Exploring the link between cancer policies and cancer survival: A comparison of International Cancer Benchmarking Partnership countries

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Summary

It has been suggested that policy differences may help explain international variation in cancer survival but empirical evidence is lacking. We reviewed cancer policies in 20 International Cancer Benchmarking Partnership jurisdictions in seven countries and conducted exploratory analyses linking an index of cancer policy consistency over time, with monitoring and implementation mechanisms, to survival from seven cancers in a subset of ten jurisdictions from 1995-2014. All ten jurisdictions had structures in place to oversee or deliver cancer control policies and had published at least one major cancer plan. Few cancer plans had explicit budgets for implementation or mandated external evaluation. Cancer policy consistency was positively correlated with improvements in survival over time for six of the seven cancer sites. Jurisdictions scoring highest on policy consistency had large improvements in survival for most sites. Our analysis provides an important first step to systematically capture and evaluate what are inherently complex policy processes. Nevertheless, the findings can help guide policymakers seeking approaches and frameworks to improve cancer services and, ultimately, cancer outcomes.

Introduction

Cancer survival is improving globally, yet continues to vary significantly across countries.[1 2] This disparity has been linked to variation in progress in cancer control.[1 3] An effective health system response to cancer requires a systematic approach along the entire cancer continuum, from primary prevention, through early detection, diagnosis, treatment, palliation and end-of-life care, and living with and beyond cancer, ideally within a national cancer control programme.[4] Many countries have introduced cancer plans, although they vary widely in scope and comprehensiveness.[5 6] Studies of their impact on cancer survival have been inconclusive.[7 8] Establishing direct links between such plans and population health outcomes remains challenging, given the complex relationships between patients, health service organisations, and health systems.[9] Also, there may be long time lags between an interventions and a subsequent positive outcome. Importantly, while a cancer plan may be necessary for improving cancer outcomes, it is unlikely to be sufficient on its own;[10] any benefits may be undermined by the wider policy and system context.

Existing research on cancer policies, including cancer plans, has mostly been cross-sectional.[5 6] Systematic longitudinal analyses, especially those that consider the degree of implementation, are lacking. A longitudinal view is essential for understanding international variation, as countries may be at different stages in the evolution of their health systems and the management of cancer within it. It offers opportunities to better understand trends in cancer outcomes, including survival. This study seeks to help fill this gap for countries in the International Cancer Benchmarking Partnership (ICBP).[11] We systematically trace the evolution of cancer plans and strategies in seven ICBP countries since 1995, and present the findings of an exploratory analysis which involved development of an 'index' of cancer policy consistency and how this can be linked to cancer survival. This represents an important first step in our overarching approach to systematically evaluate cancer policies and deploy the intelligence generated to provide insights to policymakers as they develop cancer policy frameworks to improve cancer outcomes.

Methods

ICBP brings together policymakers, academics and clinicians in Australia, Canada, Denmark, Ireland, New Zealand, Norway, and the United Kingdom (UK), and sub-national jurisdictions within them. Participating countries have high-quality population-based cancer registries, provide universal access to health care funded mainly by taxation, and spend similar sums on health (Supplement Table S.1, p. 3).[3 11]

Search strategy and selection criteria

We systematically searched and analysed documents from 20 ICBP jurisdictions: Australia (three states: New South Wales [NSW], Victoria, Western Australia), Canada (nine provinces: Alberta, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan), Denmark, Ireland, New Zealand, Norway, the UK (four nations: England, Northern Ireland, Scotland, Wales) as well as federal documentation in Australia and Canada. Documents included national or regional cancer plans, strategies and related policy frameworks, as well as reports of plan implementation and evaluation for 1995-2018. This covered the 1995-2014 period for which ICBP had already compiled survival data,[3] but extended it to more recent developments. Publicly available documents were identified through an iterative search of PubMed, Google and Google Scholar, governmental and non-governmental agencies and organisations involved in cancer services and policy in the jurisdictions, and the national cancer plan database of the International Cancer Control Partnership.[12] Keywords and phrases to identify documents included 'cancer' in combination with 'plan', 'strategy', 'control', 'programme' or 'policy', with translation into Danish, French (Quebec, Canada) and Norwegian. Searches were performed up to 31 July 2020. We further consulted members of the ICBP Programme Board[11] (who represent each of the 20 jurisdictions) to identify any additional documents published during the study period.

We focused on overarching national/jurisdictional cancer plans, linked 'events', and specific policies on the diagnostic and treatment/management components of the cancer care pathway, including capacity such as infrastructure (e.g. diagnostic centres, cancer centres), equipment (e.g. diagnostic imaging, radiotherapy) and cancer workforce. Our analysis did not consider polices or strategies around primary prevention (e.g. legislation on smoking, HPV vaccination) and screening (e.g. mammography) or those related to palliative/end-of-life care. Our focus was determined as part of our scoping work for this study, which included a conceptual model that visualises the range of possible interrelationships and causal pathways linking health system factors and cancer survival along the cancer patient journey.[9] We analysed documents in three iterative stages (Supplement Figure S.1, p. 8).

Step 1: Mapping timelines

We mapped timelines identifying (i) published cancer plans/strategies; (ii) 'events', such as legislation, the establishment of cancer institutes or oversight groups, or of cancer networks, pathways, wait times, etc.; and (iii) evaluations of plans/programmes, progress reports or wider cancer system reviews. For each cancer plan, event or evaluation, we summarised the main content and extracted this information into a tabular format (Supplement Tables S.2-S.6, p. 9-65) for the entire period for the 20 jurisdictions, plus the federal levels in Australia and Canada. Where original documents were unavailable, we inferred content from secondary sources, where appropriate (e.g. published commentaries, descriptions in subsequent documents).

Step 2: Categorisation of timelines

To systematise this information, we selected ten jurisdictions, representing one each in Australia (NSW) and Canada (Ontario), as well as Denmark, Ireland, New Zealand, Norway, and the four nations of the UK (England, Northern Ireland, Scotland and Wales). The selection of jurisdictions was agreed with members of the ICBP Programme Board, motivated by our aim to develop an 'index' of cancer policy consistency over time and how this can be linked to cancer survival. We refined our initial categorisation described in step 1 into nine sub-categories. A 'major cancer plan' was defined as a written document setting out a multiyear cancer control strategy or programme for a given jurisdiction. We also considered written plans or strategies on specific diagnostic or treatment components. Draft timelines were reviewed for accuracy and completeness by country representatives from ICBP's Programme Board.

Step 3: Scoring categories

We narrowed the nine sub-categories into five core categories (Figure S.1, p. 8) and allocated a score from zero to 1 according to whether a given category was fully present (score of 1), partly present (0.25-0.75) or absent (0), using pre-determined criteria (Table 1). Scoring was done for 1995-2014 only to enable linkage with cancer survival data for the same time period.

<Table 1. Summary overview of scoring of cancer policies for the period 1995-2014>

The initial scoring was developed by the lead author (EN) with further iterations and refinement discussed and agreed with three core members of author team (MM, JB, ML), followed by discussion and agreement with the wider author team and PB members. Scoring was based on pragmatic considerations of presence or absence of particular conditions indicative of coherent and consistent policy formulation and implementation. This was informed by our related ICBP work on the role of political leadership and strategic investment in driving improvement in population cancer outcomes,[13 14] and the wider literature on health systems and what constitutes 'good' governance.[15 16] We applied a weighting of 1.25 to consistency over time to cancer plans that build on each other, to cancer plans accompanied by an action/ implementation plan, and to plans that had been formally evaluated. We summed the scores for the five categories for each of the ten jurisdictions into an overall score (index) as an indicator of consistency of cancer policies over time. The scoring, including the weighting, is described in full in Supplement Table S.7 (p. 66).

Step 4: Exploratory analysis

We explored associations between scores developed in Step 3 with published ICBP data[3] on survival for seven cancer sites in each of the ten jurisdictions. Cancer sites were chosen to capture both relatively common cancers (lung, colon, rectum) and those that are hard to treat (ovarian, pancreas, stomach and oesophagus).[11] We linked changes in survival from 1995 to 2014 (absolute percentage difference in five-year survival from the start to the end of the period) with our index of cancer policy consistency over time by plotting a simple linear regression, including correlation coefficient (R^2). We did not apply a formal statistical test to investigate associations.

Results

Table 2 presents the evolution of cancer policies in these jurisdictions (1995-2018). We first report on the documentary analysis within three overarching themes: governance arrangements; evolution of cancer plans; and cancer plan evaluation. We then report the exploratory analysis, linking indices of cancer policy consistency and cancer survival.

Governance arrangements for cancer control

All jurisdictions have some high-level structure tasked with overseeing, steering or delivering cancer control policies or strategies. The mechanisms involved vary substantially, as do the scope and remit of these structures. Only Ontario and New South Wales established a dedicated, government-endorsed or funded cancer institute: Cancer Care Ontario (CCO, launched in 1997) is tasked with coordinating and integrating cancer treatment services across Ontario,[17] while the Cancer Institute NSW (created in 2003) has a legal mandate to increase cancer survival, reduce incidence, improve the quality-of-life of cancer patients and provide expertise on cancer control to policy, practice and research.[18] Elsewhere, similar functions are performed by arrangements such as national programmes, steering groups, or taskforces. For example, in Ireland, the National Cancer Control Programme (2007) oversees a number of activities similar to those performed by CCO in Ontario, including developing evidence-based guidelines, organisation of cancer services, and developing and monitoring cancer performance indicators.[19]

Several jurisdictions established steering or working groups explicitly tasked with informing or developing cancer strategies or plans, with a smaller number also establishing groups with a special remit in, for example, radiotherapy (Denmark, Ireland, Scotland) or acute oncology (Northern Ireland). Such groups were typically established in the late 1990s or early 2000s for a time-limited period, bringing together stakeholders whose remit was frequently limited to the development of a specific plan. Examples include the Cancer Steering Group in Denmark, set up in 1998 in response to a public debate about the quality of cancer treatment and outcomes in Denmark; the group was eventually tasked with developing Denmark's first national cancer plan (2000).[20] Similar groups were created in Ireland (National Cancer Forum, 2000[21]), New Zealand (Cancer Control Steering Group, 2001[22]), Norway (Cancer Plan Selection Committee, 1996[23]), Scotland (Scottish Cancer Group, 1998[24]) and Wales (Cancer Services Expert Group, 1995[25]). These groups were subsequently replaced with or followed by other structures that took on a wider remit around cancer control. For example, the Scottish Cancer Group was replaced by the Scottish Cancer Taskforce in 2008 to initially oversee the delivery of actions set out in the 2008 cancer plan,[26] subsequently expanded to cancer control more widely.[27]

In Northern Ireland, cancer steering groups also informed cancer strategies, such as the Regional Cancer Services Framework (Steering) group created in 2004 to develop recommendations for cancer services.[28] Additionally, the Northern Ireland Cancer Network (2004), has an important oversight and steering function, while supporting its members.[29] England and New Zealand have both intermittently implemented high-level structures to oversee and direct cancer control, but these governance arrangements have changed several times over the past two decades (Panel 1).

Panel 1. Evolution of governance arrangements for cancer control in England and New Zealand, 1995-2014

In England, national cancer control during the 2000s was overseen by the National Cancer Director, appointed by the government in 1999, and supported by a National Cancer Action Team,[30] with a further Cancer Taskforce established in 2000, also chaired by the National Cancer Director and tasked with driving implementation of the 2000 NHS Cancer Plan.[31] The National Cancer Director and National Cancer Action Team remained in place for just over ten years, with their remit extending beyond the immediate implementation of the 2000 plan. In 2013, the role of the National Cancer Director was unfortunately reduced to a part-time advisory post within the newly established NHS Commissioning Board (NHS England), while the National Cancer Action Team, which had provided support on and coordinated cancer policy implementation was disbanded; this followed a major reorganisation of the health service in England in 2012.[32]

In New Zealand, a Cancer Control Council (Cancer Control New Zealand from 2010) was established in 2005 with a wide remit, including monitoring and reviewing implementation of the 2003 Cancer Control Strategy and providing independent strategic advice to the Minister of Health and other stakeholders, among other tasks.[33] The same year also saw the appointment of a Principal Advisor Cancer Control within the Ministry of Health, aligned to the Cancer Control Work Programme established by the ministry.[34] However, the national cancer oversight function was disestablished in 2015, on the basis that its role was seen to be "superseded by the progress made in improving cancer services for New Zealanders" at the time.[35]

Evolution of cancer plans

All jurisdictions published major cancer plans during 1995-2018, with most publishing four plans at more or less regular intervals, the only exceptions being Ireland (3 plans), New Zealand (2 plans) and Northern Ireland (1 plan) (Table 2). Several also issued plans that focused on specific areas of cancer diagnosis and treatment, including radiotherapy (NSW, Denmark, New Zealand, Scotland), diagnosis (Ontario), systemic therapy (Ontario) and medical oncology (New Zealand). Ontario further published successive cancer plans with a remit to address cancer within Aboriginal peoples specifically (Supplement Table S.3, p. 28-36).

Cancer plans in NSW, Ontario and Denmark built successively upon each other. For example, Denmark's first two cancer plans (2000, 2005), while addressing the entire cancer care continuum, emphasised clinical diagnosis and treatment, in particular infrastructure and equipment (e.g. radiotherapy, diagnostic capacity).[20 36] Subsequent plans shifted focus to prevention and early detection, rehabilitation, palliation and patient involvement,[37] with patient participation becoming the core aim of the 2016 cancer plan ('Patients' Cancer Plan').[38] The three jurisdictions also maintained continuity in terms of plan development, albeit with input from other organisations, with the Cancer Institute NSW leading efforts in New South Wales (Panel 2), CCO in Ontario and the National Board of Health (Danish Health Authority from 2015) in Denmark. These organisations were also typically in charge of overseeing plan implementation, although only Denmark put more formal arrangements in place by means of agreements between the government and the regions for delivery of the 2010 and 2016 cancer plans.[39 40]

Panel 2. Cancer plans in New South Wales, Australia

The New South Wales Cancer Institute, established by the 2003 Cancer Institute (NSW) Act, is legally mandated to develop and regularly review cancer plans.[18] The first State Cancer Plan was to be developed "in conjunction with the Ministry of Health and public health organisations" by 30 June 2004, with financial allocations to the institute contingent on the publication of the plan. Legislation further stipulated that the cancer plan was to be reviewed and recommendation of changes to be made every two years (or as stipulated by the Minister for Health). The 2003 Act also mandates the Cancer Institute to assess cancer control services or programmes and to report the findings to the NSW government. While such assessments are undertaken on a regular basis, findings would generally be for government use only and not released into the public domain. Annual reports, published from 2004/05 to 2013, document progress on cancer plans and spending on main plan programmes (e.g. [41]). With the Cancer Institute formally becoming a pillar of the NSW Ministry of Health (NSW Health) in 2013, the Institute's reporting was incorporated into NSW Health annual reports from 2013–14 (Supplement Table S.2).

Cancer plan development in the other jurisdictions appears to have been somewhat less coherent, although patterns vary. Ireland published three plans, of which the latter two were clearly linked (Table 2). In Norway, the 1997[23] and 2006[42] plans were clearly linked, as were the 2013[43] and 2018[44] plans. Importantly, both the 1997 and 2013 cancer plans were followed by action plans,[45 46] detailing specific measures to be put in place to achieve the objectives of respective cancer plans, with timelines for implementation. Similarly, Scotland published four cancer plans (2000, 2004, 2008, 2016), with a clear change in emphasis between the 2004[47] and 2008[26] plans, possibly reflecting a change in government in 2007.

There was an equally clear change in emphasis in cancer plan evolution in England, with the 2000[31] and 2007[48] plans building upon each other (see also Panel 1), while the subsequent 2011 plan signalled a departure from previous strategies, explicitly referencing a new government's changed focus on outcomes in line with planned health reforms at the time.[49] The subsequent 2015 cancer strategy signalled a further change in direction; it was developed by an Independent Cancer Taskforce[50] in contrast to previous cancer plans that were developed by the government. In both England and Scotland, only the first cancer plan was accompanied by a specific plan for implementation.[31 51 52]

At the other end of the spectrum were Northern Ireland and New Zealand, which published only one and two cancer plan(s) respectively throughout the observation period (Table 2). This does not necessarily mean a lack of strategic direction; as noted above, both countries put in place national cancer coordinating mechanisms.

Finally, only a few cancer plans provided an explicit, detailed financial commitment to implementation, with Denmark and Ontario the only jurisdictions that did so on a regular basis plans (Table 2). While NSW did not publish detailed financial commitments for the major cancer plans (but see Panel 2), it did so for those expanding radiotherapy capacity. In all other jurisdictions, financial commitments were only made explicit for some cancer plans (Norway, England, Scotland), or were not made explicit (New Zealand, Northern Ireland, Wales); in Ireland, detailed financial commitments for plan implementation were published in national service planning documentation (Supplement Table S.6, p. 57).[53]

Evaluation of cancer plans

Formal evaluations of cancer plan achievements were uncommon, with only Denmark, Ireland, NSW and Norway publishing related documents. Evaluations were typically limited to the first cancer plan, assessing key achievements and degree of implementation, often identifying areas for strengthening that were followed up in subsequent plans or strategies. For example, evaluation of the 1996 cancer strategy in Ireland highlighted expansion of radiotherapy, involvement of primary care, regionalisation of services, quality assurance, information and evidence-based practice as areas for further development;[54] these were addressed in the 2006 cancer plan,[21] with parallel work focusing on expansion of radiotherapy specifically.[55] Ireland also had its 2006 cancer strategy externally evaluated, along with an assessment of implementation, with insights informing the development of the 2017 cancer plan.[56]

Less frequent forms of scrutiny include public inquiries into delivery of cancer services (Northern Ireland (2002)[57], Wales (2014))[58] in response to perceived lack of progress. While not explicitly referred to, both inquiries informed subsequent action, such as the development (and subsequent publication) of a regional cancer plan in Northern Ireland from 2003[28] and the establishment of the Wales Cancer Network in 2015 in an attempt to provide a national level oversight group for the delivery of cancer services.[59]

Other jurisdictions published progress reports on cancer plan achievements, although there was no consistent pattern, with those available published at irregular intervals (New Zealand, England, Wales). Ontario has not published regular progress reports on cancer plan achievements, although with the creation in 2002 of the Cancer Quality Council of Ontario (a quasi-independent body advising CCO and the Ministry of Health) it was the first jurisdiction to have institutionalised the systematic monitoring and public reporting of cancer system performance.[60]

<Table 2. Evolution of cancer policies in ten ICBP jurisdictions, 1995-2018>

Consistency of cancer policies

Table 3 shows the scores for cancer policy consistency in the ten jurisdictions (average score: 2·72). Denmark scored highest, followed by Ontario and NSW, with Norway and Ireland displaying very similar above-average scores. Scotland and England were the next highest scoring, while New Zealand, Wales and Northern Ireland scored lowest. The scores reflect the results described above. All ten jurisdictions score highly on oversight, since all have some form of high-level structure tasked with overseeing, steering or delivering cancer policies or strategies. Conversely, only five jurisdictions had formalised activities to implement their cancer plans through an action or implementation plan, although even these were not published on a regular basis.

<Table 3. Consistency of cancer policies in ten jurisdictions, 1995-2014 (weighted scores)>

Figure 1 shows scatter plots of weighted cancer policy consistency scores against changes in survival 1995-2014 for oesophageal, stomach, colon, rectal, pancreatic, lung and ovarian cancer in the ten jurisdictions. We also show 5-year survival figures for each cancer and jurisdiction in 1995-1999 and changes over time, to aid interpretation of observed patterns. Overall, the exploratory analysis points to a positive, albeit weak, correlation of cancer policy consistency and improvements in survival over time for six of the seven cancer sites. Correlations tended to be strongest for lung cancer (correlation coefficient: 0.49), followed by colon, ovarian and stomach cancer (R^2 of 0·34, 0·33 and 0·31), and lower for pancreatic and rectal cancer (R^2 of 0·25 and 0·18). There was no correlation between policy consistency score and changes in survival for oesophageal cancer (R^2=0·01). Weighting slightly reduced observed correlations for oesophageal cancer, while remaining stable for all other cancers (Supplement Figure S.2, p. 68).

Our findings suggest that jurisdictions that scored higher on cancer policy consistency also showed, in the main, large improvements in survival for most cancer sites over time. Denmark scored highest and also showed among the highest increases in survival during 1995-2014 for most cancers. Conversely, New Zealand scored low and also showed much smaller changes in cancer survival. Ireland and Norway scored above average and also showed substantial improvements in survival for most cancers. Observed relationships are not clear-cut, however, with, for example, England also showing large improvements for most cancers, while scoring lower than average on cancer policy consistency (Figure 1). The reverse was true for NSW and Ontario, although both jurisdictions entered the observation period with much higher 5-year survival rates than Denmark, England or Ireland. This indicates higher potential for improvement in the latter three jurisdictions, although the large improvement in survival from pancreatic cancer in NSW between 1995 and 2014 is notable (Figure 1).

<Figure 1. Correlation between cancer policy consistency and survival from selected cancers in ten jurisdictions (weighted scores)>

Discussion

To our knowledge, this is the first study that has systematically brought together evidence on the evolution of cancer plans and strategies over a period of over 20 years in a range of countries and linked observed patterns of policy development to changes in survival from major cancers. Focusing on a sample of ten jurisdictions in seven high income countries, we found that all had implemented some form of high-level oversight structure; all had also published at least one major cancer plan. However, there was great variation in oversight mechanisms, ranging from institutionalising cancer control (NSW, Ontario) to cancer steering groups or taskforces (Denmark, Northern Ireland, Wales). Frequency and consistency of cancer plans also varied, from a succession of plans that build on each other (Denmark, NSW) to the publication of isolated plans (New Zealand, Northern Ireland). Furthermore, there was great variation in supportive measures to ensure plan implementation, with only a small number of jurisdictions formulating action or implementation plans that also specified an explicit budget for plan implementation. Commissioning of external evaluations of cancer plans to inform future strategies was uncommon.

Jurisdictions implementing cancer control policies that are consistent over time tended to be more successful in improving survival for a wide range of cancers. This observation in itself is not surprising, given what we know about and expect from the evidence about national cancer control plans.[4 6 61] However, in demonstrating empirical evidence of a positive relationship between policy consistency and increases in cancer survival, we can begin to formulate hypotheses about the relationships between cancer strategies and outcomes and identify options for policymakers as they develop cancer polices seeking to improve cancer services and systems and, ultimately, patient outcomes.

Denmark achieved the most sustained improvements for most cancers over time, while also scoring highest in cancer policy consistency, with considerable improvements also seen in several other jurisdictions with greater than average scores. For example, in Ireland, survival for lung, pancreas, rectal and oesophageal cancer accelerated from the late 2000s, likely reflecting the programme of service centralisation for these cancer sites as per the 2006 cancer plan and its implementation from 2009.[62] This highlights the impact that targeted initiatives can have in light of wider resource constraints, as Ireland was seeking to protect cancer services in the context of the global financial crisis of 2007-2008.[13] Such impacts were also seen for oesophageal cancer in Northern Ireland, benefiting from a collaborative programme of work for this cancer site with the Republic of Ireland.[63] Targeted strategies are thus important, although, as the example of Denmark indicates, over the long-term, sustained and consistent strategic planning and investment are crucial to ensure continued improvement in cancer outcomes at population level.[14]

We previously highlighted the role that central bodies or agencies, such as the Cancer Institute NSW or Cancer Care Ontario, can play in ensuring consistency by providing long-term follow-through of cancer plans and strategies, and using funding levers to ensure implementation.[13] Clearly, the feasibility of central coordination of cancer programmes or strategies will be influenced by the wider context. For example, jurisdictions evaluated in this study vary widely in geography and population size, impacting on the ability to provide for and sustain capacity to implement and deliver on cancer policies, in particular in rural and remote settings.[14] However, without political commitment and leadership, along with strategic investment, countries will face the same health governance challenges whether small or large.[64] Furthermore, evidence from England during the 2000s suggests that effective leadership does not necessarily require a central organisation; instead what is required is the mandate and political will at the centre to drive change.[10 13]

Limitations

Our work has important limitations. First, to ensure consistency and transparency, our analysis is based on documents in the public domain but not every policy may have been published. We have consulted with representatives of each of the jurisdictions (members of the ICBP Programme Board) and are confident that we have captured key documents and events. Second, we recognise that written policies, whether published or not, do not necessarily translate into action; documents also rarely capture the complexity of the political, economic and social context within which policy is being developed and implemented, and contexts vary between and within countries and jurisdictions. However, in line with understandings of key attributes of governance[15] we argue that a transparent and accountable cancer system should inform the public of decisions about commitments to and investment in cancer control, and how these have been implemented to ensure delivery and allow for assessments of achievement. It is for this reason that we applied strict scoring criteria. For example, in terms of financial commitments, we only considered publicly available documents that provided a detailed breakdown of funding as they related to a specific cancer plan. It is reasonable to assume that all jurisdictions have allocated funding to plan implementation (or indeed, that plan development and implementation are shaped around budget availability), for example as part of annual budget statements, such as allocations to the NSW Cancer Institute.[65] We have not systematically searched for such statements and have not included general cancer service allocations in our scoring.

Similarly, there should be a mechanism for systematic tracking of progress towards cancer plan delivery or more comprehensive evaluations, but this was not common. We note that a few jurisdictions have established cancer monitoring systems that, while not assessing cancer plan delivery specifically, can serve to systematically monitor progress in cancer care over time. Examples include Ontario's Cancer System Quality Index tracking progress in cancer care across the province,[66] the Reporting for Better Cancer Outcome programme in New South Wales,[67] or site-specific cancer care audits performed by the Northern Ireland Cancer Registry from 1996.[68]

Third, the exploratory analysis covered ten jurisdictions only, although all seven ICBP countries are represented. Based on the detailed analyses presented in the supplementary material and trends in survival in jurisdictions reported elsewhere[3] we feel reasonably certain that consideration of all 20 jurisdictions would not have provided fundamentally different results. Fourth, our exploratory analysis assesses the 1995-2014 period only and does not capture more recent cancer policy developments and survival trends, in particular whether observed improvements in survival have been sustained. Indicative evidence from England suggests that the observed increase in survival from some cancers may have stalled for people diagnosed between 2014 and 2018, and followed up to 2019.[69] However, comparative survival data for all jurisdictions for this period are currently unavailable and it is not possible to confirm these trends at the time of writing. Additionally, several jurisdictions have since implemented efforts to strengthen their cancer policies. New Zealand established a designated Cancer Control Agency in 2019 and a new 10-year cancer action plan;[70] England and Wales also introduced more systematic approaches to cancer policy from 2016, while Northern Ireland have launched a new 10-year strategy in 2022, although disappointingly with no clear budget allocation.[71] Clearly, the impacts of these renewed strategies on cancer outcomes will only emerge in the coming years, making it critically important to understand more recent trends in cancer survival. Finally, although cancer survival is widely interpreted as an important marker of health system effectiveness,[1-3] indicators other than survival should also be considered in evaluations of cancer plans, such as incidence and mortality.[3] This is because cancer survival will be influenced by a range of factors such as quality of cancer case registration and classification[72] and there are concerns about lead-time bias for some of the cancers considered here, such as colorectal and lung.[73]

The scoring of cancer control policies presented in this study is novel although not perfect. The analysis is exploratory while based on informed judgement on a series of relevant indicators by health system experts and those involved in cancer policy and practice. We have not used formal techniques to develop the scoring such as consensus methods.[74] Our approach specifically considers policies and strategies focusing on the diagnosis and treatment components of cancer control policies only rather than the wider range of policies along the cancer control continuum. Future work should explore the use of formal approaches to elicit expert judgements on the relative impact of different strategies. Other approaches that could be deployed to specifically capture the complex dynamics between macro-level policies and meso- or micro-level activities that, ultimately, determine cancer outcomes, include Qualitative Comparative Analysis that is increasingly being used to address causality in complex systems,[75] and mathematical modelling methods for evaluating complex systems.[76 77] However, we still feel that the approach we have taken is novel and has underpinned new insight on the arbiters of higher quality cancer control.

In conclusion, our study supports our hypothesis that cancer control policies characterised by consistent oversight, a clear development plan that successively and strategically builds on what has come before, linked to explicit and transparent investment and implementation over time, may be associated with improved cancer survival. Clearly, cancer policy development and implementation will be influenced by the specific governance, organisational and financing context within which jurisdictions’ cancer systems sit and it will not always be possible, or meaningful, to institutionalise high-level oversight in the form of a single body or agency. However, our work suggests that sustained and consistent strategic planning and investment are crucial for ensuring better patient outcomes, and this requires strong and sustained commitment at all levels.

Authors’ contributions

EN and MMK conceptualised the overall study and obtained the funding. EN led on study design, with significant inputs from MM and SL. MM and SL led on data collection and the development of cancer control policy timelines, with support from MS. EN led on preparation of the manuscript and on additional analyses presented in the manuscript, with significant inputs from MM, JB and ML. All authors contributed to the interpretation of the results and critically reviewed the manuscript. All authors agreed with the decision to submit it for publication.

Conflict of interest statements

ML reports having received honoraria unrelated to to this work from Bayer, Carnall Farrar, Novartis, Pfizer and Roche. All other authors declare no competing interests.

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Ethics committee approval

Ethical approval was granted by the Observational / Interventions Research Ethics Committee at the London School of Hygiene & Tropical Medicine (LSHTM Ethics Ref: 15169).

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Table 1. Summary overview of scoring of cancer policies for the period 1995-2014

Category	Score (without weighting)	Description	Jurisdiction
Dedicated institute/ oversight function	**1**	Consistent and dedicated oversight group throughout observation period	NSW, Ontario, Denmark, Ireland, New Zealand, Scotland, Wales
	0·75	Consistent and dedicated oversight function for much of the observation period / oversight function located within Ministry of Health	Norway, England, Northern Ireland
	0·5	Oversight function for some of the observation period, lacking consistency	*None identified*
	0·25	Oversight function for a minority of the observation period, no consistency	*None identified*
	0	No identified oversight function	*None identified*
Cancer plans	**1**	At least 3 cancer plans that build on each other	NSW, Ontario, Denmark
	0·75	At least 3 cancer plans but only 2 build on each other	Norway, England, Scotland
	0·5	3 unlinked cancer plans **or** 2 cancer plans that are explicitly linked	Wales Ireland
	0·25	Fewer than 3 unlinked cancer plans	New Zealand, Northern Ireland
	0	No published cancer plans	*None identified*
Action/ implementation plan	**1**	Every cancer plan is accompanied by an action/implementation plan	*None identified*
	0·75	Most cancer plans are accompanied by an action/implementation plan	Norway
	0·5	50% of cancer plans are accompanied by an action/implementation plan	New Zealand
	0·25	A minority of cancer plans are accompanied by an action/implementation plan	Denmark, England, Scotland
	0	No published cancer plan is accompanied by an action/implementation plan	NSW, Ontario, Ireland, Northern Ireland, Wales
Explicit budget for implementation*	**1**	Every cancer plan includes an explicit budget	Ontario, Denmark
	0·75	A majority of cancer plans include an explicit budget	Scotland
	0·5	Theme-specific cancer plans or wider service plans include an explicit budget	NSW, Ireland
	0·25	A minority of cancer plans include an explicit budget	Norway, England
	0	No published cancer plan includes an explicit budget	New Zealand, Northern Ireland, Wales
Evaluation / progress reporting	**1**	Every cancer plan is formally evaluated	*None identified*
	0·75	A majority of cancer plans are formally evaluated	Denmark, Ireland
	0·5	A majority of cancer plans are followed by a published progress report **or** Cancer plan is subject to parliamentary inquiry	England, NSW Wales
	0·25	A minority of cancer plans are followed by a published progress report	New Zealand

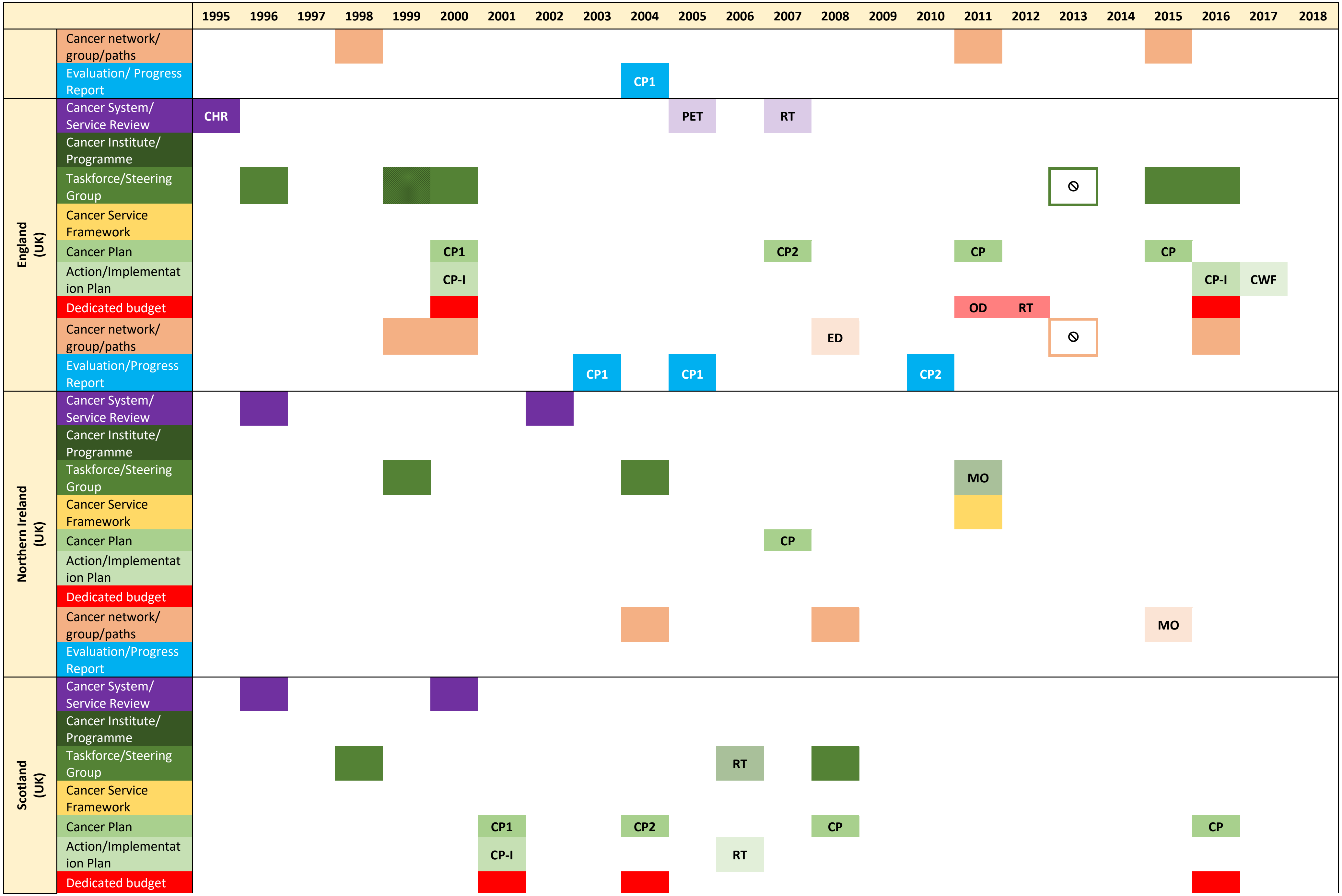
Category	Score (without weighting)	Description	Jurisdiction
		or A minority of cancer plans are formally evaluated	Norway
	0	No formal evaluation of or published progress reporting on published cancer plan/s	Ontario, Northern Ireland, Scotland

Note: * In the interests of transparency, we only considered publicly available documents that provided a detailed breakdown of funding commitments as they relate to a specific cancer plan.

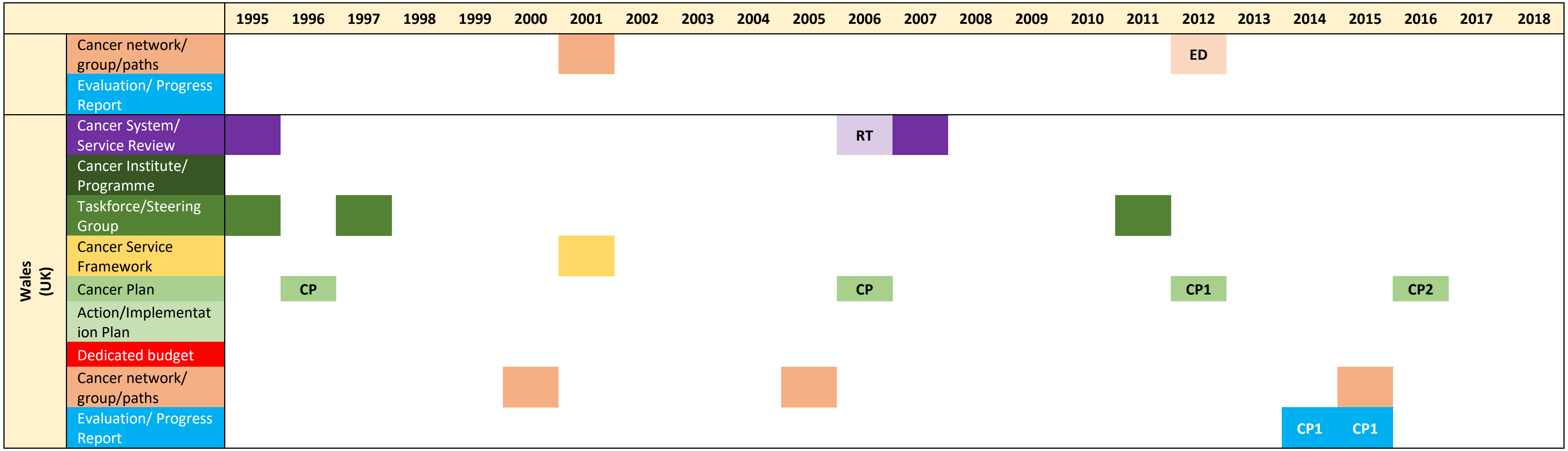
Table 2. Evolution of cancer policies in ten ICBP jurisdictions, 1995-2018

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
New South Wales (Australia)	Cancer System/ Service Review																								
	Cancer Institute/ Programme									🟩															
	Taskforce/Steering Group																								
	Cancer Service Framework									🟨															
	Cancer Plan	**RT**								**RT**	**CP1**		**CP2**				**CP3; RT**						**CP4**		
	Action/Implementation Plan																								
	Dedicated budget	**RT**								**RT**							**RT**								
	Cancer network/ group/paths											🟧													
	Evaluation/ Progress Report												**CP1**											**CP3**	
Ontario (Canada)	Cancer System/ Service Review							🟪		**Qual**															
	Cancer Institute/ Programme			🟩					**Qual**																
	Taskforce/Steering Group	🟩																							
	Cancer Service Framework																								
	Cancer Plan										**CP1**				**CP2**	**ST**		**CP3**			**ST; D**	**CP4**			
	Action/Implementation Plan									**ED**															
	Dedicated budget										🟥				🟥			🟥							
	Cancer network/ group/paths										🟧	🟧													
	Evaluation /Progress Report																								
Denmark	Cancer System/ Service Review								**PET**				**PET**												
	Cancer Institute/ Programme																								
	Taskforce/Steering Group				🟩								**RT**	▩											
	Cancer Service Framework																								
	Cancer Plan					**RT**	**CP1**					**CP2**					**CP3**						**CP4**		
	Action/Implementation Plan																	**CP3I**						**CP4I**	
	Dedicated budget						🟥					🟥					🟥						🟥		

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Cancer network/ group/paths										🟧				🟧									🟧	
	Evaluation/ Progress Report										CP1			CP2											
Ireland	Cancer System/ Service Review									RT											OD				
	Cancer Institute/ Programme																								
	Taskforce/Steering Group						🟩							🟩								🟩			
	Cancer Service Framework																								
	Cancer Plan		CP										CP1											CP2	
	Action/Implementation Plan																								
	Dedicated budget		🟥													🟥	🟥								
	Cancer network/ group/paths													🟧		🟧			OD						
	Evaluation/ Progress Report									CP-96											CP-06	CP-06			
New Zealand	Cancer System/ Service Review	🟪						N-SCT						CWF											
	Cancer Institute/ Programme																								
	Taskforce/Steering Group							🟩				🟩					🟩					⦸			
	Cancer Service Framework																								
	Cancer Plan									CP											CP+ RT			RT	
	Action/Implementation Plan											CP-A							MO						
	Dedicated budget																								
	Cancer network/ group/paths												🟧	🟧					🟧						
	Evaluation/ Progress Report													CP-A											
Norway	Cancer System/ Service Review										🟪														
	Cancer Institute/ Programme																								
	Taskforce/Steering Group		🟩																	🟩					
	Cancer Service Framework																								
	Cancer Plan			CP1									CP2							CP1					CP2
	Action/Implementation Plan				CP-A																	CP-A			
	Dedicated budget				🟥																				



		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Cancer network/ group/paths				🟧													🟧				🟧			
	Evaluation/ Progress Report										CP1														
England (UK)	Cancer System/ Service Review	CHR										PET		RT											
	Cancer Institute/ Programme																								
	Taskforce/Steering Group		🟩			▨	🟩													⦸		🟩	🟩		
	Cancer Service Framework																								
	Cancer Plan						CP1							CP2				CP				CP			
	Action/Implementation Plan						CP-I																CP-I	CWF	
	Dedicated budget						🟥											OD	RT				🟥		
	Cancer network/ group/paths					🟧	🟧								ED					⦸			🟧		
	Evaluation/Progress Report									CP1		CP1					CP2								
Northern Ireland (UK)	Cancer System/ Service Review		🟪						🟪																
	Cancer Institute/ Programme																								
	Taskforce/Steering Group					🟩					🟩							MO							
	Cancer Service Framework																	🟨							
	Cancer Plan													CP											
	Action/Implementation Plan																								
	Dedicated budget																								
	Cancer network/ group/paths										🟧				🟧							MO			
	Evaluation/Progress Report																								
Scotland (UK)	Cancer System/ Service Review		🟪				🟪																		
	Cancer Institute/ Programme																								
	Taskforce/Steering Group				🟩								RT		🟩										
	Cancer Service Framework																								
	Cancer Plan							CP1			CP2				CP								CP		
	Action/Implementation Plan							CP-I					RT												
	Dedicated budget							🟥			🟥												🟥		



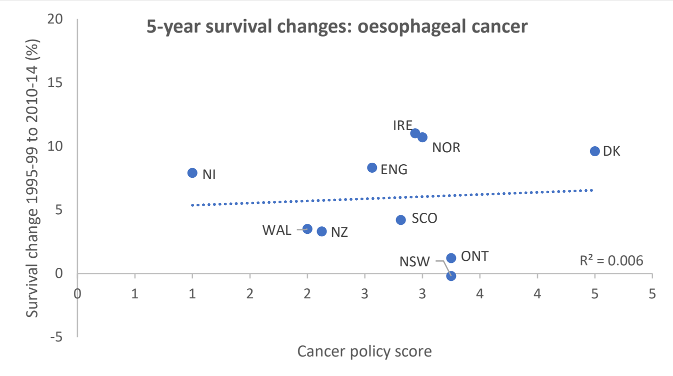
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Cancer network/ group/paths							🟧											ED						
	Evaluation/ Progress Report																								
Wales (UK)	Cancer System/ Service Review	🟪											RT	🟪											
	Cancer Institute/ Programme																								
	Taskforce/Steering Group	🟩		🟩														🟩							
	Cancer Service Framework							🟨																	
	Cancer Plan		CP										CP						CP1				CP2		
	Action/Implementation Plan																								
	Dedicated budget																								
	Cancer network/ group/paths						🟧					🟧										🟧			
	Evaluation/ Progress Report																				CP1	CP1			

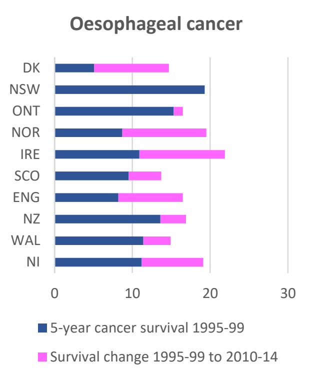
Note: Solid colour boxes indicate activities related to cancer more broadly, while shaded boxes denote a focus on specific areas around treatment (e.g. radiotherapy), equipment (e.g. positron emission tomography, PET) or workforce; open boxes denote discontinuation of a given activity

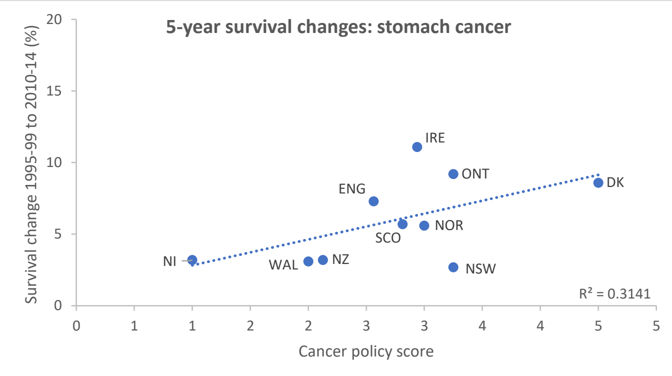
CP: Cancer Plan (with 1, 2, 3,…. indicating successive cancer plans that build on each other); CP-I (A): CP Implementation (Action) plan/strategy; CWF: cancer workforce; D: diagnostics; ED: early diagnosis; MO: medical oncology; N-ST: non-surgical treatment; OD: oncology drugs; PET: positron emission tomography; Qual: cancer care quality RT: radiotherapy; ST: systemic therapy; ⃠: programme/activity discontinued

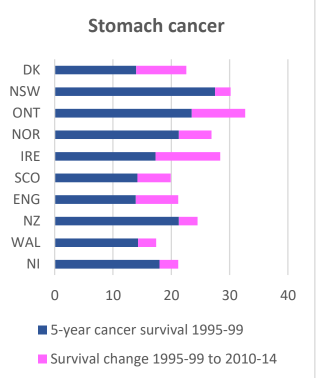
Table 3. Consistency of cancer policies in ten jurisdictions, 1995-2014 (weighted scores)

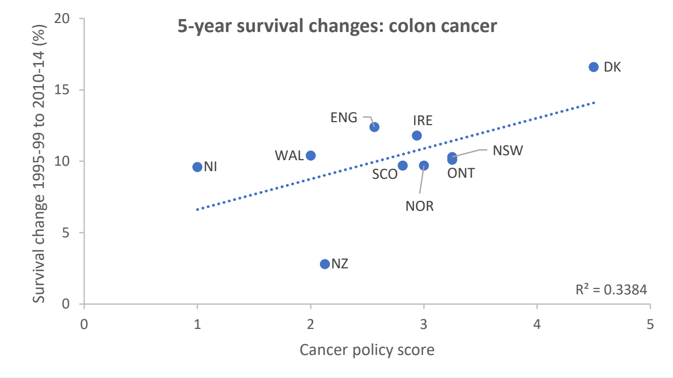
	Denmark	NSW	Ontario	Norway	Ireland	Scotland	England	New Zealand	Wales	Northern Ireland
Dedicated institute/ oversight group	1	1	1	0·75	1	1	0·75	1	1	0·75
Successive cancer plans that build on each other	1·25	1·25	1·25	0·75	0·5	0·75	0·75	0·25	0·5	0·25
Cancer plan is accompanied by action/ implementation plan	0·31	0	0	0·94	0	0·31	0·31	0·63	0	0
Cancer plan includes explicit budget for implementation	1	0·5	1	0·25	0·5	0·75	0·25	0	0	0
Cancer plan is regularly evaluated/progress report	0·94	0·5	0	0·31	0·94	0	0·5	0·25	0·5	0
Total score	**4·50**	**3·25**	**3·25**	**3·0**	**2·94**	**2·81**	**2·56**	**2·13**	**2·0**	**1·0**

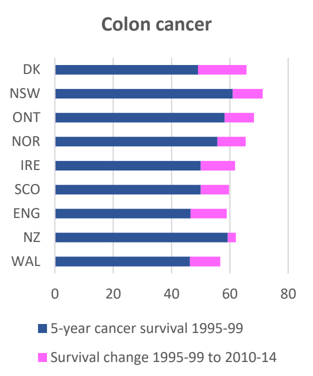

5-year survival changes: oesophageal cancer
Survival change 1995-99 to 2010-14 (%)
Cancer policy score
-5
0
5
10
15
20
0
1
2
3
4
5
IRE
NOR
DK
NI
ENG
SCO
WAL
NZ
NSW
ONT
R² = 0.006

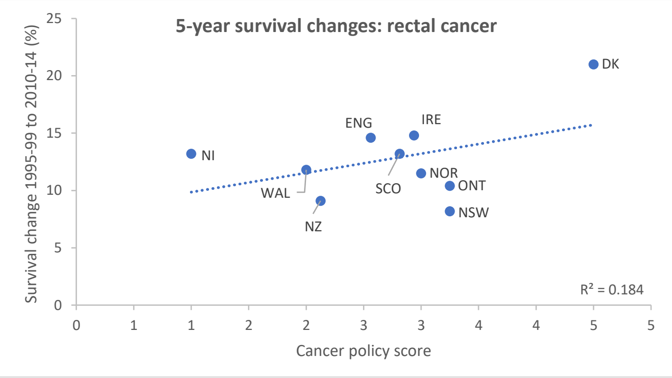

Oesophageal cancer
DK
NSW
ONT
NOR
IRE
SCO
ENG
NZ
WAL
NI
0
10
20
30
5-year cancer survival 1995-99
Survival change 1995-99 to 2010-14

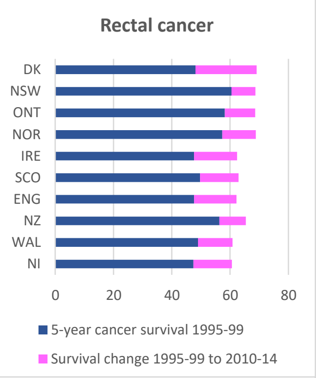

5-year survival changes: stomach cancer
Survival change 1995-99 to 2010-14 (%)
Cancer policy score
0
5
10
15
20
0
1
2
3
4
5
IRE
ONT
DK
ENG
SCO
NOR
NI
WAL
NZ
NSW
R² = 0.3141

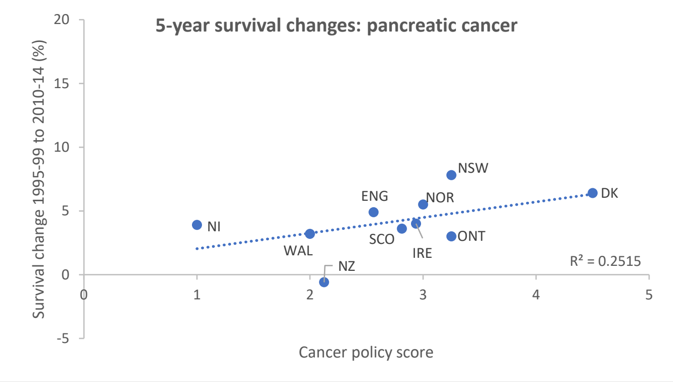

Stomach cancer
DK
NSW
ONT
NOR
IRE
SCO
ENG
NZ
WAL
NI
0
10
20
30
40
5-year cancer survival 1995-99
Survival change 1995-99 to 2010-14

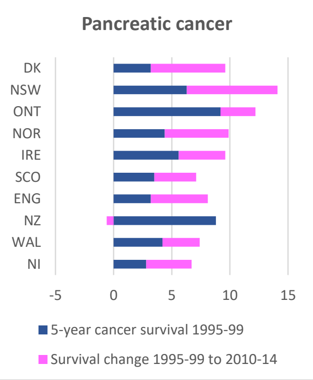

5-year survival changes: colon cancer
Survival change 1995-99 to 2010-14 (%)
Cancer policy score
0
5
10
15
20
0
1
2
3
4
5
DK
ENG
IRE
WAL
NSW
NI
SCO
ONT
NOR
NZ
R² = 0.3384

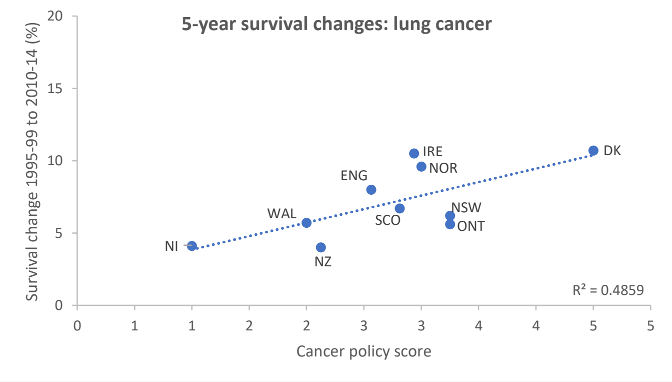

Colon cancer
DK
NSW
ONT
NOR
IRE
SCO
ENG
NZ
WAL
0
20
40
60
80
5-year cancer survival 1995-99
Survival change 1995-99 to 2010-14

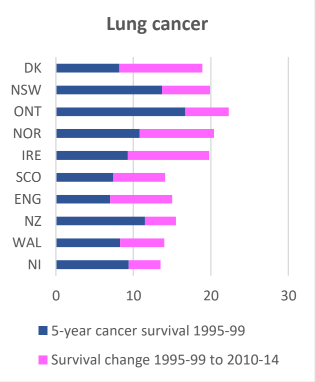

5-year survival changes: rectal cancer
Survival change 1995-99 to 2010-14 (%)
Cancer policy score
0
5
10
15
20
25
0
1
2
3
4
5
DK
ENG
IRE
NI
WAL
SCO
NOR
ONT
NZ
NSW
R² = 0.184

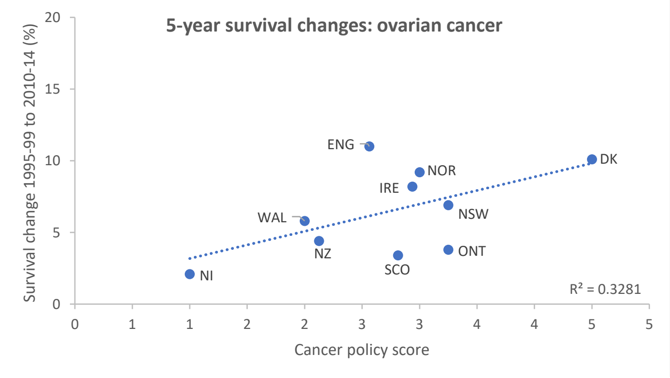

Rectal cancer
DK
NSW
ONT
NOR
IRE
SCO
ENG
NZ
WAL
NI
0
20
40
60
80
5-year cancer survival 1995-99
Survival change 1995-99 to 2010-14

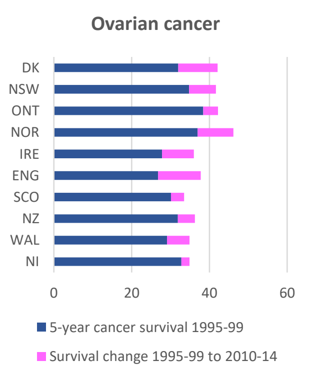

5-year survival changes: pancreatic cancer
Survival change 1995-99 to 2010-14 (%)
Cancer policy score
-5
0
5
10
15
20
0
1
2
3
4
5
NSW
ENG
NOR
DK
NI
SCO
ONT
WAL
IRE
NZ
R² = 0.2515


Pancreatic cancer
DK
NSW
ONT
NOR
IRE
SCO
ENG
NZ
WAL
NI
-5
0
5
10
15
5-year cancer survival 1995-99
Survival change 1995-99 to 2010-14


5-year survival changes: lung cancer
Survival change 1995-99 to 2010-14 (%)
Cancer policy score
0
5
10
15
20
0
1
2
3
4
5
IRE
DK
NOR
ENG
WAL
NSW
SCO
ONT
NI
NZ
R² = 0.4859


Lung cancer
DK
NSW
ONT
NOR
IRE
SCO
ENG
NZ
WAL
NI
0
10
20
30
5-year cancer survival 1995-99
Survival change 1995-99 to 2010-14


5-year survival changes: ovarian cancer
Survival change 1995-99 to 2010-14 (%)
Cancer policy score
0
5
10
15
20
0
1
2
3
4
5
ENG
NOR
DK
IRE
WAL
NSW
NZ
ONT
SCO
NI
R² = 0.3281


Ovarian cancer
DK
NSW
ONT
NOR
IRE
ENG
SCO
NZ
WAL
NI
0
20
40
60
5-year cancer survival 1995-99
Survival change 1995-99 to 2010-14