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Original Article

Cost of illness of leukemia in Japan − Trend analysis and future projections

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Abstract

Background: Leukemia is a deadly hematological malignancy that usually affects all age groups and imposes significant burden on public funds and society. The objective of this study was to analyze the cost of illness (COI) of leukemia, and to mark out the underlying driving factors, in Japan.
Methods: COI method was applied to the data from government statistics. We first summed up the direct and indirect costs from 1996 to 2014; then future COI for the year 2017−2029 was projected.
Results: Calculated COI showed an upward trend with a 13% increase from 1996 to 2014 (270−305 billion yen). Increased COI was attributed to an increase in direct costs. Although mortality cost accounted for the largest proportion of COI, but followed a downward trend. Decreased mortality costs reflected the effects of aging. Mortality cost per person also decreased, however, the percentage of mortality cost for individuals ≥65 years of age increased consistently from 1996 to 2014. If a similar trend in health-related indicators continue, COI would remain stable from 2017 to 2029 regardless of models.
Conclusion: COI of leukemia increased from 1996 to 2014, but was projected to decrease in foreseeable future. With advancement of new therapies, leukemia has become potentially curable and require long-term care; so direct cost and morbidity cost will remain unchanged. This reveal the further continuing burden on public funds. Thus, the information obtained from this study can be regarded as beneficial to future policy making with respect to government policies in Japan.

Keywords: Cost of illness (COI); Economics; Health policy; Japan; Leukemia; Medical

1. Introduction

Leukemia (ICD-10 code: C91−C95) is the 11th most common form of malignancy; its global prevalence is 2.5% of all cancers with around 352,000 new cases diagnosed in 2012.[1,2] Incidence and mortality rates are 1.5−2 times higher in Western countries than in Japan.[3] The age adjusted incidence rate in Japan was 6.5 per 100,000 people in 2012.[4] Leukemia occurs most often in older adults but it is also the most common form of malignancy in children. In Japan, the incidence of leukemia in children under 15 years of age has not changed much since 1975; accounting for 39.3% of all cancers in 2012.[4] The crude mortality rate of leukemia is still increasing as the number of therapy resistant patients are increasing with aging.[5,6]

Several studies from different countries have reported cost analysis of leukemia. For instance, Blankart et al. reported that, the cost of chronic lymphocytic leukemia amounted to 4946 €(≈601,059 yen) per person from payer's perspective in Germany, in 2008.[7] In Japan, Matsumoto et al. reported that the cost of illness (COI) of leukemia followed an upward trend

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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from 1996 to 2008, during which time direct costs increased by 100%.[8]

However, studies addressing both direct and indirect costs of leukemia are relatively sparse in the international literature. To the best of our knowledge, this is the first COI study of leukemia with future projections; that dealt with both direct and indirect costs, and included opportunity costs caused by disease and death.

The aim of the study was to evaluate and predict the future costs attributable to leukemia; and to identify the reasons in Japan, which will improve the informational basis for the allocation of scarce resources, while controlling costs and preserving quality.

2. Methods

The well-known COI method proposed by Rice DP in 1960, was used here to estimate the social burden of disease.[9–16] The adapted top-down approach of the COI method used herein was the same as that described in our previous study.[8] In the current study, future predictions were made for the years 2017–2029 to analyze the time trend, based on data from the COI calculated for 1996–2014. Details of the methodology are outlined in previously published COI studies.[17–20]

2.1. Data sources

All calculations were performed using government statistical data. We used "Vital Statistics" to evaluate the number of deaths caused by leukemia according to sex and 5 years age group. We utilized data from "Basic Survey on Wage Structure," "Labor Force Survey" and "Estimates of Monetary Valuation of Unpaid work" to calculate the labor value according to sex and 5 years age group. Future COI predictions for 2017–2029 were based on data from "Population Projection for Japan: 2011–2060 (January 2012)" by the National Institute of Population and Social Security Research in Japan. Survey results from the "National Medical Care Insurance Services" were used to determine the annual medical expenses. The "Patient Survey" was employed to identify the number of patients, total person-days of outpatient visits and average length of stay according to sex and 5 years age group.[21]

2.2. Calculation and analysis procedure

COI includes direct costs (DCs) and indirect costs (ICs), which further comprise morbidity costs (MbCs) and mortality costs (MtCs).

DCs are defined as medical expenses that originate directly from treatment costs, hospital charges, laboratory diagnostic costs and drug costs. In this study, we calculated annual medical costs derived from the total medical expense data collected in the Survey of National Medical Care Insurance Services. ICs are defined as opportunity costs lost due to disease or death. MbC was calculated by summing the costs related to inpatient and outpatient care. The MbC of inpatients was calculated by multiplying total person days of hospitalization by the labor value per person for one day. MbC of outpatients was determined by multiplying the total person-days of outpatient visits by half of the one day labor value per person. MtC was measured as the loss of human capital (human capital approach) which we got by multiplying the number of deaths from leukemia by the lifetime labor value per person. Lifetime labor value was determined by summing the person's potential income (which might be the present value of their future earning if they had not died) from the time of death to average life expectancy.[17–20]

We used a discount rate of 3% to present value to get the adjusted future labor value. Three percent is broadly accepted as discount rate in developed countries such as Japan and the United States where the COI method got applicability. We performed a sensitivity analysis of the discount rate using rates in the 0%–5% range.

2.3. COI projection over time

The year 2014 was determined as benchmark for the one day labor value by sex and 5 years age group. At first, we calculated COI for the years 1996–2014 using available past data to estimate the trend over time. Then, to make future projections, we calculated COI for the years 2017–2029 utilizing two methods described below.

The first method involved creating a "fixed model" in which health-related indicators (such as mortality rate, number of outpatient visits, number of hospitalization and average length of stay) were fixed at 2014 level by sex and 5 years age group, hence the term "fixed model". However, this model did not fix the future population estimation of each age group.

The other one is the "variable model" which involved estimating changing trends in health-related indicators in addition to population and age structure, hereafter referred to accordingly. Future health-related indicators were grouped by sex and 5 years age group and obtained using three variable models according to approximation: 1. linear model (using linear regression), 2. logarithmic model (using logarithmic regression); and 3. mixed model (combination of the approximation with higher coefficient of determination). We found the mixed model to be most valid as it used the value from the higher coefficient of determination. The fixed model can be used as a reference due to its simple approach. The logarithmic and linear models can be considered as sensitivity analyses showing the robustness of the mixed model.

DCs, in case of fixed unit costs, were calculated by multiplying the rate of the increase in the number of outpatients and inpatients from 2014 to 2017, 2020, 2023, 2026 and 2029 by the outpatient and inpatient costs for 2014. DCs, taking changes in unit cost into account, was calculated by multiplying the number of outpatient visit by the DC of outpatients per visit and the number of hospitalizations by the DC of inpatients per day.

We received approval from the Institutional Review Board of Toho University School of medicine (no. A16019).