The Economics of CANCER CARE

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This book examines the interaction of economics and the delivery of cancer care in the global context. It analyses the causes of tension between those paying for care, those providing the care and those marketing drugs and devices for cancer. The concept and requirement for rationing is examined in different economic environments. As cancer increases in incidence and prevalence, the economics becomes a far more important subject than ever before. Written by a leading health economist and oncologist, this is the first comprehensive book on the economics of cancer and is a must have for health professionals and policy makers alike.

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Contents

1

The challenge of cancer

Introduction

The title of this book, *The economics of cancer care*, raises important questions: Why are we interested in the economics of cancer care? And why are we especially interested *now*? This book will explore these two principal questions. First, it will review the current scientific literature on the economics of cancer care. The literature on the economics of cancer care is sparse and has received very little attention from the mainstream health economics field. Both the authors have reviewed the leading journals in the health economics and health policy field for the last 5 years. This has accrued 14,415 papers on the economics of cancer care since 1950, yet the subject remains noticeable by its absence in leading textbooks on cancer care. This compares with a total of over 16 million papers on cancer care and 85 million web sites on cancer. Only in a few specialised areas such as the cost-effectiveness of screening for breast cancer has there been much research.

Within health economics, most disease-specific work has been on the development of new drug therapies. The vast majority of the literature for the established programmes, especially in Europe, is generic and system-wide. The research has tended to focus on the cost-effectiveness of specific therapies with far less attention paid to the economics of choice at various stages of cancer treatment. However, there are fundamental reasons why the economic dimensions of cancer care need urgent attention.

Why the economics of cancer care deserve urgent attention

Increased prevalence due to longer survival is raising the cost of cancer care and creating new funding options for longer-term care and treatment programmes.

There is a continuous flow of new and very expensive therapies both in chemotherapy and in radiotherapy. The cost of drug therapies in oncology

within the USA has risen by tenfold since 1991 compared to a rise of threefold for all other therapies. Within radiotherapy a course of brachytherapy for prostate cancer can cost more than twice as much as the older therapy, which it replaced.

There are new and compelling reasons for re-engineering services; in order to improve communication with patients; provide longer-term care programmes; enable more targeted treatment; and invest in infrastructure and staff skills to effectively use the new direct therapies.

There are system-wide issues about how to achieve results from the developing model of care, which is at the core of a national cancer strategy. Specific initiatives to address the important problems associated with prevention and care over the past two decades can now be distilled into a single model, which all countries (north/south from Finland to Chile and east/west from Japan to the USA) are seeking to use. The main stages are:

- prevention,
- screening,
- treatment,
- continuing care and risk management,
- palliative care.

Most of the research has been conducted *within* stages yet increasingly there are important interactions *between* stages. Prevention is the most cost-effective way of reducing cancer: successful prevention will reduce the incidence of a type of cancer (smoking cessation has reduced the number of new cases of lung cancer). However, if prevention is not so easy (as in the case of prostate cancer, for example) then early detection from screening and the prospect of increasing survival rates create a plethora of problems to overcome.

Increasing screening is difficult and costly to organise on an effective basis. It requires a sizeable expansion in diagnostics and early-stage treatment. Treatment per patient is becoming increasingly costly as treatment combinations with different mixes of; surgery, radiotherapy and chemotherapy are being used. The area of treatment may begin to show greater differences within the "cancer industry", for example, between treatment for early-stage cancers detected through screening and the treatment of recurrent or faster acting types of cancer. These two "industries" may come to differ in their location, their staffing dynamics and their use of generics, as well as in their expected outcomes. The challenges of preventing recurrence, improving quality of life,

Box 1.1: The challenges for future cancer care

1. Increasing the focus on prevention.
2. Improving screening and diagnosis.
3. New targeted treatments: How effective and affordable will they be?
4. Personalised medicine for cancer: delivering the diagnostics.
5. How people's expectations will translate into care delivery.
6. Reconfiguration of health services to deliver optimal care.
7. Geographical distribution of services: How close to people's homes?
8. Integrating public, private and charitable providers.
9. The impact of reconfiguration on professional territories.
10. The changes in the doctor–patient relationship.
11. Will society accept the potential financial burden?

and risk management, represent a rapidly growing area for cancer professionals where better communication with patients is urgently required. The model is likely to raise the need for long-term palliative care, which is currently underprovided in many existing systems of care (Box 1.1).

The prognosis for early-stage cancers has improved greatly over recent decades with the exception of lung cancer. Five-year survival rates for most early-stage cancers in the USA and Europe are now 90% or more (see Table 1.1). Further improvements are required both in survival and in improving the quality of life of survivors. However, these will require effective strategies to use the stage model to detect more cancers at an early stage and to target costly new therapies on "hard-to-cure" cancers. We write with optimism about the potential for further improvement and wherever possible we point to successes.

This book represents collaboration between an economist and a clinician. We have tried in the specific chapters to develop a dialogue between the "desire to cure every patient" spirit of the clinician, and the practical and more analytical questions raised by economists who recognise that there is not a "never-ending pot of money" to treat cancer, and that cancer is not the only cause of mortality and morbidity. Medical research and innovation develops the potential for new services: the take-up and speed of diffusion depends on economic incentives. Once an innovation is taken up the incentives may then contribute to the selection of different kinds of innovation. There are tensions between the absolutism of the medical demand for rapid take-up of costly new therapies and devices, and the counter forces of funding, regulation and provider

Table 1.1. US data on the benefits (5-year survival rates 1995–2000) of early diagnosis for major cancers

	All stages 5 year (%)	Localised 5 year (%)	Regional 5 year (%)	Distant 5 year (%)	Unstaged 5 year (%)
Prostate (M)	99.3	100.0	–	33.5	81.3
Colon and rectum*	63.4	90.5	67.9	9.4	35.2
Urinary bladder*	81.7	89.7	36.9	5.5	59.0
Non-Hodgkin lymphoma*	59.1	71.5	63.5	47.7	66.3
Breast (F)	87.7	97.5	79.1	20.4	56.7
Corpus and uterus (F)	84.4	95.8	67.0	22.5	56.0
Lung*	13.2	48.8	22.8	3.3	8.7
Cervix uteri (F)	72.7	92.2	55.1	17.2	59.2
Ovary (F)	44.0	94.2	77.6	28.5	23.9
Kidney and renal pelvis*	63.9	90.9	59.7	9.5	31.6
Stomach*	23.3	59.9	23.9	3.3	12.6

*Male and female combined.

Five-year survival rates, US

	Men			Women		
Type of cancer	1975–1979	1995–2000	Change (%)	1975–1979	1995–2000	Change (%)
All	42.7	64.0	21.3	56.6	64.3	7.7
Lung	11.6	13.6	2.0	16.6	17.2	0.6
Colon and rectum	50.3	63.7	13.4	52.3	63.1	10.8
Kidney and renal pelvis	51.8	63.7	12.1	51.3	63.9	12.6
Breast				74.9	87.7	12.8

Source: Jemal, 2004.[1]

resistance. For each treatment stage we have sought to identify both the opportunities in new therapies and the likely impact of economic incentives.

Our work with funders and professionals in Europe and the USA has convinced us that in order to improve services, change is inescapable. A new kind of cancer service is required and linear development of the old UK/European model will lead to great losses to patients and frustration to professionals as we fail to use new therapies effectively. New bottlenecks and communication problems will emerge as development of screening programmes, clinical governance and patient awareness raise demand faster than even enlarged services of the older types can deliver.

Our study draws on the work already being done to develop the new model. We pay tribute to the WHO's World Cancer Report which is our starting point. We hope to show that changing direction is both feasible and fundable. In the words of the Chinese sage Sun-Tzu:

> It is a matter of strategic positioning that the army that has this weight of victory on its side, in launching its men into battle, can be likened to the cascading of pent-up waters thundering through a steep gorge.[2]

The economic future of cancer care

Here we examine the economic future of cancer care; its incidence and prevalence; effects on global health; treatment methods; health and social care delivery structures; financial mechanisms; and its impact on society. We construct a series of alternative futures created by the potentially different levels of success of new technology, willingness to deal with the financial consequences and the capacity of society to adapt to the wider impact. We have tried to create a vision of the economic future of cancer and capture it in a concise format for health policy-makers, health and social care providers and purchasers, the health media, politicians and those professionals involved in delivering future cancer care.

Incidence of cancer set to increase

The incidence of cancer is increasing and is set to rise further. An ageing population will contribute more to this over the next two decades in Asia and Europe than in the USA. For the UK, incidence rates for all cancers will

Table 1.2. Mortality worldwide in 2000 – numbers of deaths (1000s)

Type of cancer	Male	Female	Both
Oesophagus	226.9	110.6	337.5
Colon/rectum	405.2	241.4	646.6
Liver	383.6	165.0	548.6
Pancreas	112.0	101.5	213.5
Lung	810.4	292.7	1031.1
Prostate	204.3	–	204.3
Breast	–	373.0	373.0
Cervix	–	233.4	233.4
Total	**3522.4**	**2686.3**	**6208.7**

Source: Parkin et al., 2001.[3]

rise by 2.5% per year in the over the age of 75 years. The age factor alone will increase patient numbers significantly over the next two decades. Improvements in screening and in diagnostics will also contribute to rising incidence especially for breast, prostate and colo-rectal cancers. Since 2000 it is estimated that 46% of men and 36% of women in the USA would be diagnosed with cancer in the course of their life spans. These probabilities are set to rise further with increasing incidence. Worldwide mortality is already high (Table 1.2).

Prevalence of cancer set to increase

Improved survival will increase prevalence especially as lung cancer (where survival rates are very poor) becomes less common. For the USA, the number of cancer survivors has risen from 3 million in 1970 to 10 million in 2000 and numbers are set to double as the full effects are felt of shifts to slower growing, less-aggressive cancers (prostate) and better survival through earlier detection. There will be a dramatic increase in global cancer prevalence over the next 20 years because of ageing populations.

Technological advances

The targeting of therapy will continue to improve and should achieve a more localised destruction of cancers with greater certainty and fewer adverse effects.

Minimally invasive surgery will reduce the need for routine organ resection without compromising survival. The application of sophisticated computer systems to radiotherapy planning will allow the precise shaping of beam delivery conforming exactly to the shape of the tumour. The increased precision of both these local modalities of tumour ablation will bring additional costs and the requirement for increasingly skilled technical manpower. Some of this time will come from new sources such as the outsourcing of complex radiotherapy planning through web-based links from the USA to groups of physicists and radiotherapists in India. The emergence of China as a massive information-based technocracy will have a huge impact on global service provision over the next decade simply because of its numbers of highly educated and skilled people working within a unique hierarchical social structure. Even so, costs of treatment are likely to increase both with rising incidence and increased intensity of treatment.

New chemotherapy drugs

Chemotherapy will be the area of greatest change. Expanding knowledge on the molecular genetics of cancer will impact on prevention, screening, diagnosis and treatment and drug discovery. There is much more understanding of the basic biological processes that become disturbed in cancer. We now know the key elements of growth factor binding, signal transduction, gene transcription control, cell cycle checkpoints, apoptosis and angiogenesis. This has widened options for drug discovery. The process is to identify novel targets known to be altered in cancer. This approach has already led to a record number of novel compounds currently in trials. Over the next decade there will be a marked shift in the types of agents used in the systemic treatment of cancer. Because we know the precise targets of these new agents, there will be a re-orientation in how we prescribe cancer therapy. Instead of defining drugs for use empirically and relatively ineffectively for different types of cancer, we will identify a series of molecular lesions in tumour biopsies. Future patients will receive drugs that target these lesions directly. The human genome project provides a vast repository of comparative information about normal and malignant cells. The new therapies will be more selective, less toxic and be given for prolonged periods of time, in some cases for the rest of the patient's life. We will convert cancer into a chronic, controllable illness similar to diabetes today.

Table 1.3. Summary of research on the value of medical technology changes

Condition	Years	Change in treatment costs	Outcome change	Value	Net benefit
Heart attack	1984–1998	$10,000	1 year increase in life expectancy	$70,000	$60,000
Low-birth weight infants	1950–1990	$40,000	12 year increase in life expectancy	$240,000	$200,000
Depression	1991–1996	$0 <$0	Higher remission probability at some cost for those already treated	More people treated with benefits exceeding costs	Highly positive
Cataracts	1969–1998	$0 <$0	Substantial improvements at no cost increase for those already treated	More people treated with benefits exceeding costs	Highly positive
Breast cancer	1985–1996	$20,000	4 months increase in life expectancy	$20,000	$0

Source: Cutler and McClellan, 2001.[4]

Individual cancer-risk assessment

Individual cancer-risk assessment will lead to tailored prevention messages and a specific screening programme to pick up early cancer. This will have far reaching implications for public health. Cancer preventive drugs will be developed to reduce the risk of further genetic deterioration. The use of gene arrays to monitor serum for fragments of DNA containing defined mutations could ultimately develop into an implanted gene chip. When a significant mutation is detected, the chip would signal the holder's home computer and set in train a series of investigations based on the most likely type and site of the primary tumour. Over the last two decades the evidence on the effectiveness of new therapies has been mixed. There have been some very positive gains for early-stage cancers but overall costs increased rapidly while survival showed only small increases. Thus Cutler and McClellan showed a contrast with other forms of therapy where results were highly favourable (Table 1.3).

New therapies are likely to face more stringent tests on value for money and cost-effectiveness.

Paying for cancer care

Cancer care was a declining proportion of total US health care costs from 1970 to 1995 but since then costs have started to rise rapidly.

The funding of cancer care will become a significant problem in all countries, rich and poor alike. Already we are seeing differences in access to the taxanes for breast and ovarian cancer, gemcitabine for lung and pancreatic cancer, and herceptin for breast cancer. Indeed, during the previous 2 years no less than five expensive therapies have been approved for marketing in the USA by the Food and Drug Administration. These drugs are only palliative, adding just a few months to life. The emerging compounds are likely to be far more successful, and their long-term administration will be considerably more expensive. Increased consumerism in medicine will lead to increasingly informed and assertive patients seeking out novel therapies and bypassing traditional referral pathways through global information networks. It is likely that integrated molecular solutions for cancer will develop, leading to far greater differences in access to treatment than at present. Novel financial structures constructed by consortia of the pharmaceutical, insurance and health care sectors will enable future patients to choose the levels of care they wish to pay for by insurance schemes or directly.

Projection of the future in cancer care

Eventually chemotherapy is likely to replace other treatment modalities for most cancers. Cancer will become a chronic, controllable illness rather like diabetes or hypertension today. Biomarkers of response will be used to guide, titrate and monitor chronic therapy. People living with cancer will receive care in an attractive hotel-like environment rather than a hospital, run by competing private sector providers. Global franchises will emerge using the web to disseminate treatment plans and control their quality. Many state health care systems will become regulators and insurers so eventually relinquishing their role as providers by 2010. This transition will bring new ethical and moral dilemmas. The alternative futures will be created by the interaction of four complex factors: technological success, society's willingness to pay,

future health care delivery systems and the financial mechanisms that underpin them.

Societal and political pressures

The ageing of the population will also mean that it is far more likely that individuals affected by cancer and their carers' will have multiple diseases. This will affect both the treatment opportunities and the care services needed during and after treatment. Predictions for the main causes of death and disability 20 years hence suggest that worldwide, the top five causes of death will be; ischaemic heart disease, cerebrovascular disease, chronic obstructive pulmonary disease, respiratory infections and lung cancer. Disability will be mainly due to cerebrovascular disease, ischaemic heart disease, cancers and neuropsychiatric conditions. It is debatable whether lengthening life expectancy will be disability-free, or whether the added years of life will bring with them more years of life lived with disability. If the latter, demand for tending care will escalate as age-related conditions including cancer evolve from acute to chronic.

The rise in age-related disease and demand for holistic care of the individual will be accompanied by an age-related decline in the workforce: current proposals to abandon a statutory retirement age will not stop us all getting older. The health workforce in developed countries will shrink as cohorts of nurses and general practioners (GPs) become eligible for retirement. The growth of single-person households will reduce the amount of family care available. The workforce available for the "tending trades" will continue to diminish, unless perhaps offset by migration from the new member states of the European union (EU) with youthful populations, the domestication of health technologies, shifting of professional role boundaries and employment of those above current retirement age.

Wealth and cancer incidence

The world is in a period of health transition. Communicable disease (infections) as a major cause of suffering and death is giving way to new epidemics of non-communicable disorders such as cardiovascular disease, diabetes and cancer. Different countries are in different stages of this transition depending on their age structure and economy. Some countries are faced with a double

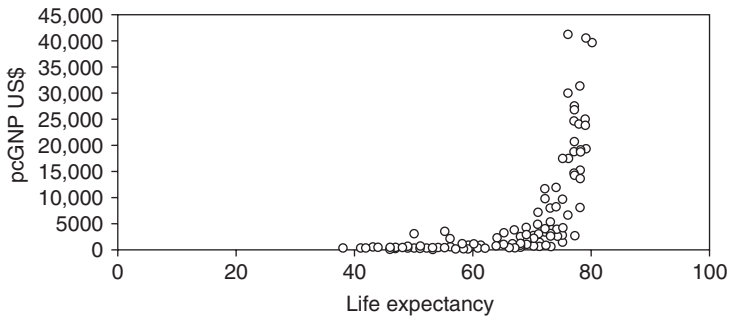
burden with increasing infection problems compounded by surging cancer rates. This is fuelled in part by the globalisation of unhealthy lifestyles. The pace of this change is difficult to predict. The world population is ageing with a predicted average longevity of 73 years by the year 2020 compared with 66 in 1997. It has been estimated that there will be a greater than 100% increase in the population aged over 65 in more than 30 countries. Ageing alone will dramatically increase the cancer burden.

The next 25 years will be a time of unprecedented change in the way in which we will control cancer. However, the optimal organisation of prevention, detection and care programmes, as well as treatment services, is a universal problem in all economic environments. There are clear relationships between current cancer incidence figures for different countries with their relative wealth. Using demographic data we can also predict changes in cancer incidence over the next 25 years and relate this change to relative wealth.

Longevity and wealth

Figure 1.1 examines the relationship between life expectancy at birth for both men and women, and wealth of the 155 countries studied. There is a clear relationship between increasing gross national product (GNP) and longer life. There are relatively large gains for small increases in per capita GNP in dollars (pcGNP$) in the poorer countries, reflecting reduced infant and childhood mortality. Above a pcGNP$ of 1000 the proportional gain in longevity is markedly reduced. This almost certainly reflects the importance of basic measures such as vaccination, good water supply, improved health education and access to simple medical care. After this longevity continues to increase with wealth but increasingly slowly reflecting the biological determinants that cause disease and death in all human populations.

There are two interesting clusters (Figure 1.1). The first are those countries where longevity is significantly less than expected for their relative wealth with a pcGNP$ of above 2000 but a longevity of less than 60 years. These are three African countries: Namibia, Botswana and Gabon. The high level of HIV-related disease is the factor responsible for this. The second cluster are those states with a higher than expected longevity of greater than 65 years but a pcGNP$ of below 1000. These include: Egypt, Thailand, Honduras,



Lower than expected	Higher than expected
pcGNP$ >2000	pcGNP$ <1000
Longevity <60	Longevity >65
Namibia Botswana Gabon	Egypt, Trinidad, Honduras, Nicaragua, Vietnam, Mongolia, Indonesia, China, Surinam, Kyrgistan, Sri Lanka, Tajikstan, Turkmenistan, Uzbekistan, Armenia, Georgia, Azerbaijan, Albania, Macedonia, Solomon Islands

Figure 1.1 Longevity and wealth.

Nicaragua, Vietnam, Mongolia, Indonesia, China, Surinam, Kyrgistan, Sri Lanka, Tajikstan, Turkmenistan, Uzbekistan, Armenia, Georgia, Azerbaijan, Albania, Macedonia and the Solomon Islands. Common factors are efficient public health systems, low infant and childhood mortality and an integrated primary care system. A further confounding factor are the relatively recent reductions in pcGNP$ in these countries caused by changes in external factors and the political structures in such countries. Clearly there is a long incubation period between the factors responsible for longevity and the outcome. Major changes over the last decade will have considerable impact over the next 25 years.

Figures 1.2 and 1.3 show the relationship between wealth and cancer in men and women. There is a clear correlation between increasing wealth and cancer incidence. This is almost certainly due to the influence of tobacco and dietary factors as well as other more complex lifestyle factors together with increased longevity of the population. Exceptions include a cluster with a pcGNP$ of greater than 5000 and a cancer incidence of less than 150 per