

The Economics of End-Of-Life Health Care

by

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PRELIMINARY AND INCOMPLETE

Section 1: Introduction

Medical care at the end of life often encounters skepticism from payers and policy makers who question their high cost, and often minimal health benefits. Indeed, many studies have found that a large share of overall life-time spending on medical care, about a quarter, occurs at an individual's last year of life, regardless of whether that care is privately or publicly financed (Hogan et al. 2000; Lubitz and Riley 1993). It therefore seems generally agreed upon that medical resources are being wasted on excessive care at the end-of-life treatments that often only prolong an already frail life. This excessive care at the end of life partially affects the overall distribution of the spending on health care as it is highly skewed, and the average spending level is driven by the few biggest spenders. This is often driven by extreme spending levels on dying individuals. For example, it has been estimated that about close to half of the overall spending on old individuals in the US stems from the top 5 % of the spending distribution (Garber et al (1998)).

From an economic standpoint, it seems obvious that much of this extreme end of life-spending is irrational in the sense that the value of a life year is often estimated to be in the range of 100K, but overall spending in extending life a few months near death can sometimes be in the millions. Indeed, it can be argued that this vast misallocation of resources induced by excessive end of life health care has important consequences for the overall economy as end of life care makes up a substantial share of the 16% or so of the economy spent on health care. This over-spending on terminal care also has important implications for the public programs, such as Medicare and Medicaid in the US, that pay for much of this excessive end of life care, as well as Social Security, which ends up financing the longer living it induces.

However, though many observers have claimed that such spending is often futile, irrational, and wasteful, little explicit and systematic analysis exists on the incentives that determine end of life health care spending. More importantly, there exist no positive theory that attempt to explain the high degree of end-of life spending and why differences across individuals or time occur in such spending. We argue that such a positive analysis is the prerequisite before any normative claims can be made and before any policy proposals aimed at limiting such care can be justified on an efficiency basis.

In this paper, we attempt to provide a first systematic analysis of the incentives behind end of life care. The main argument we make is that existing estimates of the value of a life year do not apply to the valuation of life at the end of life. The main issue is that existing estimates of the value of a life year, e.g. from labor market studies, product demand studies, or regulatory studies, are inapplicable to the valuation that takes place near end of life. In particular, several forces operate in allocating resources towards extending life at its end that implies that the value of extending life in those situations appear larger than those estimated in the literature.

First, if resources are invaluable when dead, a self-interested individual would be willing to forego his entire wealth to extend his life when dying, even if the extension was

minimal. A substantial amount of spending is rational when there is no value of leaving wealth behind. We stress that often end of life care involves infra-marginal valuation, rather than the marginal valuations estimated in the literature. When there is non-linearity in the willingness to pay, as when one values life more on the margin the less one has of it left, then the infra-marginal tradeoff relevant for end-of life care differs from aggregating the marginal valuations estimated in the empirical literature. Indeed, many times when the concept of the value of a statistical life is brought up, it is prefaced with claiming that it is not about how much people are willing to pay to avoid the infra-marginal choice of having a gun put to their head, which is clearly related to ones wealth. However, terminal care decisions are often of exactly that nature and the non-linearity therefore matters.

Second, we argue that an important ignored component of spending on end-of-life care concerns preserving “hope” of living, and that preserving hope raises valuation. We define the value of hope explicitly as the *current* consumption of *future* survival. If a patient is given 6 months to live, he values those 6 months less than if he was given the chance to live after that. We derive how this value of hope raises the willingness to pay for what appears as otherwise futile treatments. This is because increased survival in the future is now “double-counted” as both having a current consumption value in addition to its traditional future consumption value. A related issue of the value of future survival would be in the option value of seeing a new treatment being discovered before ones death. The late Christopher Reed devoted much time and resources of the last part of his life finding a cure to save himself, but even when others invests, the option value of future cures may still be high.

Third, the *social* value of a life is often greater than the *private* value of the same life. However, empirical estimates of the value of a life year concerns only private valuation¹. If the extension of a given persons life has positive external effects on others (family members, altruistic tax-payers, or interest groups benefiting from public provision of care), larger spending than what is privately optimal, and estimated, would be observed. Indeed, as the willingness to pay for life extension is limited privately by ones wealth, the mere existence of the Medicaid program for the poor seems inconsistent with a private valuation approach being relevant, as it would be infeasible for those patients to pay the end of life care they receive.

Lastly, we argue that rational terminal care often is larger for frail patients than commonly argued. In particular, we show when the value of life-extension is the same regardless of the “quality” of life of the patient whose life is extended. Therefore, even though a person may be frail and in very ill health, it may nevertheless be rational for him to value life-extension as much as a perfectly healthy person. There is a vast health economic literature arguing that there is less value in prolonging a life of lower quality, as is the driving assumption of so called “quality-of-life-year” (QUALY) analysis. However, we argue that rational terminal care may often involves spending equally much for extending the life of a very frail person as it does for a perfectly healthy one.

¹ See Philipson et al (2003) on the general R&D implications of a wedge in the social and private value of health care.

In summary, our theory differs from previous analysis by attempting to understand the high, indeed often extreme, spending levels we observe for terminal care and explaining why such spending levels are often order of magnitudes higher than existing empirical estimates of the value of a life.

The paper may be briefly outlined as follows. Section 2 discusses the non-linearity of the value of life. Section 3 discusses how the value of hope raises spending. Section 4 discusses altruism within and across families affects terminal care. Section 5 discusses the impact of quality of life on rational terminal care. Lastly, section 6 concludes and discusses some implications of our analysis for so called cost-effectiveness analysis in adopting new medical technologies.²

Section 2: Rational Terminal Care and the Non-Linearity of The Value of Life

Consider the indirect utility function $V(Y,S)$ of an individual with lifetime wealth Y and survival function S . For example, this indirect utility function may be the one resulting from a canonical consumption problem:

$$V(Y, S) = \max \int_0^{\infty} \exp(-\rho t) S(t) u(c(t)) dt \quad (1)$$

subject to

$$Y = \int_0^{\infty} \exp(-rt) S(t) y(t) dt = \int_0^{\infty} \exp(-rt) S(t) c(t) dt, \quad (2)$$

where $y(t)$ is income at age t , $c(t)$ consumption at t , r and ρ is the interest rate and time-preference, and where the budget constraint, for now, implicitly assumes the existence of a complete contingent claims market.

For any such indirect utility function V , consider how much an individual would be willing to pay for a product that changed his survival function from S to S' . If we denote this amount by $v(S', S)$, the payment satisfies³:

$$V(Y - v(S', S), S') = V(Y, S). \quad (3)$$

This *infra-marginal* valuation formula differs from the existing value-of-life methodology used in the empirical literature which considers *marginal* changes in life-gains.

² The literature is vast, but for examples, see Weinstein and Stason (1977), Johanneson and Weinstein (1993), Gold et al. (1996), Meltzer (1997), Drummond et al. (1997), Garber and Phelps (1997), Garber (2000), Cutler and McClellan (2001), and Cutler (2005).

³ An analogous argument occurs if the individual is asked to value a probability distribution over a set of feasible survival functions induced by treatment.

This basic equality has remarkably strong implications for the economic value of raising survival for people who are near their end of their life. In particular, consider the value of a gain in survival to S' for an individual who is near his end of life, approximated by his existing survival function satisfying $S = 0$. The value of this survival gain satisfies:

$$v(S', 0) = Y \text{ for all } S' \quad (4)$$

This strikingly simple implication states that an individual is willing to pay his entire wealth for any gain in survival. In particular, the individual is willing to give up all his wealth *no matter how small the gain in survival is*. Put differently, as there is no value of leaving resources behind when dead, an individual is willing to spend all of his wealth to prolong life. This is an extreme implication induced by the complementarity between consumption and longevity (see Dow et al (1999)); as consumption is worthless without life, all of it will be sacrificed to gain more life.

More generally, there may be inherent non-linearities in valuation of life that makes aggregating up the value of life-savings from estimated marginal values inappropriate. To see this, consider a parameterization of the survival function $S(b)$ by a parameter b that increases survival at each age. Then define the infra-marginal value of life $v(b)$ from increasing the value of this parameter from some initial level a to b is defined by

$$V(Y - v(b), S(b)) = V(Y, S(b)).$$

The implicit function theorem implies that the marginal value of raising the survival satisfies

$$v'(b) = [(dV/dS)(dS/db)] / (dV/dY)$$

There is no reason why this marginal valuation should be constant across levels of survival. This is the implicit assumption when aggregating up the value of life-improvements from marginal valuations by multiplying life years gained with a constant marginal value of life of, say, \$100 thousand.

Section 3: The Value of Hope in Terminal Care

Many observers of end of life care claim that some notion of “hope” is important for patients to invest time and money into staying alive. We formalize the value of hope as stemming from the current consumption of future survival; the person values knowing today that there is chance of living tomorrow. If certain death was known to prevail tomorrow the person would be without hope and thereby enjoy living less today. This is incorporated into the previous analysis by letting current utility being an increasing function of survival. Consider the case when this takes the linear form

$$U(S, c) = H E + U(c)$$

where H is the marginal value of hope and E is the life-expectancy induced by the survival. For the canonical consumption problem above the present value of expected utility now satisfies

$$V(Y, S; h) = A H E + V(S, Y)$$

where A is the value of a life-long annuity and $V(Y,S)$ is the value function from before. If we denote by $v(H)$ the infra-marginal value of life as a function of the value of hope this satisfies

$$V(Y-v(H),S')-V(Y,S) = H[AE - A'E']$$

The left hand side is simply the standard definition of the infra-marginal value of life and the right hand side falls with the value of hope and the infra-marginal change in survival. Consequently the function $v(H)$ would be increasing so that the infra-marginal value of life rises with hope. Whenever, future survival is valued in terms of current consumption Future survival gains are 'double counted' in their value; they affect the value of future consumption in a standard manner but in addition also raise s the value of current consumption. This double counting implies may take place more so in end of life care decisions than in the labor- or product market setting where marginal valuations of life are estimated.

[TO DO: Discuss formally why hope not picked up in the empirical literature but nevertheless affects terminal care decisions?]

5.2: The Supply Side Impact on Hope

Future survival may not have consumption value in itself but may be valued nonetheless through its effect on being able to take advantage of future technologies developed while being in a diseased state is treatment effect heterogeneity in life-saving therapies, then variance is valuable when there is an option value in taking advantage of future R&D.

[TO BE COMPLETED]

Section 3: The Social vs Private Value of Life

The previous section considered a self-interested individual in isolation, which is the concern of existing empirical work on the statistical value of a life. This strand of work measures the private value of a life year by considering labor market tradeoffs and product market demand. This section considers the social value of a life, when there is altruism within and across families.

3.1 Altruism within Families

Altruism within families operates in two ways in affecting the value of life. First, altruism towards children means that the value of life is reduced by bequest motives as the person dying values resources left behind. Second, altruism from children raises the value of life as the more than the person surviving who value the person's survival.

More precisely, consider when a parent and child share the payment $v(S,0)$ according to $(s,1-s)$ that is undertaken to have the parent face survival S and not $S=0$. If the wealth levels of the parent and the child are (Y_p, Y_c) then the this reservation payment level v is defined by

$$(1+a_c)V(Y_p-sv,S)+(1+a_p)V_c(y-(1-s)v)=(1+a_p)V_c(Y_p+Y_c)$$

Here a_c is the altruism of the child towards the parent and a_p the altruism of the parent towards the child. The right hand side is the child's welfare when no treatment is undertaken, the parent dies, and all the wealth of the parent is bequested. The left hand side is the joint welfare of the two when the payment is shared. This may be rewritten as

$$(1+a_c)V(Y_p-sv,S)=(1+a_p)[V_c(Y_c+Y_p)-V_c(Y_c-(1-s)v)]$$

This simply equates the gain in welfare of the parent surviving with the foregone consumption of the child. Clearly, for large enough altruism of the child and low enough altruism of the parent, we may have that altruism raises the willingness to pay above self-interested levels

$$v > Y_p$$

and for low enough altruism if the child and high enough altruism of the parent, it lowers the willingness to pay beyond self-interested levels

$$v < Y_p$$

If altruistic spending raises with income, the two side nature of altruism may therefore even raise spending above wealth levels of the sick individuals if the children are richer than the dying parent.

[TO DO: Improve this section].

3.2 Altruism across Families and Pay-As-You-Go (PAYG) Health Care

Consider the public pay-as-you-go insurance that finances most health care spending in the developed world. It is a natural extension of the analysis under altruism with children, now each parent being supported by the average child in the economy as opposed to their own child in the previous section.

The analysis is therefore analogous to multiple children that exhibit heterogeneous altruism among them towards the parent as well as from the parents towards them. Within family altruism is stronger than across family altruism. This case may represent an economy where altruism motivates public health care spending but altruism is stronger within families than between families. Therefore, altruistically induced and PAYG financed terminal care have many features similar to the analysis of a single family above.

More precisely, consider when there are $i=1, \dots, N$ children and the biological child is indexed $i=-1$. Assume each child has an equal tax-burden of s_i to pay for the care of a given old individual to get the survival S rather than $S=0$. Then the condition for the reservation price becomes

$$(1+ \sum a_{ci})V(Y_p-sv,S) = (1+ \sum a_{pi})[V_c(Y_c)-V_c(Y_c-s_iv)]$$

Where a_{ci} is the altruism of child i towards the dying adult and a_{pi} is the altruism of the dying adult towards child i . If there is more altruism among biological children then $a_{c1} > a_{c2}$ and $a_{p1} > a_{p2}$ for all $i > 1$.

Again it is the relative altruism of the old relative to the young that matter for whether a PYAG financed health care program has a larger value of saving an adult from dying compared to the adult himself. If, as seems reasonable, younger generations cannot tolerate old people dying without using life-saving technologies more than the older generations care about making younger generations poorer, then optimal spending levels may be well beyond the wealth of the dying person.

Section 5: The Quality of a Life Year and The Value of Extending It

In this section we analyze rational terminal care as a function of the level of health or “quality” of life. We stress that terminal care often is larger for frail patients than commonly argued. Even though a person may be frail and in very ill health, it may nevertheless be rational for him to value life-extension as much as a perfectly healthy person. A special case of this is the analysis above where the opportunity cost of wealth is zero for a dying self-interested individual, regardless of whether that individual is frail or healthy.

Valuation of a Quality Dependent Life

More precisely, consider when the utility function $U(c,q)$ is extended to depend on both of consumption c and quality of life (health) q . We assume that the value of consumption rises with health so that both partials of U are positive. For a given quality of life, consider the indirect utility function no discounting and perfect capital markets so that full consumption smoothing takes place over time

$$V(Y,S)=AU(Y/A,q)$$

The infra-marginal value of life $v(q)$ for a given level of quality q is then defined by

$$A'U(Y/A'-v(q),q)=AU(Y/A,q)$$

This has the direct implication that the quality of life has two *offsetting* effects on the value of life; it raises it by raising the level of utility under the improved survival (left-hand side) because living longer is enjoyed more when the quality of that life is higher. However, note that it also raises the value of the remaining at the lower survival (right-hand side). Therefore, a higher quality of life means the new life is enjoyed more but also means the old life is through the value of foregone consumption. Dependent on the complementarity between consumption and the quality of life, the value of life $v(q)$ may be falling or rising in the quality of life. In the case of particular utility functions, the two effects will be fully offsetting making the value of life independent of the quality of life; $dv(q)/dq=0$.

Section 6: Savings and Non-Insurability

The previous analysis assumes that there are complete contingent claims markets so that *consumption insurance* can take place across different life-spans. Such insurance in consumption should be separated from *lifespan-insurance*, which is unlikely to be complete because of technological constraints in medical technologies.

[Gary and Kevin Insert New Section if You Want]

Section 7: Conclusion

Despite the skepticism medical care at the end of life often encounters from payers and policy makers, it may be rational. We analyzed the incentives giving rise to larger spending levels on terminal care than the value of life estimated in the empirical literature. We stressed the low opportunity cost of spending near death, the importance of hope, the social value of life, as well as the insignificance in quality of life in lowering its value. Our analysis differed from previous analysis by attempting to understand the high, indeed often extreme, spending levels we observe for terminal care and explaining why such spending levels are often order of magnitudes higher than existing empirical estimates of the value of a life.

Our analysis has important implications for using so called cost-effectiveness criteria in adopting medical technology in private and public plans. CE analysis has been the major method proposed to evaluate new inventions and has been argued to be central in managing new technologies, their adoptions, and their impact on long term health care spending. Examples include cost-effectiveness using spending per quality- or disability adjusted life years, as is common by public buyers outside the US, or cost-benefit analysis monetizing mortality reductions through value-of-life estimates, as is common in studies assessing the gains of increased health care spending. In general, our analysis stressed the incentives that implied larger valuations than simply multiplying out the average treatment effect on survival from a technology by estimates of the value of a life year from existing studies using private and marginal valuations.

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