

# The Economic Burden of Acute Myeloid Leukemia in Iran

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## Research Article

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# Abstract

## Background

Cancer imposes a significant economic burden on the health system and society. Acute myeloid leukemia (AML) is the third deadliest leukemia and is one of the leading health problems worldwide. The present study aims to estimate the economic burden of AML in Iran for 2020.

## Methods

In this study, we estimated a prevalence-based on the cost-of-illness of the AML in Iran. A societal perspective was considered, in which the direct costs and productivity losses with the adoption of the human capital approach in the AML cases were estimated for 2020. Moreover, in the present study, several resources including national cancer registry reports, hospital records, occupational data, and interviews with experts were cited.

## Result

Approximately 98% of patients with AML received induction therapy. The AML economic burden was \$ 33243107.39. Indirect costs accounted for 60% of this amount, and direct medical costs made up for 19% of this estimated economic burden.

## Conclusion

The economic burden of AML in Iran is very significant and due to the increasing prevalence of this disease, it is expected to increase more gradually. Awareness of the costs associated with this disease provides a great opportunity for policymakers and managers of the health systems to improve resource allocation efficiently.

## Introduction

AML is the most common type of acute leukemia in adults, accounting for 15-20% of leukemias in children, and is the leading cause of death among various types of leukemia worldwide (AML is the third leading cause of leukemia). These characteristics make it one of the most important health problems in the world (62%). According to the US and European registry system, the age-adjusted incidence rate of AML varies from 4.3 to 5.4 per 100,000 person-year [1-3].

AML is more prevalent in the elderly, and reports indicate that the age-adjusted incidence rate for patients'  $\geq 65$  years is 20.1 per 100,000 patients per year, while in younger patients it is 2.0 per 100,000 patients per year. The registry data showed that there was no difference in the prevalence of AML between men and women up to 65 years of age, while in older patients there was a lower prevalence for women (0.03 v vs. 0.06,  $p < .001$ ) [1- 3].

In Iran, AML is the second prevalent type of leukemia, which accounts for 15.66% and 12.24% of total leukemia cases in men and women, respectively [4].

Not only AML affects the patients' health and their quality of life, but also it makes a huge cost on households and health system. Costs are likely to increase due to the increasing number of patients seeking expensive drugs as well as economic challenges. Therefore, it is important for patients and their families to be aware of the costs and economic burden of AML, as well as the health care system and the community [5].

On the other hand, we need to be clearly aware of cancer costs in order to provide the right information to policymakers and insurance companies so that they can determine the appropriate allocation of resources to health systems and decide on payment methods. Thus, evaluating the economic burden of the disease provides worthwhile information for policymakers to devise appropriate health plans for health sectors and manage health research on population, and decide on human and financial resource management. This ultimately improves the capacity of the health care system to advance cost-effective prevention, treatment and rehabilitation policies. [6, 7, 8].

However, despite the importance of the economic burden of this kind of cancer on health policymakers in Iran, there are not enough studies in this field [9-12]. Therefore, this study was conducted with the aim of estimating the costs of AML based on the prevalence of this disease from the societal perspective in Iran for 2020.

## **Materials And Methods**

In estimating the economic burden of diseases, two main methods are used, including "prevalence-based" and "incidence-based". In the incidence-based method, the patient's costs are calculated from the time of diagnosis to a specific time, for example, one year after diagnosis or the final stage of the disease leads to death or recovery. In the prevalence-based approach, the costs of the disease are calculated over a period of time, for example over a one-year period. This procedure is an appropriate method for evaluating the economic burden of disease [13]. In the present study, the economic burden of AML in Iran for 2020 is estimated from a social perspective using the prevalence-based method. Cost analysis included direct medical, non-medical, and indirect costs.

### **Estimating the prevalence of AML in Iran**

The Cancer Registration Program in Iran was established in 2003 and its reports have been published annually. Therefore, these national data were used to calculate the incidence and prevalence of AML in Iran. Then, by modifying the incidence and mortality rates from their underestimating data, we estimate the prevalence of AML in Iran based on registry system data using the annual percentage change (APC) and survival rate in 2019. Finally, the AML survival rate was achieved from published reports [9].

Data were collected from inpatients or outpatients at Shariati Hospital, one of the most prestigious medical, research, and educational centers in Tehran, Iran. This Center is the largest referral center for AML patients in Iran and under the supervision of the Tehran University of Medical Sciences.

Leukemia patients need more outpatient care services due to frequent referrals for treatment and recurrence. This Hospital annually provides medical services for more than 190,000 outpatients, more than 305,000 clinical outpatients, and approximately 19,800 emergency cares and is one of the top 4 stem cell and bone marrow transplant centers in the world.

To extract direct medical costs, patient records, demographic and pathological data (for disease staging) were used. Data on direct non-medical and indirect costs were obtained from telephone interviews with patients or their families. Other information was collected using a standard questionnaire [14, 15]. To access patients' records, the necessary authorization was obtained from the Vice-Chancellor of Research and Technology of Iran University of Medical Sciences. And also, the purpose of the study was explained in a telephone interview and the verbal consent of the interviewees was obtained.

### **Direct medical costs**

Progress in AML treatment has increased recovery rates to 15% and 40% in patients over 60 and under 60, respectively [4, 16]. Therapeutic approaches in AML are different based on patients' risk-stratification like patient's age, blast percentage, cytogenetic and molecular studies. These therapeutic methods include chemotherapy regimens (induction and consolidation steps), and an autologous or allogeneic hematopoietic stem cell transplantation [16].

We calculated direct costs for Induction therapy, salvage chemotherapy, Consolidation chemotherapy, and hematopoietic stem cell transplantation.

Induction therapy has 7 + 3 protocol chemotherapy, evaluation of response to treatment at +14 and +28 days of the protocol with bone marrow study and flow cytometry and supportive care treatments. Patients who had no response to induction protocol or relapse after the first remission and who contains high-dose chemotherapy (FLANG, FLAG, CLANG, and CLAG protocols) were candidates for receiving salvage chemotherapy. Evaluation of response to the therapy at +14 and +28 days of the protocol with bone marrow study and flow cytometry, and supportive care treatments [17,18].

Consolidation chemotherapy depends on risk stratification after the first remission. If the risk is low, the patient treats with HIDAC or 5+2 chemotherapy protocols and if the risk is moderate or high, the patient treats with allogeneic hematopoietic stem cell transplantation (Allo-HSCT). Allo HSCT cost includes pre-transplant evaluation tests, CT-scans, and consultations, cell separation, transplant chemotherapy protocol, and basic supportive care treatments [17,18].

Finally, patient records were used to extract the average cost of each diagnostic and therapeutic scale at different stages of the disease. The average cost per patient was calculated [19]. To optimize Iran's

Medical tariff in 2020 that are obligated from the ministry of health and estimates the costs of medical services, expert opinions were also used [20].

### **Direct non-medical costs**

Although there were no non-medical cost studies or data from cancer patients such as AML cancer patients, transportation costs and home care costs were estimated. A questionnaire was used to assess non-medical direct costs. Information was obtained through telephone interviews with patients or their families [21].

### **Indirect costs**

Indirect costs of AML include loss of productivity due to disability, job loss, and early death. The indirect costs were calculated by using the human capital approach, assuming that the monetary value of the production loss due to a disability or untimely death of the patient is equal to the patient's wages before disability and death.

To calculate the cost of productivity lost due to disability, the number of days of disability due to AML was extracted by interviewing patients and their families. The average number of days lost is then multiplied by the patient's average daily wage. Different daily wages were used for employed and unemployed patients.

The minimum daily wage approved by the Ministry of Labor Cooperation and Social Welfare of Iran in 2019 was considered for unemployed patients [22]. Because usually a family member accompanies the patient at the time of referral. Therefore, these time costs were estimated for a family member as a patient, and assuming that family members are unemployed, the minimum wage rate was considered.

To estimate the cost of productivity lost due to early death in AML, the number of deaths due to AML was calculated and adjusted based on age groups and gender from data obtained from the Ministry of Health [23, 24]. Then, the number of years lost in each age group was provided by subtracting the average age group from the life expectancy rate in 2019, published in the World Health Organization (WHO) database [25].

Finally, the years lost in different age groups were calculated by multiplying the number of deaths in the age groups by the corresponding life expectancy. The minimum annual cost and the average annual cost were used for employed and unemployed patients, respectively. Information on the employment rate in each age group based on gender, as well as the average annual wage and the minimum annual wage was obtained from the Ministry of Labor Cooperation and Social Welfare of Iran [22]. All costs were calculated using the average annual exchange rate of 2020 in US dollars.

## **Results**

Data analysis showed that most of the patients in the present study were men (58.4%) with a mean age of 47.82. Patient profiles are shown in Table 1. 98% of patients received induction therapy, which accounted for 39% of direct medical expenses, and 75% of patients with relapse accounted for 31% of direct medical expenses.

Although only 36% of patients received consolidation treatment, the cost per patient (\$ 961.91) was higher than the other components. In addition, the cost of transplantation after salvage therapy had the lowest share of direct medical costs (59481414/28) and also the cost per patient (\$ 358.52). Table 2 shows the direct medical cost components in AML patients.

According to a telephone interview, most patients require home care during or after being discharged from the hospital. The average home care days were 64 days. In more than 90% of cases, patients care was conducted by a spouse or family member, whereas in less than 10% care was provided by a trained nurse, nurse or practical nurse. Also, the average transportation for patients consisted of approximately 21 trips. The average cost of traveling and caring for patients at home were \$153.46 and \$647.20 respectively. The direct non-medical costs of AML in 2020 are presented in Table 3.

The average days of disability and absence from work for patients and their companions were 92 and 23 days, respectively. And, the average monthly wage for each employed and unemployed person was \$ 252.96 and \$ 151.20, orderly. The average cost of disability and absence from job was \$ 758.89 per patient. We estimated that the total cost of disability and job absence was approximately \$ 2,323,779 in 2020 (Table 4).

Our findings showed that there were a total of 267 deaths due to AML. The mean number of years lost due to early death of AML per patient was 19 years. The highest death rates occurred in the age groups of  $65 \pm 69$  years and  $55 \pm 59$  years, respectively. Also, the highest mortality rate was calculated for the age group of  $50 \pm 54$  (\$ 3998200.29). Cost of lost productivity due to AML early death in 2020 is presented in Table 5. The economic burden of AML in Iran in 2020 was \$ 3324310739 and its main components were indirect costs (Table 6) (Figure 1).

## Discussion

Our work is the first study that evaluates the economic burden of acute myeloid leukemia (AML) in Iran. According to the results, AML has a significant economic burden for the Iranian medical system and patients. The economic burden of AML in Iran was \$ 33243107.39, of which 65% was related to indirect costs (\$ 21593764.4) and part of direct medical expenses was 19% (\$ 6359380.88). Although it is difficult to compare total costs of economic burden among studies conducted in other countries due to differences in their study approaches, estimated costs, different treatment patterns in their countries and health systems, it seems by comparing the AML economic burden among different countries with different health systems, we could provide a better understanding of the economic consequences of health policies and programs.

Despite that, 59% of patients received transplant therapy, the cost of this method was less than consolidated and recurrent induction per each patient (358.52\$). 98 percent of the patients after diagnosis of the disease received induction; therefore, the highest portion of medical direct costs was due to induction treatment (0.39). Since after early diagnosis of the disease, patients who receive this kind of treatment, often encountered to a numerous chemical complications of the treatment at the early phases of the treatment. Therefore, it is required to assign many of resources and allocate a high range of costs at the first steps of this treatment course. In addition, 75% of patients developed relapse which its portion out of total direct medical costs was 0.31. Chemotherapy in treatment of AML patients, has lots of complications which lead to increase in frequency of hospitalization in hospital and as well a remarkable increase in costs [26].

According to the results of this study, 36% of patients need consolidation therapy and the cost of this type of treatment was only 0.15 of the total direct medical costs. This small amount may be due to less resource use, fewer additional treatments, and later hospitalization after induction. On other hand, following the induction, the side effects of this treatment are reduced for a while.

According to studies in the United States and the United Kingdom, the cost of transplantation is higher than other interventions, followed by the cost of induction and then consolidation chemotherapy [27].

The cost of transplant in the United Kingdom and the United States was the highest direct medical cost at \$177,187 and \$352,682, respectively in 2019. About 80% of direct medical costs in the UK are set at the cost of transplants, while in Iran due to the acceptance of treatment costs by patients and hidden subsidies for these patients, transplant costs have been lower than in the UK and other countries. And its cost in each case is about \$ 358.52 and \$ 594814.28 for all patients. However, in general, transplant is associated with higher mortality, toxicity, and costs; in the long-term, it costs less because of the reduced risk of recurrence [27]

In our study, the total direct medical cost was 6359380.88 \$ and the direct medical cost per case was 3460.04\$. The average direct medical cost in one study was shown to be 819247 and the total cost was 225293 million (SEK) in which the portion of costs of induction therapy and consolidation chemotherapy were predominant. 45 percent of patients with induction treatment had an average cost was 379470 SEK per patient and the total cost of induction treatment for them was 104354 SEK million [28].

Besides, the average cost of consolidation therapy was 135525 SEK per case and the total cost was 26156 SEK million; the cost of the transplant was 657655 SEK per case and the total cost was 7234 SEK million and recurrence cost was 437140 SEK per case and the total cost was 51145 SEK million [28].

According to a study by Lang et al, the average cost of treatment for these patients was \$ 73,451 [29], while another study reported the cost of treatment between 1997 and 2007 at \$ 10,8138 [30]. Besides, the cost of treating such patients in 2007 was \$ 5,817 in Egypt [31] and \$ 104,386 in the Netherlands [32]. According to a study that reports direct medical costs to these patients over two decades, the average overall cost of treatment increases over time, especially the cost of medication, chemotherapy, and

outpatient costs, so that in the decade from 1973-1980, total medical expenses were SEK 211,138 (\$ 32,000) and for 1988-1981 SEK 356,911 (\$ 55,000) [33].

This increase is attributed to ascending trend of medications' costs, wide use of diagnostic technologies and expensive equipment, and improvement of patients' survival [34].

In one study by Bella et al, the total direct medical cost of 237 patients with AML who received chemotherapy and transplant was 24512\$. According to the results of this study, the portion of the direct medical cost of the economic burden is 19% and the portion of indirect cost is 65% which the part of the cost of productivity lost due to mortality was more than indirect costs [35].

In a study conducted by Hartunian et al., in the United States, the indirect costs accounted for 81% and the direct costs for 19% of the total economic burden [36]. In another study conducted in Sweden in 1975, the indirect costs of the disease were SEK 163 and the direct costs were SEK 86 million [37], and in another study in 1989, the total economic burden of AML was SEK 460,799 million, which means productivity lost due to disability in each case was SEK 2063834 million and the total was SEK 22330 million and the average cost of productivity lost due to mortality was SEK 2920219 million and the total lost productivity was SEK 213176 million [28].

Few studies have considered indirect costs, but in these studies, indirect costs were a quarter to a half of the economic burden, and it seems that the main economic burden of this disease is due to indirect costs and most of it is due to indirect costs [27]. The cost of lost productivity was consistent with the present study

In a Swedish study, an approximate homogeneity distribution was achieved among direct and indirect costs [28], while in another study, direct costs were three times the indirect costs [38].

Diagnosis of AML in patients with the high frequency of hospitalization, repetitive outpatient visits, and considerable use of expensive medications may result in higher costs for these patients [35, 39]. Also, the progression of the disease and the increase in care increments the costs and need for intensive care and thus increase the cost of hospitalization in these patients. Due to the differences in health systems, the calculation and comparison of results between countries are not almost easy, and the local conditions of each country and the method of calculation (retrospective and prospective) are very important. Obviously, the development of current treatments and newer technologies and access to more efficient drugs with fewer side effects over time significantly increases the survival rate, life expectancy, and can also reduce the economic burden of the disease.

## **Strengths And Limitations**

This study is the first estimate of the economic burden of AML in Iran, several data sources, including the national cancer registry, hospital records, occupational data, and interviews with experts were used.

The present study includes some limitations. First, our result may be underestimated. As we have mentioned, the treatment tariff in Iran may not reflect the real cost imposed on the health care system, and the tariff will increase to provide the real cost soon. Second, the human capital method has been used to estimate indirect costs. Although this method is still widely used, one of its weaknesses is that it underestimates the value of life in some groups, such as children, women, and retirees [40].

Another limitation of this study was that due to the lack of access to appropriate data, it was not possible to estimate some costs: these costs include follow-up costs and costs imposed on patients and their families, such as home care, informal treatments, and intangible costs such as pain and depression. Interpretation of these results requires further caution and validation by larger, standardized prospective studies.

## Conclusion

According to the results of the study, the economic burden of AML on the health system is very high and most of it is related to indirect costs. Due to the implementation of health programs and hidden subsidies in the Iranian health sector, most of the direct medical costs in these patients are provided through insurance and the health system. And it creates significant costs for the health system to allocate more resources to these patients. Awareness of these costs, therefore, helps policymakers and programmers to allocate resources much more rationally.

## Declarations

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**Code availability** Not applicable.

**Authors' contributions** Nargesi and Alipour and Mezginejad participated in study design, collected data, conducted statistical analysis, and drafted the manuscript Jahangiri participated in study design and interpretation of the data. Nargesi and Jahangiri and Meshkani participated in statistical analysis, interpretation of the data, critical revision, and editing of the manuscript. Rad and Mousavi participated in study design, supervised its execution, helped with interpretation of the data, and helped to draft the manuscript. Dolatshahi participated in editing of the manuscript. All authors read and approved the final manuscript

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**Availability of data and materials** The authors have full control over the primary data. The data are analyzed in this study are housed at the Palliative Care Unit, Department of Oncology, Hematology and BMT, Tehran University of Medical Sciences

## Compliance with ethical standards

**Conflict of Interests** The authors declare that they have no competing interests.

Ethical committee approval was granted by the ethics committees of the health management and economics research center affiliated to Iran University of Medical Sciences (ethical code: IR.IUMS.REC .1397.1360). Written informed consent was obtained from all participants included in the study.

**Code availability** Not applicable.

## References

1. Shallis RM, Wang R, Davidoff A, et al. (2019) Epidemiology of acute myeloid leukemia: Recent progress and enduring challenges *Blood reviews*,36 (70-87).
2. Key Statistics for Acute Myeloid Leukemia (AML): American Cancer Society; 2020 [Available from: <https://www.cancer.org/cancer/acute-myeloid-leukemia/about/key-statistics.html>].
3. Acute myeloid leukemia (AML): Leukemia and Lymphoma Society. 2020. [Available from: <https://www.lls.org/leukemia/acute-myeloid-leukemia>].
4. Medeiros BC, Chan SM, Daver NG, Jonas BA, Pollyea DA. Optimizing survival outcomes with post-remission therapy in acute myeloid leukemia. *American journal of hematology*. 2019;94(7):803-11
5. Larg A, Moss JR. Cost-of-illness studies: a guide to critical evaluation. *Pharmacoeconomics*. 2011; 29 (8):653±71. <https://doi.org/10.2165/11588380-000000000-00000> PMID: 21604822.
6. Clabaugh G, Ward MM. Cost-of-illness studies in the United States: a systematic review of methodologies used for direct cost. *Value in health: the journal of the International Society for Pharmacoeconomics and Outcomes Research*. 2008; 11(1):13±21. <https://doi.org/10.1111/j.1524-4733.2007.00210.x> PMID: 18237356.
7. Naghavi M, Abolhassani F, Pourmalek F, Jafari N, Moradi Lakeh M, Eshrati B, et al. The burden of disease and injury in Iran in the year 2003. *Iranian Journal of epidemiology*. 2008; 4(1):1±19.
8. Larg A, Moss JR. Cost-of-illness studies. *Pharmacoeconomics*. 2011; 29(8):653±71. <https://doi.org/10.2165/11588380-000000000-00000> PMID: 21604822.
9. Daroudi R, Sari AA, Nahvijou A, Kalaghchi B, Najafi M, Zendehtdel K. The economic burden of breast cancer in Iran. *Iranian journal of public health*. 2015; 44(9):12±25. PMID: 26587497
10. Nahvijou A, Sari AA, Zendehtdel K, Marnani AB. Management of precancerous cervical lesions in iran: a cost minimizing study. *Asian Pac J Cancer Prev*. 2014; 15(19):8209. PMID: 25339007.
11. Daroudi A, Zendehtdel K, Nahvijou A, Zahmatkesh H, Akbarisari A. A Review of Methods for Estimating Economic Burden of Cancer. 2014:349±357. Persian.
12. Vahdatimanesh Z, Zendehtdel K, Akbari Sari A, Farhan F, Nahvijou A, Delavari A, et al. Economic burden of colorectal cancer in Iran in 2012. *Medical Journal of The Islamic Republic of Iran (MJIRI)*. 2017; 31(1):768±73.

13. World Health Organization. WHO guide to identifying the economic consequences of disease and injury. 2009. Available from: [http://www.who.int/choice/publications/d\\_economic\\_impact\\_guide.pdf](http://www.who.int/choice/publications/d_economic_impact_guide.pdf)
14. Ahmadzadeh N, Rezapour A, Ghanavatinejad Z, Nouhi M, Karimi S, Saravani A, et al. Estimation of economic burden of preterm and premature births in Iran. *Medical Journal of the Islamic Republic of Iran*. 2017; 31:78. <https://doi.org/10.14196/mjiri.31.78> PMID: 29445706
15. Hasoumi M, Nasehi M, Khakian M, Mohseni M, Ziaifar H, Keykale MS. Cost of Illness of Tuberculosis in Tehran in the Year 2011. *Materia Socio-Medica*. 2014; 26(5):339±42. <https://doi.org/10.5455/msm.2014.26.339-342> PMID: 25568635.
16. De Kouchkovsky I, Abdul-Hay M. 'Acute myeloid leukemia: a comprehensive review and 2016 update'. *Blood cancer journal*. 2016; 6(7):e441-e.
17. Estey EH. Acute myeloid leukemia: 2019 update on risk-stratification and management. *American Journal of Hematology*. 2018;93(10):1267-91.
18. E. Acute myeloid leukemia: 2014 update on risk-stratification and management. *Am J Hematol* 2014;89:1063–108.
19. Pfister DG, Spencer S, Brizel DM, Burtness B, Busse PM, Caudell JJ, et al. Head and neck cancers, version 1.2015. *Journal of the National Comprehensive Cancer Network*. 2015; 13(7):847±56. PMID: 26150579.
20. Ministry of Health and Medical Education. Book of relative value of healthcare in Islamic Republic of Iran. Ministry of Health and Medical Education 2019. Available from: <http://treatment.sbm.u.ac.ir/uploads/rvu-book-1398-final.pdf>.
21. Rezapour A, Nargesi S, Mezginejad F, Rashki Kemmak A, Bagherzadeh R (2020) The Economic Burden of Cancer in Iran during 1995-2019: A Systematic Review. *Iran J Public Health*. 50(1):35-45.
22. Ministry of Cooperation, Labour and Social Welfare. labour market information system 2019. Available from: <http://www.amarkar.ir/handler/getfile.ashx?type=pub&id=429>
23. Ministry of health and medical education. Iranian Annual of National Cancer Registration Report 2017. Available from: <http://yon.ir/ircancer>
24. Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. *International journal of cancer*. 2015; 136(5). <https://doi.org/10.1002/ijc.29210> PMID: 25220842
25. World Health Organization. World Health Statistics 2019. Geneva: World Health Organization; 2019.
26. L. Bryant, A. M. Deal, A. Walton, W. A. Wood, H. Muss, and D. K. Mayer, "Use of ED and hospital services for patients with acute leukemia after induction therapy: one year follow-up," *Leuk. Res.*, vol. 39, no. 4, pp. 406–410, 2015. doi: 10.1016/j.leukres.2015.01.006
27. Zeidan AM, Mahmoud D, Kucmin-Bemelmans IT, Alleman CJM, Hensen M, SkikneB, et al. Economic burden associated with acute myeloid leukemia treatment. *Expert Rev Hematol* 2016;9:79–
28. Tennvall GR, Persson U, Nilsson B. The economic costs of acute myeloid leukemia in Sweden. *Int J Technol Assess Health* 1994;10(4):683–694

29. Lang K, Earle CC, Foster T, et al. Trends in the treatment of acute myeloid leukaemia in the elderly. *Drugs Aging*. 2005; 22(11):943–955.
30. Meyers J, Yu Y, Kaye JA and Davis KL. Medicare fee-for-service enrollees with primary acute myeloid leukemia: an analysis of treatment patterns, survival, and healthcare resource utilization and costs. *Appl Health Econ Health Policy*. 2013 Jun;11(3):275–286
31. Zawahry HM, Zeeneldin AA, Samra MA, et al. Cost and outcome of treatment of adults with acute myeloid leukemia at the National Cancer Institute- Egypt. *J Egypt Natl Canc Inst*. 2007;19(2):106–113. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19034340>
32. Uyl-de Groot CA, Gelderblom-den Hartog J, Huijgens PC, et al. Costs of diagnosis, treatment, and follow up of patients with acute myeloid leukemia in the Netherlands. *J Hematother Stem Cell Res*. 2001;10(1):187–192. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/11276372>
33. Stalfelt AM, Brodin H. Costs over time in conventional treatment of acute myeloid A study exploring changes in treatment strategies over two decades. *J Intern Med [Internet]*. 1994;236(4):401– 409. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/7931043>
34. Leunis A, Blommestein HM, Huijgens PC, et al. The costs of initial treatment for patients with acute myeloid leukemia in the Netherlands. *Leuk Res*. 2013;37:245–250.
35. Bell JA, Galaznik A, Farrelly E, BlazerM, Murty S, Ogbonnaya A, Eaddy M, Fram RJ, Faller DV, Kota V, Economic Burden of Elderly Patients With Acute Myeloid Leukemia Treated in Routine Clinical Care in the United States, *Leukemia Research* (2018), <https://doi.org/10.1016/j.leukres.2018.06.010>.
36. Hartunian, N. S., Smart, C. N., & Thompson, M. S. The incidence and economic costs of major health impairments. Lexington, MA: Lexington Books, 1981.
37. Lindgren, B. *Costs of illness in Sweden 1964-1975*. Lund, Sweden: Liber, 1981.
38. Sotak ML, Marin M, Coombs J, et al. PSY19 burden of illness (BOI) of FLT3- mutated acute myeloid leukemia (AML). *Value Heal [Internet]*. 2012;15(4):A101– Available from: <http://linkinghub.elsevier.com/retrieve/pii/S1098301512006183>
39. Preussler JM, Meyer CL, Mau LW, et al. Healthcare costs and utilization for patients age 50 to 64 years with acute myeloid leukemia treated with chemotherapy or with chemotherapy and allogeneic hematopoietic cell transplantation. *Biol Blood Marrow Transplant*. 2017;23:1021–1028.
40. Brown ML and Yabroff KR (2006). Economic impact of cancer in the united states; *Cancer epidemiology and prevention*, Eds schottenfeld and faumeni, 1st ed. oxford university press, new york. pp 202-209.

## Tables

**Table1. Studied patient characteristics and epidemiological data of acute myeloid leukemia 2020.**

<b>Variables</b>	<b>Mean ± SD</b>	<b>Relative frequency</b>
<b>Gender</b>		
Male		58.4%
Female		41.6%
<b>Age group</b>		
	45.73(±12.56)	
19-28		16.1%
29-38		19.8%
39-48		21.4%
49-58		26.6%
59-68		16.8%
69-78		1.6%
<b>Education</b>		
Academic		33.4%
Non academic		66.6%
<b>Medical insurance</b>		
		94.3%
<b>Average monthly income</b>	89.45(±18)	
<b>LOS</b>	69.42(±25.41)	

**SD: Standard deviation**

**Table 2. The direct medical costs of AML management in Iran in 2020(\$)**

t type	Direct medical costs				
	Per patient	percentage of patient	Number of patients	Total	Percentage of direct medical cost
action	908.10	98%	2755.76	2502510.24	0.39
validation	961.91	36%	1012.32	973770.43	0.15
MT	358.52	59%	1659.08	594814.28	0.09
apse	942.35	75%	2109	1987430.50	0.31
vage	289.16	37%	1040.44	300855.43	0.05
ul cost	3460.04			6359380.88	

**Table 3. The direct non-medical costs due to acute myeloid leukemia in Iran in 2020(\$)**

	Cost type	Travelling costs	Home care costs	Total
ct Non-medical costs	Per patient	153.46	647.20	800.66
	Total	3470028.51	1819933.59	5289962.11

**Table 4. The indirect costs of disability and absence from work due to AML in Iran in 2020(\$)**

us	Mean of missed work days	Mean Cost per patient, \$US	Total cost, \$US
ents	92	758.89	2134021.17
ompanies	23	202.95	189758.25
l	115	961.84	2323779.42

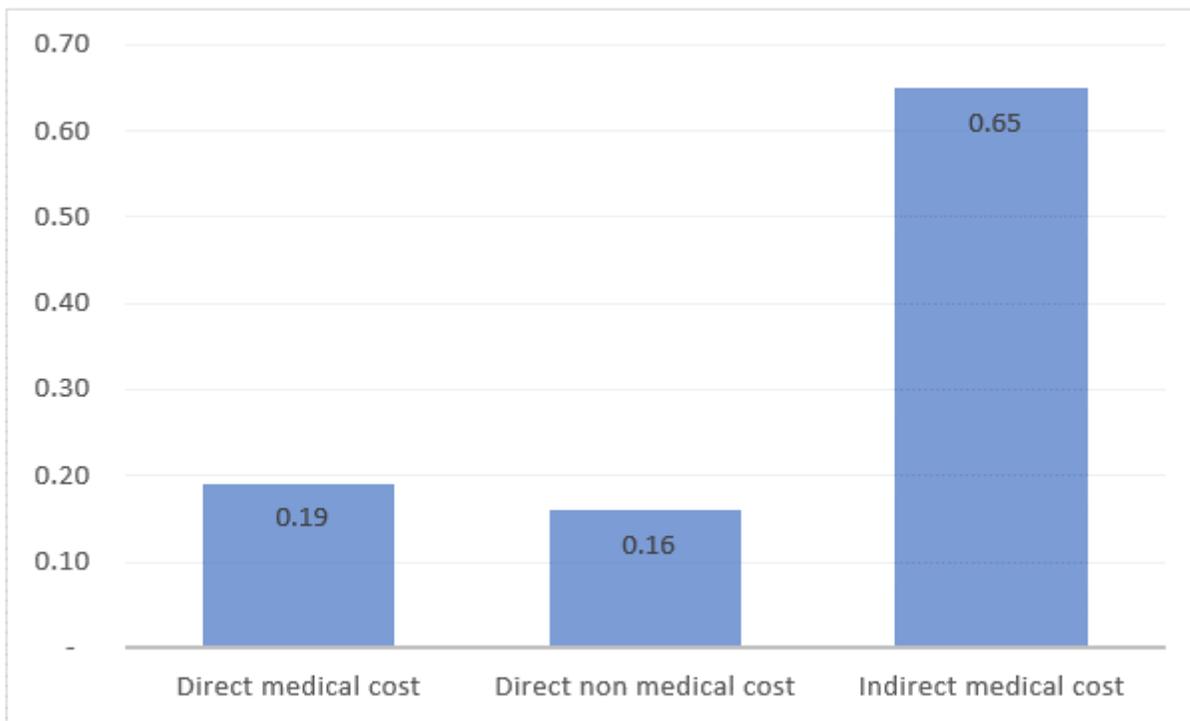
**Table 5. The indirect costs of AML due to premature mortality in Iran in 2020(\$)**

Age group (year)	Number of death		Number of years lost	mortality cost		Total mortality cost
	Men	Women		Men	Women	
15-19	1	0	116	180238.35	164876.09	345114.44
20-24	2	4	320	442279.19	678307.52	1120586.71
25-29	3	3	288	674982.05	485087.32	1160069.37
30-34	4	2	256	829015.65	289115.60	1118131.25
35-39	7	5	454	1283076.31	634052.21	1917128.52
40-44	4	3	230	632869.09	330424.79	963293.88
45-49	21	10	857	2715660.67	912794.48	3628455.15
50-54	32	12	992	3133487.80	864712.49	3998200.29
55-59	39	10	510	1595359.42	346948.56	1942307.98
60-64	24	18	540	1060412.94	713966.70	1774379.64
65-69	42	21	483	786038.40	516279.35	1302317.75
Total	179	88	5046			19269984.98

**Table 6. The economic burden of AML in Iran in 2020(\$)**

us	Direct medical cost	Direct non-medical cost	Indirect cost	Total
omic burden	6359380.88	5289962.11	21593764.4	33243107.39

## Figures



**Figure 1**

The economic burden of AML in Iran in 2020.