



Determining the Burden of Suicidal Behaviors Using the DALY Approach: A Case Study in Iran (2018-2021)

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Abstract

Background: Suicide is a significant and growing concern in health systems worldwide. It is considered a crucial part of the comprehensive mental health action plan in every country. Kerman, one of the largest provinces of Iran with a relatively high population, has witnessed an increasing trend in this phenomenon, especially during the COVID-19 pandemic.

Methods: This was a cross-sectional study conducted in urban and rural areas of Kerman. Suicide data for 2018–2021 were acquired from the Psychosocial Health and Addiction Prevention Group of the Deputy for Health at Kerman University of Medical Sciences. The burden resulting from suicide during these years was measured using the disability-adjusted life years (DALY) index.

Findings: During these four years, 23701 suicide attempts were recorded in Kerman, with 59% and 41% of the suicide attempts made by men and women, respectively, and 668 (2.82%) attempts leading to death. The highest rate (68%) was observed in the 15–29 age range and the lowest rate (1.1%) was seen in people older than 60. Poisoning (89.3% of the attempts) was the most common suicide method. The suicide burden in Kerman in 2021 was 4417 according to the DALY index, which is 162.6 per 100 000 people; men and women endure 38% and 62% of this burden, respectively. The highest DALY rates were seen in the 15–29 and 30–44 age groups.

Conclusion: The burden resulting from suicide highlights the necessity of taking immediate measures to prevent this behavior, especially among vulnerable groups.

Keywords: Burden of disease, Suicidal behaviors, DALY, Iran

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Introduction

Suicide is a conscious attempt someone makes to end their life and therefore is specific to humans; however, environmental, genetic, anatomical, and neural factors can cause suicide.¹ Systematically, suicide methods differ based on age and gender and suicide rates differ among countries and over time. Suicide has been recognized by the World Health Organization (WHO) as a critical and growing concern related to public health and a part of the comprehensive mental health action plan.² Every year, more than 700 000 people die due to suicide; on average, one in every 20 suicide attempts leads to death.³

Suicide is a tragedy affecting the family and society and has long-term effects on the deceased person's family members. Suicide may occur anytime throughout life. It was the fourth leading cause of death in the 15–29 age group worldwide in 2019.³ In 2012, the death rate due to suicide was 1.8 times higher in men,⁴ while suicide attempts and self-harm were 2–4 times more prevalent in women.⁵ The mean age of suicide ranges from 30 to 49 years worldwide.⁶ According to the WHO, death due

to suicide has increased by 60% over the past 50 years, accounting for 1.4% of premature deaths worldwide.⁷

The suicide rate increased by 60% between 1960 and 2012, and approximately 75% of the deaths occurred in developing countries.^{8,9} In 2016, 26 000 deaths due to suicide were reported in the Middle East and North Africa, which equals 4.8 per 100 000 deaths.¹⁰ Throughout the world, the number of deaths caused by suicide is higher than those caused by Malaria, HIV/AIDS, breast cancer, war, or murder. More than one (1.3%) out of 100 deaths was due to suicide in 2019.¹¹

Reducing the number of deaths due to suicide has been prioritized as a global goal by the WHO and has been included among the sustainable development objectives set out by the United Nations.¹¹ The measures recommended to the WHO members include developing and implementing comprehensive preventive measures at a national level focusing on groups at risk of suicide. Since January 2018, 28 out of the 194 WHO member countries have reported implementing suicide prevention strategies.¹² In Western countries, there is a strong



relationship between mental diseases and suicide¹³; however, this relationship is considerably less significant in Asia.¹⁴

A complex network of risk factors and protective factors at individual, family, and social levels leads to suicide.¹⁵ Considering the focus on preventing suicide at international and national levels, statistical data on death due to suicide based on region, country, age, and gender are necessary for preventive measures. However, since suicide is a social stigma and is illegal in some countries, the reports are not complete and accurate. This leads to changing and inefficient data classification.^{16,17}

The suicide rate in Iran in 2019 was 5.20 per 100 000 people, which showed an 8.77% decrease compared with 2018. Moreover, this rate was 5.70 per 100 000 people in 2018, which showed a 5% decrease compared to 2017.¹⁸

According to the results of this study, Kerman is a region witnessing an increasing rate of suicide, especially during the COVID-19 pandemic.

DALY calculation is one of the useful methods utilized to estimate the burden of disease. This study aimed to use DALY for evaluating the burden of disease and providing useful information for health planning and priority setting. Furthermore, this study aimed to estimate the burden of suicide in Kerman to determine the effects of this issue on society, draw the local and national authorities' attention to this phenomenon, and finally pave the way for proper policy-making and decreasing suicide attempts and suicide mortality.

Methods

This was a cross-sectional study conducted in urban and rural areas of Kerman. Suicide data for 2018–2021 were acquired from the Psychosocial Health and Addiction Prevention Group of the Deputy for Health at Kerman University of Medical Sciences. Moreover, all cases of suicide attempts, those leading to death, and the burden resulting from suicide during these years were measured using the DALY index.

A quantitative index is required to estimate the effects of a disease, which includes the three factors of impact, severity, and duration, based on which the resulting disability and economic consequences for society can be determined. Health authorities have used various indices, such as morbidity and mortality for this purpose. Disability-adjusted life years (DALY) was introduced by Murray and Lopez to estimate the global burden of diseases. Unlike the previous indices in which health-related gaps and inadequacies were the bases of measurement, DALY is based on health expectations and is calculated by measuring the difference between the existing condition and the ideal and desirable health status. In other words, DALY equals the years of life lost (YLL) plus years lived with disability (YLD).¹⁹

DALY includes three important public health

components in determining the health status of society.²⁰ These components are quantity of life based on life expectancy rate and disease duration, quality of life based on disease severity score, and social importance based on the number of people affected by the disease (prevalence).

Accordingly, lost health is when the target population's quality of life deteriorates, which includes years lost and years lived with a disability. Therefore, DALY is estimated based on the following three components:

- The number of people affected by the disease (N)
- An estimation of the mean time of the disease's harmful effects, including lost life expectancy and premature death (D)
- The weighted ratio of the adverse condition severity (W)

YLL was calculated based on the life table and life expectancy for different age and sex groups and the number of deaths due to suicide in these groups using the following formula:

$$YLL = \sum(N \times L)$$

In the primary formula, the calculated values were crude; hence, the formula was changed to the following more realistic one with parameters such as discount rate and age weight:

$$YLL = \sum(NCe^{-(\beta+r)}(e^{-(\beta+r)(L+a)} - 1) - e^{-(\beta+r)a - 1})$$

Where N is the incidence of death, r stands for discount rate with a standard value of 0.03% reported in different studies, C is the correction coefficient for age weight with a standard value of 0.1658, β is a parameter of the age weight function with a standard value of 0.04, a is the age at the beginning of the incident (disease or death), and L stands for disability period or time lost due to premature death.²¹

To measure YLD, non-fatal outcomes of suicide (incident), the mean of the time the individual is affected by each outcome, and the disability weight resulting from each outcome in the age and sex groups of the study were required.²² YLD for each outcome was determined by multiplying these three factors:

$$YLD = \sum(N \times L \times W)$$

If discount rate and age weight are included in the YLD calculation, the formula mentioned above will change into the following, which is the most complete form:

$$YLD = \sum(IDW Ce^{-(\beta+r)}(e^{-(\beta+r)(L+a)} - 1) - (\beta+r)a - 1))$$

As mentioned before, DALY includes years lost due to dying earlier than the life expectancy (premature death) (YLL) and years lived with disability (YLD); in

other words:

$$DALY = YLL + YLD$$

Underreporting or misassigning deaths to suicide are some of the issues in estimating suicide mortality, and the level and type of these wrong assignments vary according to location, age, gender, and time.²²

SPSS 25 and Excel were used to analyze the data. DALY, YLL, YLD, and YLD/YLL ratio values were calculated for the study population based on age and sex groups and background variables.

Results

From 2018 to 2021, 23 701 suicides were registered in Kerman province, 668 (2.82%) of which led to death (Figure 1)

The suicide rate has always been higher in women. From 2018 to 2021, 59% (13 978) of the suicides were attempted by women and 41% (9723) by men. The highest rate, accounting for 68% (16 112) of the suicides, occurred in the 15–29 age group, followed by the 30–44 group with 22.1% (5242). The lowest rate was observed in people over 60 with 1.1% (256). Suicide percentages in each year based on age and gender are presented in Table 1.

The highest number of suicide attempts (46%) were made by single people and the lowest (0.09%) by widows and widowers (Figure 2).

The results also showed 89.3% (21 176) attempted suicide by poisoning, 1.75% (414) by hanging, 1.65% (392) with a knife or razor, 0.36% (85) by self-immolation, 0.08% (18) by falling from heights, 0.12% (28) using firearms, 5.59% (1307) via other methods, and 1.20% (281) used unspecified ways of attempting suicide (Table 2 and Figure 3).

The suicide burden in Kerman province in 2018 was 3411 based on the DALY index (126.6 per 100 000 people). Women and men were affected by 27.6% (940) and 72.4% (2471) of this burden, respectively. The DALY index was

3654 in 2019 (134.5 per 100 000 people) and women and men were affected by 25.9% (946) and 74.1% (2708) of this burden, respectively (Table 3).

In addition, DALY index was 3411 in 2020, and women’s and men’s shares of this burden were 32.1% (1539) and 68.9% (3263), respectively. In 2021, the DALY index was 4417 (162.6 per 100 000 people). In this year, women’s and men’s shares of this burden were 38% (1721) and 62%% (2696), respectively (Table 4, Figure 4).

These two age groups, both in men and women, had

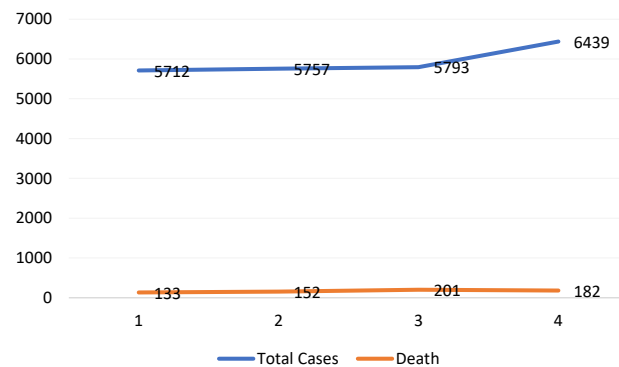


Figure 1. Cases of non-fatal suicide attempts and death in Kerman province.

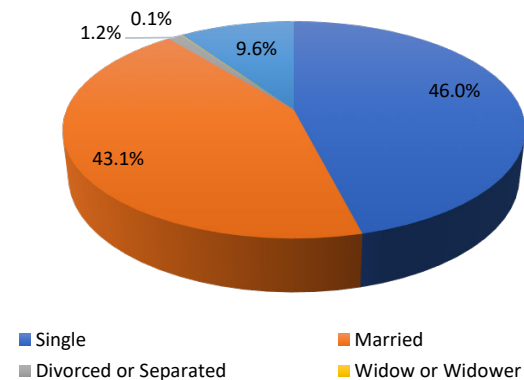


Figure 2. Demographic characteristics for suicide attempt cases.

Table 1. Frequency of suicide and non-fatal attempts according to age and gender

Variable	2018		2019		2020		2021		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Gender										
Male	2295	40.18	2321	40.3	2444	42.19	2663	41.36	9723	41.02
Female	3417	59.82	3436	59.7	3349	57.81	3776	58.64	13978	59.98
Age group (y)										
5–14	239	4.2	258	4.5	381	6.6	361	5.6	1239	5.2
15–29	4011	70.2	3911	67.9	3927	67.8	4263	66.2	16112	68.0
30–44	1218	21.3	1318	22.9	1206	20.8	1500	23.3	5242	22.1
45–59	169	3	204	3.5	226	3.9	253	3.9	852	3.6
60–69	54	0.9	51	0.9	31	0.5	42	0.7	178	0.8
70–79	15	0.3	11	0.2	12	0.2	10	0.2	48	0.2
80+	6	0.1	4	0.1	10	0.2	10	0.2	30	0.1
Total	5712	100	5757	100.0	5793	100.0	6439	100.0	23701	100.0

Table 2. Frequency of suicide methods

Method	2018		2019		2020		2021		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Poisoning	5034	88.13	4972	86.36	5230	90.28	5940	92.25	21176	89.35
Hanging	78	1.37	98	1.70	139	2.40	99	1.54	414	1.75
Knife or Razor	96	1.68	87	1.51	95	1.64	114	1.77	392	1.65
Self-Immolation	22	0.39	13	0.23	24	0.41	26	0.40	85	0.36
Falling from heights	2	0.04	6	0.10	8	0.14	2	0.03	18	0.08
Firearms	4	0.07	7	0.12	12	0.21	5	0.08	28	0.12
Others	388	6.79	507	8.81	204	3.52	208	3.23	1307	5.59
Unspecified	88	1.54	67	1.16	81	1.40	45	0.70	281	1.20
Total	5712	100	5757	100.0	5793	100.0	6439	100.0	23701	100.0

Table 3. DALY index for suicide in 2018 and 2019

	C. DALY=YLL+YLD (2018)						C. DALY=YLL+YLD (2019)					
	Male		Female		Total		Male		Female		Total	
	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000
Age												
5-14	142	51.8	-	-	142	26.5	29	6.10	85	5.32	114	3.21
15-29	1230	392.6	457	149.3	1687	272.4	1569	6.500	637	0.208	2206	0.356
30-44	959	257.4	264	82.8	1222	176.9	858	4.230	117	6.36	975	1.141
45-59	112	58.6	88	46.1	201	52.3	195	0.102	57	8.29	253	9.65
60-69	13	18.1	111	140.8	124	82.0	39	3.53	28	3.35	67	9.43
70-79	6	21.4	15	42.1	21	32.5	10	8.33	11	0.32	22	9.32
80+	8	39.6	5	26.6	13	33.1	8	6.39	10	8.52	18	2.46
Total	2471	177.8	940	70.8	3411	125.6	2708	9.194	946	3.71	3654	5.134

Table 4. DALY index for Suicide in 2020 and 2021

	C. DALY=YLL+YLD (2020)						C. DALY=YLL+YLD (2021)					
	Male		Female		Total		Male		Female		Total	
	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000	DALY	DALY per 100 000
Age												
5-14	142	51.8	171	65.4	313	58.4	28	10.3	113	43.3	142	26.4
15-29	1704	543.9	758	247.7	2462	397.5	1497	477.7	1021	333.7	2518	406.5
30-44	1031	276.8	517	162.3	1548	224.1	906	243.2	436	137.0	1342	194.3
45-59	307	160.4	39	20.4	346	90.3	157	82.1	70	36.4	227	59.2
60-69	57	78.6	40	50.7	97	64.1	90	124.2	68	85.7	158	104.1
70-79	13	42.9	13	36.1	26	39.2	10	33.8	9	24.1	19	28.5
80+	8	39.6	1	6.7	9	23.1	8	39.6	4	20.0	12	29.8
Total	3263	234.9	1539	116.0	4802	176.8	2696	194.1	1721	129.7	4417	162.6

the highest share of DALY index for suicide (Tables 3 and 4). Other age groups' shares of DALY index are also presented in Tables 3 and Table 4.

The total YLL due to premature death resulting from suicidal behaviors was 2451 in Kerman province in 2018 (176.4 years per 100 000 people), 2688 in 2019 (193.5

years per 100 000 people), 3243 in 2020 (233.4 years per 100 000 people), and finally, 2676 in 2021 (192.6 years per 100 000 people). The total YLD was estimated to be 20 years (1.4 years per 100 000 people). The YLD/YLL ratio was 0.008 (Table 5). Table 5 presents the YLL, YLD, and YLD/YLL ratio based on gender from 2018 to 2020 in

Kerman province.

The female-to-male DALY ratio is indicated in Figure 5.

The highest DALY rate was attributed to the 15–29 and 30–44 age groups accounting for 49.5% and 35.8% of the total DALY in 2018, 60.3% and 26.4% of the total DALY in 2019, 51.2% and 32.2% of the total DALY in 2020, and 57% and 30% of the total DALY in 2021, respectively.

Table 5. YLL for males and females

Year	Male		Female	
	YLL	Rate	YLL	Rate
2018	2451	176.4	816	61.4
2019	2688	193.5	915	68.9
2020	3243	233.4	1489	112.1
2021	2676	192.6	1635	123.2
Mean	2765	199.0	1214	91.4

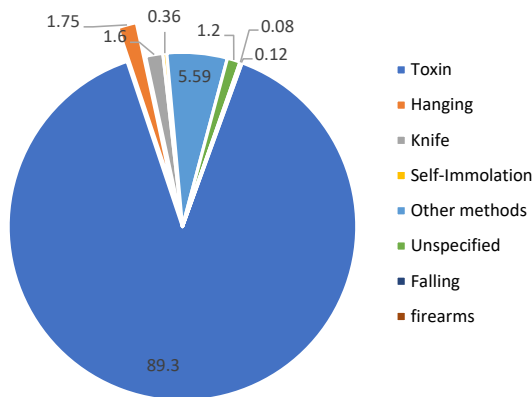


Figure 3. The percentage of different suicide methods.

Discussion

Suicide is one of the prominent preventable causes of death worldwide, leading to the death of thousands of people annually. Suicide is not a disease but can be the outcome of many diseases and social problems. Lives will be lost but suicide can be prevented. In a study, Amini et al assessed the epidemiological status of suicide in the Middle East and North Africa (MENA) from 1990 to 2017. This study aimed to compare the suicide burden in MENA to provide the basis for efficient health policy-making. Suicide showed an increasing trend followed by a decrease in the 20–24 age group. Furthermore, according to the annual suicide report (ASR), the DALY rate of self-harm was 371.91 (337.34–414.96) in Iran in 1990 and 272.5 (236.93–290.01) in 2017, showing a decreasing trend. About 75.5% of suicides were attempted by low and middle-income people. This is in line with the evidence proving the positive relationship between suicide and adverse socioeconomic factors, such as poverty, financial crisis, debt, and unemployment.²¹

In another study conducted by Hassanian-Moghaddam and Zamani, the articles on suicide published in the previous 20 years were analyzed. The findings revealed that the overall trend of mortality due to suicide was increasing in Iran, and the mean rate of suicide was 9.9 per 100000 people. This study suggested that Iran had the highest increase in deaths due to suicide among the Eastern Mediterranean Region (EMR) and Islamic countries, and called for immediate intervention as the preventive policies have not been effective.²²

Another study by Naghavi et al analyzed the global

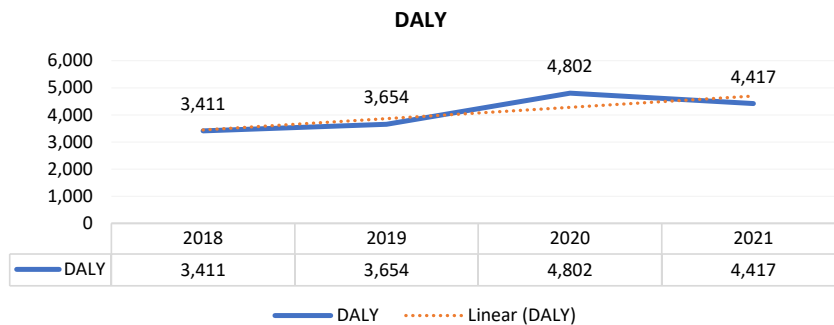


Figure 4. DALY trend for suicide and the resulting behaviors from 2018 to 2021.

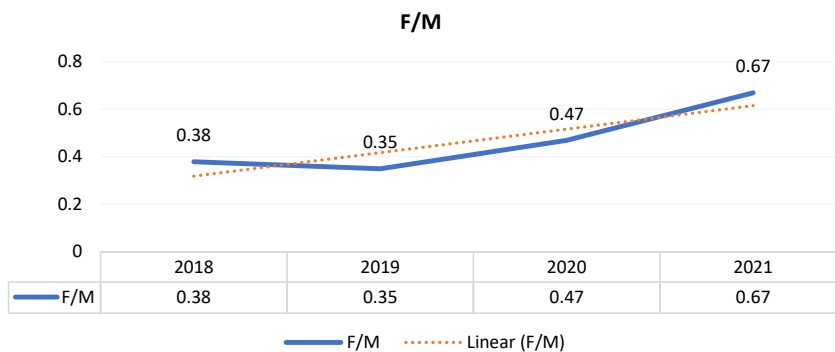


Figure 5. The female-to-male DALY ratio from 2018 to 2021

burden of suicide from 1990 to 2016. The crude and standardized rates of suicide mortality and YLL were compared in regions and countries based on age, gender, and sociodemographic indices (a composite measure of fertility, income, and education). The total number of global deaths due to suicide increased by 6.7% in the 27-year period and reached 817 000 deaths in 2016. The female to male YLL ratio in MENA was 0.4 in this study, which confirms the results of the present study, with a mean value of 0.45 within four years. The age-standardized rates of suicide mortality also decreased dramatically since 1990, which is in line with the results of the present study.²² In another study conducted by Khorshidi et al, the burden of suicidal behaviors was estimated in Ilam province. The total years of life lost due to death and disability resulting from suicide in this province was 4891 years (9.7 per 1000 people). This number is reasonable compared with that of Kerman Province. In their study, the 20–29 and 10–19 age groups had the highest share of DALY, with 41% and 33%, respectively, which is in line with the results of the current study. Moreover, 73% of the total DALY was related to self-immolation, and 80% of this figure was attributed to women. Poisoning had the lowest share of DALY with 2.6% and was mostly attributed to men.²³

A study by Lew et al reported the standardized rate of suicide in Muslim-majority countries between 2000 and 2019. This study analyzed the 20-year trend of suicide in 46 Muslim-majority countries worldwide and compared their suicide rate and trend with the global average. The suicide rate was lower in the Muslim-majority countries compared with the global average, which can reflect the changes in religious practices or implementation of rules in judicial and social structures. This finding requires further in-depth research in specific countries or regions, accompanied by political analysis of the data.²⁴

The live life implementation guide for suicide prevention (WHO, 2021) introduces four effective evidence-based interventions for preventing suicide.²⁵ These include limiting access to the means of suicide, interacting with the media for responsible reporting of suicide, fostering socio-emotional life skills in adolescents, and early identification, assessment, management, and follow-up of anyone affected by suicidal behaviors. The WHO has announced that suicide may be underreported by 20–100%, especially in developing countries. Moreover, it is stated that about 20 to 25% of suicide attempts lead to death.²⁵

In Iran, according to the latest statistics, the suicide rate was 5.20 per 100 000 people in 2019 which was higher than the rate in various countries, including the neighboring countries, such as Iraq (3.6 per 100 000 people) and lower than that of Russia (25 per 100 000 people). Some European countries such as Switzerland (14.5 per 100 000 people), France (13.8 per 100 000 people), and Germany (12.3 per 100 000 people) have a worse situation than Iran.

Finally, Inaccurate statistics on suicide mortality provided by the authorities, such as in forensics reports, may have affected the results.

Conclusion

Suicide is a global health issue affecting all age groups, genders, and regions. Suicide mortality varies in different places based on gender and age group. The suicide burden highlights the necessity of taking prompt action to prevent suicide. With foresight and planning, preventive approaches can be directed to vulnerable populations. It is essential for the health policy-makers, especially in Kerman province, to be aware that national policies for preventing suicide are not effective enough, and there is a need for immediate intervention, especially for high-risk groups. Developing programs for vulnerable people can prevent suicide. Moreover, it is necessary to improve social, cultural, and economic factors and take effective measures to prevent suicide, specifically in low- and middle-income countries, through more studies and accurate registration of suicide cases, especially where it is seen as a social stigma.

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Supervision: Mohsen Barouni.

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Visualization: Zakieh Ostad Ahmadi.

Writing—original draft: Anahita Behzadi.

Writing—review & editing: Zakieh Ostad Ahmadi.

Competing Interests

The authors declare that they have no conflict of interest.

Ethical Approval

This study was approved by the Ethics Committee of Kerman University of Medical Sciences (Ethics No. IR.KMU.KNRC/EC/99-97).

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