Health Policy Paper for Lancet Oncology

The Future of UK Cancer – time for a radical and sustainable National Cancer Plan

Ajay Aggarwal[1], Ananya Choudhury[2], Nicola Fearnhead[3], Pam Kearns[4], Anna Kirby[5], Mark Lawler[6], Sarah Quinlan[7], Carlo Palmieri[8], Tom Roques[9], Richard Simcock[10], Fiona M. Walter[11], Pat Price*[12], Richard Sullivan*[13]

1. Dr Ajay Aggarwal, PhD FRCR, Department of Health Services Research & Policy, London School of Hygiene and Tropical Medicine, London ajay.aggarwal@lshtm.ac.uk
2. Prof Ananya Choudhury PhD FRCR, Dept of Clinical Oncology & Division of Cancer Sciences, The Christie NHS Foundation Trust, Manchester, M20 4BX ananya.choudhury@nhs.net
3. Miss Nicola Fearnhead FRCS, PhD, Department of Colorectal Surgery, Box 201, Cambridge University Hospitals NHS Foundation Trust Hills Road, Cambridge CB2 0QQ Nicola.fearnhead@nhs.net
4. Prof Pamela Kearns FRCP PhD, Institute of Cancer and Genomic Sciences, NIHR Birmingham Biomedical Research Centre, College of Medical and Dental Sciences , University of Birmingham, Edgbaston, Birmingham, B15 2TT p.r.kearns@bham.ac.uk
5. Prof Anna Kirby, PhD FRCR, Royal Marsden Hospital, London UK Anna.Kirby@rmh.nhs.uk
6. Prof Mark Lawler FRCPath PhD, Patrick G Johnston Centre for Cancer Research, Queens University Belfast Belfast, UK mark.lawler@qub.ac.uk
7. Sarah Quinlan, MBE, Radiotherapy UK, patient charity SQuinlan@radiotherapy.org.uk
8. Dr Carlo Palmieri FRCP PhD, The Clatterbridge Cancer Centre NHS Foundation Trust, & Department of Molecular and Clinical Cancer Medicine, Institute of Systems, Molecular and Integrative Biology, University of Liverpool, Liverpool, L69 3GE **c.palmieri@liverpool.ac.uk**
9. Dr Tom Roques FRCR PhD, Vice President, Clinical Oncology, Royal College of Radiologists & Norfolk and Norwich University Hospitals NHS Foundation Trust, Norwich, UK Tom_Roques@rcr.ac.uk
10. Prof Richard Simcock MRCPI FRCR, University Hospitals Sussex NHS Foundation Trust, Brighton, BN2 5BE, richard.simcock@nhs.net
11. Prof Fiona Walter MD FRCGP, Wolfson Institute of Population Health, Faculty of Medicine & Dentistry, Queen Mary University of London, London fiona.walter@qmul.ac.uk
12. Prof Pat Price*, MD FRCR, Imperial College London, London. p.price@imperial.ac.uk
13. Prof Richard Sullivan* FRCS PhD, Institute of Cancer Policy, Centre for Cancer, Society & Public Health, Guy's Hospital Campus, King's College London, London richard.sullivan@kcl.ac.uk

*Joint senior authors. PP and RS are papers guarantors]

Acknowledgements: We would like to thank Dr Emma Kipps and Steve Williamson for helping to provide SACT and cancer drug fund data. *This work uses data that has been provided by patients and collected by the NHS as part of their care and support. It is sourced* *from NHS England and collated, maintained and quality assured by the National Disease Registration Service, which is part of NHS England*

Conflicts of Interest: The authors declared no conflicts of interest

Contributors Section: All authors contributed equally to the co-design and writing of this manuscript

Search strategy and selection criteria: World of Science, PUBMED and EMBASE were searched for English language publications relevant to UK cancer policy over the last decade using a series of bibliometric macros.

Summary

Cancer affects 1 in 2 people in the UK and incidence is set to increase. The UK NHS is facing major workforce deficits and cancer services have struggled to recover after the COVID-19 pandemic, with waiting times for cancer care being the worst on record. There are significant and widening disparities across the country and survival rates remain unacceptably poor for many cancers. This is at a time when cancer care has become increasingly complex, specialised, and expensive. The current crisis has deep historic roots and to be reversed, the scale of the challenge has to be acknowledged and a fundamental re-set is needed. The loss of a dedicated National Cancer Control Plan in England & Wales, poor operationalisation of plans elsewhere in the UK and the closure of the National Cancer Research Institute have all added to a sense of strategic misdirection. The UK finds itself at a crossroads, where the political decisions of governments, the cancer community and research funders will determine whether we can, together, achieve equitable, affordable and high-quality cancer care for patients to improve our outcomes to amongst the best in the world. In this policy analysis we describe the challenges and opportunities that are needed to develop radical, yet sustainable, plans which are comprehensive, evidence based, integrated, patient focused, and affordable.

Foreground

Cancer is one of the UK's greatest societal challenges. In just over a decade, the UK will have to care for 457,000-564,000 new cancer patients annually (a 30% increase), with annual cancer mortality projected to be 174,000-234,000, and nearly 4 million people living with cancer[1].

Today's crisis in UK cancer care, patient experiences and outcomes has deep historic roots. During the 1990's, UK cancer performance was poor[2]. By early 2000's, a radical political change created the first dedicated NHS Cancer Plan. This sustained focus on multidisciplinary, faster cancer diagnosis and treatment with integrated research led to better population outcomes, albeit unevenly[3]. However, from 2010, a combination of reduced accountability, siloed "arms-length" bodies, a market-orientated NHS, and significant reductions in health funding eroded NHS services and cancer care[4,5]. Whilst some funding was directed towards cancer from 2010 onwards[6] overall UK healthcare indicators were consistently in the bottom third compared to other OECD countries[7]. Cancer pathways from community to hospital settings entered the COVID-19 pandemic severely weakened.

COVID-19 and measures to control it had major impacts on UK cancer services[8,9], which will persist[10] despite efforts to ensure continuation of care[11]. In the immediate aftermath of the pandemic, the UK was under serious pressure with backlogs, long waiting times, and major workforce deficits. *Ad hoc* solutions such as 'shopping around' failed to address these fundamental issues[12]. The House of Commons Health and Social Care Committee report (March 2022) pulled no punches, describing unacceptable variation in care and outcomes, together with inadequate progress on workforce planning[13].

Absorption of a dedicated national cancer control plan (NCCP) into a Major Conditions Strategy in England and Wales[14], coupled with the recent closure of the National Cancer Research Institute(NCRI)[15], as well as the creation of new NHS organisations (Integrated

Care Systems) signal a watershed moment for UK cancer[16]. Loss of a dedicated NCCP, coupled with low public spending on health[17] has been a major miss-step at a time of rapid change and complexity in cancer care as well as counter to international consensus.[18]

In this health policy analysis, a broad range of senior clinical cancer experts articulate their long-term collective vision for UK cancer policy to improve outcomes and provide a service "fit-for-the-future". One that puts patients first, is led by health service professionals, is research active as well as accountable, affordable, and equitable.

Workforce Planning

The UK has shortages in almost every staff group who treat people with cancer, from diagnostics through treatment to end-of-life care[19-23]. Chronic underinvestment and lack of workforce planning are being compounded by increased service demands. As treatments become more complex, workforce requirements are accelerating faster. Clinical complexity of patients is also increasing as the population ages. Staff shortages increase workforce stress and burnout, leading to more people leaving the workforce. Those remaining spend more time coping with service demands and less time innovating or leading services. Workforce gaps occur in an unplanned fashion, exacerbating regional and socioeconomic care inequalities.

In the short-to-medium term, renewed focus on enabling the workforce to perform to the best of their ability is required, as well as recruitment and retention strategies. Integrated, modern IT systems and better administrative support will improve efficiency. Remote working can enable staff to manage patients across traditional boundaries, particularly if there are inequalities in provision; local governance arrangements need to facilitate rather than prohibit this. Changes to culture and use of technology is needed to facilitate flexible working where needed. We urgently need to embed more time and resource for leadership, teaching and service development and find ways to compensate for the reduction in clinical time.

The broad recruitment targets in the NHS Long Term Workforce Plan[24] are welcome, but must be translated into ambitious but necessary specific increases in cancer workforce that the Health Education England Cancer Workforce Plan evidenced in 2017[25]. Ethical overseas recruitment needs to be supported and streamlined so that people with the required skills can move to the UK and participate in earn, learn and return schemes. We need a better understanding of why people are leaving the workforce and how we could change this. Improving pay will be part of the solution, but we must also improve working conditions, with renewed focus on time for professional development, more options for flexible working and adjustment of clinical roles as people approach retirement age[26].

Long-term workforce planning must consider the skills that a future workforce will need, such as genomics literacy to realise the benefits of testing and targeted therapies, and an understanding of how to implement digital technologies to improve decision-making[27]. Investment in proven technologies like artificial intelligence (AI), including time to train existing staff and develop new roles, is required to ensure their promise is realised[28]. We need to challenge traditional role boundaries and training routes and embrace skill mix so that more people work at the top of their licence; this will require development of new practitioner roles to backfill tasks and time for training and doing so in a way which does not overreach and avoids de-professionalisation. Competency-based training needs to be flexible so staff acquire new skills when they wish to acknowledging life commitments which prevent linear career progression.[29]. Generalist skills are also needed to ensure new cancer detection approaches are accessible and that treatments are delivered optimally to an aging population with comorbidities. We need to plan for a modern workforce that will work less than full time and have portfolio careers that change over their working lives.

Prevention, Early Detection, Primary Care and & Screening

Prevention, early detection, and screening are core to cancer control. Public health measures to reduce smoking have been successful, indeed the UK has one of the most comprehensive tobacco control approaches in the world,[30] but much remains to be done there remains significant issues with, for example, funding of smoking cessati90on services and the impact of vaping. Preventable factors such as high alcohol intake and obesity are now emerging as a major drivers of cancer incidence[31]. A major improvement in health behaviours is required, but this needs to be accompanied by public health measures to reduce poverty, socio-economic inequalities[32], deliver better education, *etc* i.e. a focus on the social determinants of cancer[33].

Critical to this is public awareness and early presentation with suspicious symptoms. A decade ago, Public Health England ran ‘Be Clear on Cancer’ campaigns; later in 2023 NHS England (NHSE) will run the ‘Help Us, Help You’ national cancer campaign to tackle barriers to timely presentation, including knowledge of cancer signs and symptoms. These campaigns need to be rigorously assessed, as evidence of their effectiveness has been ambivalent[34]. Extending innovative communication partnerships with retailers, celebrity and social media engagement may inform a national conversation but again need to be tested.

Primary care is the main setting from which suspected cancer is referred for early diagnosis. In the UK, most cancer patients present to primary care; 67.5% first reporting symptoms in general practice compared with 7% in emergency care and 5% in outpatients[35]. It is also the setting in which most pre-symptomatic risk assessment takes place such as for smoking or obesity. Primary care also has the added challenge of having to make the the right call in terms of referral for suspected cancer. For example, only 2.4% of patients presenting to their GP with haemoptysis are subsequently found to have lung cancer[36]. The NHS has set a target of increasing early diagnosis at Stages 1 and 2 to 75% of cases by 2028. This will not be achievable with piece-meal approaches and tunnel vision that technology will solve the problem[37]. Primary care networks of triage and referral need to be made more efficient[38] coupled to more primary care resourcing[39] and downstream diagnostic technologies. Furthermore, the impact of infrastructure changes e.g., community diagnostic centres need to be carefully and critically evaluated. Better integration between primary, diagnostic and onward care is needed.

The COVID-19 pandemic dramatically reduced cancer screening. More than 1 million breast cancer screens were missed or delayed in England in 2020–2021, with significant impact on mortality[40]. Screening service reduction disproportionately impacted already vulnerable populations, causing a worsening of inequalities [41]. Screening services recovery needs urgent improving. The UK needs to focus on supporting new screening programs e.g. low dose CT lung cancer screening,[42] not only in England but across the UK. Other approaches to screening of high-risk groups are emerging, such as multi-factorial cancer risk assessment including polygenic risk scores, and multi-cancer early detection tests[43] which may improve early detection and/or screening. However, these all need rigorous and critical evaluation to ensure their cost-effectiveness and ability to close the inequalities divide.

Supportive Care and Survivorship

A large proportion of cancer patients, (110,000 in England alone), will have treatable but non-curable disease [44]. Genomic advances have facilitated highly-targeted therapies, but these 'precision' approaches don't address people's wider needs/priorities. Conversations about those needs are at the heart of 'personalised care'. Delivering high-quality personalised care is a stated aim for the NHS, but is threatened when a workforce is deeply siloed due to increasingly specialisation[45]. UK cancer systems must enable dialogue about holistic needs and navigation towards services that meet those needs. "What is important for you" needs establishing from the outset". Economic impacts of care are also critical; the NHS must protect the most vulnerable for their travel, prescriptions etc. Prioritising proven interventions like personalised care and support planning remain crucial. In some parts of the UK where systems are more integrated, holistic needs assessments are already being mainstreamed[46].

Psychosocial and physical recovery from cancer therapies requires investment in rehabilitation and recognition that many problems may be mitigated by being addressed before therapy starts. Prehabilitation reduces perioperative complications in major cancer surgery and gives better functional outcomes in non-surgical oncology[47]. Appropriately constituted prehabilitation services offer the triple benefits of personal empowerment, physical and psychological resilience and improved long-term health[48].

Cancer doesn't occur in a clinical vacuum. Nearly two-thirds of cancer survivors in the UK are >65 years old; ~40% will have at least one other long-term condition[49]. Multimorbidity requires generalist medical input into specialist management. Overlapping domains of co-existent diseases underpin the concept of 'cluster medicine'[50]. Arguably the most urgent cluster to address in cancer is co-existence of frailty and a cancer diagnosis. Cancer services need to assess this to avoid under-treatment of those with reversible frailty syndromes and overtreatment of others.

Palliative Care (282 words)

Integrated Care Boards in England have a statutory duty to those with "progressive illness or those nearing end-of-life; to receive the care and support they need to live and to die well"[51]. High-quality palliative care services in both hospitals and community are key, but these skills must be supported by documented conversations exploring a patient's expectations and wishes. Healthcare staff need appropriate psychosocial skills-training to discuss a patient's advance and anticipatory care planning. Honest discussions permit informed decisions on continuing/stopping treatment. These conversations should also cover holistic needs - emotional, practical, financial, and spiritual. Historical precedent means that hospice services funding rely on charitable funding; in 2023, costs for the hospice sector rose by £100m[52]. Whilst there is ongoing debate about funding hospice services, it remains an anomaly that this is the only part of our health continuum not fully funded within the NHS.

Despite repeated surveys showing that for most citizens their preferred place of death is their home, more than 44% of people still die in hospital[53]. People living with cancer who require emergency admission to hospital have a very high risk of dying within 12 months, yet less than a third of acutely unwell cancer patients admitted to hospital had a recorded discussion about treatment escalation[54]. Acute presentations need to prompt advanced planning conversations. Expansion to acute oncology services may facilitate these changes, but recognition of the issue is a responsibility for all healthcare professionals.

When advance care plans are in place, they are often not shared between teams. High-quality palliative care requires 24/7 access and linkage between multiple agencies including pharmacy, emergency services and nursing. To facilitate this, better access to digital patient records across services is needed.

Radiotherapy

Radiotherapy is required in around 50% of cancer patients, delivering 40% of cancer cures as well as significant palliation [55]. As one of the most cost-effective treatments, radiotherapy benefits from continuous advances in technology[56]. Gains from this innovation require workforce planning, infrastructure and national implementation pathways[56]. Issues of access need to consider whether increasing specialisation and centralisation for some modalities is required[57]. A wide range of issues are currently impacting UK radiotherapy[56]:

- increasing number of patients with advanced cancer and cases with increased complexities[58] e.g. oligometastatic disease
- delivering advanced technology, but with few clear pathways to implementation, unlike SACT
- increasing complexity of decision-making around different radiation techniques (IMRT, SBRT, brachytherapy, protons, molecular radiotherapy) and integrating surgery, SACT, tissue and imaging biomarkers[59]
- lower investment in radiotherapy delivery and research from healthcare systems compared to SACT
- managing post-radiotherapy survivorship[60] and commitment to high quality care.

Radiotherapy covers a wide range of different techniques. Sixty NHS centres deliver external beam radiotherapy using linear accelerators (Linacs) and two proton-beam facilities treat children as well as delivering clinical research. Brachytherapy is also used in a number of NHS trusts. With precision radiotherapy and long term survivorship, re-irradiation will become increasingly important, but requires expertise, flexibility and resources. Over the past fifty years, the UK has been at the forefront of delivering and implementing innovative practice-changing trials in radiotherapy[61] achieved through a networked, national approach.

However, radiotherapy has been the Cinderella of cancer treatment in both investment priority and visibility;[62] reflected in much lower access rates than international standards outline. Solutions need to focus on properly funded procurement pathway. This includes new radiotherapy machines to meet present demand, machines to replace those that have already reached their life span, but also machines that will be needed in 5 years. This would critically consider where this infrastructure will be sited, hospital capacity (for new bunkers or *de novo* hospitals) and what workforce is required. This is complex and requires significant capital investment as well as long range planning[63].

Delivery of high-quality radiotherapy requires multi-disciplinary collaboration with clinical scientists, allied health professionals to provide optimal patient care and solutions for workforce gaps [64]. It also requires a UK-wide radiotherapy outcomes-reporting programme[65]. Advances with hypofractionation including stereotactic body radiotherapy reduces burden on patients and departments, and the UK must continue to lead design/delivery in this area. Here the work of the NIHR funded RTTQA group is vital and must be supported. Telehealth and virtual technology could help maintain oversight of patients, especially with long-term survivorship. AI[66] will eventually be able help automate radiotherapy processes such as contouring treatment volumes, optimising planning and workflow efficiencies.

In a "10 year Vision for Radiotherapy in the UK"[67] improving patient outcomes based on emerging international consensus on essentials in radiotherapy national planning (Resources | GCR (globalradiotherapy.org) is articulated through a sustainable interlinked UK radiotherapy service, embracing cloud-based connectivity, and an expansion of a skilled multidisciplinary workforce. However, a considered approach to investment needs to be made using value-based frameworks[68] which will ensure quicker access to technology that delivers clinically meaningful benefit.

Systemic Therapy

Systemic anticancer therapy (SACT) has rapidly expanded over the last decade with now around 2,800 regimens for adult and childhood cancers. The UK now faces a number of challenges in SACT delivery due to :

- increasing number of patients with advanced cancer[69] and cases with increased complexities[70].
- on-boarding treatments into routine use via multiple routes including Cancer Drugs Fund (CDF), Early Access to Medicines Scheme (EAMEs) and pharma access schemes[71] as well as faster regulatory approvals[72].
- increasing complexity of decision-making around SACT, integrating genetic, genomic and additional tumour immunohistochemistry testing[73] [74].
- increases in SACT lines available for advanced disease and increased time on treatment.
- changing nature and frequency of toxicities associated with modern SACT[75].
- The current cancer drug spend is likely unsustainable and a national conversation is also needed particularly around regulatory authorisation and HTA[76]. To ensure SACT sustainability, the NHS needs to consider the following long term solutions are needed.

Education and empowerment of cancer patients to take more active roles in SACT delivery and safe monitoring is required. Group education sessions with a subject expert has a number of advantages. Firstly, remote access is possible; Secondly, it ensures uniformity of information, giving opportunities for patients to ask questions; Thirdly, it enables a focus on use of supportive measures to ameliorate adverse effects. Informed consent can be part of such group education sessions.

The predominant model for SACT delivery is hospital-centric, although treatment delivery in the community is offered by some centres. Alternate models for safe 'dehospitalisation' of SACT[77,78], particularly oral and subcutaneous treatments [79]should be considered. Scaling this approach requires development of 'community oncology' where patients could have routine assessment, blood testing and dispensing of oral/subcutaneous SACT. Such care should be a continuum of hospital-based care. Self-administration of subcutaneous SACT and use of electronic Patient Reported Outcome (PROMs) for monitoring are other key elements of this approach[80,81].

Currently, the NHS acts reactively to on-boarding of new SACTs. A more proactive horizon scanning, and assessment process should be developed, planning for capacity implications and implementation, particularly for pharmacy. SACT impact assessment scores should be developed to quantify impact, factoring-in treatment setting, number of patients eligible, treatment duration, visits needed and toxicities. National SACT protocols should be harmonised at national level, complimented by education packages for healthcare professionals and patients. In addition, the integration of several HTA approvals has doubled the number of consultations and interactions with hospitals services. Budget impact analyses are critical to ensuring integration of new pathways of care are adequately resourced.

SACT innovation 'sandpits' should be developed to test and embed innovations with meaningful impacts on sustaining SACT, as well as planning for future innovation. Such an approach may also be useful for radiotherapy. For sustainable, affordable SACT delivery, NCCPs must address increasing number of patients and treatments. A multi-faceted approach, involving the patient, improving SACT planning and on-boarding, as well as evolving oncology care outside of hospital and ensuring the mainstreaming of impactful innovation will be key.

Surgery

Surgical excision is the mainstay of treatment for many solid tumours, as well as being a major modality for palliation. Nine million cancer operations are performed annually worldwide; the need for cancer surgery is likely to increase to nearly 14 million operations by 2040[82]. The UK though faces a range of challenges to sustainable surgical oncology services:

- adapting to a shift from "surgery first" to an "optimal time for surgery" within the multidisciplinary delivery of cancer care[83]

- reducing unwarranted variation in cancer outcomes through implementing and embedding evidence-based changes in surgical timing and techniques in national cancer programmes[84]
- effective assessment and evaluation, including cost effectiveness, of new techniques and adjuncts (AI, augmented reality, remote operating) in cancer surgery within the principles of the IDEAL Collaboration[85]
- national adoption of best practice in pre-optimisation to minimise perioperative morbidity with tagetted programmes to encourage exercise, weight loss, and smoking cessation *et al*
- impact on services with greater patients numbers due to earlier detection

Positioning of surgery within the multidisciplinary management of cancer has evolved considerably in recent years, with the rise of neoadjuvant and adjuvant therapies; surgery is no longer necessarily the first line treatment for many cancer types. The culture of surgery has also evolved with changing workforce patterns. Technological advances have seen the rise of minimally-invasive approaches, including radiological interventions and ablative therapy as well as endoscopic, laparoscopic and robotic innovations, and specialised interventions resulting in quicker recovery times and less scarring, without impacting cancer outcomes. AI, augmented and virtual reality, image-guided interventions and remote operating systems offer tantalising opportunities going forward. However, there is a difference between what is possible and what has an evidence base for implimentation.

Ensuring sufficient capacity to allow treatment to be given on time is needed. Surgical cancer hubs need to be prioritised as well as the balance between specialised and general cancer surgical services. Incremental gains in preoptimization and enhanced recovery programmes are needed. The concept of the multidisciplinary perioperative team facilitates shared decision-making avoids unnecessary risk to patients and futile procedures[86]. Big data and genomic approaches may provide the opportunity for decision-aids to assist the patient and clinician in personalised surgical care. Risks of surgery can be reduced with preoperative programmes to promote exercise, weight loss, and smoking cessation, coupled with optimisation of comorbidities and correction of anaemia. The surgical mindset has also evolved, with emphasis on outcomes other than mortality, particularly reducing re-admission and re-operation rates.

Surgery has a key role in palliation of symptoms, management of oncological treatment complications, treatment of metastatic, and oligometastatic disease as well as timely surgical intervention and potential salvage surgery. Surgical delivery of emerging stem-cell therapies may yet offer reconstructive options after cancer resection. Training the next generation of surgeons will need to accommodate the growing evolution of cancer surgery alongside knowledge of a range of other disciplines including molecular biology, genomics, data literacy, AI, sustainable surgery, human factors etc.

Cancer in Children and Young People

Cancers in Children and Young People (CYP) differ from cancers in adults in their biology, aetiology, and treatment context. Up to the age of 25 years, over 4000 are diagnosed annually in the UK and, despite overall 5-year survival rates >80%, cancer remains the commonest cause of death from disease in under 16-year-olds. Approximately two thirds of UK CYP survivors live with sometimes life-changing long-term consequences of their treatment.

UK benefits from a highly-coordinated approach to childhood cancer care, focussed in 21 principal treatment centres (PTCs), delivered by specialist multi-disciplinary teams, with some care provided closer to patients' home in a network of Paediatric Oncology Shared Care Units (POSCUs). The situation for teenagers/young adults (TYA; 16-25 years) is more complex, with a mixture of designated TYA PTCs and cancer care for some 19–25-year-olds delivered within adult cancer services. The multi-stakeholder Children's and Young People's Cancer Clinical Reference Group has published excellent service specifications for specialist cancer services for children and TYA [87].

Despite this benchmarking, inequalities persist, with variability in levels of resourcing - workforce for psychosocial support, physical rehabilitation, and notably support for long-term follow-up care, including transition from paediatric to adult services. Resourcing paediatric and TYA PTCs to meet these well-defined standards would ensure national equity for CYP patients.

CYP cancer treatment is characterised by high participation in clinical trials. At least two thirds of childhood cancer patients participate in a clinical trial at diagnosis. Trials commonly include tissue collections, supporting translational science. TYA trial recruitment lags behind, due to combination of lack of trials and poor consideration of specific needs of this age group[88]. Bottlenecks to UK trial delivery, described in the 2023 Independent Report to UK Government, are equally applicable to trials that are pivotal to CYP cancer care; extrapolation of recommendations to non-commercial trials is urgently needed.

CYP cancer drug development is a major area of unmet need, due to limited market value for drugs developed for these rare cancers[89]. Although UK collaborates in International multi-stakeholder initiatives to increase CYP drug development trials, [90] it can struggle to open trials. Our departure from the EU has added new bureaucratic complexity, cost and further delays to UK trial delivery.

In January 2023, Young Lives vs Cancer and the Children Cancer and Leukaemia Group published a UK CYP 10-year Cancer Plan with recommendations/roadmap to improve CYP outcomes and patient experience. Implementation of this plan by UK Government would ensure UK CYP care and research remained the best in the world.

International Partnerships

International collaboration and partnerships are key to better research and enhanced patient outcomes. UK cancer has a long history of partnerships with a range of global organisations and countries, particularly the EU and USA[91]. The UK community also influences professional and practice guidelines through our partnerships with European Society for Radiotherapy, European Society of Medical Oncology and European Cancer Organisation. Research partnerships, for example with EORTC and the NCI are crucial to the globalisation of UK's research impact.

Arguably the UK's strongest suit is its ability to run large practice-changing randomised clinical trials (RCTs) - It has been world-leading in its ability to develop international RCTs in areas such as hypofractionated radiotherapy for breast[92] and prostate cancer[93]. The UK continues to be uniquely placed to deliver large RCTs, for example evaluating the Cytosponge-TFF3 testing for diagnosis of treatable oesophageal dysplasia and early cancer[94], and proton beam therapy[95]. These have been challenging to undertake in different health economic settings, but require ongoing prioritisation at government level to sustain the necessary infrastructure.

An ongoing opportunity for the UK to impact meaningfully on European cancer care and research is through involvement in the EU's Cancer Mission and the related Europe Beating Cancer Plan. The EU Cancer Mission seeks to revolutionise cancer research, prevention, diagnosis and treatment by leveraging cutting-edge technologies and collaborative research. The UK can contribute its world-renowned infrastructure and innovative expertise, but this is currently compromised by Brexit. Ensuring that UK researchers continue to collaborate with European colleagues as part of Horizon Europe-funded research programmes is critical to the UK's commitment to remaining a key player in the European cancer research landscape[96].

Beyond Europe, the UK's impact requires ongoing international partnership. The UK contributes via the World Health Organisation (WHO), particularly IARC, to global health initiatives that improve access to healthcare services and promote health equity, sharing best practices in cancer prevention, contributing to global guidelines, sharing research data to inform global strategies for cancer control. More than a dozen UK-led Lancet and Lancet Oncology Commissions have outlined strategies for improving multiple aspects of cancer care and research globally from imaging[97] to surgery[98]. The UK remains a key partner in reducing global inequities in cancer care, underpinned by funding via the UK government's Research and Innovation Fund. The UK Global Cancer Network aims to collate and direct the vast array of collaborations between UK research teams and international counterparts in academia and industry that seek to improve cancer care in LMICs[99].

Devolved Nations: Delivering Equity

The COVID pandemic had a profound effect on cancer services and patients across all Devolved Nations[100]. A pan-UK study first highlighted the impact of the pandemic on cancer diagnosis and cancer treatment in the UK[101], where progress in outcomes for certain cancers may have been set back by over a decade[102]. Crucially, the pandemic also highlighted the lack of resilience in cancer health systems across the UK Nations[103].

The best way to improve cancer outcomes through a systems approach is through delivery and implementation of a NCCP. However, a recent study from the International Cancer

Benchmarking Partnership (ICBP), revealed that the UK's current approaches are not working[104]. The study examined the relationship between consistency of cancer policy and improvements in five-year survival for seven cancers. For six of the seven cancers, there was a correlation between dedicated cancer control policies and better five-year survival.

Disappointingly, all UK nations were in the bottom half of this particular league table, with Northern Ireland conspicuously adrift, a situation not helped by it having published and implemented only one cancer plan during the 20-year study period. If there is only one cancer plan in a 20-year period, how can we expect to achieve the best survival for Northern Ireland patients? And the situation is not set to improve, given England's short-sighted decision to forgo its NCCP in favour of a Major Condition's Plan, an incomprehensible decision not in the best interests of cancer patients[105]. A Northern Ireland Cancer Strategy was finally developed, but sits gathering dust, unimplemented some 18 months after it was belatedly launched[106]. For Scotland, there has been a commitment to spend £100M over the next five year as part of it's Cancer Strategy[107].

Cancer knows no borders; it is crucial that the 4 UK nations consider how best to address the cancer challenge collectively, particularly in areas like early cancer diagnosis, including screening (see above) cancer inequalities and cancer survivorship, where common UK-wide solutions may exist. Bringing together the best minds and expertise from across the four UK nations with comparable data and turning those data into intelligence in a manner akin to our highly successful pan-UK COVID studies, will help deliver true UK cancer control equity[108]. Certain challenges will be unique to particular jurisdictions, but working together more closely than currently will deliver a roadmap addressing both common and distinct challenges that the UK faces, underpinning the achievement of best outcomes for cancer patients across the four nations.

Services & Systems

Strengthening UK health policy, systems and services (HPSR) will be critical for fiscally-sustainable improvements in cancer outcomes over the next decade[109]. Health systems fund, organize and deliver cancer care; the wider societal context within which they are embedded defines when and how patients present with cancer, what treatments are available, who gets treatment, the cost of treatment and the quality. Despite its integral importance, cancer HPSR research represents less than 3% of UK's cancer research [110]. Instead, the narrative is dominated by hyperbole that technological solutions alone e.g. multi-cancer early detection tests can overcome the fundamental inequalities that pervade our cancer system[111,112,113].

UK cancer has an opportunity to deploy its unique integrated data intelligence platforms to address many of issues above. These systems of data capture and linkage enable formulation of datasets that include information on every cancer diagnosis, all hospital episodes and procedures, information on radiotherapy, surgery and SACT[114] as well as the opportunity to integrate genetic testing data, GP records and patient reported outcome measures[115-119].

This integrated platform has provided the environment for the most robust quality assurance program of hospital-based cancer care that exists internationally[120]. National Cancer Audits have provided the basis for transparently and publicly reporting the structure, processes, and outcomes of care across all NHS facilities, as well as the determinants of variation using a clinical epidemiological approach. Whilst initially based around a portfolio of 5 cancers, this has since expanded to 10 cancers (breast (primary and metastatic), bowel, kidney, lung, non-hodgkin's lymphoma; oesophago-gastric, ovarian, pancreatic, prostate) as part of NATCAN (National Cancer Audit Collaborating Center)[121].

Audits provide a level of transparency around variation in care across the NHS, benchmarking best practice and highlighting outlying performance, creating the necessary incentives to establish quality improvement [122-125]. They also support reimbursement and adoption of effective innovations where these are established as drivers of improvement in outcome and provide a pathway for a clinical intelligence network and knowledge translation pathway[120]. Other audits have evaluated the early-phase diagnostic pathway[126].

On the backbone of NATCAM, the UK now has the opportunity to expand these audits:
1. Geographically – integration of the devolved nations
2. Methodologically - to establish indicators of quality across all treatment modalities (markers of recurrence/progression)[127-129]; understand better case-mix[130]; measure functional outcomes (using PROMs) and experience (PREMs) of care[131,132]
3. Better understand the determinants of variation using a clinical-epidemiological programme to provide vertical interventions (to target inequalities)[133].

This is also an area where the UK leads the way. Europe, North America, and Australia currently do not have the level of national systems integration. Deploying common nomenclature for defining cohorts, treatments, and outcomes, would enable international benchmarking using measures beyond survival to truly understand what the social, economic, and political levers that improve cancer outcomes[104].

Research

Despite the UK having an exceptional reputation for cancer research, a range of strategic issues create an uncertain future. Brexit[134] and the delay of the UK to re-join Horizon Europe are having serious detrimental impacts on both the UK's delivery of cancer research and our standing in the global cancer community. The UK remains one of the major powerhouses of European cancer research[62] and an urgent 'reset' with Europe is required to ensure our full participation, not just in research programmes but the wider political cancer agenda e.g. Europe's Cancer Mission. This is a strategic misstep that needs urgent rectifying[135]. How the UK positions some of its cutting-edge research, for example, in immuno-oncology also needs reviewing, in light of the significant globally-competitive R&D space[136].

The UK cancer research ecosystem funding is dominated by discovery science and biopharmaceutical research[137] and technologies such as MCED and AI[138]. This techno-centric culture will not, alone, deliver the breadth of research and data intelligence needed to ensure equitable[139], affordable and high-quality outcomes. While the NIHR provides a research delivery infrastructure, it needs to be more effective with a stronger clinical voice and integration across the devolved nations, and the new NHS reginal delivery networks. The UKRI and NIHR also have a leadership roll in setting both national and global cancer strategy. Research domains that need strengthening include prevention, health services research and implementation science, amongst many others. The UK's integrated data science systems offer huge potential for health services research[140]. For example, we still have limited understanding of how best to organize our services[57,141,142]. We must understand the implication of different service models on travel burden, equity in access, outcomes and efficiency[143,144]. Equally, questions remain, how to adequately resource cancer care and how intelligence can support better patient-centred decision-making[145]. More widely, a focus on revitalising UK clinical cancer research systems post pandemic is essential[146]. Globally, the UK has advanced its research interests with many high-income countries, particularly the USA[147], but it has seriously fallen behind in it's obligations to supporting cancer research with low- and middle- income countries(LMICs)[147].

The recent sudden closure of the NCRI was a major blow. The strategic direction for UK cancer cannot, and should not be set by any one organisation or sector. Co-ordinated horizon scanning, joint funding, global research partnerships, including with LMICs, independent strategic analysis and challenge must be at the heart of a new and more effective pan-UK National Cancer Research Institute coordinating a future integrated UK-wide cancer research strategy integrating study development and delivery and recognising the central importance of clinical research, grounded in national and global reality[148].

Lastly, responsible adoption of technology (value-based healthcare) requires evidence development in managed environments i.e. specific research hubs that can undertake, at pace, implementation science coupled and the required political economic analysis to test and the scale up new technologies to deliver faster and more equitable access[149].

Cancer across the UK: a ten-point plan

Crises force commonality of purpose. The UK finds itself at a crossroads, where the collective political decisions of devolved governments, research funders and the wider cancer community, including patient and professional organisations, will determine whether we can, together, achieve equitable, affordable and high-quality care, research, workforce and patient outcomes that are commensurate with our wealth, and position us amongst the best in the world. Much will depend on how the wider NHS systems perform and to what degree public spend on health is radically improved. Such are the issues facing the NHS that a Royal Commission may be needed.

The proeceding sections articulate a wide range of interlocking issues facing cancer care, research, and training. The macro-pressures of the post pandemic, post Brexit environment, create their own impact through the social determinants of cancer; poverty, social isolation, *etc* irrespective of how good the care is that we deliver[150]. The staggering cancer workforce deficits stand "front-and-centre" as the most critical issue. More broadly, a reset is also needed on the wider culture around clinical disempowerment, as well as the need to have honest societal dialogue around what really matters for better outcomes in the face of finite health budgets. The loss of both a dedicated NCCP and the NCRI are retrograde steps[151].

Fragmentation is a growing problem, between devolved nations, between primary and secondary care, between commissioning bodies and between cancer centres. Managing greater complexity - patient comorbidities, expansions of subtypes of cancer, multi-modal treatment, in an affordable way requires much better intelligence-driven service and systems policies, for example the creation of NATCAN offers the opportunity to deliver this. Whilst new technology is essential, a much more critical approach is needed to determine their true value. There is an emerging understanding of the political economy of cancer and its importance to ensure equitable and efficient cancer care, e.g. Health Technology Assessment (HTA), commissioning and reimbursement systems, and pharmaceutical regulation. But regulatory and public policy is currently at odds with delivering value-based healthcare[152]. All new interventions should deliver clinically-meaningful benefit and more cost-effective pathways and models of care need re-evaluation.

Research is a key driver of better care and is no longer a luxury, but a necessity. However, the UK research ecosystem remains too focused on basic cancer biology and, biopharmacuetical and other commercially-driven technologies for it to deliver the breadth of insights that patients and systems need. An urgent cancer research reset is also required. The scale of the problem should not be underestimated; good news stories should not cloud the challenges or reality.

Cancer care has become increasingly complex, specialised, and expensive. The UK must acknowledge the enormity of the challenge and opportunities and develop radical but sustainable plans which are comprehensive, evidence based, responsive, patient-outcome focused, equitable and deliver value for money, and which not only recovers from the disruption following the pandemic, but which provides the world-class service which UK patients deserve.

Insert Box: Ten-point plan

1. **Create and properly fund a dedicated UK-wide National Cancer Control Plans (NCCP)** through an integrated Devolved government consultation.**Within NCCP specific consideration needs to be given to challenges and solutions** that are unique to domain specific therapies and disease entitities e.g. childhood cancers, radiotherapy, surgery, systemic anti-cancer therapies etc
2. **Re-establish a strengthened National Cancer Research Institute** focused on providing a balanced needs-led research strategy, e.g. services and systems, childhood cancers, surgery & radiotherapy *etc*.
3. **Deliver on NHS Long Term Workforce Plan** with fair pay and better working environments coupled to a rethink on future cancer workforce skill sets.
4. **Significantly strengthen diagnostic pathways to achieve** target of 75% of cases diagnosed at stage 1 or 2 by 2028 through enhanced screening, pathways.
5. **Properly fund a UK wide evidenced-driven prevention program** particularly for tobacco control, alcohol, and obesity
6. **Integrate hospice care within the NHS and expand palliative care in both secondary and primary care** and increase support for psychosocial and survivorship.

7. **Develop an integrated pan-UK data intelligence infrastructure** to inform policy and practise in areas of service design, including addressing inequalities, performance assessment and quality improvement.
8. **Deliver a sustainable plan for equipment and infrastructure** that considers the implications of technology integration (location, capacity, workforce).
9. Create an integrated UK wide approach – regulatory, HTA and research - to **delivering innovation across cancer services** that are affordable and equitable
10. **Rethink on governance, structure, and relationship of advice** to Government and NSHE for cancer care and cancer research strategy and delivery. Reinstate the role of the independent Cancer Leadership with authority to drive through changes alongside an office of support to liaise between government and the NHS to provide robust independent oversight.

References

1. International Agency for Research on Cancer. Global Cancer Observatory. 2023. https://gco.iarc.fr/ (accessed 20th September 2023).
2. Carnall D. Britain ranks poorly for cancer survival rates. *BMJ* 1995; **310**(6991): 1352-3.
3. Allemani C, Matsuda T, Di Carlo V, et al. Global surveillance of trends in cancer survival 2000-14 (CONCORD-3): analysis of individual records for 37 513 025 patients diagnosed with one of 18 cancers from 322 population-based registries in 71 countries. *Lancet* 2018; **391**(10125): 1023-75.
4. Roderick P, Pollock AM. Dismantling the National Health Service in England. *Int J Health Serv* 2022; **52**(4): 470-9.
5. Montgomery HE, Haines A, Marlow N, et al. The future of UK healthcare: problems and potential solutions to a system in crisis. *Ann Oncol* 2017; **28**(8): 1751-5.
6. Government U. 2010 20 2015 government policy: cancer research and treatment. 2015. https://www.gov.uk/government/publications/2010-to-2015-government-policy-cancer-research-and-treatment/2010-to-2015-government-policy-cancer-research-and-treatment (accessed 26th August 2023 2023).
7. OECD. Health at a Glance 2015; 2015.
8. Purushotham A, Roberts G, Haire K, et al. The impact of national non-pharmaceutical interventions ('lockdowns') on the presentation of cancer patients. *Ecancermedicalscience* 2021; **15**: 1180.
9. Watt T, Sullivan R, Aggarwal A. Primary care and cancer: an analysis of the impact and inequalities of the COVID-19 pandemic on patient pathways. *BMJ Open* 2022; **12**(3): e059374.
10. Aggarwal A, Spencer K, Sullivan R. COVID-19 and cancer in the UK: which will prove to be the lesser of two evils? *BMJ Oncology* 2023; **2**(1): e000012.
11. Spencer K, Jones CM, Girdler R, et al. The impact of the COVID-19 pandemic on radiotherapy services in England, UK: a population-based study. *Lancet Oncol* 2021.

12. Aggarwal A, Walter FM, Sullivan R, van der Meulen J. "Shopping around" for treatment is not a solution to cancer backlog. *BMJ* 2022; **379**: e071967.
13. Committee HaSC. Cancer Sevices. Twelfth Report of Ssession 2021-22. London: House of Commons, 2022.
14. Sullivan R, Aggarwal A. Proposal to scrap England's long term plan for cancer. *BMJ* 2023; **380**: p326.
15. Wilkinson E. NCRI stuns cancer trial researchers with closure announcement. *Lancet Oncol* 2023; **24**(8): 840.
16. Price P, Sullivan R, Ahmed A, Wishart GC. UK cancer care: a watershed moment and the need for urgent intervention. *Lancet Oncol* 2023; **24**(2): 133-8.
17. Charlesworth A, Anderson M, Donaldson C, et al. What is the right level of spending needed for health and care in the UK? *Lancet* 2021; **397**(10288): 2012-22.
18. Romero Y, Trapani D, Johnson S, et al. National cancer control plans: a global analysis. *Lancet Oncol* 2018; **19**(10): e546-e55.
19. Radiologists RC. Clinical Oncology Workforce Censes. London, 2022.
20. UK CR. Building a cancer workforce that delivers for patients today and tomorrow. London: Cancer Research UK, 2023.
21. Richards M, Thorlby R, Fisher R, Torton C. Unfinished business: an assessment of the national approach to improving cancer services in England 1995–2015. London: Health Foundation, 2018.
22. Support MC. Cancer nursing on the line: why we need urgent investment across the UK. London, 2021.
23. Support MC. Shaping the future healthcare experience for people with cancer. London, 2023.
24. England N. NHS Long Term Workforce Plan. London, 2023.
25. England NHE. Cancer workforce plan. 2023. https://www.hee.nhs.uk/our-work/cancer-workforce-plan2023).
26. Physicians RC. RCP view on the NHS workforce: short-and medium-term solutions. London: RCP, 2022.
27. England HE. Topol Review. Preparing the healthcare workforce
to deliver the digital future. An independent report on behalf of the
Secretary of State for Health and Social Care. London: NHS, 2019.
28. Goldacre B, Morely J. Better, Broader, Safer: using health data for research and analysis. London: Department for Health and Social Care, 2022.
29. England NHE. Aspirant Cancer Career and Education Development programme. 2023. https://www.hee.nhs.uk/our-work/cancer-diagnostics/aspirant-cancer-career-education-development-programme (accessed 28 August 2023).
30. Cairney P. 84The Transformation of UK Tobacco Control. In: t Hart P, Compton M, eds. Great Policy Successes: Oxford University Press; 2019: 0.
31. Inan-Eroglu E, Huang BH, Sarich P, Nassar N, Stamatakis E. Joint association of alcohol consumption and adiposity with alcohol- and obesity-related cancer in a population sample of 399,575 UK adults. *Br J Nutr* 2023; **130**(3): 503-12.
32. Vaccarella S, Georges D, Bray F, et al. Socioeconomic inequalities in cancer mortality between and within countries in Europe: a population-based study. *Lancet Reg Health Eur* 2023; **25**: 100551.

33. Alcaraz KI, Wiedt TL, Daniels EC, Yabroff KR, Guerra CE, Wender RC. Understanding and addressing social determinants to advance cancer health equity in the United States: A blueprint for practice, research, and policy. *CA Cancer J Clin* 2020; **70**(1): 31-46.
34. Lai J, Mak V, Bright CJ, Lyratzopoulos G, Elliss-Brookes L, Gildea C. Reviewing the impact of 11 national Be Clear on Cancer public awareness campaigns, England, 2012 to 2016: A synthesis of published evaluation results. *Int J Cancer* 2021; **148**(5): 1172-82.
35. Swann R, McPhail S, Witt J, et al. Diagnosing cancer in primary care: results from the National Cancer Diagnosis Audit. *Br J Gen Pract* 2018; **68**(666): e63-e72.
36. Hamilton W. Cancer diagnosis in primary care. *Br J Gen Pract* 2010; **60**(571): 121-8.
37. Commitee HaSC. The future of general practise: Fourth Report of Session 2022-23. London: House of Commons, 2022.
38. Smith JA, Checkland K, Sidhu M, Hammond J, Parkinson S. Primary care networks: are they fit for the future? *Br J Gen Pract* 2021; **71**(704): 106-7.
39. Hutchinson J, Hammond J, Sutton M, Checkland K. Equity and the funding of Primary Care Networks. *Br J Gen Pract* 2021; **71**(710): 422-4.
40. Duffy SW, Seedat F, Kearins O, et al. The projected impact of the COVID-19 lockdown on breast cancer deaths in England due to the cessation of population screening: a national estimation. *British Journal of Cancer* 2022; **126**(9): 1355-61.
41. Hudson SM, Binysh K, Duffy SW. Did the use of open invitations in place of timed appointment invitations reduce the uptake of breast screening in the London region during the COVID-19 recovery? *Journal of Medical Screening* 2023; **30**(2): 87-91.
42. Osarogiagbon RU, Yang PC, Sequist LV. Expanding the Reach and Grasp of Lung Cancer Screening. *Am Soc Clin Oncol Educ Book* 2023; **43**: e389958.
43. Nadauld LD, McDonnell CH, 3rd, Beer TM, et al. The PATHFINDER Study: Assessment of the Implementation of an Investigational Multi-Cancer Early Detection Test into Clinical Practice. *Cancers (Basel)* 2021; **13**(14).
44. White R, Stanley F, Than J, et al. Treatable but not curable cancer in England: a retrospective cohort study using cancer registry data and linked data sets. *BMJ open* 2021; **11**(1): e040808.
45. England N. Personalised care. 2023 (accessed 26 August 2023 2023).
46. Snowden A, Young J. Evaluation of Glasgow: Improving the Cancer journey programme. Glasgow, 2015.
47. Stout NL, Fu JB, Silver JK. Prehabilitation is the Gateway to Better Functional Outcomes for Individuals with Cancer. *J Cancer Rehabil* 2021; **4**: 283-6.
48. Support MC. Principles and guidance for prehabilitation within the management and support of people with cancer. London, 2020.
49. Ahmad T, Gopal D, Ullah AZMD, Taylor S. Multimorbidity in patients living with and beyond cancer: protocol for a scoping review. *BMJ open* 2022; **12**(5): e057148.
50. Whitty CJM, MacEwen C, Goddard A, et al. Rising to the challenge of multimorbidity. *BMJ* 2020; **368**: l6964.
51. England N. Palliative and end of life care: Statutory guidance for integrated care boards NHS, 2022.
52. Powell T, Lewis A. Fiscal support to the hospice sector and increases in the cost of living. London: House of Commons, 2023.
53. Trust N. End of lofe care. London, 2023.
54. McPhail S, Swann R, Johnson SA, et al. Risk factors and prognostic implications of diagnosis of cancer within 30 days after an emergency hospital admission (emergency

presentation): an International Cancer Benchmarking Partnership (ICBP) population-based study. *Lancet Oncol* 2022; **23**(5): 587-600.
55. Poortmans P, Valentini V, Lievens Y. Expanding global access to radiotherapy: the European Society for Radiotherapy and Oncology perspective. *The Lancet Oncology* 2015; **16**(10): 1148-9.
56. Chandra RA, Keane FK, Voncken FEM, Thomas CR, Jr. Contemporary radiotherapy: present and future. *Lancet* 2021; **398**(10295): 171-84.
57. Kyaw JYA, Rendall A, Gillespie EF, et al. Systematic Review and Meta-analysis of the Association Between Radiation Therapy Treatment Volume and Patient Outcomes. *Int J Radiat Oncol Biol Phys* 2023.
58. Thind K, Roumeliotis M, Mann T, et al. Increasing Demand on Human Capital and Resource Utilization in Radiation Therapy: The Past Decade. *Int J Radiat Oncol Biol Phys* 2022; **112**(2): 457-62.
59. Glatzer M, Panje CM, Siren C, Cihoric N, Putora PM. Decision Making Criteria in Oncology. *Oncology* 2020; **98**(6): 370-8.
60. Miller KD, Nogueira L, Devasia T, et al. Cancer treatment and survivorship statistics, 2022. *CA Cancer J Clin* 2022; **72**(5): 409-36.
61. Thompson MK, Poortmans P, Chalmers AJ, et al. Practice-changing radiation therapy trials for the treatment of cancer: where are we 150 years after the birth of Marie Curie? *British Journal of Cancer* 2018; **119**(4): 389-407.
62. Lawler M, Davies L, Oberst S, et al. European Groundshot-addressing Europe's cancer research challenges: a Lancet Oncology Commission. *Lancet Oncol* 2023; **24**(1): e11-e56.
63. (APPGRT) AfR. Transforming Radiotherapy: A six-point Covid-19 recovery plan to save lives and save money within the NHS. London: House of Commons, 2020.
64. Tsang Y, Roberts N, Wickers S, Nisbet H. Embracing Skill Mix in the Clinical Oncology Workforce - Capturing Impacts of Consultant Therapeutic Radiographers in the UK. *Clin Oncol (R Coll Radiol)* 2021; **33**(5): e239-e42.
65. Aggarwal A, Nossiter J, Parry M, et al. Public reporting of outcomes in radiation oncology: the National Prostate Cancer Audit. *Lancet Oncol* 2021; **22**(5): e207-e15.
66. Huynh E, Hosny A, Guthier C, et al. Artificial intelligence in radiation oncology. *Nature Reviews Clinical Oncology* 2020; **17**(12): 771-81.
67. Radiotherapy APPGf. Manifesto For Radiotherapy. Improving cancer survival with modern world-class radiotherapy
: House of Commons, 2018.
68. Lievens Y, Borras JM, Grau C, Aggarwal A. Value-based radiotherapy: A new chapter of the ESTRO-HERO project. *Radiother Oncol* 2021; **160**: 236-9.
69. Luyendijk M, Visser O, Blommestein HM, et al. Changes in survival in de novo metastatic cancer in an era of new medicines. *J Natl Cancer Inst* 2023; **115**(6): 628-35.
70. Fowler H, Belot A, Ellis L, et al. Comorbidity prevalence among cancer patients: a population-based cohort study of four cancers. *BMC cancer* 2020; **20**(1): 2.
71. O'Callaghan S, Ferner RE, Barron A, Saxby K, Sofat R. Free-of-charge medicine schemes in the NHS: A local and regional drug and therapeutic committee's experience. *Br J Clin Pharmacol* 2022; **88**(6): 2571-80.
72. Lythgoe MP, Krell J, Bower M, et al. From the European Medicines Agency to Project Orbis: new activities and challenges to facilitate UK oncology drug approval following Brexit. *Lancet Oncol* 2023; **24**(4): e150-e60.

73. Rahman B, Lamb A, Protheroe A, et al. Genomic sequencing in oncology: Considerations for integration in routine cancer care. *Eur J Cancer Care (Engl)* 2022; **31**(3): e13584.
74. Doroshow DB, Bhalla S, Beasley MB, et al. PD-L1 as a biomarker of response to immune-checkpoint inhibitors. *Nat Rev Clin Oncol* 2021; **18**(6): 345-62.
75. Conroy M, Naidoo J. Immune-related adverse events and the balancing act of immunotherapy. *Nature Communications* 2022; **13**(1): 392.
76. Lythgoe MP, Sullivan R. Project Orbis: the UK experience after 1 year. *Lancet Oncol* 2022; **23**(8): 978-81.
77. King MT, Hall J, Caleo S, Gurney HP, Harnett PR. Home or hospital? An evaluation of the costs, preferences, and outcomes of domiciliary chemotherapy. *Int J Health Serv* 2000; **30**(3): 557-79.
78. Corrie PG, Moody AM, Armstrong G, et al. Is community treatment best? a randomised trial comparing delivery of cancer treatment in the hospital, home and GP surgery. *Br J Cancer* 2013; **109**(6): 1549-55.
79. Lassalle A, Thomaré P, Fronteau C, et al. Home administration of bortezomib in multiple myeloma is cost-effective and is preferred by patients compared with hospital administration: results of a prospective single-center study. *Ann Oncol* 2016; **27**(2): 314-8.
80. Basch E, Deal AM, Dueck AC, et al. Overall Survival Results of a Trial Assessing Patient-Reported Outcomes for Symptom Monitoring During Routine Cancer Treatment. *Jama* 2017; **318**(2): 197-8.
81. Denis F, Lethrosne C, Pourel N, et al. Randomized Trial Comparing a Web-Mediated Follow-up With Routine Surveillance in Lung Cancer Patients. *J Natl Cancer Inst* 2017; **109**(9).
82. Perera SK, Jacob S, Sullivan R, Barton M. Evidence-based benchmarks for use of cancer surgery in high-income countries: a population-based analysis. *Lancet Oncol* 2021.
83. Davis CH, Beane JD, Gazivoda VP, et al. Neoadjuvant Therapy for Pancreatic Cancer: Increased Use and Improved Optimal Outcomes. *J Am Coll Surg* 2022; **234**(4): 436-43.
84. Haneuse S, Dominici F, Normand SL, Schrag D. Assessment of Between-Hospital Variation in Readmission and Mortality After Cancer Surgical Procedures. *JAMA Netw Open* 2018; **1**(6): e183038.
85. Khachane A, Philippou Y, Hirst A, McCulloch P. Appraising the uptake and use of the IDEAL Framework and Recommendations: A review of the literature. *Int J Surg* 2018; **57**: 84-90.
86. Santhirapala R, Fleisher LA, Grocott MPW. Choosing Wisely: just because we can, does it mean we should? *Br J Anaesth* 2019; **122**(3): 306-10.
87. England N. Children and young people’s cancer service portfolio. London: NHS England, 2023.
88. Bozovic Spasojevic I, Ferrari A, De Munter J, et al. Have we made progress in taking care of adolescents and young adults with cancer? Results of a European multi-professional survey. *Tumori* 2023: 3008916231183477.
89. Vassal G, de Rojas T, Pearson ADJ. Impact of the EU Paediatric Medicine Regulation on new anti-cancer medicines for the treatment of children and adolescents. *Lancet Child Adolesc Health* 2023; **7**(3): 214-22.
90. Pearson ADJ, Weiner SL, Adamson PC, et al. ACCELERATE - Five years accelerating cancer drug development for children and adolescents. *Eur J Cancer* 2022; **166**: 145-64.

91. Group T. The Impact of Collaboration: the value of UK medical research to EU Science and Health
. London: Cnacre Research UK, 2017.
92. Murray Brunt A, Haviland JS, Wheatley DA, et al. Hypofractionated breast radiotherapy for 1 week versus 3 weeks (FAST-Forward): 5-year efficacy and late normal tissue effects results from a multicentre, non-inferiority, randomised, phase 3 trial. *Lancet* 2020; **395**(10237): 1613-26.
93. Dearnaley D, Syndikus I, Mossop H, et al. Conventional versus hypofractionated high-dose intensity-modulated radiotherapy for prostate cancer: 5-year outcomes of the randomised, non-inferiority, phase 3 CHHiP trial. *Lancet Oncol* 2016; **17**(8): 1047-60.
94. Fitzgerald RC, di Pietro M, O'Donovan M, et al. Cytosponge-trefoil factor 3 versus usual care to identify Barrett's oesophagus in a primary care setting: a multicentre, pragmatic, randomised controlled trial. *Lancet* 2020; **396**(10247): 333-44.
95. Zietman AL. Too Big to Fail? The Current Status of Proton Therapy in the USA. *Clin Oncol (R Coll Radiol)* 2018; **30**(5): 271-3.
96. Devi S. The UK's re-entry into the Horizon Europe programme. *Lancet Oncol* 2023; **24**(4): 318.
97. Hricak H, Abdel-Wahab M, Atun R, et al. Medical imaging and nuclear medicine: a Lancet Oncology Commission. *Lancet Oncol* 2021; **22**(4): e136-e72.
98. Sullivan R, Alatise OI, Anderson BO, et al. Global cancer surgery: delivering safe, affordable, and timely cancer surgery. *The Lancet Oncology* 2015; **16**(11): 1193-224.
99. Stanway S, Lodge M, Sullivan R, et al. The UK's contribution to cancer control in low-income and middle-income countries. *Lancet Oncol* 2021; **22**(9): e410-e8.
100. Lawler M, Crul M. Data must underpin our response to the covid-19 pandemic's disastrous impact on cancer. *BMJ* 2022; **376**: o282.
101. Lai AG, Pasea L, Banerjee A, et al. Estimated impact of the COVID-19 pandemic on cancer services and excess 1-year mortality in people with cancer and multimorbidity: near real-time data on cancer care, cancer deaths and a population-based cohort study. *BMJ Open* 2020; **10**(11): e043828.
102. Sud A, Torr B, Jones ME, et al. Effect of delays in the 2-week-wait cancer referral pathway during the COVID-19 pandemic on cancer survival in the UK: a modelling study. *Lancet Oncol* 2020; **21**(8): 1035-44.
103. Vrdoljak E, Sullivan R, Lawler M. Cancer and coronavirus disease 2019; how do we manage cancer optimally through a public health crisis? *Eur J Cancer* 2020; **132**: 98-9.
104. Nolte E, Morris M, Landon S, et al. Exploring the link between cancer policies and cancer survival: a comparison of International Cancer Benchmarking Partnership countries. *Lancet Oncol* 2022; **23**(11): e502-e14.
105. Wilson R, Kinloch E, Makaroff LE, et al. A major conditions strategy cannot replace a national cancer plan-patient advocates voice their concerns. *Lancet Oncol* 2023; **24**(5): 425-7.
106. Lawler M, Lewison G, Sullivan R. Recognising the health dividend of peace: cancer and Northern Ireland. *Eur J Cancer* 2023; **189**: 112924.
107. Government S. Beating Cancer: Ambition and Action (2016) update: achievements, new action and testing change. Edinburgh: Health & Social Care, 2020.
108. Thygesen JH, Tomlinson C, Hollings S, et al. COVID-19 trajectories among 57 million adults in England: a cohort study using electronic health records. *Lancet Digit Health* 2022; **4**(7): e542-e57.

109. Aggarwal A, Lievens Y, Sullivan R, Nolte E. What Really Matters for Cancer Care – Health Systems Strengthening or Technological Innovation? *Clinical Oncology* 2022; **34**(7): 430-5.
110. Lawler M, Davies L, Oberst S, et al. European Groundshot-addressing Europe's cancer research challenges: a Lancet Oncology Commission. *The Lancet Oncology* 2023; **24**(1): e11-e56.
111. England N. NHS backs 'pioneering' new cancer innovations set to transform cancer diagnoses in England. 2022. https://www.england.nhs.uk/2022/02/nhs-backs-pioneering-new-cancer-innovations-set-to-transform-cancer-diagnoses-in-england/ (accessed 30 August 2023).
112. Exarchakou A, Rachet B, Belot A, Maringe C, Coleman MP. Impact of national cancer policies on cancer survival trends and socioeconomic inequalities in England, 1996-2013: population based study. *BMJ* 2018; **360**: k764.
113. England N. £21 million to roll out artificial intelligence across the NHS. 2023. https://www.gov.uk/government/news/21-million-to-roll-out-artificial-intelligence-across-the-nhs (accessed 30 August 2023).
114. Service NCRaA. Welcome to CancerData. 2021. https://www.cancerdata.nhs.uk/ (accessed 30 August 2023).
115. Herrett E, Gallagher AM, Bhaskaran K, et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). *International Journal of Epidemiology* 2015; **44**(3): 827-36.
116. Stamp E, Clarke G, Wright P, et al. Collection of cancer Patient Reported Outcome Measures (PROMS) to link with primary and secondary electronic care records to understand and improve long term cancer outcomes: A protocol paper. *PLoS One* 2022; **17**(4): e0266804.
117. Downing A, Morris EJ, Richards M, et al. Health-related quality of life after colorectal cancer in England: a patient-reported outcomes study of individuals 12 to 36 months after diagnosis. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology* 2015; **33**(6): 616-24.
118. Maringe C, Spicer J, Morris M, et al. The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in England, UK: a national, population-based, modelling study. *The Lancet Oncology* 2020; **21**(8): 1023-34.
119. Tran TV, Maringe C, Benitez Majano S, Rachet B, Boutron-Ruault MC, Journy N. Thyroid dysfunction and breast cancer risk among women in the UK Biobank cohort. *Cancer Med* 2021; **10**(13): 4604-14.
120. Aggarwal A, Nossiter J, Parry M, et al. Public reporting of outcomes in radiation oncology: the National Prostate Cancer Audit. *The Lancet Oncology* 2021.
121. Centre NCAC. NATCAN. 2023 (accessed 30 August 2023).
122. Vallance AE, Fearnhead NS, Kuryba A, et al. Effect of public reporting of surgeons' outcomes on patient selection, "gaming," and mortality in colorectal cancer surgery in England: population based cohort study. *BMJ* 2018; **361**: k1581.
123. Boyle JM, van der Meulen J, Kuryba A, et al. Measuring variation in the quality of systemic anti-cancer therapy delivery across hospitals: A national population-based evaluation. *European Journal of Cancer* 2023; **178**: 191-204.
124. Dodwell D, Jauhari Y, Gathani T, et al. Treatment variation in early breast cancer in the UK. *Bmj* 2020; **371**: m4237.
125. Audit NBC. Quality improvement plan. Royal College Surgeons of England, 2021.

126. Koo MM, Swann R, McPhail S, et al. Presenting symptoms of cancer and stage at diagnosis: evidence from a cross-sectional, population-based study. *The Lancet Oncology* 2020; **21**(1): 73-9.
127. Parry MG, Cowling TE, Sujenthiran A, et al. Identifying skeletal-related events for prostate cancer patients in routinely collected hospital data. *Cancer Epidemiol* 2019; **63**: 101628.
128. Boyle JM, Cowling TE, Kuryba A, et al. Development and validation of a coding framework to identify severe acute toxicity from systemic anti-cancer therapy using hospital administrative data. *Cancer epidemiology* 2022; **77**: 102096.
129. Sujenthiran A, Charman SC, Parry M, et al. Quantifying severe urinary complications after radical prostatectomy: the development and validation of a surgical performance indicator using hospital administrative data. *BJU Int* 2017; **120**(2): 219-25.
130. Cowling TE, Cromwell DA, Sharples LD, van der Meulen J. A novel approach selected small sets of diagnosis codes with high prediction performance in large healthcare datasets. *J Clin Epidemiol* 2020; **128**: 20-8.
131. Parry MG, Sujenthiran A, Cowling TE, et al. Impact of cancer service centralisation on the radical treatment of men with high-risk and locally advanced prostate cancer: A national cross-sectional analysis in England. *Int J Cancer* 2018.
132. Pucher PH, Park MH, Cromwell DA, et al. Diagnosis and treatment for gastro-oesophageal cancer in England and Wales: analysis of the National Oesophago-Gastric Cancer Audit (NOGCA) database 2012–2020. *British Journal of Surgery* 2023; **110**(6): 701-9.
133. Barclay ME, Abel GA, Greenberg DC, Rous B, Lyratzopoulos G. Socio-demographic variation in stage at diagnosis of breast, bladder, colon, endometrial, lung, melanoma, prostate, rectal, renal and ovarian cancer in England and its population impact. *British journal of cancer* 2021; **124**(7): 1320-9.
134. Lawler M, Begum M, Lewison G, Aggarwal A, Selby P, Sullivan R. The impact of Brexit on UK cancer research. *Lancet Oncol* 2018; **19**(10): 1276-8.
135. Mukherji D, Murillo RH, Van Hemelrijck M, et al. Global cancer research in the post-pandemic world. *Lancet Oncol* 2021; **22**(12): 1652-4.
136. Lythgoe MP, Lewison G, Aggarwal A, et al. The rise of immuno-oncology in China: a challenge to western dominance? *Lancet Oncol* 2023; **24**(5): 439-41.
137. Begum M, Lewison G, Lawler M, Sullivan R. Mapping the European cancer research landscape: An evidence base for national and Pan-European research and funding. *Eur J Cancer* 2018; **100**: 75-84.
138. Healthcare S. SBRI Healthcare announce the winners of NHS England's multi-million pound funding for late stage innovation projects that advance earlier and faster diagnosis of cancer. 2022. https://sbrihealthcare.co.uk/news/sbri-healthcare-awards-multi-million-pound-funding-for-late-stage-innovation-projects-that-advance-earlier-and-faster-diagnosis (accessed 27 August 2023 2023).
139. Couespel N, Venegoni E, Lawler M. The European Cancer Pulse: tracking inequalities in cancer control for citizen benefit. *Lancet Oncol* 2023; **24**(5): 441-2.
140. Banerjee A, Sudlow C, Lawler M. Indirect effects of the pandemic: highlighting the need for data-driven policy and preparedness. *J R Soc Med* 2022; **115**(7): 249-51.
141. Aggarwal A, Lewis D, Mason M, Purushotham A, Sullivan R, van der Meulen J. Effect of patient choice and hospital competition on service configuration and technology adoption within cancer surgery: a national, population-based study. *The Lancet Oncology* 2017; **18**(11): 1445-53.

142. Han L, Boyle JM, Walker K, et al. Impact of patient choice and hospital competition on patient outcomes after rectal cancer surgery: A national population-based study. *Cancer* 2023; **129**(1): 130-41.
143. Aggarwal A, Han L, van der Geest S, et al. Health service planning to assess the expected impact of centralising specialist cancer services on travel times, equity, and outcomes: a national population-based modelling study. *Lancet Oncol* 2022; **23**(9): 1211-20.
144. Aggarwal A, Han L, Sullivan R, Haire K, Sangar V, van der Meulen J. Managing the cancer backlog: a national population-based study of patient mobility, waiting times and ‘spare capacity’ for cancer surgery. *The Lancet Regional Health – Europe* 2023; **30**.
145. Perera SK, Jacob S, Wilson BE, et al. Global demand for cancer surgery and an estimate of the optimal surgical and anaesthesia workforce between 2018 and 2040: a population-based modelling study. *The Lancet Oncology* 2021; **22**(2): 182-9.
146. Morton C, Sullivan R, Sarker D, Posner J, Spicer J. Revitalising cancer trials post-pandemic: time for reform. *British Journal of Cancer* 2023.
147. Sullivan R, Lewison G, Torode J, et al. Cancer research collaboration between the UK and the USA: reflections on the 2021 G20 Summit announcement. *Lancet Oncol* 2022; **23**(4): 460-2.
148. Lee RW, Danson S, Elliot M, et al. Importance of clinical research for the UK's 10-year cancer plan. *Lancet Oncol* 2022; **23**(8): 975-8.
149. Lievens Y, Audisio R, Banks I, et al. Towards an evidence-informed value scale for surgical and radiation oncology: a multi-stakeholder perspective. *Lancet Oncol* 2019; **20**(2): e112-e23.
150. Maruthappu M, Watkins J, Noor AM, et al. Economic downturns, universal health coverage, and cancer mortality in high-income and middle-income countries, 1990-2010: a longitudinal analysis. *Lancet* 2016; **388**(10045): 684-95.
151. Lythgoe MP, Sullivan R. Another setback for cancer research in the UK. *BMJ* 2023; **382**: e077036.
152. Aggarwal A, Lievens Y, Sullivan RE, Nolte E. What Really Matters for Cancer Care - Health Systems Strengthening or Technological Innovation? *Clinical oncology (Royal College of Radiologists (Great Britain))* 2022.

Health Policy Paper for Lancet Oncology

INFOGRAPHIC DATA

Children with cancer:
4,200 children and young people (0-24 years) are diagnosed with cancer every year in the UK. Approx 1900 diagnosed ≤16 years
>8 out of 10 survive. There are now over 40,000 survivors of childhood cancer in the UK.

Systemic Anti-Cancer Therapies:
NICE have undertaken 431 technology appraisals on cancer drugs that have resulted in 501 individual recommendations on cancer drugs. Since 2000 have recommended 211, 54 are on CDF, nine only to be available for research and 86 rejected
(each appraisal can have 1 or more recommendation and can contain more than 1 type of recommendation)
As 31 Aug 2023 there are 2,800 regimens in use by NHS

Surgery:
80% of all cancers need some form of surgical invervention be it curative or palliative.
The need for surgery in adult cancers varies from 20% (bone cancer) to over 80% for cancers urological and breast cancers
Cancer surgery covers over 277 distinct procedures across six levels of complexity