

Impact of end-of-life expenditure on age-related medical expenditure profile in Japan

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Abstract

There are still certain concerns about the impact of end-of-life expenditure on total medical expenditure in Japan. We estimated medical expenditure for the deceased elderly in Japan in 2018, and analyzed the impact of end-of-life expenditure on the age-related medical expenditure profile in Japan. Medical expenditure of the elderly in Japan is relatively high compared with other developed countries, and there is some room to cut costs. Medical expenditure of the deceased elderly in Japan seems to be similar to the other developed countries. Concerning per capita medical expenditure, the index for surviving elderly is 6 % lower than that for the total elderly population. End-of-life expenditure is certainly expensive, but the efficiency and effectiveness of the healthcare system in general is required to cope with population aging and the increasing demand of the population.

Key words: end-of-life expenditure, deceased elderly, health/medical expenditure, age-related medical expenditure profile

1. Introduction

The average Japanese life expectancy is 84.4 years (81.4 for males and 87.4 for females in 2019), and a further decline in mortality rate among the elderly is expected in future. In accordance with further population ageing, the Japanese Government has been pursuing the policy of providing services including healthcare in communities to reduce the needs for institutional care.

Most medical services in Japan are provided through the public medical insurance system. The total population, except those who receive public assistance, is covered by the public medical insurance, namely employer-based Health Insurance, municipal National Health Insurance, or Health Insurance for the Elderly aged 75+. There are hundreds of insurers (or sickness funds) linked to a person's employer, occupation, or geographic location. Insured persons cannot choose insurers. The private sector is important in delivering medical services and maintaining public health. However, the role of the private sector is relatively minor in terms of financing. All insurers cover a broad range of medical services including hospital and physician care, dental care, pharmaceuticals, and even some transportation. The insurers also pay some cash benefits, such as sickness allowance and maternity allowance, but society-managed Health Insurance of large employers generally pay greater cash benefits than National Health Insurance. Some preventive cares are provided by large employers, but this is not prevailing in Japanese medical insurance in general. Gate-keeping is not in place in Japan, and patients can choose their GP physicians and even hospitals with some penalties.

Public medical insurance in Japan is financed through contributions (individuals and employers), government subsidies and out-of-pocket payments (patient cost-sharing and direct patient payment for services not covered by insurance). Increases in the patient's cost-sharing have been the main tool of controlling medical expenditures in recent years in Japan. As out-of pocket payment is high in Japan, there are such concerns that the present level of patient's cost-sharing (30% in principle) could have induced under-utilization of medical services among low-income households.

In the past, end-of-life expenditure was focused on in Japan as an unavoidable target when trying to increase the efficiency of medical expenditure as a whole. It has since been recognized that end-of-life expenditure is certainly expensive, but containing it is not far from enough in order to reduce the total medical expenditure (Fukawa, 2015).

Under the aging of the population, the sustainability of healthcare systems is a big concern in many

developed countries. Aging of the population will be especially serious in Japan, with the total population decreasing from the present 126 million to 95 million and the aging rate (proportion of people 65 years old or over to the total population) increasing from the present 28 percent to 38 percent in 2050. It is a persistent concern in Japan regarding how to make the healthcare system more effective and efficient.

As the elderly to non-elderly ratio of per capita medical expenditures is high, reforming the system providing medical services to the elderly has always been focused in Japan. The main issues here are coordination of medical services and long-term care (LTC) services as well as elimination of inappropriate long-term hospitalization. After the implementation of the public LTC insurance in April 2000, the number of so-called socially induced hospitalization cases, especially among elderly patients, has been reduced, although not totally eliminated. The key to achieving higher quality and greater efficiency in medical care as well as in LTC is to embody proper incentives in the system. It is clearly limited to depend on reducing the demand for medical care by preventing lifestyle-related diseases.

A challenge facing all developed countries is to provide adequate medical and long-term care services for the older population at an affordable cost, and to improve the quality of the services rendered in view of the ageing of the population, changes in family structures, increasing incidences of chronic disease and progressive disability, rapid technological advances and financial constraints.

In this paper, we make a comparison of age-related profiles of medical expenditure as well as health expenditure (medical expenditure and LTC (health)) in developed countries in Section 2, and estimate medical expenditure of the deceased elderly in Japan in 2018 in Section 3, based on Fukawa (2015)'s analysis of medical expenditure of the deceased elderly during the one year prior to death in 2012 using a national database (Note 1). In Section 4, we discuss the impact of end-of-life expenditure on the age-related medical expenditure profile and draw some implications useful for future healthcare reforms in Japan. Our main conclusion is summarized as follows. Medical expenditure of the elderly in Japan is relatively high compared with other developed countries, and there is some room to cut costs. Medical expenditure of the deceased elderly in Japan seems to be similar to other developed countries. Concerning per capita medical expenditure, the index for surviving elderly is 6% lower than that for the total elderly population. Efficiency and effectiveness of the healthcare system in general is required to cope with population aging and the increasing demand of the population.

2. Age-related profiles in developed countries

Based on OECD Health Statistics 2020, Table 1 shows health expenditure by type of service in seven countries in 2018. Total long-term care (LTC) expenditure is the sum of LTC (health) and LTC (social), and LTC (health) is included in health expenditure as seen in the table. Therefore, in this paper we clearly distinguish between health expenditure and medical expenditure as follows: Health expenditure = Medical expenditure + LTC (health).

According to Table 1, inpatient expenditure amounts to about 3% of GDP in France, Germany, Japan, and the USA. Outpatient expenditure is very high in the USA on the one hand, and LTC (health) is high in the Netherlands and Sweden on the other hand. Concerning LTC expenditure, almost all of LTC (Total) is included in health expenditure in Germany and Japan, but a significant amount of LTC (Total) is outside health expenditure in the other countries in Table 1, especially the USA and the Netherlands.

Figure 1 shows per capita medical expenditure by age group for several countries (per capita average = 1.0). Per capita medical expenditure shows a peak at certain age and declines afterwards in Germany, France, Sweden and the USA. However, it continues increasing with age increase in Japan. Per capita medical expenditure is high for the elderly in the USA because they are covered by Medicare which partially includes LTC services. In any case, there is a peak at age group 90-95 (84-89 in Sweden),

suggesting that Japan is a unique exception in Figure 1.

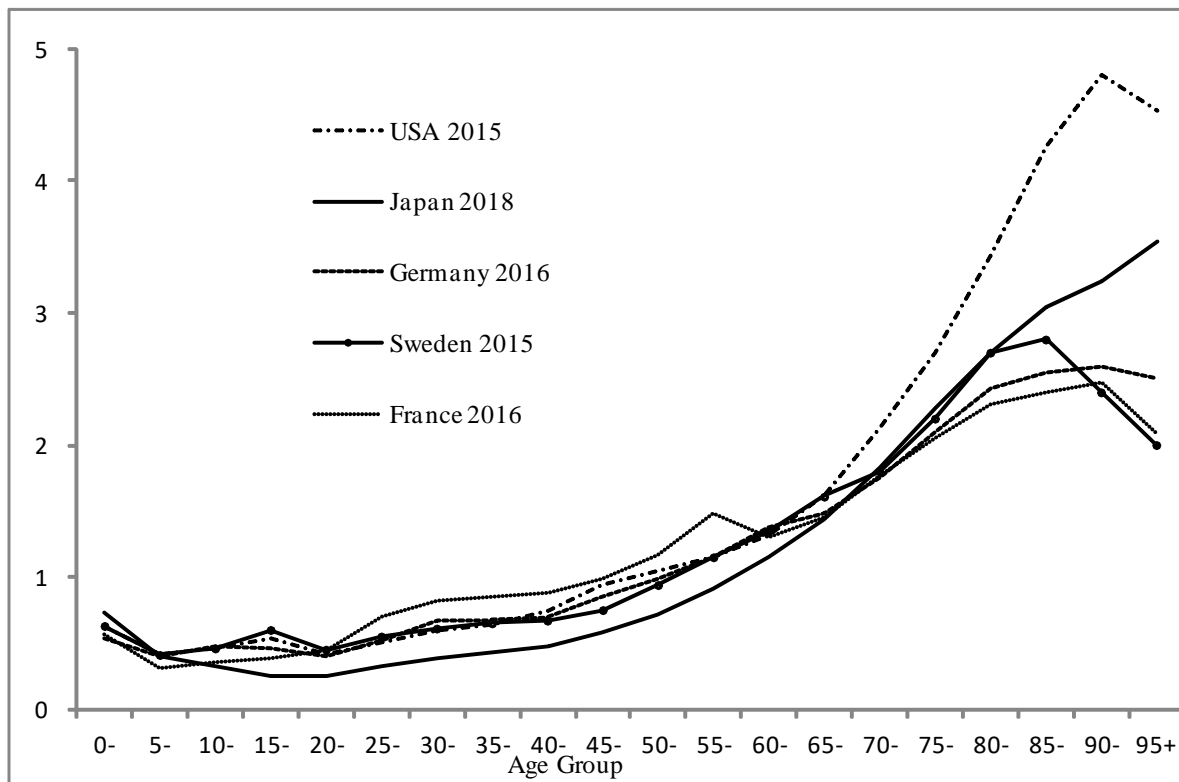
Table 1 Health expenditure by type of service in 7 countries: 2018

	France	Germany	Japan	NL	Sweden	UK	USA
As % of GDP							
Total	11.3	11.5	10.8	10.0	10.9	10.0	16.9
Inpatient	3.1	3.0	2.9	1.9	2.2	2.3	2.8
Outpatient	2.1	2.5	2.9	2.6	3.1	2.6	7.7
LTC (health)	1.8	2.1	2.0	2.7	2.9	1.8	0.8
Medical goods	2.1	2.2	2.2	1.2	1.4	1.5	2.2
Others	2.2	1.7	0.8	1.6	1.3	1.8	3.4
Proportion (%)							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Inpatient	27.3	26.2	27.1	19.3	20.2	22.9	16.7
Outpatient	18.3	21.6	26.5	26.5	28.5	25.8	45.5
LTC (health)	15.6	18.6	18.4	26.8	26.6	17.9	4.8
Medical goods	18.4	19.3	19.9	11.5	12.5	14.7	13.1
Others	20.4	14.3	8.1	15.9	12.2	18.7	19.9
(Reference) LTC/GDP (%), 2017							
LTC (Total)	2.35	2.15	2.00	3.95	3.50	2.35	1.75
LTC (health)	1.8	2.1	2.0	2.7	2.9	1.8	0.8
LTC (social)	0.55	0.05	0.00	1.25	0.60	0.55	0.95

Note1: 2017 for Japan

Note2: Data for LTC (Total) are based on OECD (2020b). LTC (social) = LTC (Total) - LTC (health)

Source: OECD (2020a) OECD Health Statistics 2020.

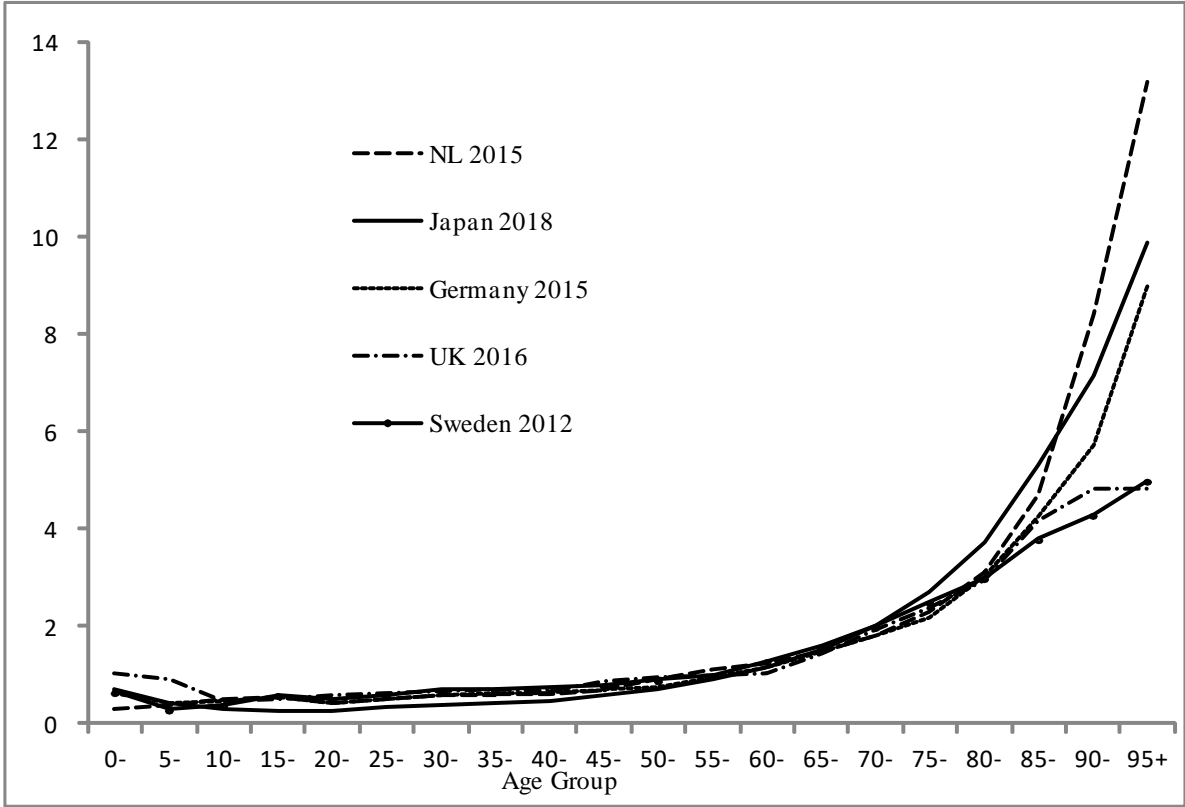


Source: European Commission (2018) for Germany and France, prepared by the author based on MHLW (2020) for Japan, and OECD (2019) for Sweden and USA.

Figure 1 Per capita medical expenditure by age-group: per capita average = 1.0

Figure 2 shows per capita health expenditure by age group for several countries (per capita average = 1.0). Total current health expenditure in the UK in 2016 was £191.7 billion (9.8% of GDP), and the LTC category is split into a health-related care element (1.8% of GDP) that is included in health expenditure and a social element relating to assistance-based services (0.6% of GDP), which sits outside the health accounts (ONS, 2018). Services included in healthcare expenditure, in LTC (health) category, include care where a substantial proportion of the service involves support with basic activities of daily living (ADLs), which include things such as bathing, dressing and walking, and LTC (social), which is not included in health expenditure, covers services where care predominantly consists of support with instrumental activities of daily life (IADLs), which include things such as shopping, cooking and managing finances (ONS, 2018).

The shape of per capita health expenditure at advanced ages is determined by the magnitude of LTC services. It increases quite rapidly at age 85 or over in the Netherland, Japan, and Germany, while the increase is rather modest in Sweden and the UK.



Source: OECD (2019) for Germany and NL, prepared by the author based on Fukawa (2019) for Japan, HEDIC (2016) for Sweden, and OBR (2016) for UK.

Figure 2 Per capita health expenditure by age-group (including LTC): per capita average = 1.0

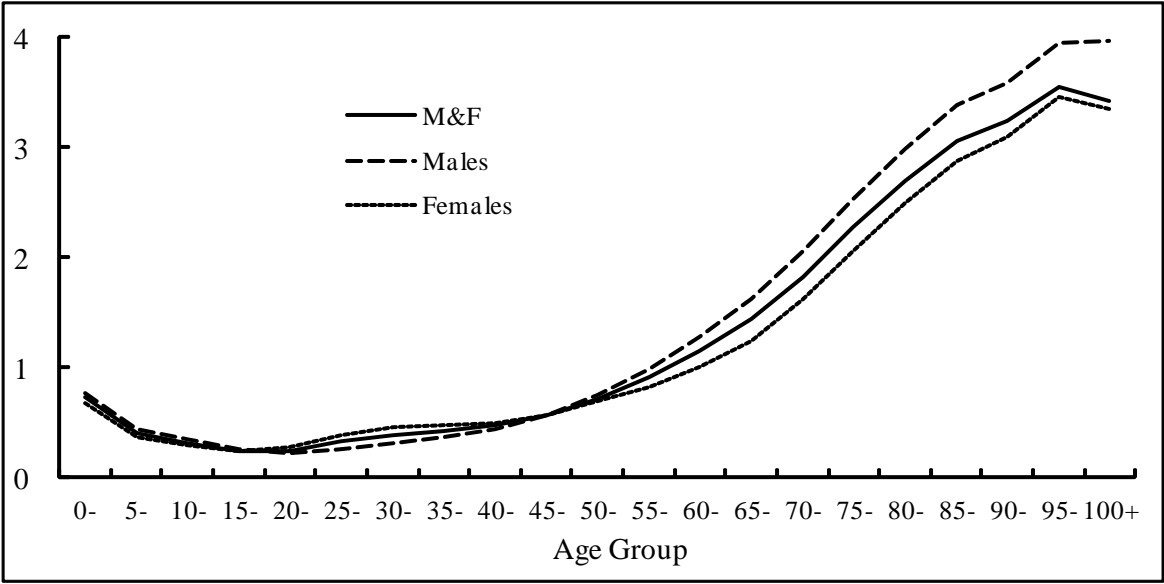
3. Medical expenditure of the deceased elderly in Japan (Note 2)

(1) Per capita medical expenditure by age group: Total (Survivor & Deceased)

National Medical Expenditure in Japan climbed to 43.4 trillion yen or 7.9% of GDP in FY2018. Among them, medical expenditure of the elderly aged 65 or over was 26.3 trillion yen, or 61% of the total. Figure 3 shows per capita medical expenditure by age group and sex in FY 2018. The age pattern of medical expenditure shows a convex shape with its peak at age group 95-99 for females, but age group 100+ was the highest for males. This age profile suggests that elderly people receive some kind of medical services

even at very advanced age in Japan.

The average per capita medical expenditure for those who are 65 or over was 3.9 times more than that for 0-64 age group in 2018 in Japan. As a result, 60.6% of the national medical expenditures were consumed by those who are aged 65 or over (28.1% of the population) and 38.1% consumed by those who are aged 75 or over (14.2% of the population). Given the rapid ageing of the population, the question of how to finance the cost of medical expenditures for the elderly has been a leading issue in recent years. Medical expenditure is not well controlled for advanced age groups as seen in Figure 3, and the control of medical expenditure of those elderly has been focused.



Source: Prepared by the author based on MHLW (2020).
 Figure 3 Per capita medical expenditure by age group and sex in Japan (per capita average = 1.0): FY 2018

(2) Per capita medical expenditure by age group: Deceased elderly

Table 2 shows per capita medical expenditure of the deceased elderly during the one year prior to death (MEDE) in FY 2018. The average of the deceased elderly as a whole was 3.3 million yen, and it decreased rapidly with age increase: from 4.7 million yen for age group 65-69 to 2.4 million yen for age group 95-99. Setting the medical expenditure per deceased elderly aged 65-69 during the one year prior to death as 100 %, then per capita MEDE was 83 % for age group 75-79, 64 % for age group 85-89, and 51 % for age group 95-99 (both sex).

The proportion of medical expenditure devoted to the deceased elderly is also shown in Table 2. For the elderly as a whole, about 8% of annual medical expenditure was used for the deceased. Reflecting death rate, the proportion was less than 5% for age group 65-69, but about 25% for age group 95-99. Also reflecting death rate, the proportion was lower for females than males at all age groups.

Table 3 shows per capita annual medical expenditure by age group for the Total elderly population as well as for the Deceased during the one year prior to death and for Survivors (both sex). Medical expenditure for Survivors was calculated deducting medical expenditure for the deceased during the period concerned from the total. For the elderly as a whole, per capita MEDE was about 5 times higher compared to per capita annual medical expenditure for surviving elderly (deceased/survivor ratio). The former drastically dropped with age increase as mentioned above, but the latter increased with age increase, resulting in the ratio dropping by 10 times for age group 65-69 to 2.3 times for age group 95-99.

Table 2 Medical expenditure for the deceased elderly in Japan: 2018

Age Group	Per capita medical expenditure for the deceased elderly for one year prior to death (in thousand yen, 65-69 = 100.0)						Proportion of medical expenditure used for the deceased elderly (%)		
	M&F	Males	Females	M&F	Males	Females	M&F	Males	Females
65+	3,275	3,570	2,984				7.7	8.9	6.6
65-69	4,706	4,789	4,516	100.0	100.0	100.0	4.4	5.7	2.9
70-74	4,320	4,395	4,159	91.8	91.8	92.1	4.8	6.2	3.2
75-79	3,904	3,993	3,746	83.0	83.4	82.9	5.7	7.5	4.0
80-84	3,375	3,452	3,270	71.7	72.1	72.4	7.7	10.0	5.8
85-89	3,010	3,107	2,919	64.0	64.9	64.6	11.3	14.6	9.3
90-94	2,580	2,686	2,521	54.8	56.1	55.8	16.3	20.2	14.6
95-99	2,407	2,561	2,364	51.2	53.5	52.3	24.5	29.1	23.4
100+	2,084	2,279	2,051	44.3	47.6	45.4	35.9	40.6	35.2

Source: Prepared by the author based on Fukawa (2015).

Table 3 Per capita medical expenditure by age group: Deceased vs. Survivors in FY 2018

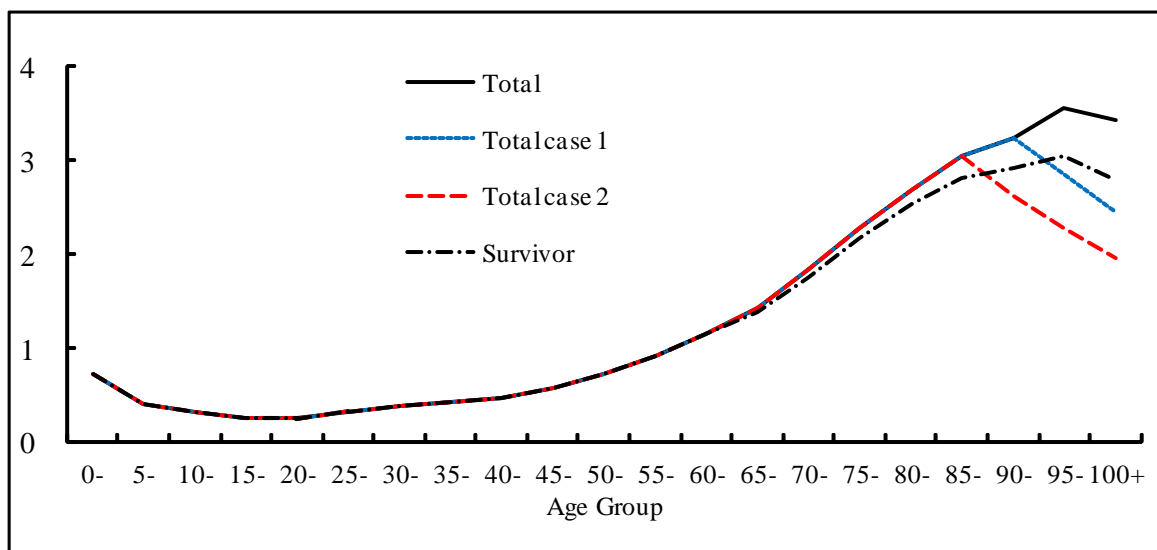
	Per capita annual medical expenditure (thousand yen)			deceased/survivor ratio
	Total	Deceased	Survivors	
65+	739	3,275	694	4.7
65-69	492	4,706	473	10.0
70-74	626	4,320	600	7.2
75-79	780	3,904	744	5.2
80-84	926	3,375	873	3.9
85-89	1,047	3,010	967	3.1
90-94	1,111	2,580	1,000	2.6
95-99	1,221	2,407	1,052	2.3
100+	1,176	2,084	945	2.2

Source: Prepared by the author based on Fukawa (2015).

(3) Per capita medical expenditure by age group: Total vs. Survivor

Fig. 4 shows per capita annual medical expenditure for Total and Survivor in FY 2018. Per capita medical expenditure peaked at age group 95-99 for both curves, and the difference between two curves shows the impact of medical expenditure of the deceased elderly, showing that it has a certain non-negligible impact on medical expenditure especially in very old age groups. For the elderly as a whole, per capita medical expenditure for Survivor is 6 % lower than that for Total, but the difference is 4% for age group 70-79, 10% for age group 90-94, and 25% for age group 100+.

If we assume per capita medical expenditure peaked at age group 90-94 and decreased thereafter for the Total (case 1 in Figure 4), medical expenditure decreased by 19% for age group 95-99 and by 30% for age group 100+. If we assume per capita medical expenditure peaked at age group 85-89 and decreased thereafter for the Total (case 2 in Figure 4), medical expenditure decreased by 17% for age group 90-94, by 33% for age group 95-99, and by 43% for age group 100+ (Note 3). However, medical expenditure of the elderly as a whole would reduce only by 0.5% for case 1 and by 2% for case 2.



Source: Prepared by the author based on MHLW (2020).

Figure 4 Per capita medical expenditure for total population and survivors: 2018, per capita average = 1.0

4. End-of-life expenditure: Discussion

The following summarizes the main findings of this paper:

- Medical expenditure of the elderly in Japan is relatively high compared with other developed countries, and there is some room to cut costs;
- Medical expenditure of the deceased elderly in Japan seems to be similar to other developed countries;
- Concerning per capita medical expenditure, the index for surviving elderly is 6 % lower than that for the total elderly population; and
- Efficiency and effectiveness of the healthcare system in general is required to cope with population aging and increasing demand of the population.

(a) Age-related medical expenditure profile

Universal healthcare coverage through a public health insurance scheme with fee-for-service payment has been the basic definition of the Japanese system so far, which has contributed to the equitable distribution of health services and relieved families from old-age support (Fukawa, 2008). However, as implied from Figures 1 and 3, Japanese elderly consume a relatively large amount of medical services. Therefore, there may be some room to reduce medical expenditure of the elderly, especially at advanced ages. The need to balance patients' freedom and cost containment makes it necessary to consider the so-called gate-keeping function of primary care physicians and to focus more on prevention of lifestyle-related diseases (Fukawa, 2009). Prevention and the empowerment of patients are gaining importance in Japan as key factors to advance higher quality and greater efficiency in the healthcare system (Fukawa, 2009). As attempts to limit the burdens are increasing, however, more should be done to alter the age-related medical expenditure profile.

(b) Medical expenditure of the deceased elderly

If medical expenditure skyrockets at the end-of-life, then policymakers should target the last few months of life to control costs. However, this is not necessarily the case. Concerning MEDE in Japan in 2018, we found the following points which are completely based on and consistent with Fukawa (2015):

- The average MEDE drastically dropped with age increase, from 4.7 million yen for age group 65-69 to 2.4

million yen for age group 95-99 (51% of the average for age group 65-69);

-For the elderly as a whole, about 8% of annual medical expenditure was used for the deceased. Reflecting the death rate, the proportion was less than 5% for age group 65-69, but about 25% for age group 95-99;

-The elderly as a whole, per capita MEDE was about 5 times higher compared to per capita annual medical expenditure for surviving elderly (deceased/survivor ratio). The former drastically dropped with age increase, but the latter increased with age increase, resulting in the ratio dropping by 10 times for age group 65-69 to 2.3 times for age group 95-99; and

-Per capita medical expenditure peaked at age group 95-99 for both Total and Survivor curves. For the elderly as a whole, per capita medical expenditure for Survivor is 6 % lower than that for Total, but the difference is 4% for age group 70-79, 10% for age group 90-94, and 25% for age group 100+.

Historically in the USA, approximately one-quarter of Medicare expenditures are for last-year-of-life (LYOL) care (Hogan et al., 2002; and Lubitz and Riley, 1993), and the ratio of Medicare decedent costs in their last year of life to survivor costs for Medicare beneficiaries (decedent/survivor ratio) steadily declines with age, from over ten times for age-group 65-69 to only four times for age group 85+ (Lubitz and Riley, 1993). The pattern of decreasing end-of-life expenditures with increasing age has been attributed to decisions reached by patients, their families, and their physicians to avoid aggressive care that may have less benefit for older patients (Levinsky et al., 2001).

CMS (2003) investigated the characteristics of Medicare expenditures for care provided in the last year of life from 1994 through 1999, and found that the percentage of Medicare expenditures attributable to those beneficiaries in their last year of life increased from 26.5% in 1994 to 27.9% in 1999, with an upward trend which was inconsistent with prior research. Several factors, changing over time, influence to varying degrees the expenditures for those in their last year of life: practice patterns, including more aggressive medical care that uses a higher intensity of services; improvements in and increased utilization of new technological devices; increased longevity due to innovations in technology and the utilization of improved and new prescription drugs; and family/beneficiary choice in receiving or declining aggressive medical care (CMS, 2003).

Medicare per capita spending was nearly 4-times greater among beneficiaries who died in 2011, on average, than among those who lived the entire year (Kaiser, 2015). Medicare per capita spending among decedents declines with age, suggesting that patients, families, and providers may be opting for less intensive and less costly end-of-life interventions for beneficiaries as they grow older (Kaiser, 2015). This possibility is consistent with the finding that average per capita spending on hospice services among beneficiaries in traditional Medicare increases with age, due to both a larger share of beneficiaries electing hospice at older ages and higher per capita hospice costs for older than younger Medicare beneficiaries who elect hospice care (Kaiser, 2015).

Davis et al. (2016) analyzed administrative claims data for older Medicare beneficiaries who died in 2012 to characterize trajectories of healthcare spending in the last year of life, and identified four unique spending trajectories among decedents: 48.7% had High Persistent spending (high spending throughout the full year before death), 29.0% had Moderate Persistent spending, 10.2% had Progressive spending, and only 12.1% had Late Rise spending. These findings suggest that spending at the end-of-life is a marker of general spending patterns often set in motion long before death (Davis et al., 2016).

MEDE declines with age, and reasons suggested for this include shorter intervals between illness and death and decreased use of acute care, hospitals, and other services with older age at death, as well as less desire among the oldest individuals or their health care providers to use advanced (and expensive) technological methods to prolong their lives (Hoover et al., 2002). To the extent that deceased/survivor

ratios continue to remain constant, the impact of increased longevity on medical expenditures could be mitigated over time, as a smaller percentage of Medicare beneficiaries would experience the higher decedent costs of the younger age groups (Thomas, 1999). However, one would expect that as life expectancies increase, physicians and older patients would become more willing to experience the increased utilization and intensity of services usually attempted only at younger ages, resulting in increased medical expenditure. On the other hand, if the younger elderly become healthier and experience decreased medical utilization, then aggregate medical expenditure would marginally decrease over time.

By using claims panel data of medical spending between 2005 and 2011 from a big German private health insurer, Karlsson et al. (2016) reported that medical spending more than doubled between ages 50 and 80 and the top 10% of all spenders were responsible for 53% of all medical spending in a given year, and that medical spending in the year before death (accounts for 5.6% of lifetime spending) was six times higher for the deceased as compared to spending of everybody else. Concerning the final point, the deceased/survivor ratio for the elderly was five times higher in Japan.

Based on French et al. (2017), which analyzed the medical data of eight countries including the USA and Japan for 2009-2011, (a) spending in the last 12 months of life accounted for 8.5–11.2% of overall spending, (b) spending in the last three years of life accounted for as much as 24.5% of overall costs, which suggests that the focus should be on reducing the costs of caring for people with chronic conditions—many of whom are approaching death.

Even though end-of-life expenses are potentially quite large, in most developed countries, including the US, they only constitute around 10% of aggregate medical spending (French et al., 2019). The high level of medical spending immediately before death is part of a pattern of elevated medical spending for several years prior to death, consistent with many end-of-life treatments being for chronic conditions (French et al., 2019).

(c) Impact of end-of-life expenditure on age-related medical expenditure profile

Proximity to death may have more important influence on medical expenditure than age, as hospital costs increase significantly in the final months of life for an average individual regardless of their age. Therefore, part of the reason that per capita medical expenditure is higher at older ages may be that mortality rates are higher at older ages.

Medicare per person spending rises steadily with age, more than doubling between ages 70 and 95 in 2011, and peaking at age 96, before declining for the relatively small number of beneficiaries at relatively older ages (Kaiser, 2015). The cost of care for Medicare beneficiaries who died in 2011 contributes to higher average per capita Medicare costs at all ages, but does not alter the pattern of per capita spending nor does it affect the peak age of Medicare spending in 2011 (Kaiser, 2015). And over time, Medicare per capita spending has peaked at older ages, from age 92 in 2000 to age 96 in 2011, based on inflation-adjusted dollars (Kaiser, 2015).

If we deduct medical expenditure devoted to the deceased elderly during the period concerned, the age pattern of per capita medical expenditure has changed remarkably, which is of great significance to the rapid ageing of the population in Japan. Per capita medical expenditure does not simply increase with age increase. Therefore, it could be more expedient to deal with the issue of terminal care expenditure from the point of view of an equitable and efficient distribution of medical resources among age groups, and between surviving patients and those in terminal care (Fukawa, 2000).

Per capita medical expenditure for the very old age group may be higher in Japan compared to the other developed countries. This suggests that Japanese elderly patients tend to receive more intensive care than they wish (Fukawa, 2015). Patients often prefer a more conservative pattern of end-of-life care than they

actually receive, and it is quite important to ensure that patients and their families engage in discussions of their preferences before they become seriously ill and that providers respect these preferences (Fukawa, 2015).

(d) Concluding remarks

As people get older, they are more likely to live with multiple chronic conditions and functional limitations, and it is not surprising that per capita medical expenditure increases with age. The age-related profile of medical expenditure shows a peak at a certain age and declines afterwards, but age-related profile of health expenditure (including LTC) continues increasing with age increase. This seems to be a norm in developed countries, but Japanese medical expenditure is an exception. Expected saving may be modest if age-related profile of medical expenditure would be modified in Japan, but the issue is whether old patients are getting the appropriate mix of services as they age.

The prerequisite for asking solidarity contribution to finance solidarity benefits is that the social security system is consistent and fair, and the purpose of the system is supported by the general public (Fukawa, 2009). The existing coupling of funding to the wages and salaries has shown weakness, not fully taking the changes in the job market into account (Fukawa, 2009). Concerning the financing of medical insurance systems, options such as increasing contribution rate instead of increasing patient’s cost-sharing, introducing multiple benefit rates according to kinds of services, and eliminating certain types of services from the benefit catalogue should be seriously considered in order to increase the sustainability of the system.

The sustainability of medical systems also depends on the attitude of the people. People wish for quality medical services, and they may pay higher prices for better medical services. People must accept greater responsibility for lifestyle-related diseases. The scale of social security does matter, but the utility of the people will differ depending on contribution and benefit structure of social security, even if the scale of it is the same (Fukawa, 2009). Focusing on ways to improve the management and coordination of care for high-need, high-cost patients will be essential to meet the needs of an aging population (Kaiser, 2015).

(Note 1) A database called the National Database of Health Insurance Claim Information and Specified Medical Checkups was used. A patient’s Health Insurance claim information file is issued monthly per medical facility, and longitudinal data for each patient has been compiled as a national database since the 2010s.

(Note 2) This section is a revision based on Fukawa (2019).

(Note 3) Case 1 followed French model and case 2 followed Swedish model in Figure 1. Expenditure profile after peak was made according to the following assumption:

Age Group	85-89	90-94	95-99	100+
Case 1	-	2.5	2.2	1.9
Case 2	2.8	2.4	2.1	1.8

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