increase survival probabilities for seniors.

TABLE 14.1

Survival after 90

Age	Annual Survival Rate	Does Not Need Assisted Living	
	Male and Female Combined	Male	Female
90	87%	66%	61%
91	87	65	60
92	86	64	59
93	83	64	58
94	80	63	57
95	79	62	56
96	78	61	55
97	80	60	54
98	78	59	53
99	80	58	52
100	79	57	51
101+	86	54	48
Source: Bragg Associates, Atlanta			

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