



APPLICATION OF A SIMPLIFIED TECHNIQUE OF LIFE EXPECTANCY CALCULATION IN PATIENTS WITH STOMACH AND DUODENUM ULCER

M.A. Mardiyan*, G.M. Mirijanyan., G.H. Sakanyan

Department of Public Health, Yerevan State Medical University after M. Heratsi, Yerevan, Armenia

Abstract

Special methods of data processing were suggested by authors for evaluation of treatment outcomes in patients with stomach and duodenum ulcer. Annual indices of treatment effectiveness, particularly in case of small sample sizes, cannot be considered as reliable source. That is why for drawing statistically significant conclusions the authors suggest to accumulate information during several years. In order to avoid undesirable consequences related to underestimation of lifetime years, the special methodic approach was used: calculation of treatment effectiveness in patients with stomach and duodenum ulcer based on life tables.

It was revealed that provision of patients suffering from stomach and duodenum ulcer with effective inpatient care is conditioned not only by economical aspects but also by the effectiveness and quality of provided medical care. Results of conducted comparative analysis show at each patient referral to secondary health care facilities should be at the most expedient for the recovery of patient's health.

For practical calculations it was recommended to distinguish four courses of stomach and duodenum ulcer: noncomplicated course ($Q_1=0.4$); course with persistent noncicatrizated ulcer ($Q_2=0.21$); course with frequent recurrences ($Q_3=0.21$); complicated course with ulcer bleeding, perforation or penetration ($Q_4=0.18$). Based on comparative analysis of different methods for assessment of treatment effectiveness the authors demonstrated obvious advantages of such integral criterion of population health status as life expectancy. The detailed analysis of the mentioned problem indicated a necessity to determine main causes of life expectancy increase or decrease and to investigate the degree of their influence on this indicator. The dynamic analysis of life expectancy in patients with certain diseases allows to assess the effectiveness of measures used for their control. For the same purpose, the life expectancy decrease caused by stomach and duodenum ulcer was calculated which in its turn allowed to calculate the increase of life expectancy in case of complete eradication of deaths caused by mentioned diseases. Earlier the mentioned techniques have not been widely used in practice for detailed and comprehensive analysis of population mortality. These calculations are made until that age interval (R_x), within which 50% of population taken as a basis for calculation of age-specific mortality rates dies. In other words, central variant-oriented expected life expectancy for patients with N-pathology is determined using the simplified technique.

It was shown that life expectancy of a patient with stomach and duodenum ulcer is 58.3 years. The indicator of life expectancy decrease shows what would be the increase of life expectancy in the entire population in case of complete eradication of mortality from a specific cause. Thus, the life expectancy decrease is equal to $l'o - l'o = 76.8 - 71.2 = 5.6$ years.

While comparing obtained indices, the direct association between cause-specific mortality rates and life expectancy shortening caused by the same pathology attracts attention. The higher is the number of deaths from a specific pathology irrespective of the age of those dead, the higher will be the shortening of life expectancy from this pathology and the mortality rate.

The obtained results allowed authors to develop organizational activities directed to the improvement of medical care quality of patients with stomach and duodenum ulcer.

Keywords: main criteria of effectiveness evaluation; treatment efficacy; diseases course variant; average life expectancy; patients with stomach and duodenum ulcer.

Address for correspondence:

Department of Public Health,
Yerevan State Medical University after M. Heratsi
2 Koryun Street, Yerevan 0025, Armenia
Tel: (+37410)284144; (+37493) 103632; (+37491) 905757
E-mail: mmarina87@mail.ru, dokga@mail.ru

Introduction

Health care reorganization and implementation of new methods of management require detailed and thorough evaluation of the outcomes of medical clinics and medical personnel activities [Antonivich V., 1987; Kolarski V. et al., 1991; Lee C. et al., 1993; Cheli R. et al., 1994].

Positive changes in population health status should be considered as the main evaluation criteria of the effectiveness of different ways and methods of medical personnel activities [Aruin L. et al., 1993; Goncharik I., 1994; Belousova Y., 2002; Belousov A. et al., 2002].

The diversity of factors influencing population health status and presence of a great number of indicators, which characterize different aspects of population health status demand to seek for methods of their integral assessment [Andersen L. et al., 1991; Cheli R. et al., 1994; Kalchenko Y., 1999].

Special methods of data processing are recommended for the assessment of certain results of chronic diseases treatment. However, annual indicators of treatment effectiveness, particularly in cases of small sample sizes, cannot be considered as sufficiently reliable. That is why there is a necessity for accumulation of data on specific results of treatment during several years.

A special technical approach, such as calculation of measure of treatment effectiveness based on life tables might be used in order to avoid undesirable consequences related to underestimation of life years.

The interest in the problem of providing gastroenterological patients with secondary health care is determined not only by economic aspects but also by the necessity of further improvement of medical care quality and its effectiveness. Each patient referral to secondary health care and his hospital stay should be at the most expedient for the recovery of patient's health.

Unfortunately, statistical data, which are used, for example, data on management of effective use of hospital beds do not give the opportunity to make conclusion about the quality of patient care (e.g. appropriateness of diagnostic and treatment procedures, treatment outcomes).

Cardinal changes occurring recently in health care financing area have shifted accents in approaches to general and social assessment of different clinical measures. The economic efficiency should be mentioned amongst key criteria, which are used currently for assessment. The main component of economic efficiency is reduction of costs and possible losses. In this context, the prognostic analysis is not an exception.

For practical calculations it is quite enough to distinguish four courses of stomach and duodenum ulcer with the following empirically calculated probability levels:

- Noncomplicated course ($Q_1=0.4$);
- Course with persistent noncicatized ulcer ($Q_2=0.21$);
- Course with frequent recurrences ($Q_3=0.21$);
- Complicated course with ulcer bleeding, perforation or penetration ($Q_4=0.18$).

Algorithm 1.

Course of the disease	Number of lost working days in a year (LD)		Average duration of 1 case treatment (HS)	
	Control	Prognosis	Control	Prognosis
Noncomplicated course	38.09	46.01	18.89	31.4
Course with persistent noncicatized ulcer	61.52	129.92	47.59	79.15
Course with frequent recurrences	60.92	84.16	34.4	51.8
Complicated course	53.79	49.34	59.61	51.51

Table 1.
Input data for calculation of antiulcer treatment effectiveness in patients with different types of stomach ulcer prognosis

Indicators	Noncomplicated course		Course with persistent noncicatrized ulcer		Course with frequent recurrences		Complicated course	
	Prognosis	Control	Prognosis	Control	Prognosis	Control	Prognosis	Control
Average duration of hospital stay	17.3 ± 1.3	27.7 ± 1.5	43.7 ± 3.1	54.7 ± 4.8	26.2 ± 2.0	25.9 ± 2.7	42.4 ± 3.4	28.1 ± 3.6
Average duration of temporary disability (DI)	34.2 ± 2.7	39.5 ± 2.2	61.4 ± 4.4	96.5 ± 7.8	44.6 ± 2.9	37.0 ± 2.9	56.6 ± 3.2	38.5 ± 4.1
Mean of the days of temporary disability in a year (SD)	18.3 ± 2.0	24.5 ± 2.9	24.8 ± 3.9	104.3 ± 8.2	36.3 ± 3.2	83.7 ± 7.4	17.9 ± 3.1	50.5 ± 4.8
Percentage of patients with ulcer recurrence during one year after the treatment (R, %)	9.0	13.4	8.9	44.7	31.3	100.0	40.6	83.3
Average duration of hospital stay	-	-	-	7.9	-	3.4	3.1	22.2

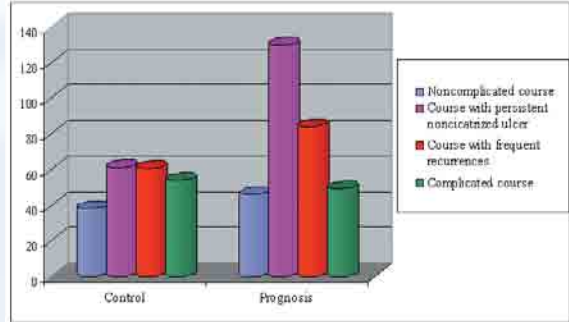


Figure 1. Influence of stomach and duodenum ulcer disease course on the number of lost working days in a year (LD).

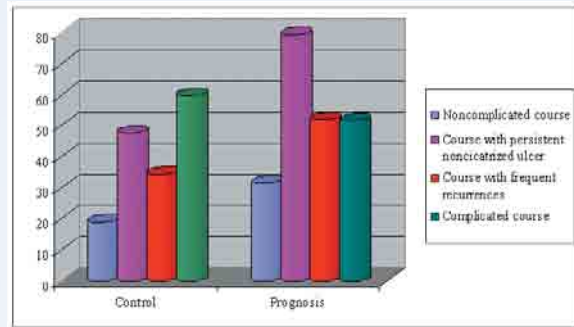


Figure 2. Influence of stomach and duodenum ulcer disease course on average duration of 1 treatment case (HS).

Inasmuch as all these variants in aggregate include all possible events, the sum of their probabilities will be equal to 1 (Figures 1 and 2):

$$\sum Q_i = 1.0 \quad (i=1,2,3,4)$$

In each of the above mentioned variants of stomach ulcer course the economic losses (L) include society costs and losses due to payment for sick-lists (K), outpatient (A) and inpatient care (H), expenditures on persons with permanent disability (D), as well as losses caused by the reduction of the volume of the gross national product (G).

The latter are expressed in the shortage of that part of national income, which could be obtained from this category of citizens in case of effective use of their labor (Table 1).

The following formula might be used for calculation of economic losses from each variant of stomach ulcer course:

$$LP_i = K_i + A_i + H_i + D_i + G_i \quad (i=1,2...4)$$

However, life expectancy is the major integral

criterion used for evaluation of population health status.

The increase of life expectancy is caused by two main factors:

- Decrease of mortality rate from different causes in separate age and sex groups, mainly at child and workable ages;
- Shift of deaths cases to ages that are more senile.

The detailed analysis of this problem brings forth the necessity to emphasize the main causes of life expectancy increase or decrease and to study the degree of their influence on this indicator. The study of life expectancy of patients with different diseases in dynamics allows to evaluate the effectiveness of measures used for their control [Andersen L. et al., 1991; Goncharik I., 1994; Mayeva I. et al., 2003].

For the same purpose the life expectancy decrease by certain diseases might be calculated which in its turn will allow to calculate the increase of life expectancy in case of complete eradication of deaths from this or that disease. The mentioned criterion, while considering its dynamics, can make easier the integral study of economic efficiency and the medical personnel contribution to decrease of mortality rate from a specific pathology.

The mentioned techniques have not been widely used yet by health authorities and medical facilities for detailed and comprehensive analysis of population mortality, because the classical technique of life expectancy calculation is very time consuming due to mathematical converting. Usually all these criteria are used in scientific research and are not frequently reported in publications.

In view of the above mentioned the application of a simplified technique of life expectancy calculation, which does not require difficult mathematical calculations and is understandable for health authorities and medical facilities, is of great interest.

Therefore, the attempt was made to use simplified technique for the calculation of life expectancy in patients with stomach and duode-

num ulcer (Algorithm 2).

In the second column age-and-cause-specific mortality rates per 1000 population in the corresponding age groups are given, they are denoted as S_R . Data in the third column present the number of age groups, which are included in the corresponding age interval (h). The first 5 age groups were taken with the annual interval, whereas the rest ones presented the five-year interval.

The fourth column includes values of products of S_R , h and special coefficient (F). F is determined irrespective of cause of death and is calculated as the ratio of the population crude and cause-specific mortality rates (deaths from digestive system diseases).

In the given example F is calculated as:

$$F = \frac{844.5}{48.5} = 17.4$$

where 844.5 is the crude mortality rate and 48.5 – the cause-specific mortality rate per 100.000 population.

After the calculation of a special coefficient, F, products $S_R \cdot h \cdot F$ might be calculated for each age group (Figure 3).

The fifth column includes cumulative values of $S_R \cdot h \cdot F$ products, which are calculated by summing-up the product for the specified age group and all previous ones, for example:

$$1.757 + 1.6008 = 3.358;$$

$$3.358 + 1.7226 = 5.081.$$

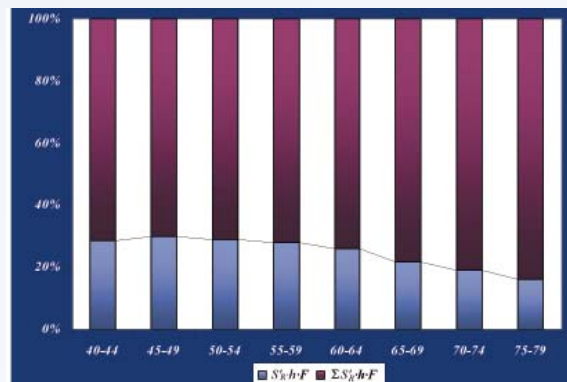


Figure 3. Age influence on life expectancy of patients with stomach and duodenum ulcer.

These calculations are made till that age group (Rx), during which 50% of population taken as a basis for the calculation of age-specific mortality rates, dies. Since all rates were calculated per

1000 population, the age group in which the number of deceased becomes equal to 500 is determined. In this example, the interval includes people of the age group from 50 to 54 years old. The generalization according to the below given formula allows to determine the certain age, at which one-half of population taken as a basis died. In other words, central variant-oriented anticipated life expectancy for patients with N-pathology is determined using a simplified technique:

Algorithm 2.
Life expectancy calculation technique in patients with stomach and duodenum ulcer

Age group (R)	S _R	h	S _R ·h·F	∑S _R ·h·F
1	2	3	4	5
under 1	0.101	1	1.757	1.757
1	0.092	1	1.6008	3.358
2	0.099	1	1.7226	5.081
3	0.096	1	1.6704	6.75
4	0.130	1	2.262	9.01
5-9	0.08	5	6.96	15.97
10-14	0.069	5	6.003	21.97
15-19	0.084	5	7.308	29.28
20-24	0.092	5	8.04	37.29
25-29	0.144	5	12.524	49.82
30-34	0.250	5	21.75	71.57
35-39	0.487	5	42.369	113.94
40-44	0.882	5	76.734	190.67
45-49	1.622	5	141.114	331.78
50-54	2.647	5	230.289	562.07
55-59	4.103	5	356.961	919.03
60-64	5.791	5	503.817	1422.85
65-69	6.356	5	552.972	1975.8
70-74	6.914	5	601.518	2577.34
75-79	7.030	5	611.61	3188.95
80 and older	5.236	20	—	—
Total	3.212.227			

$$l'o_N = R_x + \frac{50\% - \sum(S_R \cdot h \cdot F)}{1422.85 - 562.07} = 58.3$$

or:

$$L'o_N = 60 + \frac{500 - 562.07 \times 5}{1422.85 - 562.07} = 58.3$$

Thus, life expectancy of a patient with stomach and duodenum ulcer is 58.3 years. The indicator of life expectancy shortening shows what would be the increase of life expectancy of the whole population in case of complete eradication of mortality from a specific cause.

The same simplified calculation technique and the same main parameters and their symbols were used for calculation of this indicator (Algorithm 3).

The value S_R – is a mortality rate irrespective of causes minus pathology-specific mortality rate in each age group (per 1000 population).

For example, in age group under 1 year it will be: 1.8-0.1=1.7%; at the age from 50 to 54 years old: 9.3-2.6=6.7%, etc.

l'o – is the population life expectancy in case of complete eradication of mortality from a specific pathology.

According to the above given formula and from the calculations in Algorithm 3, l'o will be equal to:

$$l'o = 69 + \frac{500 - 282.6 \times 5}{421.3 - 282.6} = 76.8$$

The difference between the crude life expectancy (l'o) and l'o is a life expectancy shortening caused by mortality from a specific pathology.

The value of l'_0 in Armenia in 2004 was 71.2 years. So, the life expectancy shortening is equal to $l'_0 - l_0 = 76.8 - 71.2 = 5.6$ years.

Due to the above-mentioned techniques, indices of life expectancy (l'_{0N}) for patients with a specific pathology and life expectancy decrease in case of the same diseases. While comparing obtained indices, the direct association between the cause-specific mortality rate and life expectancy decrease caused by the same pathology attracts attention, because both parameters are directly associated with the total number of deaths. The higher is the number of deaths from a specific pathology irrespective of the age of those dead, the higher will be the decrease of life expectancy from this pathology and the mortality rate.

As regards the life expectancy of patients with a specific disease, it should be mentioned that there is no unambiguous association between this index and mortality rate, because the change of a patient life expectancy depends on decrease or increase of age-specific rates only in children and citizens of workable age. The total number of deaths does not influence index values.

It is not necessarily that in case of mortality rate decrease from N-causes, the life expectancy of a patient with N-pathology always increases, as the reason is that the decrease of mortality rate might be caused by the decrease of mortality among elderly people, and this does not influence the life expectancy (l'_{0N}).

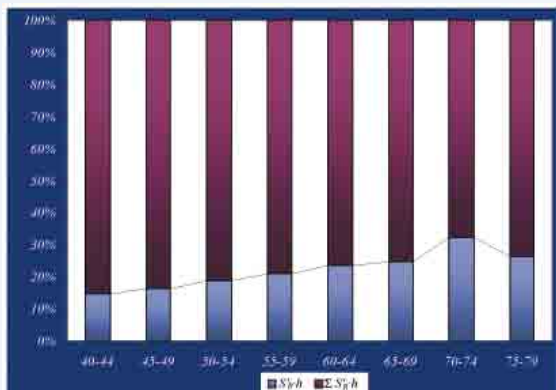


Figure 4. Age influence on patients' life expectancy in case of complete eradication of mortality from a specific pathology.

Algorithm 3.

The technique of life expectancy calculation in case of eradication of a specific pathology

Age group (R)	S'_R	h	$S'_R \cdot h$	$\Sigma S'_R \cdot h$
1	2	3	4	5
under 1	11.7	1	11.7	11.7
1	10.3	1	10.3	22
2	9.4	1	9.4	31.4
3	8.7	1	8.7	40
4	7.2	1	7.2	47.3
5-9	0.12	5	0.6	47.9
10-14	0.23	5	1.16	49.1
15-19	0.52	5	2.58	51.16
20-24	0.71	5	3.54	55.2
25-29	0.76	5	3.78	60.0
30-34	1.15	5	5.75	64.7
35-39	1.71	5	8.57	73.3
40-44	3.02	5	15.1	88.4
45-49	4.28	5	21.39	109.8
50-54	6.65	5	33.27	143.0
55-59	10.4	5	52.0	195
60-64	17.5	5	87.5	282.6
65-69	27.4	5	138.7	421.3
70-74	76.89	5	384.4	805.7
75-79	89.47	5	447.4	1253
80 and older	94.56	20	472.8	1725.9

Thus, above mentioned indices are not equivalent and reflect different aspects of mortality; consequently their application depends on aim of the study and the necessity to reveal the certain patterns in accordance with the indicated objectives.

References

1. Andersen L., Hølek S., Eslborg L., Justesen T. The Helicobacter (Campylobacter) pylori-colonized duodenal mucosa. *Acta Path. Microbiol. Immunol. Scand.* 1991; 99(3): 244-248.
2. Antonivich V. [X-ray diagnosis of oesophagus, stomach and intestines diseases. Guidelines for physicians] [published in Russian] Moscow. Medicina Publishers. 1987. 400p.
3. Aruin L.I., Grigoriev P.Y., Isakov V.A., Yakovenko E. P. Chronic gastritis. Amsterdam. 1993. 362p.
4. Belousov A.S., Vodolagin V.D., Zhakov V.P. [Diagnostics, differential diagnostics and treatment of digestive system diseases] [published in Russian] Moscow. Medicina Publishers 2002. 424p.
5. Belousova Y.A. [Ulcerative colitis and Crohn's disease] [published in Russian] Tver (Russia). Triada Publishers 2002. 128p.
6. Cheli R., Nicolo G., Borero E. Epidemiology and etiology of "autonomous" nonspecific duodenitis. *J. Clin. Gastroenterol.* 1994; 18(3): 200-205.
7. Goncharik I.I. [Stomach and intestines diseases] [published in Russian] Minsk 1994. P. 24-32.
8. Kalchenko Y.I. [Methodological approaches to studies on influence of conditions and lifestyle on health status] [published in Russian] Moscow. Medicina Publishers 1999. 240p.
9. Kolarski V., Tsenova V., Petrova-Shopova K. Helicobacter pylori in chronic erosive gastritis, duodenitis and gastroduodenitis. *Vntr. Boles.* 1991; 30 (2): 72-74.
10. Lee C.M., Changehien C.S., Chen P.C. *et al.* Eosinophilic gastroenteritis: 10 years experience. *Am. J. Gastroenterol.* 1993; 88: 70-74.
11. Mayeva I.V., Kucheryavyi Yu.A. Pirogova A.I., Ovsyannikova Y.V. [Pariet effectiveness in the complex therapy of the chronic pancreatitis exacerbations] [published in Russian] Clinical perspectives of gastroenterology and hepatology. 2003. P. 18-24.