

The economic burden of prostate cancer

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In the present review we discuss expenditure on prostate cancer diagnosis, treatment and follow-up and evaluate the cost of prostate cancer and its management in different countries. Prostate cancer costs were identified from published data and internet sources. To provide up-to-date comparisons, costs were inflated to 2010 levels and the most recent exchange rates were applied. A high proportion of the costs are incurred in the first year after diagnosis; in 2006, this amounted to 106.7–179.0 million euros (€) in the European countries where these data were available (UK, Germany, France, Italy, Spain and the Netherlands). In the USA, the total estimated expenditure on prostate cancer was 9.862 billion US dollars (\$) in 2006. The mean annual costs per patient in the USA were \$10612 in the initial phase after diagnosis, \$2134 for continuing care and \$33 691 in the last year of life. In Canada, hospital and drug expenditure on

What's known on the subject? and What does the study add?

Prostate cancer is the most common malignancy in men. Treatment is costly; the majority of men are treated with radiation or surgery, but even watchful waiting strategies are expensive. With increasing life expectancy more men are being diagnosed with prostate cancer, effectively increasing the economic burden of this disease.

This study provides estimates of the cost of prostate cancer for different countries. These estimates could be used to populate models that explore economic costs of treating and preventing prostate cancer. Our review found considerable variation in costs across different countries, which may be due to differences in detection and management practices.

prostate cancer totalled C\$103.1 million in 1998. In Australia, annual costs for prostate cancer care in 1993–1994 were 101.1 million Australian dollars. Variations in costs between countries were attributed to differences in incidence and management practices. Per patient costs depend on cancer stage at diagnosis, survival and choice of treatment. Despite declining mortality rates, costs are expected

to rise owing to increased diagnosis, diagnosis at an earlier stage and increased survival. Unless new strategies are devised to increase the efficiency of healthcare provision, the economic burden of prostate cancer will continue to rise.

KEYWORDS

prostate cancer, economic burden, costs

INTRODUCTION

Prostate cancer is a major public health concern and is associated with significant healthcare costs. It is the second most common malignancy in men, with 782 600 incident cases estimated globally in 2007 [1]. In the USA alone, an estimated 192 280 new cases of prostate cancer occurred in 2009, with 27 360 deaths [2].

With an estimated increase in the elderly population in the industrialized world from 400 million individuals >65 years in 2000, to ≈1.5 billion by 2050 [3], and an apparent increase in the 10-year relative survival rate of those diagnosed with prostate cancer, the economic burden of prostate cancer is predicted to increase markedly [4]. Earlier detection through screening of serum PSA has been successful in identifying men who might benefit from treatment; as a result, many men are now diagnosed earlier and

with lower-stage cancer than was previously the case, effectively increasing the economic burden of this disease [4–6]. The present article aims to evaluate the cost of prostate cancer and its management in different countries.

METHODS

In the present analysis, we considered data on the direct costs of prostate cancer (e.g. diagnosis, treatment and follow-up), which were obtained from publicly available data sources on the internet, e.g. the Bank of England, the London School of Economics and PubMed. To project published direct costs up to recent rates, the 2010 Medical Consumer Price Index published by the Bureau of Labor Statistics was used [7]. Figures were then converted to US dollars (\$), pound sterling (£) and euros (€), using exchange rates (Australian \$1.6508,

US\$1.4436, €1.1667) published by the Bank of England for 18 May 2010. The cost calculations were performed against pound sterling [8].

RESULTS

CURRENT ECONOMIC BURDEN OF PROSTATE CANCER

A summary of prostate cancer cost data is shown in Table 1 [9–17]. In Table 2, where costs in the original currencies have been adjusted for inflation up to 2010 and converted to US dollars and euros. The costs are shown in three categories: annual costs, costs for diagnosis including the first year of treatment, and costs for diagnosis with a total of 5 years' follow-up.

There are limitations to the cost studies presented below. They do not distinguish between active treatment and active

TABLE 1 Summary of published costs associated with the management of prostate cancer

Reference	Region	Year(s) for which costs are reported	Reported cost	
Annual costs*				
Chamberlain <i>et al.</i> [9]	England/Wales	1997	Total costs for prostate cancer £55 000 000 Direct costs for prostate cancer £45 000 000	
Marks <i>et al.</i> [10]	Australia	1993–1994	Total costs for prostate cancer AU\$101 100 000	
Koopsmanschap <i>et al.</i> [11]	Netherlands	1988	Total costs for prostate cancer Dutch guilders 110 000 000	
National Cancer Institute [12]	USA	2006 (projected)	Estimated annual costs for prostate cancer \$9 862 000 000	
First-year costs after diagnosis				
Lazzaro <i>et al.</i> [13]	Italy	2000	Cost per patient €6 600	
Fourcade <i>et al.</i> [14]	Europe	2006	<i>Total cost</i>	<i>Per patient cost</i>
	UK		€116 700 000	€3 171
	Germany		€179 000 000	€4 057
	France		€167 500 000	€5 851
	Italy		€106 700 000	€5 226
	Spain		€114 600 000	€3 256
Roehrborn <i>et al.</i> [15]	USA	2004	Cost per patient \$13 901 (average across cancer stages) ^a	
Diagnosis and treatment costs over 4–5 years				
Sangar <i>et al.</i> [16]	UK	2001–2002	Total cost for PCa £92 740 000 Average cost per pt £7 294.20 Treatment costs; Watchful waiting £1 800 000 Treatment £89 920 000	
Benedict <i>et al.</i> †	Europe	2006	<i>Total costs</i>	<i>Per patient cost</i>
	UK		€269 000 000	£5 984
	Germany		€486 000 000	€10 949
	France		€618 000 000	€9 725
	Italy		€364 000 000	€8 516
	Spain		€198 000 000	€7 753
Stokes <i>et al.</i> [17]	USA	2004 (projected)	Initial treatment \$13 901/patient (average across cancer stages) [15] ^a 4-year follow-up \$18 168/patient (average across cancer stages) ^b Combined prostate cancer costs of \$18 168 for 81 659 patients over an average follow-up of 4 years produced total prostate cancer-specific costs of \$1 483 580 712.	

*Crawford *et al.* [18] provided 2-year costs and, therefore, was not included in this table. †Benedict A, Fourcade RQ, Black LK, Stokes ME, Alcaraz A, Castro RS. Long term costs of prostate cancer: estimates for France, Germany, Italy, Spain and the UK. In preparation. 2011.

^aProstate cancer-related costs only. Total per-patient first-year costs were \$21 040 (\$13 901 prostate cancer-related costs and \$7949 other costs); ^bProstate cancer-related costs only. Total per-patient four-year costs were \$46 751 (\$18 168 prostate cancer-related costs and \$28 583 other costs).

surveillance and, therefore, the costs associated with specialist prostate cancer treatment, as opposed to just disease monitoring, cannot be identified.

As noted, the present review considers the direct cost of prostate cancer diagnosis and treatment, and therefore does not consider indirect costs, such as time and productivity lost through cancer-related illnesses. There are limited data on indirect costs, and

prostate cancer primarily affects older men in whom the disease has less impact on indirect costs, such as productivity loss. While it is also important to consider end-of-life costs associated with prostate cancer, there are limited end-of-life cost data in the literature (e.g. the costs of palliative care, nursing homes, etc.). Furthermore, investigating the impact of the physical and mental suffering both patients and relatives endure during prostate cancer

diagnosis and follow-up is beyond the scope of this article.

ECONOMIC BURDEN IN EUROPEAN COUNTRIES

Economic burden in the first year after diagnosis

Six articles were identified that presented costs for prostate cancer for the UK,

TABLE 2 Summary of prostate cancer costs adjusted to 2010 levels and converted to US dollars, euros and pound sterling

Citation	Country	Cost at 2010 level	US\$	€	£
Annual costs					
Chamberlain <i>et al.</i> [9]	England/Wales	£94 240 004	136 044 870	109 949 813	94 240 004
Marks <i>et al.</i> [10]	Australia	AU\$204 136 795	178 514 585	144 273 321	123 659 314
Koopmanschap <i>et al.</i> [11]	Netherlands	€147 865 973*	182 959 903	147 865 973	126 738 642
National Cancer Institute [12]	USA	\$11 524 053 605	11 524 053 605	9 313 600 264	7 982 857 859
First-year costs after diagnosis					
Per Patient					
Lazzaro <i>et al.</i> [13]	Italy	€10 165	12 578	10 165	8 713
Fourcade <i>et al.</i> [14]	UK	€3705	4 585	3 705	3 176
	Germany	€4741	5 866	4 741	4 063
	France	€6837	8 460	6 837	5 860
	Italy	€6107	7 556	6 107	5 234
	Spain	€3805	4 708	3 805	3 261
Roehrborn <i>et al.</i> [15]	USA	\$17 725	17 725	14 325	12 278
Total prostate cancer					
Fourcade <i>et al.</i> [14]	UK	€136 367 578	168 732 524	136 367 578	116 883 156
	Germany	€209 167 065	258 809 956	209 167 065	179 280 933
	France	€195 728 958	242 182 500	195 728 958	167 762 885
	Italy	€124 682 267	154 273 867	124 682 267	106 867 461
	Spain	€133 913 663	165 696 206	133 913 663	114 779 860
Diagnosis, treatment and 5 years plus follow-up costs					
Per patient					
Benedict <i>et al.</i> †	UK	£6992	10 094	8 158	6 992
	Germany	€12 794	15 831	12 794	10 996
	France	€11 364	14 061	11 364	9 740
	Italy	€9951	12 313	9 951	8 529
	Spain	€9060	11 210	9 060	7 765
Stokes <i>et al.</i> [17]	USA	\$23 116	23 116	18 722	16 047
Total prostate cancer					
Sangar <i>et al.</i> [16]	UK	£136 278 237	196 731 262	158 995 819	136 278 237
Benedict <i>et al.</i> †	UK	€314 334 863	388 937 866	314 334 863	269 422 185
	Germany	€ 567 906 110	702 690 717	567 906 109	486 762 758
	France	€ 722 152 213	893 544 986	722 152 213	618 969 927
	Italy	€ 425 345 317	526 295 105	425 345 316	364 571 284
	Spain	€ 231 369 156	286 281 403	231 369 156	198 310 753

*Converted from Guilders using the fixed rate of 1 euro = 2.20371. †Benedict A, Fourcade RQ, Black LK, Stokes ME, Alcaraz A, Castro RS. Long term costs of prostate cancer: estimates for France, Germany, Italy, Spain and the UK. In preparation. 2011.

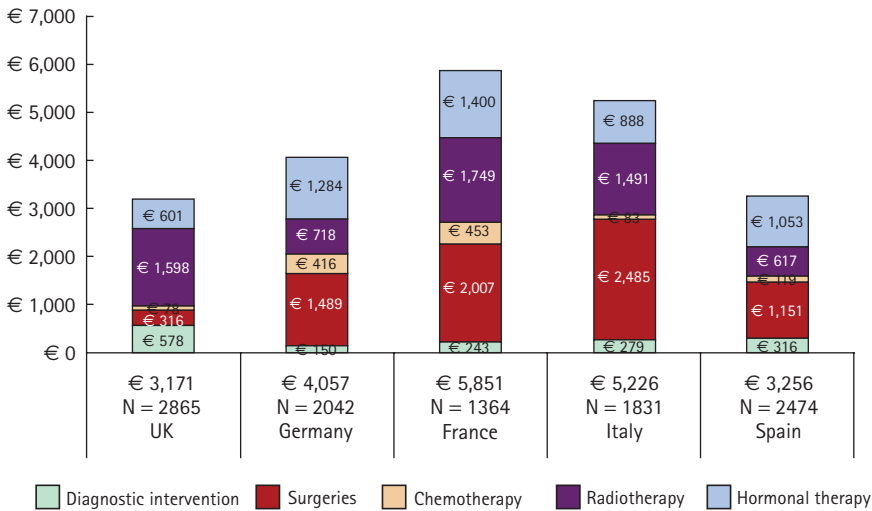
Germany, France, Italy, Spain and the Netherlands [9,11,13,14,16]. Annual costs were available for England and Wales, and the Netherlands [9,11]. Cost estimates for prostate cancer in England and Wales in 1997 were at least £45 million per annum. However, this is an underestimate as it only accounted for primary care costs (primary care physician consultations and prescriptions) and inpatient days, as national statistics were lacking for the cost of treatments such as radiotherapy, hormone therapy and chemotherapy, outpatient consultations, and home

nursing and palliative care. If these components were to be factored in, the true total costs are likely to exceed £55 million (Table 1) [9,16]. When total national direct costs of the first year after diagnosis were calculated to include initial non-hormonal therapies, the cost of a 6-month maximum follow-up treatment and hormonal therapy, as well as the costs for patients who relapse within a year, the incidence total cost for the UK was estimated at £97 million in 2007, ≈0.12% of the UK's annual spending on the NHS of that year [14,19].

In the Netherlands in 1988, the annual total cost of prostate cancer care was 110 million Dutch guilders (Table 1), which represented 6% of the country's total cancer costs [11]. Of this, the majority (87%; ≈96 million guilders) was absorbed by in-hospital care [11].

A sizeable proportion of the costs for prostate cancer are incurred in the first year after diagnosis [20]. A recent publication by Fourcade *et al.* [14] presented the first-year prostate cancer costs for UK, Germany, France, Italy and Spain using: data from the

FIG. 1. Initial treatment cost distribution total per patient for the UK, Germany, France, Italy and Spain. Reproduced in original printed form with permission from Fourcade *et al.* [14].



Information Management Systems, Inc. Oncology Analyzer database, survival data, expert opinion, data from the literature, and unit costs from various published official sources. Costs were inflated to 2006 rates using consumer price indexes (France, Germany, Italy and Spain) or a health inflation index (UK). The initial treatment costs per patient, which included the cost of biopsy and subsequent surgical or non-surgical treatment, were €3171 in the UK, €4057 in Germany, €5851 in France, €5226 in Italy and €3256 in Spain (Fig. 1). Surgery accounted for the largest proportion of initial treatment costs in most countries, with the exception of the UK, where radiotherapy accounted for a greater percentage (Fig. 1). Costs of treatment over 1 year were calculated for all patients, regardless of whether they were treated, and included the unit costs of treatment, relapse costs and average monthly follow-up costs. The total costs for all diagnosed patients in the first year after diagnosis were €116.7 million (UK), €179 million (Germany), €167.5 million (France), €106.7 million (Italy) and €114.6 million (Spain). In comparison, a recent study in Italy by Lazzaro *et al.* [13] also looked at the first-year costs of prostate cancer in 2000. The estimated cost per patient in Italy was €6600, which is higher than the value estimated in the Fourcade publication [14]. The difference in values is probably attributable to lower rates of radiation treatment and a higher use of hormonal treatment in the Lazzaro study, in which

almost half the patients had node-positive and/or metastatic cancer [13].

Economic burden in the years after diagnosis

Total 5-year costs, including costs of both diagnosis and treatment of prostate cancer, is reported in a second study by Fourcade *et al.* (Benedict A, Fourcade RO, Black LK, Stokes ME, Alcaraz A, Castro RS. Long term costs of prostate cancer: estimates for France, Germany, Italy, Spain and the UK. In preparation. 2011). These values were €269 million (UK), €618 million (France), €486 million (Germany), €364 million (Italy) and €198 million (Spain). A UK study estimated that total costs for men diagnosed with prostate cancer in the 2001–2002 BAUS data with 5-year follow-up, were £92.74 million, with an average cost per patient of £7294 over 5 years [16], higher than Fourcade's UK estimates, which ranged between €7040 and €8580 (£5547–£6761) depending on cancer stage. Discrepancies between the two studies may arise through differences in the estimations of individual treatment costs, the proportions of patients receiving each type of therapy, or a combination of both.

ECONOMIC BURDEN IN THE USA

Results from three sources presenting cost data for prostate cancer in the USA are shown in Table 1 [12,15,17]. The National Cancer Institute (NCI) has published annual cost data for prostate cancer using the most recent cancer incidence, survival and cost

of care data [12]. The NCI estimate for expenditure on prostate cancer treatment in 2006 was \$9.862 billion, and average Medicare payments per patient in the first year after diagnosis were \$11 000. It should be noted when interpreting this data that use of PSA testing for prostate cancer is more widespread in the USA than in many other countries, thus increasing the number of cases identified. In addition, Medicare did not cover certain cancer care expenses such as oral medicines, commonly used to treat prostate cancer until January 2006. These out-of-pocket costs may comprise 10% of the \$11 000 estimate. Direct medical expenditures are only one part of the total economic burden of cancer, as cancer-related illnesses and death lead to losses in economic productivity.

Recent analyses of the Surveillance, Epidemiology and End Results (SEER)-Medicare database tracked healthcare use and costs (projected to 2004 levels) from diagnosis and initial treatment [15], in addition to a 4-year follow-up [17], for a cohort of 81 659 elderly patients with prostate cancer who had Medicare claims from 1991 to 2003 [15], and 1991 to 2004 [17], respectively. Treatment in the first year after diagnosis was calculated to incur costs of \$21 040 per patient; \$13 091 for prostate cancer-related costs and \$7949 for medical costs unrelated to prostate cancer [15]. In terms of cost at each stage, as expected, there was an increase in costs from stage I to IV [15,17]. Prostate cancer-related costs over 4 years from diagnosis averaged \$18 168 per patient [17]. The annual healthcare cost burden estimated in 2009 is >\$2.5 billion annually for initial care alone [17].

A recent analysis of US managed care data revealed similar costs for initial therapy in men with prostate cancer [18]. During the first 2 years after diagnosis, the average total cost across all patients was \$48 808, with \$29 417 representing prostate cancer-related costs. Those patients receiving treatment incurred costs five times higher than those undergoing watchful waiting (\$38 945 vs \$7595). The highest costs were incurred within the first 3 months after diagnosis and decreased substantially over time. Among patients receiving initial treatment, surgery incurred costs of \$31 666 with the majority attributable to inpatient costs (\$26 539).

Radiation therapy resulted in higher treatment costs (\$42 554, with over half of the costs attributable to outpatient resource utilization) than multiple therapies (\$37 258), hormone therapy (\$29 984) or chemotherapy (\$17 753). Unfortunately, this analysis did not incorporate end-of-life costs, as this information was not available in the managed care database. The mean monthly prostate cancer-related costs for terminal care averaged \$3130, as deduced from the SEER-Medicare data [18].

Cost prediction models were created for patients who undergo up-front radical prostatectomy or active surveillance, based on men followed for 15 years [21]. The cost per patient was \$15 235 for the former and \$6558–\$11 992 for the latter, taking into account the increase in costs for men who initially opt for active surveillance but subsequently choose to undergo radical prostatectomy. For radical prostatectomy, 92% of the costs occur in the first year, whereas for watchful waiting, later years incur more costs. In a 2008 model analysis, in which data from SEER-Medicare claims files were used, mean annual costs were estimated to be \$10 612 in the initial phase after diagnosis, \$2134 for continuing care and \$33 691 in the last year of life [22].

ECONOMIC BURDEN IN CANADA AND AUSTRALIA

Two national reports were identified that provided annual cost data for prostate cancer in Canada and Australia. The Canadian study looked at cancer costs for 1998; however, the data only included hospital costs and drug costs. In 1998, hospital expenditure for patients with prostate cancer was C\$77.4 million and drug costs were C\$25.7 million; these costs combined represent ≈5% of the country's total hospital and drug costs related to cancer in 1998 [23]. There was no information on the inclusion of primary care services, regional specialist nursing services, nursing homes, etc., and therefore these data were not included in Tables 1 and 2. In Australia, annual costs for prostate cancer care in 1993–1994 were AU\$101.1 million [10]. The majority of costs were attributed to hospital costs (AU\$65.8 million), whereas drug costs were AU\$7.8 million and specialist services including nursing, GP and nursing homes accounted for AU\$13.9 million [10].

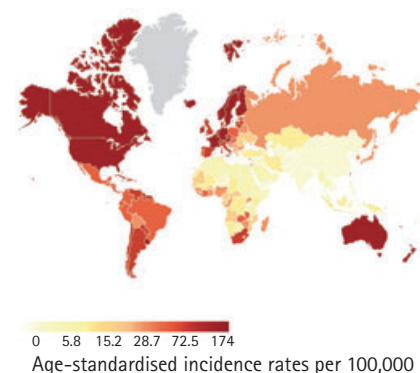
A study of 42 484 men with prostate cancer in Ontario, Canada, determined that prostate cancer costs were lowest before diagnosis (C\$1297/100 days), increased after diagnosis (C\$3289/100 days), declined during continuing care after the first year from diagnosis (C\$1495/100 days), and increased markedly before death (C\$16 020/100 days in the 6 months preceding death and C\$5629/100 days in the penultimate 12 months) [24]. Drugs account for >60% of costs in the continuing-care phase. Total healthcare costs were higher for patients who were older, diagnosed at an advanced stage of disease or who had a comorbid illness.

COMPARISON OF TREATMENT COSTS

The studies described above show the significant burden of prostate cancer on healthcare resources, the precise cost of which varies between countries for many reasons, such as variation in population characteristics, rates of screening, treatment patterns and healthcare systems (private- vs state-funded). To compare the treatment costs reported in these various studies, the costs need to be adjusted to account for the fact that the studies were done in different years and the costs were reported in different currencies (Table 2). By accounting for the variation in national populations and prostate cancer incidence, per-patient treatment costs can be calculated which circumvent some of the issues that arise from comparing data from different studies. Any differences seen thereafter reflect methodological study differences, differences in treatment patterns and differences in unit costs between countries.

Variations in national prostate incidence rates are caused mainly by differences in rates of screening and in detection procedures, and ultimately result in differences in national total prostate cancer costs. Figure 2 shows the global variation in age-standardized prostate cancer incidence rates (based on Globocan 2008), showing a high incidence in the USA, Canada, Australia and New Zealand, as well as several European countries [25,26]. While routine population-based PSA testing is common in the USA, it is not recommended by the national urological associations of Canada, Australia or New Zealand. In these three countries, doctors are advised to discuss PSA testing with appropriate patients and testing

FIG. 2. Worldwide incidence of prostate cancer in 2008. International variation in age-standardized prostate cancer incidence rate (per 100 000) from the Globocan 2008 database. Reproduced as originally presented with permission from the International Agency for Research on Cancer [26].



is available on patient request. Population-wide PSA testing is not recommended by the European Association of Urology (EAU) or by national urological bodies within Europe, but PSA tests are routinely performed in many European countries when there are clinical grounds for suspecting the presence of prostate cancer (e.g. abnormal findings on a DRE) [27]. In the Netherlands, however, screening for prostate cancer with PSA testing is, strictly speaking, not allowed, whether requested by a physician or by a patient [28].

Prostate cancer costs per country based on the inflation figures from the Bureau of Labor Statistics are shown in Table 2 [7]. The 2010 figures have been converted into US\$, £ and € as common denominators for comparison.

There are limitations in comparing data from different studies because there are variations in the exact costs included in the estimates and differences in guidelines, and therefore, management practices. More importantly, the variation in estimated prostate cancer incidence is not accounted for in the conversion to 2010 figures. Perhaps the most valid comparison is between Europe and the USA in the costs per patient in the first year after diagnosis. It is clear that more is spent on prostate cancer patients in the USA than in Europe. This may be related to the AUA's past recommendation for active screening of men >50 years, thereby detecting more early-stage tumours and resulting in more

men receiving treatment [29], although the AUA policy on early cancer detection has since been revised [30]. The USA costs may also be affected by the difficulty in distinguishing indolent tumours from aggressive tumours that cause morbidity and death; thus, in most cases, patients diagnosed with low-grade cancers are treated aggressively in the USA [31]. This has resulted in many men receiving aggressive treatment who are not at risk of dying as a result of their malignancy [31]. Cost differences between private and public healthcare systems will also contribute. Comparison between European countries shows that France, Germany and Italy spend more than other European countries on patients with prostate cancer. This is likely to reflect the disparity in screening practice and treatment patterns across Europe, and also the tremendous variation in costs between different treatments. After publication of the EAU Guidelines for Prostate Cancer in 2007, it is hoped that treatment patterns across Europe will become more similar [27].

Globally, initial treatment costs of prostate cancer (i.e. within the first year after diagnosis) represent the largest part of the overall prostate cancer burden on healthcare budgets. As the natural course of the disease takes several years and patients may be required to receive long-term treatment, cost variation can be attributable to the percentage of patients receiving active treatment vs watchful waiting, as well as age at diagnosis.

DISCUSSION

Globally, prostate cancer is the second most frequently diagnosed malignancy in men, with an estimated 782 600 new cases in 2007 [1]. Incidence varies fiftyfold globally, primarily because of variation in rates of active screening, including the use of PSA testing. Prostate cancer is the sixth leading cause of cancer-related death in men worldwide; however, death rates are declining as a result of improved treatments and early detection [1]. The 5-year survival rate for prostate cancer patients (all stages) is 99%, 10-year survival is 91% and 15-year survival is 76% [2,32]. Although prostate cancer mortality rates are declining, there are increasing numbers of patients diagnosed with prostate cancer and an

increase in the proportion of elderly patients requiring treatment [20]. This imposes a substantial economic burden on healthcare providers and society – an economic burden which is only likely to increase as the number of individuals diagnosed with prostate cancer increases, especially as the use of PSA screening rises.

A number of strategies may help reduce, or at least limit, the rise in the cost of prostate cancer. First, identifying and treating only those cancers which will become clinically significant would considerably reduce treatment costs. While there is currently no single technique available to identify indolent prostate cancer, use of indicators such as PSA dynamics, PCA3, TMPRSS2:ERG gene fusion and other genetic markers (perhaps in combination) may help to differentiate between low- and high-risk prostate cancer [33]. Alternatively, primary or secondary chemoprevention could be considered to either reduce the risk of developing prostate cancer or to prevent its progression to clinically relevant disease that needs treatment. This may involve the use of 5 α -reductase inhibitors in men with a PSA \leq 3.0 ng/mL, as per the AUA guidelines [34]. Lastly, the cost of existing interventions could be reduced to bring down overall costs, such as through cost negotiations. It is open to debate as to whether there is scope for success of this idea.

The data presented here show considerable variation in the costs of prostate cancer in different countries. Such variation may be attributable to differences in detection and treatment patterns in different countries, and in local drug choice and costs, but may also reflect inherent limitations in comparison of the cost data available from the literature. Limitations include the differences in methodologies for data collection and reporting in the various publications, e.g. whether diagnosis costs are included in the first-year costs, whether indirect costs are included (i.e. cost of days lost from work because of illness and premature death, end-of-life costs), whether the cost data collected accurately reflects specialist care for prostate cancer patients, and whether cost estimates are based on incidence or prevalence of disease. Variation in the cost of prostate cancer may also be a result of the different ages of populations studied; because watchful waiting is more likely to be used as initial therapy in older

men, higher costs may be associated with populations studied that include younger men [15]. While these limitations should be borne in mind, the overall message that many prostate cancer treatment methods are costly remains valid.

End-of-life costs are important when considering the total cost of prostate cancer; however, few databases other than the SEER-Medicare database have enough longitudinal data to adequately capture end-of-life costs. Studies that do capture end-of-life data are usually conducted at an institutional level; thus, cost estimates will vary based on variability of institutional costs and practices. Costs are greatest in the resource-intensive 6 months before death, because of home-care services, hospitalization and palliative care costs [24].

In conclusion, prostate cancer is prevalent globally and its treatment is costly. Costs of prostate cancer treatment are only likely to increase in the future unless new strategies are devised to reduce the number of diagnoses and/or focus treatment where it is clinically most appropriate. These challenges are going to become increasingly important as those in control of healthcare budgets continue to come under pressure to contain or reduce costs and increase efficiency in healthcare provision.

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CONFLICT OF INTEREST

None declared.

REFERENCES

- 1 Garcia M, Jemal A, Ward EM *et al*. Global Cancer Facts & Figures 2007. American Cancer Society, Atlanta, GA, USA. Available at: <http://www.cancer.org/Research/CancerFactsFigures/>

- GlobalCancerFactsFigures/global-cancer-facts-figures-2007. Accessed 22 December 2010
- 2 Jemal A, Siegel R, Ward E, Hao Y, Xu J, Thun MJ. Cancer statistics, 2009. *CA Cancer J Clin* 2009; **59**: 225–49
 - 3 Lunenfeld B. The ageing male: demographics and challenges. *World J Urol* 2002; **20**: 11–6
 - 4 Helgesen F, Holmberg L, Johansson JE, Bergstrom R, Adami HO. Trends in prostate cancer survival in Sweden, 1960 through 1988: evidence of increasing diagnosis of nonlethal tumors. *J Natl Cancer Inst* 1996; **88**: 1216–21
 - 5 Sedjo RL, Byers T, Barrera E Jr *et al*. A midpoint assessment of the American Cancer Society challenge goal to decrease cancer incidence by 25% between 1992 and 2015. *CA Cancer J Clin* 2007; **57**: 326–40
 - 6 Taichman RS, Loberg RD, Mehra R, Pienta KJ. The evolving biology and treatment of prostate cancer. *J Clin Invest* 2007; **117**: 2351–61
 - 7 United States Department of Labor. Consumer Price Index. US Medical Care Services Bureau of Labor Statistics, Washington, DC, USA. Available from: <http://data.bls.gov/cgi-bin/surveymost?au>. Accessed 1 September 2010
 - 8 Bank of England. Interest and Exchange Rates. Bank of England, London, UK. Available at: <http://www.bankofengland.co.uk/mfsd/iadb/Index.asp?first=yes&SectionRequired=1&HideNums=-1&ExtraInfo=true&Travel=Nlx>. Accessed 1 September 2010
 - 9 Chamberlain J, Melia J, Moss S, Brown J. Report prepared for the Health Technology Assessment panel of the NHS Executive on the diagnosis, management, treatment and costs of prostate cancer in England and Wales. *Br J Urol* 1997; **79** (Suppl. 3): 1–32
 - 10 Marks GC, Pang G, Coyne T, Picton P. Cancer Costs in Australia – the potential impact of dietary change. Australian Food and Nutrition Monitoring Unit, Commonwealth Department of Health and Aged Care, Canberra, ACT, Australia. Available at: <http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-food-pdf-cancercosts-cnt.htm>. Accessed 1 September 2010
 - 11 Koopmanschap MA, van Roijen L, Bonneux L, Barendregt JJ. Current and future costs of cancer. *Eur J Cancer* 1994; **30A**: 60–5
 - 12 National Cancer Institute. Cancer Trends Progress Report – 2009/2010 Update. Costs of Cancer Care. Available at: http://progressreport.cancer.gov/doc_detail.asp?pid=1&tid=2009&chid=95&coid=926&mid. Accessed 23 December 2010
 - 13 Lazzaro C, Gruppo Informale di Studio sugli aspetti Economico-Sanitari del Carcinoma Prostatico in Italia. [Managing patients with prostate cancer in Italy during the first year after diagnosis. A cost description based on a sample of 8 urological wards. *Arch Ital Urol Androl* 2003; **75**: 138–49 [Article in Italian]]
 - 14 Fourcade RO, Benedict A, Black LK, Stokes ME, Alcaraz A, Castro R. Treatment costs of prostate cancer in the first year after diagnosis: a short-term cost of illness study for France, Germany, Italy, Spain and the UK. *BJU Int* 2010; **105**: 49–56
 - 15 Roehrborn CG, Albertsen P, Stokes ME, Black L, Benedict A. First-year costs of treating prostate cancer: estimates from SEER-Medicare data. *Prostate Cancer Prostatic Dis* 2009; **12**: 355–60
 - 16 Sangar VK, Ragavan N, Matanhelia SS, Watson MW, Blades RA. The economic consequences of prostate and bladder cancer in the UK. *BJU Int* 2005; **95**: 59–63
 - 17 Stokes ME, Black L, Benedict A, Roehrborn CG, Albertsen P. Long-term medical-care costs related to prostate cancer: estimates from linked SEER-Medicare data. *Prostate Cancer Prostatic Dis* 2010; **13**: 278–84
 - 18 Crawford ED, Black L, Eaddy M, Kruep EJ. A retrospective analysis illustrating the substantial clinical and economic burden of prostate cancer. *Prostate Cancer Prostatic Dis* 2010; **13**: 162–7
 - 19 Centre for Economic Performance. Election Analysis 2010. The London School of Economics and Political Science, London, UK. Available at: <http://cep.lse.ac.uk/pubs/download/ea009.pdf>. Accessed 19 July 2010
 - 20 Warren JL, Yabroff KR, Meekins A, Topor M, Lamont EB, Brown ML. Evaluation of trends in the cost of initial cancer treatment. *J Natl Cancer Inst* 2008; **100**: 888–97
 - 21 Corcoran AT, Peele PB, Benoit RM. Cost comparison between watchful waiting with active surveillance and active treatment of clinically localized prostate cancer. *Urology* 2010; **76**: 703–7
 - 22 Yabroff KR, Lamont EB, Mariotto A *et al*. Cost of care for elderly cancer patients in the United States. *J Natl Cancer Inst* 2008; **100**: 630–41
 - 23 Public Health Agency of Canada. Economic Burden of Illness in Canada. Ottawa, ON, Canada: Policy Research Division, 1998. Available from: <http://www.phac-aspc.gc.ca/ebic-femc98/pdf/ebic1998.pdf>. Accessed June 2011
 - 24 Krahn MD, Zagorski B, Laporte A *et al*. Healthcare costs associated with prostate cancer: estimates from a population-based study. *BJU Int* 2009; **105**: 338–46
 - 25 Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *Int J Cancer* 2010; **127**: 2893–917
 - 26 Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. GLOBOCAN 2008, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 10. World Health Organisation, International Agency for Research on Cancer, Lyon, France. Available at: <http://globocan.iarc.fr>. Accessed 22 December 2010
 - 27 Heidenreich A, Aus G, Bolla M *et al*. EAU guidelines on prostate cancer. *Eur Urol* 2008; **53**: 68–80
 - 28 Vela Navarrete R. Frans Debruyne Valedictory Lecture. A look into the future of Urology. *Actas Urol Esp* 2007; **31**: 431–6
 - 29 American Urological Association. Statement on early detection of prostate cancer: Update May 2006. AUA, Linthicum, MD, USA. Available at: <http://www.auanet.org/content/guidelines-and-quality-care/policy-statements/e/early-detection-of-prostate-cancer.cfm>. Accessed 7 April 2009
 - 30 American Urological Association. Policy statement on early detection of prostate cancer: Update April 2009. AUA, Linthicum, MD, USA. Available at: <http://www.auanet.org/content/guidelines-and-quality-care/policy-statements/e/early-detection-of-prostate-cancer.cfm>. Accessed 1 September 2010
 - 31 McNaughton-Collins M, Walker-Corkery E, Barry MJ. Health-related quality of life, satisfaction, and

economic outcome measures in studies of prostate cancer screening and treatment, 1990–2000. *J Natl Cancer Inst Monogr* 2004; **2004**: 78–101

- 32 **American Cancer Society.** Global Cancer Facts & Figures 2008. American Cancer Society, Atlanta, GA, USA. Available at: <http://www.cancer.org/acs/groups/content/@nho/documents/document/2008cafffinalsecuredpdf.pdf>. Accessed 23 December 2010
- 33 **Thomas G, Jacobs KB, Yeager M *et al.*** Multiple loci identified in a genome-wide association study of prostate cancer. *Nat Genet* 2008; **40**: 310–5
- 34 **Kramer BS, Hagerty KL, Justman S *et al.*** Use of 5alpha-reductase inhibitors for prostate cancer chemoprevention: American Society of Clinical Oncology/American Urological Association 2008 Clinical Practice Guideline. *J Urol* 2009; **181**: 1642–57

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Abbreviations: NCI, National Cancer Institute; SEER, Surveillance, Epidemiology and End Results; EAU, European Association of Urology.