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Provision of Interventional Oncology Services in the United Kingdom: Pilot Study

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Provision of Interventional Oncology Services in the United Kingdom: Pilot Study

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Contributorship Statement

Dr Jim Zhong (JZ) was also involved with designing the initial study concept, initial literature search, designing the survey and questionnaire layout, all data collection and analysis, writing up the manuscript and revising the manuscript in discussion with other authors. He has prepared the manuscript for publication.

Dr Peter Atiiga (P A) was also involved with designing the survey and questionnaire layout, the data collection and revising the manuscript in discussion with other authors.

Dr Des J Alcorn (DJA) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr David Kay (DK) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

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Dr Tze Min Wah (TMW) was also involved with designing the initial study concept, approving the survey and questionnaire layout, reviewing the results and analysis, and revising the manuscript in discussion with other authors and approving the manuscript for publication in discussion with the other authors.

Abstract

Objective:

To map out the current provision of interventional oncology (IO) services in the United Kingdom.

Design:

Multi-centre survey

Setting:

All NHS Trusts in England and Scottish, Welsh and Northern Ireland health boards.

Participants:

Interventional Radiology departments in all NHS trusts/ health boards in the United Kingdom.

Results

A total of 179 NHS trusts/health boards were contacted. We received 100% response rate. 144 trusts (80%) provided IO services or had a formal pathway of referral in place for patients to a recipient trust. 21 trusts (12%) had plans to provide an IO service or formal referral pathway in the next 12 months only. 14 trusts (8%) did not have a pathway of referral and no plans to implement one.

70 trusts (39%) offered both supportive and disease-modifying procedures. 73 trusts (41%) provided only supportive procedures. Of these, 43 (59%) had a referral pathway for disease-modifying IO procedures, either from a regional cancer network or through interventional radiology networks. 14 (8%) did not have a pathway of referral and no plans to implement one.

Conclusion

The provision of IO services in the UK is promising however collaborative networks are necessary to ensure disease-modifying IO procedures are made accessible to all patients and to facilitate larger registry data for research with commissioning of new services.

Article Summary

Strengths and limitations of this study

- 100% response rate from 179 Acute NHS Trusts and Health Boards throughout the United Kingdom
- Provides comprehensive map of Interventional Oncology (IO) Services throughout the UK to allow for more integrated cancer pathways on a national level.
- Map of the provision and geographic variation in disease modifying procedures such as tumour ablation, which will allow for future planning of new IO services.
- Identifies types of supportive IO treatments, which are less routinely available apart from in larger tertiary centres and therefore highlights areas to target for IO training.
- Limitations include those inherent to survey/ questionnaire format, such as subjective bias.

Introduction

More than 1-in-3 people will develop cancer in their lifetime[1]. Since the NHS Cancer Plan in 2000, the Department of Health has strived to improve diagnosis and treatment[1]. As part of the NHS plans to deliver world-class cancer services, there is a drive to achieve better outcomes by ensuring all patients have access to the best treatments available[2]. Wide variation remains in performance across the country with major differences in access to cancer services[1].

Interventional oncology (IO), image guided procedures used to diagnose and treat oncological patients, is fast becoming the four pillar of oncological care alongside medical, surgical and radiation oncology. The Royal College of Radiologists have set out best practice guidance for the incorporation of interventional oncology into all cancer services nationally[3]. There remains a significant shortage of interventional radiologists, who are the primary contributors towards IO, with almost half of services in England unable to provide a local or networked out of hours access to Interventional Radiology (IR)[4]. Undoubtedly this shortfall will have consequences on the provision of elective IO services in the UK and potentially affect patient care through limitations to access.
The current provision of Interventional Oncology services throughout the UK is unknown, therefore NHS commissioners are unable to realistically factor IO into national cancer pathways as evident in a previous Department of Health publication[1] which did not acknowledge IO as a treatment option for patients out with surgery, chemotherapy and radiotherapy.

The primary objective of this national survey was to map out the current provision of interventional oncology services in the UK. We also sought to uncover formal patient referral pathways, the types of IO procedures offered and any limitations to providing IO. Ultimately, we aim to develop IO networks and improve access to these treatments for cancer patients.

The survey was designed and undertaken in collaboration with the Interventional Oncology United Kingdom (IOUK) group, a specialist interest group of the British Society of Interventional Radiology (BSIR).

Method

No research ethics committee approval was required for this service redesign data-gathering project. No patient identifiable data was gathered.

All NHS Foundation Trusts in England[5] and all health boards in Scotland, Wales and Northern Ireland were contacted by email (see supplementary material). This was followed by a telephone follow-up of all hospital radiology departments that did not complete the survey within 2 weeks of the first email being sent out. Telephone follow-up was conducted by a single radiologist (JZ). The survey could be completed by any of the following: Head of department of radiology/ interventional radiology, any consultant radiologist (diagnostic or interventional) or superintendent radiographer who has insight into the local provision of services.

The surveys key points were:

- Are IO procedures offered in the trust?
- If so, are these supportive treatments only or both supportive and disease-modifying?
- We asked about the types of procedures undertaken
- If not, is there an agreed formal pathway to another recipient trust?
- If there was no agreed pathway, was there a plan to provide IO or a pathway in the next 12 months?
- What barriers are there to setting up an IO service?

The full survey can be found in the online supplementary file.

Supportive and symptomatic procedures were defined as those providing relief from tumour-related symptoms but do not modify the underlying malignant disease process and includes diagnostic tests such as image guided biopsy which 'support' the provision of definitive treatment[3]. Disease modifying procedures were defined as those where the intent is to modify malignant progression and/or modify the prognosis and includes image-guided ablation, trans-arterial chemoembolisation (TACE) and selective internal radiation therapy (SIRT).

Following the initial survey we followed up all trusts/ health boards which only offered supportive treatments to see if there were formal referral pathways for disease-modifying procedures.

A formal referral pathway was defined as an existing mechanism of referral through a multi-disciplinary team responsible for the patient, usually through a pre-existing local oncology or radiology network.

Results

A total of 179 NHS trusts or health boards were contacted throughout the United Kingdom. We received 100% response rate. The responses came from consultant interventional and diagnostic radiologists and superintendent radiographers who had insight into the local provision of services.

144 trusts (80%) provided IO services or had a formal pathway of referral in place for patients to a recipient trust (Figure 1). 21 trusts (12%) had plans to provide an IO service or formal referral pathway in the next 12 months only. 14 trusts (8%) did not have a pathway of referral and no plans to implement one. 70 trusts (39%) offered both supportive and disease-modifying procedures on site (Figure 2). 73 trusts (41%) provided only supportive procedures on site. One trust had a formal referral pathway for supportive IO. Only 19 (11%) institutions had an interventional oncology lead.

The number of trusts providing each supportive/ symptomatic IO procedure and disease-modifying procedure are shown in table 1 and table 2. These are represented in graphical form in Figure 3. Figure 4 and 5 show the maps of the trusts providing each type of disease-modifying procedure.

For England only, a total of 153 NHS Foundation trusts in England were contacted. 127 (83%) trusts provided IO services or had a formal pathway of referral to another agreed recipient trust for IO procedures (Figure 1). Out of the 26 that did not have a formal referral pathway, 21 (14%) trusts had plans to provide an IO service or formal referral pathway for patients to have IO at another trust within the next 12 months. 5 (3%) trusts did not have a pathway and had no plans of providing IO or a referral pathway in the next 12 months (Figure 1). 57 out of 127 (45%) trusts providing IO

offered both supportive and disease modifying procedures (Figure 2). 70 out of 127 (55%) provided only supportive procedures.

For Scotland, 10 out of 14 health boards provided IO or had a formal pathway of referral to a specialist hospital in another health board (Glasgow or Edinburgh). Of these, 8 health boards provided both supportive and disease-modifying IO while 2 provided only supportive IO. 4 health boards (29%) did not provide IO and did not have plans to provide a pathway in the next 12 months.

For Wales, 6 out of 7 health boards (86%) provided IO or had a referral pathway in place. 4 Welsh health boards (57%) provided both types of IO, one health board provided only supportive IO and one had a formal referral pathway. One welsh health board did not offer IO or have a referral pathway implemented in the next 12 months.

Only 1 out of 5 health boards in Northern Ireland (Belfast Health and Social Care Trust) provided IO (both types).

Out of the 70 English NHS trusts and 3 Scottish/ Welsh Health Boards, which provided only supportive IO, 43 trusts (59%) had a referral pathway to another hospital/ trust for disease-modifying IO procedures. This was from a local regional cancer network referral initiated following a formal discussion at the multi-disciplinary team meeting.

The most common barriers to providing disease-modifying IO were insufficient funding, lack of staff, lack of support from other non-radiology clinicians, having a pathway already in place and problems with recruitment into IR.

Discussion

Overall, the provision of IO in the UK is promising. Based on the Royal College of Radiologists definition of 'supportive' IO[1], this encompasses many routine procedures that can be carried out by diagnostic radiologists which is reflected in the excellent availability of these procedures

throughout the UK. Beyond basic image-guided drainage procedures, the provision of specialist vascular, gastro-intestinal or biliary 'symptomatic' intervention is less routinely available apart from in the larger tertiary centers which were also providing disease-modifying IO. This highlights important areas to target for radiology and IO training.

Given the vital role of IR in the management of critically ill patients, the comprehensive provision of supportive IO in most parts of the UK reflects the drive to train more radiologists with basic interventional skills, which are also transferrable to IO[6]. We acknowledge that providing out of hours IR is not directly related to IO however it will allow for 'supportive' IO to be routinely available which encompasses many routine procedures that are the backbone of IO, whereas disease-modifying treatments can be centralized as part of the current NHS model for cancer services[7]. There are still NHS trusts/ boards, most noticeably in rural Scotland and Northern Ireland where provision of IO services appear limited and linking up with neighboring hospitals to set up formal pathways would be a first step to improving access for patients to disease-modifying IO. What remains unclear is what the current demand for IO services are generally but particularly in these rural regions, as we have no data to suggest current arrangements are sub-optimal. It would not be necessary or appropriate for all providers to liaise with IO services, and these should be facilitated through regional cancer networks with more integrated pathways of care[7]. Currently there appears to be 136 out of 153 acute NHS trusts in England, which are listed to offer acute oncology services[8]. Further work is required to elucidate whether there is any discrepancy in the regional demand and supply of disease-modifying IO.

Of the trusts that only offered supportive IO, 59% had a formal referral pathway to another centre for disease-modifying IO. The perceived barriers from these trusts to starting up elective disease-modifying services stemmed from shortfalls in funding, staffing and support from other specialties. With tertiary centres undertaking much higher volumes of disease modifying IO procedures, some smaller district general hospitals felt unsupported in starting up their own service, from financial considerations when purchasing the equipment to garnering support from allied specialties such as surgery and oncology. This is an important point as it highlights the need for greater awareness of

the role of the interventional radiologist in oncology care and we must strive to work even closer with oncologists given the new evidence suggesting the added value of combination therapies and incorporation of IO procedures into European cancer guidelines[9]. However, with the current model of centralizing cancer services, these barriers would only be an issue if cancer centers were unable to provide IO. To improve patient selection for complex IO procedures, interventional radiologists should have a regular role in multi-disciplinary team meetings. With only 19 institutions (11%) currently having a formal IO lead clinician, there is a role for dispersed leadership to achieve structural change in established cancer networks.

Local expertise and facilities help determine the IO that is offered. An example is the provision of disease-modifying IO for the liver, which is centred around the national liver transplant units[10]. The reasons for this are clear given that image-guided tumour ablation, TACE and SIRT are effective therapies than can be used solely or in combination with chemotherapy or surgery to improve the outcome of such patients who can be complex and should be managed by multi-disciplinary teams (MDT) [11 12]. Interventional radiologists must endeavor to participate in MDT discussions to educate other clinicians on the role of IO in the management of patients and contribute towards improvement and restructuring of services. This will also open opportunities to undertake collaborative research that will be higher impact and wider reaching to the oncology community.

The recurrent issue of lack of staffing within IR remains a barrier. Despite the promising provision of supportive IO, most departments are struggling to cope with the demand for basic vascular, urological and biliary procedures, necessary to provide a sustainable out of hours service, without compounding this with additional workload and need for additional training for disease-modifying IO. Additional need for interventional radiographers and nursing cover for IO services should not be overlooked either to allow a new service to be introduced.

Changes to the delivery of healthcare throughout the UK demands that IO treatments can demonstrate not only a therapeutic benefit but also cost-effectiveness. For units with a referral

pathway for disease-modifying IO, there was a common theme that this set-up was more cost effective than starting a service from scratch. Without knowledge of the actual demand for these IO procedures, there is no answer to this currently, and clinical investigators must incorporate measures of cost-effectiveness and patient-reported outcomes into large-scale studies to provide more robust evidence[13]. Even if these IO treatments can be shown to be equally effective compared with the current standard of care but with significantly less morbidity, then it will allow the specialty to develop further, however current studies have not offered definitive conclusions[14]. Building upon the knowledge of these IO networks will allow better registry data that can be used to derive larger cohorts for future trials and also commissioning of new services.

The limitations of the present study include those inherent in the survey/ questionnaire format such as the subjective element depending on whether a superintendent radiographer or consultant radiologist responded given their underlying experience and knowledge of their radiology services which could impact on the detail of their survey answers. The strengths of the survey include 100% response rate from 179 acute NHS trusts/ health boards which allowed a comprehensive map of both supportive and disease-modifying IO procedures offered in the UK that will help direct radiology/IO training, future planning of new IO services and allow for more integrated cancer pathways.

Conclusion

The provision of IO services in the UK is promising however collaboration and networking is necessary to ensure disease-modifying IO procedures are made accessible to all patients throughout the UK and to facilitate larger registry data for research and commissioning of new services.

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All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Transparency declaration: I affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Data sharing: no additional data available.

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Figure Legends:

Figure 1: UK Map showing the overall provision of interventional oncology (IO) services throughout the UK.

Figure 2: UK Map showing what types of IO procedures (supportive and/ or disease modifying procedures) are undertaken in each NHS trust/ health board.

Figure 3: Bar charts showing number of trusts offering: (A) Each type of supportive/symptomatic IO procedure and (B) Each type of disease-modifying IO procedure.

Figure 4: UK Map showing the provision of ablation services: (A) Renal ablation (B) Liver ablation (C) Bone ablation and (D) Lung ablation.

Figure 5: UK Map showing the provision of (A) Trans-arterial chemoembolization (TACE) and (B) Selective internal radiation therapy (SIRT).

Table Legends

Table 1: Type of supportive/ symptomatic IO procedure and number of trusts that offer each and percentage of total number of trusts (n=179).

Type of supportive/ symptomatic IO procedure	Number of trusts	Percentage (%)
Ascitic diversion	39	22
Vena caval stenting	79	44
Enteral tube placement e.g. Radiologically Inserted Gastrostomy (RIG)	81	45
Percutaneous Trans-hepatic Cholangiography (PTC)	84	47
Gastrointestinal stenting	87	49
Vena caval filtration	88	49
Biliary drainage and stenting	118	66
Ureteric stenting	124	69
Central venous catheter	125	70
Image-guided drainage	128	72
Nephrostomy	129	72
Image-guided biopsy	137	77

Table 2: Type of disease-modifying IO procedures and number of trusts that offer each and percentage of total number of trusts (n=179).

Type of disease-modifying IO procedure	Number of trusts	Percentage (%)
Prostate ablation	2	1
Selective Internal Radiation Therapy (SIRT)	17	9
Bone ablation	18	10
Lung ablation	28	16
Liver ablation	39	22
Kidney ablation	39	22
Trans-arterial chemoembolization (TACE)	40	22

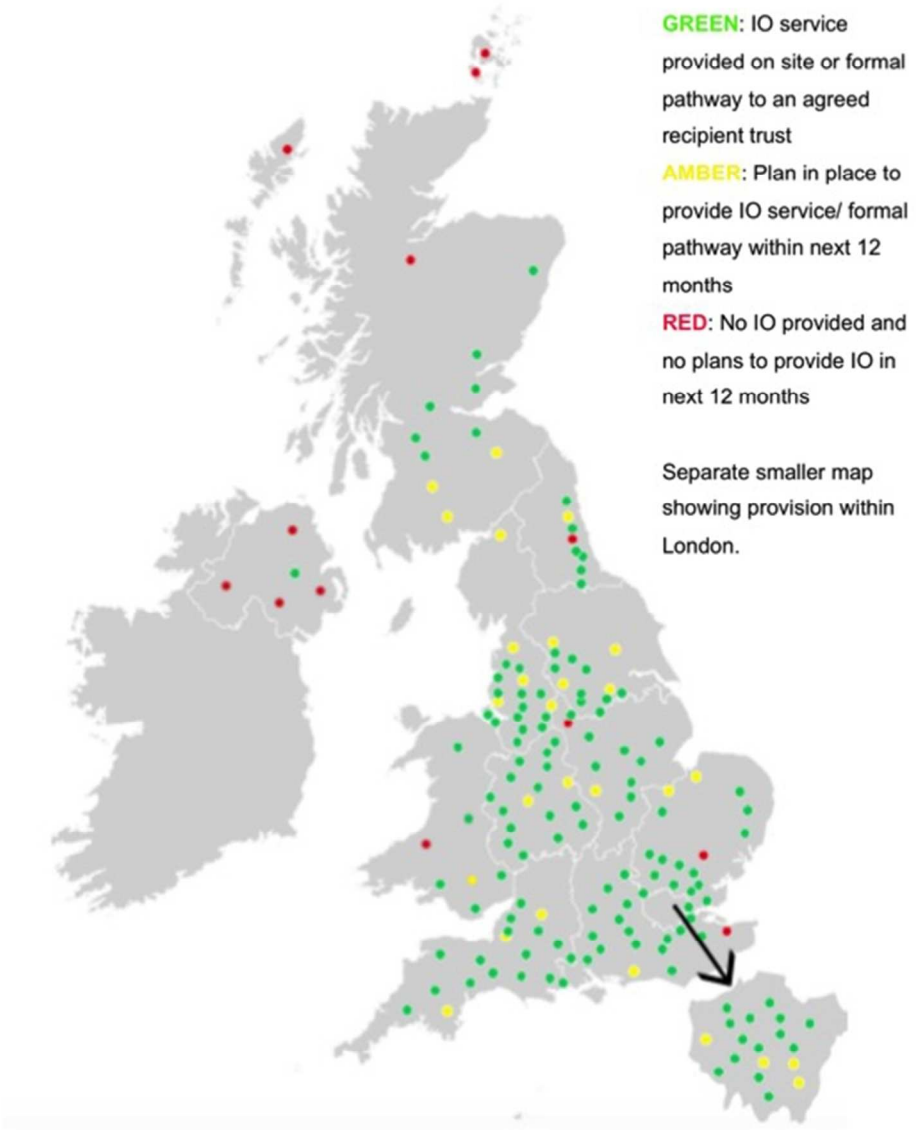

Figure 1: UK Map showing the overall provision of interventional oncology (IO) services throughout the UK.

199x254mm (72 x 72 DPI)

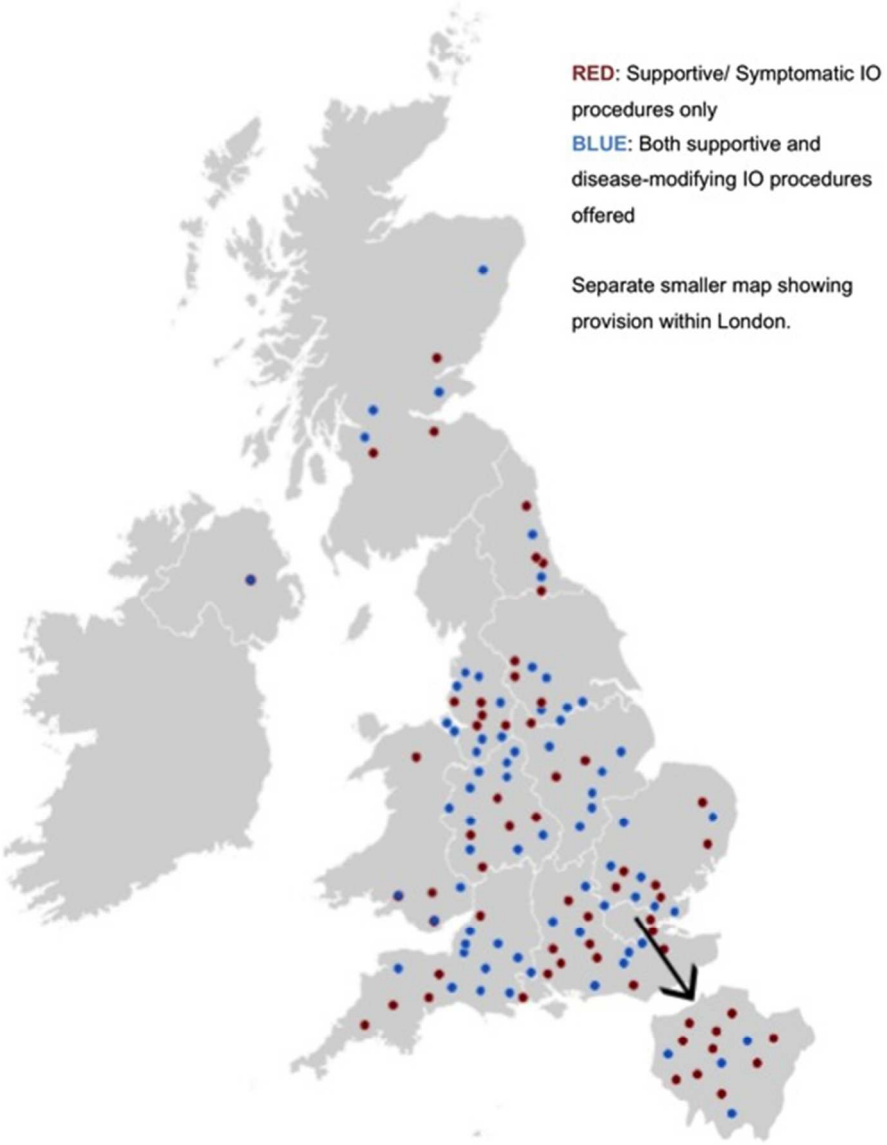

Figure 2: UK Map showing what types of IO procedures (supportive and/ or disease modifying procedures) are undertaken in each NHS trust/ health board.

187x247mm (72 x 72 DPI)

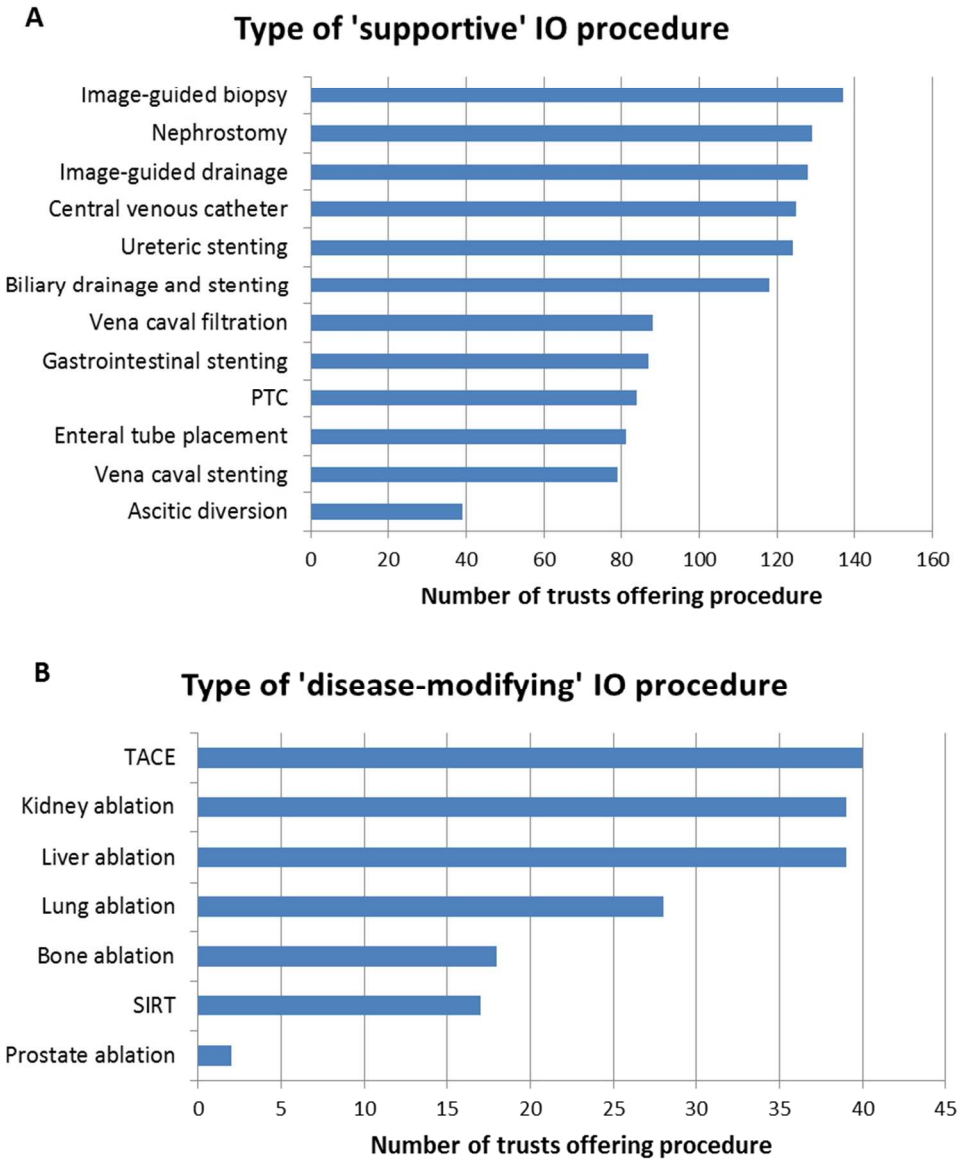

Figure 3: Bar charts showing number of trusts offering: (A) Each type of supportive/symptomatic IO procedure and (B) Each type of disease-modifying IO procedure.

156x189mm (150 x 150 DPI)

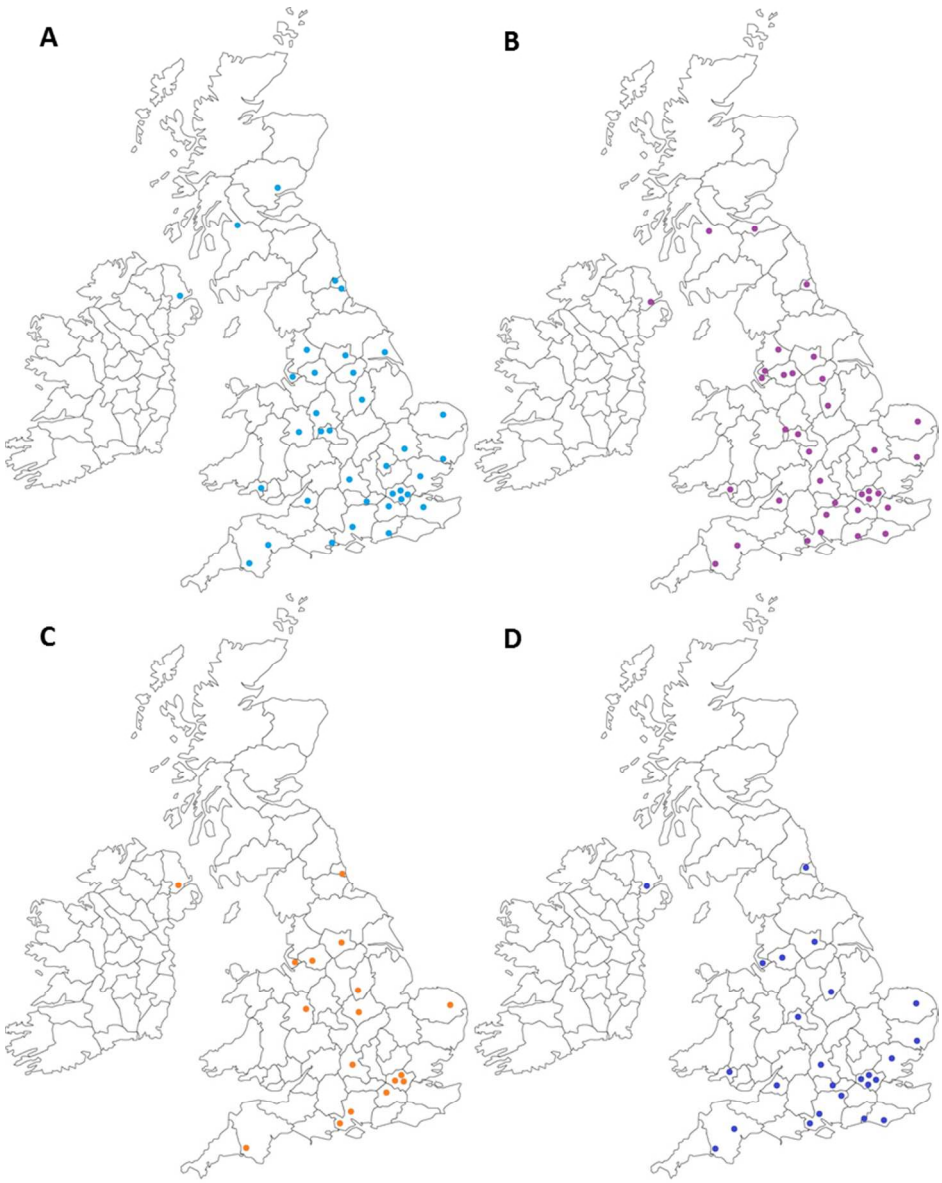

Figure 4: UK Map showing the provision of ablation services: (A) Renal ablation (B) Liver ablation (C) Bone ablation and (D) Lung ablation.

232x299mm (96 x 96 DPI)

Figure 5: UK Map showing the provision of (A) Trans-arterial chemoembolization (TACE) and (B) Selective internal radiation therapy (SIRT).

259x176mm (150 x 150 DPI)

Provision of Interventional Oncology Services in the United Kingdom: Pilot Study

SRQR Qualitative Research Checklist Adapted from:
OBrien BC; Harris IB; Beckman TJ; Reed DA; Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. Academic Medicine. 89(9):1245-51, 2014 Sep. DOI: 10.1097/ACM.0000000000000388

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Cross-sectional Study of the Provision of Interventional Oncology Services in the United Kingdom

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Contributorship Statement

Dr Jim Zhong (JZ) was also involved with designing the initial study concept, initial literature search, designing the survey and questionnaire layout, all data collection and analysis, writing up the manuscript and revising the manuscript in discussion with other authors. He has prepared the manuscript for publication.

Dr Peter Atiiga (P A) was also involved with designing the survey and questionnaire layout, the data collection and revising the manuscript in discussion with other authors.

Dr Des J Alcorn (DJA) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr David Kay (DK) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr Rowland Illing (RI) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr David Breen (DB) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr Nicholas Railton (N R) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr Ian J McCafferty (IJM) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr Philip J Haslam (PJH) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr Tze Min Wah (TMW) was also involved with designing the initial study concept, approving the survey and questionnaire layout, reviewing the results and analysis, and revising the manuscript in discussion with other authors and approving the manuscript for publication in discussion with the other authors.

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Abstract

Objective:

To map out the current provision of interventional oncology (IO) services in the United Kingdom.

Design:

Cross-sectional multi-centre study.

Setting:

All National Health Service (NHS) Trusts in England and Scottish, Welsh and Northern Ireland health boards.

Participants:

Interventional Radiology departments in all NHS trusts/ health boards in the United Kingdom.

Results

A total of 179 NHS trusts/health boards were contacted. We received a 100% response rate. Only 19 (11%) institutions had an interventional oncology lead. 144 trusts (80%) provided IO services or had a formal pathway of referral in place for patients to a recipient trust. 21 trusts (12%) had plans to provide an IO service or formal referral pathway in the next 12 months only. 14 trusts (8%) did not have a pathway of referral and no plans to implement one.

70 trusts (39%) offered supportive and disease-modifying procedures. 1 trust had a formal referral pathway for supportive procedures. 73 trusts (41%) provided only supportive procedures (diagnostic or therapeutic). Of these, 43 (59%) had a referral pathway for disease-modifying IO procedures, either from a regional cancer network or through interventional radiology networks and 30 trusts (41%) did not have a referral pathway for disease-modifying procedures.

Conclusion

The provision of IO services in the UK is promising however collaborative networks are necessary to ensure disease-modifying IO procedures are made accessible to all patients and to facilitate larger registry data for research with commissioning of new services.

Article Summary

Strengths and limitations of this study

- 100% response rate from 179 Acute NHS Trusts and Health Boards throughout the United Kingdom
- Provides comprehensive map of Interventional Oncology (IO) Services throughout the UK to allow for more integrated cancer pathways on a national level.
- Map of the provision and geographic variation in disease modifying procedures such as tumour ablation, which will allow for future planning of new IO services.
- Identifies types of supportive IO treatments, which are less routinely available apart from in larger tertiary centres and therefore highlights areas to target for IO training.
- Limitations include those inherent to survey/ questionnaire format, such as subjective bias.

Introduction

More than 1-in-3 people will develop cancer in their lifetime[1]. Since the NHS Cancer Plan in 2000, the Department of Health has strived to improve diagnosis and treatment[1]. As part of the NHS Cancer Plan to deliver world-class cancer services, there is a drive to achieve better outcomes by ensuring all patients have access to the best treatments available[2]. Wide variation remains in performance across the country with major differences in access to cancer services[1].

Interventional oncology (IO) ,the use of image guided techniques to diagnose and treat cancer patients is fast becoming the fourth pillar of oncological care alongside medical, surgical and radiation oncology; The Royal College of Radiologists have set out best practice guidance for the incorporation of interventional oncology into all cancer services nationally[3].

Supportive and symptomatic procedures were defined as those providing relief from tumour-related symptoms but not modifying the underlying malignant disease process and include diagnostic tests such as image guided biopsy which 'support' the provision of definitive treatment[3]. These may be palliative procedures such as image guided drainage or stent insertion. Disease modifying procedures were defined as those where the intent is to modify malignant progression and/or modify the prognosis and include image-guided ablation, trans-arterial chemoembolisation (TACE) and selective internal radiation therapy (SIRT).

There remains a significant shortage of interventional radiologists, who are the primary contributors towards IO, with almost half of services in England unable to provide a local or networked out of hours access to Interventional Radiology (IR)[4]. Undoubtedly this shortfall will have consequences on the provision of elective IO services in the UK and potentially affect patient care through limitations to access.

The current provision of Interventional Oncology services throughout the UK is unknown, therefore NHS commissioners are unable to realistically factor IO into national cancer pathways as evident in a previous Department of Health publication[1] which did not acknowledge IO as a treatment option for patients.

The primary objective of this cross sectional study was to map out the current provision of interventional oncology services in the UK. We also sought to uncover formal patient referral pathways, the types of IO procedures offered and any limitations to providing IO. Ultimately, we aim to develop IO networks and improve access to these treatments for cancer patients.

The survey was designed and undertaken in collaboration with the Interventional Oncology United Kingdom (IOUK) group, a specialist interest group of the British Society of Interventional Radiology (BSIR).

Method

No research ethics committee approval was required for this data-gathering project. No patient identifiable data was captured.

This cross-sectional study involved all acute NHS Foundation Trusts in England[5] and all health boards in Scotland, Wales and Northern Ireland which were contacted by email with the survey (see supplementary material). This was followed by a telephone follow-up of all hospital radiology departments that did not complete the survey within 2 weeks of the first email being sent out. Telephone follow-up was conducted by a single radiologist (JZ). The survey could be completed by any of the following: The head of department of radiology/ interventional radiology, any consultant radiologist (diagnostic or interventional) or superintendent radiographer who has insight into the local provision of services.

The surveys key points were:

- Are IO procedures offered in the trust?
- If so, are these supportive treatments only or both supportive and disease-modifying?
- We asked about the types of procedures undertaken
- If no IO procedures are offered, is there an agreed formal pathway to another recipient trust?

- If there was no agreed pathway, was there a plan to provide IO or a pathway in the next 12 months?
- What barriers are there to setting up an IO service?

The full survey can be found in the online supplementary file.

Following the initial survey we followed up all trusts/ health boards which only offered supportive treatments to see if there were formal referral pathways for disease-modifying procedures.
A formal referral pathway was defined as an existing mechanism of referral through a multi-disciplinary team responsible for the patient, usually through a pre-existing local oncology or radiology network.

Results

A total of 179 NHS trusts or health boards were contacted throughout the United Kingdom. We received 100% response rate. The responses came from consultant interventional and diagnostic radiologists and superintendent radiographers who had insight into the local provision of services.
143 trusts (80%) had an IR department in their trust. All trusts with an IR department offered IO procedures. Only 19 (11%) institutions had an interventional oncology lead.
144 trusts (80%) provided IO services or had a formal pathway of referral in place for patients to a recipient trust (Figure 1 and 2), of which 137 trusts (77%) stated what types of IO services they offered. 21 trusts (12%) had plans to provide an IO service or formal referral pathway in the next 12 months only. 14 trusts (8%) did not have a pathway of referral and no plans to implement one.
70 trusts (39%) offered both supportive and disease-modifying procedures (Figure 3). 1 trust had a formal referral pathway for supportive procedures. 73 trusts (41%) provided only supportive procedures (diagnostic or therapeutic).

The number of trusts providing each supportive/ symptomatic IO procedure and disease-modifying procedure are shown in table 1 and table 2. The 7 trusts that gave no details to which IO procedures were offered were excluded when calculating the percentages

129 trusts out of 179 (72%) offered therapeutic IO procedures after excluding trusts, which only offered diagnostic image guided biopsy. Figure 4 and 5 show the maps of the trusts providing each type of disease-modifying procedure.

For England only, a total of 153 NHS Foundation trusts in England were contacted. 127 (83%) trusts provided IO services or had a formal pathway of referral to another agreed recipient trust for IO procedures (Figure 1). Out of the 26 that did not have a formal referral pathway, 21 (14%) trusts had plans to provide an IO service or formal referral pathway for patients to have IO at another trust within the next 12 months. 5 (3%) trusts did not have a pathway and had no plans of providing IO or a referral pathway in the next 12 months (Figure 1). 57 out of 127 (45%) trusts providing IO offered both supportive and disease modifying procedures (Figure 3). 70 out of 127 (55%) provided only supportive procedures.

For Scotland, 10 out of 14 health boards provided IO or had a formal pathway of referral to a specialist hospital in another health board (Glasgow or Edinburgh). Of these, 8 health boards provided both supportive and disease-modifying IO whilst 2 provided only supportive IO. 4 health boards (29%) did not provide IO and did not have plans to provide a pathway in the next 12 months.

For Wales, 6 out of 7 health boards (86%) provided IO or had a referral pathway in place. 4 Welsh health boards (57%) provided both types of IO, one health board provided only supportive IO and one had a formal referral pathway. One Welsh health board did not offer IO or have a referral pathway implemented in the next 12 months.

Only 1 out of 5 health boards in Northern Ireland (Belfast Health and Social Care Trust) provided IO (both types). 4 health boards did not have plans to offer IO or have a referral pathway implemented in the next 12 months.

Out of the 70 English NHS trusts and 3 Scottish/ Welsh Health Boards, which provided only supportive IO, 43 trusts (59%) had a referral pathway to another hospital/ trust for disease-

modifying IO procedures. This was from a local regional cancer network referral initiated following a formal discussion at the multi-disciplinary team meeting or through interventional radiology networks. 30 trusts (41%) did not have a referral pathway for disease-modifying procedures.

The most common barriers to providing disease-modifying IO were insufficient funding, lack of staff, lack of support from other non-radiology clinicians, having a pathway already in place and problems with recruitment into IR.

Discussion

Overall, the provision of IO in the UK is unevenly spread.. Based on the Royal College of Radiologists definition of 'supportive' IO[1], this encompasses many routine procedures that can be carried out by diagnostic radiologists which is reflected in the excellent availability of these procedures throughout the UK. Beyond basic image-guided drainage procedures, the provision of specialist vascular, gastro-intestinal or biliary 'symptomatic' intervention is less routinely available apart from in the larger tertiary centers which were also providing disease-modifying IO. This highlights important areas to target nationally for radiology and IO training.

Given the vital role of IR in the management of critically ill patients, the comprehensive provision of supportive IO in most parts of the UK reflects the drive to train more radiologists with basic interventional skills, which are also transferrable to IO[6]. Only 1 trust without an IR department offered IO. We were unable to capture if most of the IO procedures were done by the IR department or not, with institutions occasionally splitting non-vascular (e.g. ablation) and vascular interventions (e.g. transarterial chemoembolization - TACE) between the diagnostic radiologists and the interventional radiologists who also have to cover the on-call service for non-oncology related emergency procedures such as trauma, bleeding or aortic syndromes. A major recruitment drive currently is the provision of on-call IR services and given the overlap between IO and IR training, emergency IR provision is therefore linked with the provision of IO services not only for maintaining the availability of supportive services in small district hospitals but also for the provision of disease-modifying IO in specialist centres. Additional need for interventional

radiographers and nursing cover for IO services should not be overlooked either to allow a new IO service to be introduced.

We acknowledge that disease-modifying treatments form a smaller proportion of IO workload and centralization of this is happening as part of the current NHS model for cancer services[7]. One argument for this model in the context of IO is to ensure that more complex IO procedures are undertaken by those who carry out a sufficient number of cases to maintain competency however this should not preclude suitable patients from being referred due to their geographic location. There are NHS trusts/ boards, most noticeably in rural Scotland and Northern Ireland where access to disease-modifying IO services appears limited and linking up with neighboring hospitals to set up formal referral pathways should be considered. What also remains unclear is what the current demand for IO services are generally but particularly in these rural regions, as we have no data to suggest current arrangements are sub-optimal. It would not be necessary or appropriate for all providers to liaise with IO services, and these should be facilitated through regional cancer networks with more integrated pathways of care[7]. Currently there appears to be 136 out of 153 acute NHS trusts in England, which are listed to offer acute oncology services[8]. Further work is required to elucidate whether there is any discrepancy in the regional demand and supply of disease-modifying IO.

The perceived barriers to starting up elective disease-modifying services stemmed from shortfalls in funding, staffing and support from other specialties. With tertiary centres undertaking much higher volumes of disease modifying IO procedures, some smaller district general hospitals felt unsupported in starting up their own service, from financial considerations when purchasing the equipment to garnering support from allied specialties such as surgery and oncology. This is an important point as it highlights the need for greater awareness of the role of the interventional radiologist in oncology care and we must strive to work even closer with oncologists given the new evidence suggesting the added value of combination therapies and incorporation of IO procedures into European cancer guidelines[9]. However, with the current model of centralizing cancer services, these barriers would only be an issue if cancer centers were unable to provide IO. To

improve patient selection for complex IO procedures, interventional radiologists should have a regular role in multi-disciplinary team meetings. With only 19 institutions (11%) currently having a formal IO lead clinician, there is a role for dispersed leadership to achieve structural change in established cancer networks.

Local expertise and facilities help determine the IO that is offered. An example is the provision of disease-modifying IO for the liver, which is centred around the national liver transplant units[10]. Clearly image-guided tumour ablation, TACE and SIRT are effective therapies than can be used solely or in combination with chemotherapy or surgery to improve the outcome of such patients. [11 12]. Participation in MDT discussions will also allow interventional radiologists and radiologists familiar with IO Techniques to educate other clinicians on the role of IO in the management of patients and contribute towards improvement and restructuring of services. This will also open opportunities to undertake collaborative research that will be higher impact and wider reaching to the oncology community.

The recurrent issue of lack of staffing within IR remains a barrier. Despite the promising provision of supportive IO, most departments are struggling to cope with the demand for basic vascular, urological and biliary procedures, necessary to provide a sustainable out of hours service, without compounding this with additional workload and need for additional training for disease-modifying IO.

Changes to the delivery of healthcare throughout the UK demands that IO treatments can demonstrate not only a therapeutic benefit but also cost-effectiveness. For units with a referral pathway for disease-modifying IO, there was a common theme that this set-up was more cost effective than starting a service from scratch. Without knowledge of the actual demand for these IO procedures, there is no answer to this currently, and clinical investigators must incorporate measures of cost-effectiveness and patient-reported outcomes into large-scale studies to provide more robust evidence[13]. Even if these IO treatments can be shown to be equally effective compared with the current standard of care but with significantly less morbidity, then it will allow

the specialty to develop further, however current studies have not offered definitive conclusions[14]. Building upon the knowledge of these IO networks will allow better registry data that can be used to derive larger cohorts for future trials and also commissioning of new services.

The limitations of the present study include those inherent in the survey/ questionnaire format such as the subjective element depending on whether a superintendent radiographer or consultant radiologist responded given their underlying experience and knowledge of their radiology services which could impact on the detail of their survey answers. The strengths of the survey include 100% response rate from 179 acute NHS trusts/ health boards which allowed a comprehensive map of both supportive and disease-modifying IO procedures offered in the UK that will help direct radiology/IO training, future planning of new IO services and allow for more integrated cancer pathways.

Conclusion

The provision of IO services in the UK is promising however collaboration and networking is necessary to ensure disease-modifying IO procedures are made accessible to all patients throughout the UK and to facilitate improved registry data collection for research and commissioning or funding of new services.

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Transparency declaration: I affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Data sharing: no additional data available.

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Figure Legends:

Figure 1: UK Map showing the overall provision of interventional oncology (IO) services throughout the UK.

Figure 2: Middle pie chart (A) displaying total number/percentage of trusts which offer IO or have a referral pathway, number which plan to set up IO service or referral pathway in the next 12 months (All English trusts) and those without any plans to set up a IO service pathway. The top (B) and bottom (C) pie charts display the breakdown of healthcare trusts/ health boards by country.

Figure 3: UK Map showing what types of IO procedures (supportive and/ or disease modifying procedures) are undertaken in each NHS trust/ health board.

Figure 4: UK Map showing the provision of ablation services: (A) Renal ablation (B) Liver ablation (C) Bone ablation and (D) Lung ablation.

Figure 5: UK Map showing the provision of (A) Trans-arterial chemoembolization (TACE) and (B) Selective internal radiation therapy (SIRT).

Table Legends

Table 1: Type of supportive/ symptomatic IO procedure and number of trusts that offer each and percentage of total number of trusts that provided information on the types of procedure offered (n=137). 7 out of 144 who offered IO did not include what procedures were offered and were excluded from calculations.

Type of supportive/ symptomatic IO procedure	Number of trusts	Percentage of total (%)
Image-guided biopsy	137	100
Nephrostomy	129	94
Image-guided drainage	128	93
Central venous catheter	125	91
Ureteric stenting	124	91
Biliary drainage and stenting	118	86
Vena caval filtration	88	64
Gastrointestinal stenting	87	64
Percutaneous Trans-hepatic Cholangiography (PTC)	84	61
Enteral tube placement e.g. Radiologically Inserted Gastrostomy (RIG)	81	59
Vena caval stenting	79	58
Ascitic diversion	39	28
Vertebroplasty	6	4
Isolated perfusion chemotherapy	5	4

Table 2: Type of disease-modifying IO procedures and number of trusts that offer each and percentage of total number of trusts (n=179).

Type of disease-modifying IO procedure	Number of trusts	Percentage (%)
Trans-arterial chemoembolization (TACE)	40	22
Liver ablation	39	22
Kidney ablation	39	22
Lung ablation	28	16
Bone ablation	18	10
Selective Internal Radiation Therapy (SIRT)	17	9
Prostate ablation	2	1

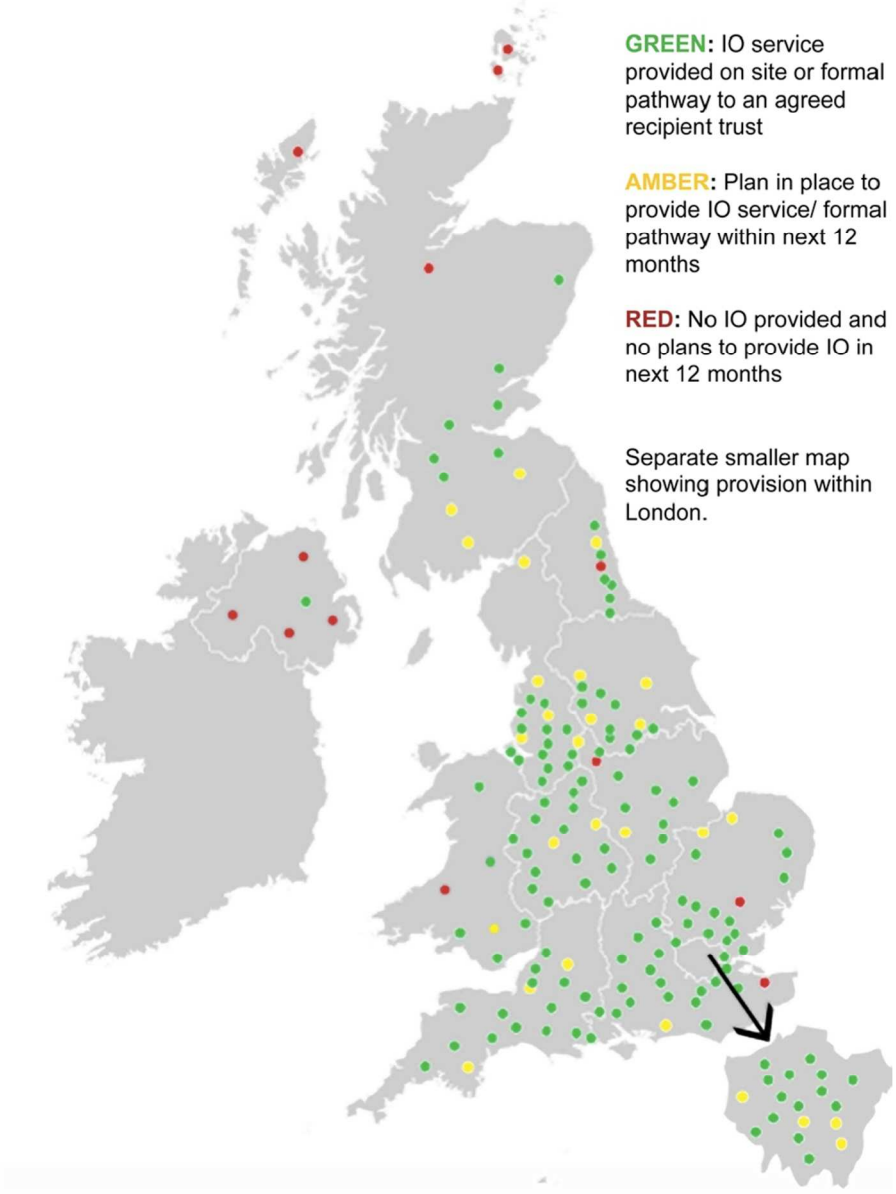
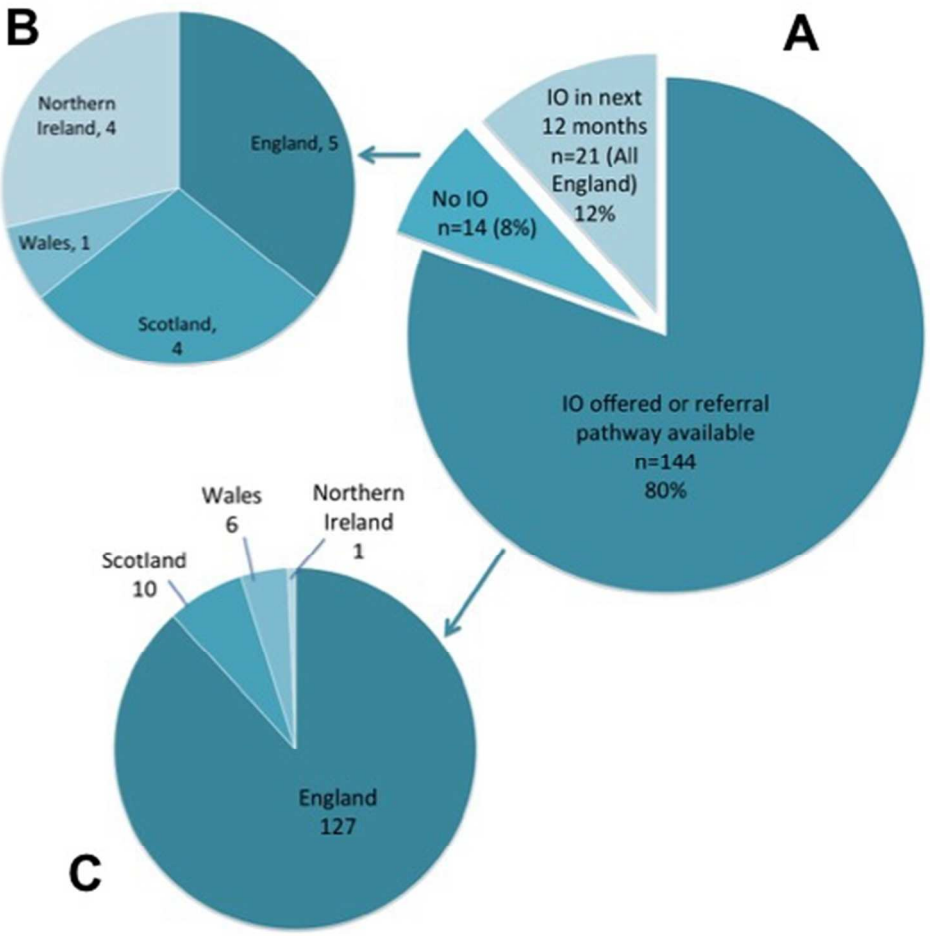


Figure 1: UK Map showing the overall provision of interventional oncology (IO) services throughout the UK.

94x127mm (300 x 300 DPI)



Middle pie chart (A) displaying total number/percentage of trusts which offer IO or have a referral pathway, number which plan to set up IO service or referral pathway in the next 12 months (All English trusts) and those without any plans to set up a IO service pathway. The top (B) and bottom (C) pie charts display the breakdown of healthcare trusts/ health boards by country.

196x190mm (72 x 72 DPI)

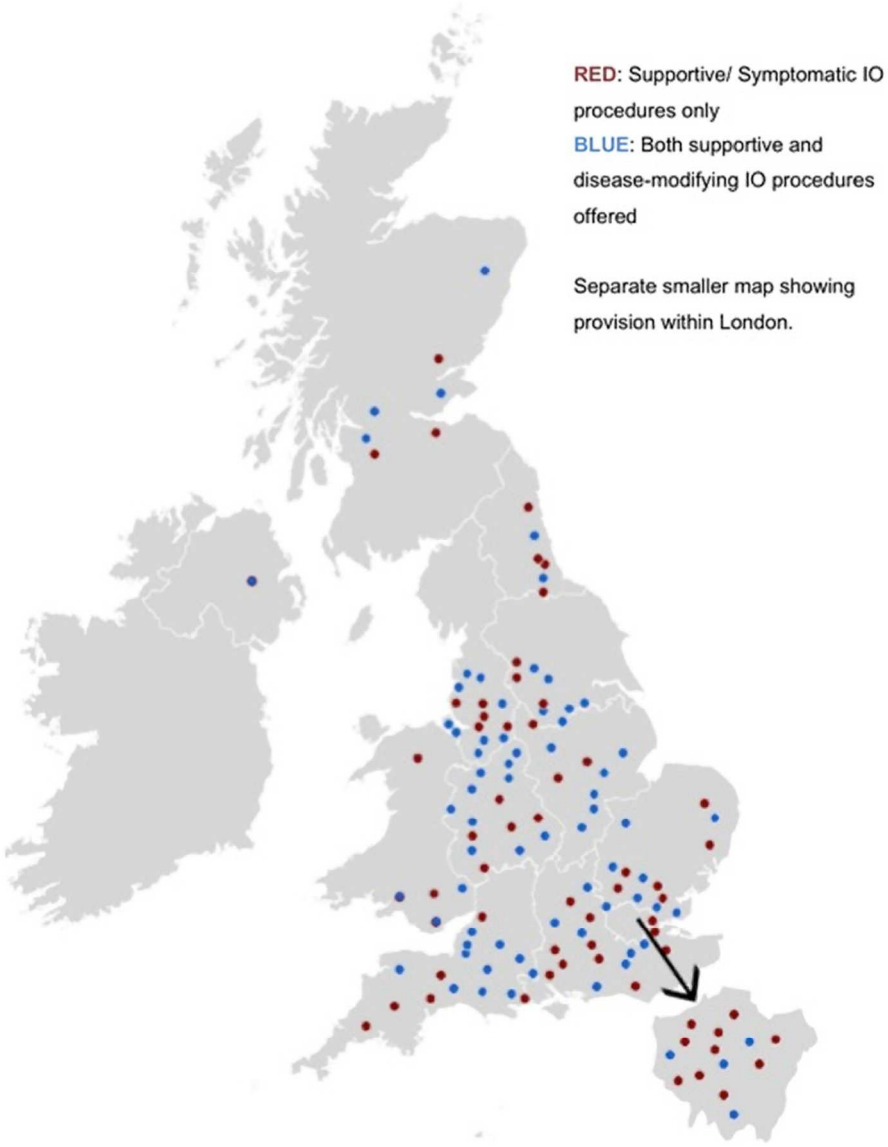


Figure 3: UK Map showing what types of IO procedures (supportive and/ or disease modifying procedures) are undertaken in each NHS trust/ health board.

118x157mm (300 x 300 DPI)

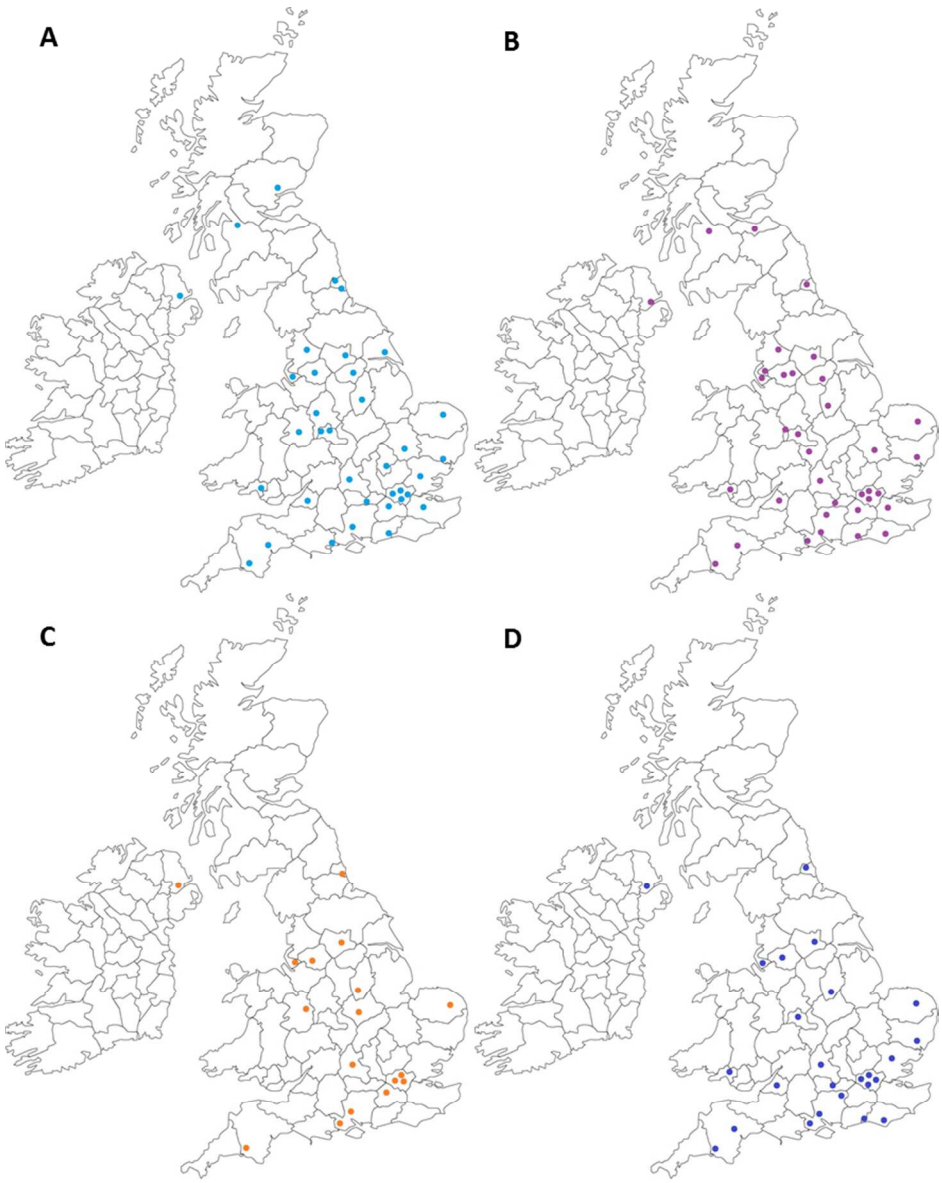


Figure 4: UK Map showing the provision of ablation services: (A) Renal ablation (B) Liver ablation (C) Bone ablation and (D) Lung ablation.

232x299mm (96 x 96 DPI)

Figure 5: UK Map showing the provision of (A) Trans-arterial chemoembolization (TACE) and (B) Selective internal radiation therapy (SIRT).

259x176mm (150 x 150 DPI)

Cross-sectional Study of the Provision of Interventional Oncology Services in the United Kingdom

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page in Manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*7*
Bias	9	Describe any efforts to address potential sources of bias	13
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8

		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	8-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	n/a
		(*b*) Report category boundaries when continuous variables were categorized	8-10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	10-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Cross-sectional Study of the Provision of Interventional Oncology Services in the United Kingdom

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Cross-sectional Study of the Provision of Interventional Oncology Services in the United Kingdom

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Contributorship Statement

Dr Jim Zhong (JZ) was also involved with designing the initial study concept, initial literature search, designing the survey and questionnaire layout, all data collection and analysis, writing up the manuscript and revising the manuscript in discussion with other authors. He has prepared the manuscript for publication.

Dr Peter Atiiga (P A) was also involved with designing the survey and questionnaire layout, the data collection and revising the manuscript in discussion with other authors.

Dr Des J Alcorn (DJA) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

Dr David Kay (DK) was also involved with finalizing the initial study concept, reviewing and approving the survey and questionnaire layout, reviewing the data and analysis and approving the manuscript for publication in discussion with the other authors.

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Dr Tze Min Wah (TMW) was also involved with designing the initial study concept, approving the survey and questionnaire layout, reviewing the results and analysis, and revising the manuscript in discussion with other authors and approving the manuscript for publication in discussion with the other authors.

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Abstract

Objective:

To map out the current provision of interventional oncology (IO) services in the United Kingdom.

Design:

Cross-sectional multi-centre study.

Setting:

All National Health Service (NHS) Trusts in England and Scottish, Welsh and Northern Ireland health boards.

Participants:

Interventional Radiology departments in all NHS trusts/ health boards in the United Kingdom.

Results

A total of 179 NHS trusts/health boards were contacted. We received a 100% response rate. Only 19 (11%) institutions had an interventional oncology lead. 144 trusts (80%) provided IO services or had a formal pathway of referral in place for patients to a recipient trust. 21 trusts (12%) had plans to provide an IO service or formal referral pathway in the next 12 months only. 14 trusts (8%) did not have a pathway of referral and no plans to implement one.

70 trusts (39%) offered supportive and disease-modifying procedures. 1 trust had a formal referral pathway for supportive procedures. 73 trusts (41%) provided only supportive procedures (diagnostic or therapeutic). Of these, 43 (59%) had a referral pathway for disease-modifying IO procedures, either from a regional cancer network or through interventional radiology networks and 30 trusts (41%) did not have a referral pathway for disease-modifying procedures.

Conclusion

The provision of IO services in the UK is promising however collaborative networks are necessary to ensure disease-modifying IO procedures are made accessible to all patients and to facilitate larger registry data for research with commissioning of new services.

Article Summary

Strengths and limitations of this study

- This is the first study to investigate the provision of Interventional Oncology (IO) Services in the UK.
- The sample size is large and covers all acute trusts and health boards in the UK.
- Cross-sectional study design allowed for multiple variables to be studied
- Data was self-reported therefore at risk of incompleteness.
- Limitations include those inherent to survey/ questionnaire format, including subjective bias.

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests

Introduction

More than 1-in-3 people will develop cancer in their lifetime[1]. Since the NHS Cancer Plan in 2000, the Department of Health has strived to improve diagnosis and treatment[1]. As part of the NHS Cancer Plan to deliver world-class cancer services, there is a drive to achieve better outcomes by ensuring all patients have access to the best treatments available[2]. Wide variation remains in performance across the country with major differences in access to cancer services[1].

Interventional oncology (IO) the use of image guided techniques to diagnose and treat cancer patients is fast becoming the fourth pillar of oncological care alongside medical, surgical and radiation oncology; The Royal College of Radiologists have set out best practice guidance for the incorporation of interventional oncology into all cancer services nationally[3].

Supportive and symptomatic procedures were defined as those providing relief from tumour-related symptoms but not modifying the underlying malignant disease process and include diagnostic tests such as image guided biopsy which 'support' the provision of definitive treatment[3]. These may be palliative procedures such as image guided drainage or stent insertion. Disease modifying procedures were defined as those where the intent is to modify malignant progression and/or modify the prognosis and include image-guided ablation, trans-arterial chemoembolisation (TACE) and selective internal radiation therapy (SIRT).

There remains a significant shortage of interventional radiologists, who are the primary contributors towards IO, with almost half of services in England unable to provide a local or networked out of hours access to Interventional Radiology (IR)[4]. Undoubtedly this shortfall will have consequences on the provision of elective IO services in the UK and potentially affect patient care through limitations to access.

The current provision of Interventional Oncology services throughout the UK is unknown, therefore NHS commissioners are unable to realistically factor IO into national cancer pathways as evident in a previous Department of Health publication[1] which did not acknowledge IO as a treatment option for patients.

The primary objective of this cross sectional study was to map out the current provision of interventional oncology services in the UK. We also sought to uncover formal patient referral pathways, the types of IO procedures offered and any limitations to providing IO. Ultimately, we aim to develop IO networks and improve access to these treatments for cancer patients.

The survey was designed and undertaken in collaboration with the Interventional Oncology United Kingdom (IOUK) group, a specialist interest group of the British Society of Interventional Radiology (BSIR).

Method

No research ethics committee approval was required for this data-gathering project. No patient identifiable data was captured.

This cross-sectional study involved all acute NHS Foundation Trusts in England[5] and all health boards in Scotland, Wales and Northern Ireland which were contacted by email with the survey (see supplementary material). This was followed by a telephone follow-up of all hospital radiology departments that did not complete the survey within 2 weeks of the first email being sent out. Telephone follow-up was conducted by a single radiologist (JZ). The survey could be completed by any of the following: The head of department of radiology/ interventional radiology, any consultant radiologist (diagnostic or interventional) or superintendent radiographer who has insight into the local provision of services.

The surveys key points were:

- Are IO procedures offered in the trust?
- If so, are these supportive treatments only or both supportive and disease-modifying?
- We asked about the types of procedures undertaken
- If no IO procedures are offered, is there an agreed formal pathway to another recipient trust?

- If there was no agreed pathway, was there a plan to provide IO or a pathway in the next 12 months?
- What barriers are there to setting up an IO service?

The full survey can be found in the online supplementary file.

Following the initial survey we followed up all trusts/ health boards which only offered supportive treatments to see if there were formal referral pathways for disease-modifying procedures.

A formal referral pathway was defined as an existing mechanism of referral through a multi-disciplinary team responsible for the patient, usually through a pre-existing local oncology or radiology network.

Results

A total of 179 NHS trusts or health boards were contacted throughout the United Kingdom. We received 100% response rate. The responses came from consultant interventional and diagnostic radiologists and superintendent radiographers who had insight into the local provision of services.

143 trusts (80%) had an IR department in their trust. All trusts with an IR department offered IO procedures. Only 19 (11%) institutions had an interventional oncology lead.

144 trusts (80%) provided IO services or had a formal pathway of referral in place for patients to a recipient trust (Figure 1 and 2), of which 137 trusts (77%) stated what types of IO services they offered. 21 trusts (12%) had plans to provide an IO service or formal referral pathway in the next 12 months only. 14 trusts (8%) did not have a pathway of referral and no plans to implement one.

70 trusts (39%) offered both supportive and disease-modifying procedures (Figure 3). 1 trust had a formal referral pathway for supportive procedures. 73 trusts (41%) provided only supportive procedures (diagnostic or therapeutic).

The number of trusts providing each supportive/ symptomatic IO procedure and disease-modifying procedure are shown in table 1 and table 2. The 7 trusts that gave no details to which IO procedures were offered were excluded when calculating the percentages

129 trusts out of 179 (72%) offered therapeutic IO procedures after excluding trusts, which only offered diagnostic image guided biopsy. Figure 4 and 5 show the maps of the trusts providing each type of disease-modifying procedure.

For England only, a total of 153 NHS Foundation trusts in England were contacted. 127 (83%) trusts provided IO services or had a formal pathway of referral to another agreed recipient trust for IO procedures (Figure 1). Out of the 26 that did not have a formal referral pathway, 21 (14%) trusts had plans to provide an IO service or formal referral pathway for patients to have IO at another trust within the next 12 months. 5 (3%) trusts did not have a pathway and had no plans of providing IO or a referral pathway in the next 12 months (Figure 1). 57 out of 127 (45%) trusts providing IO offered both supportive and disease modifying procedures (Figure 3). 70 out of 127 (55%) provided only supportive procedures.

For Scotland, 10 out of 14 health boards provided IO or had a formal pathway of referral to a specialist hospital in another health board (Glasgow or Edinburgh). Of these, 8 health boards provided both supportive and disease-modifying IO whilst 2 provided only supportive IO. 4 health boards (29%) did not provide IO and did not have plans to provide a pathway in the next 12 months.

For Wales, 6 out of 7 health boards (86%) provided IO or had a referral pathway in place. 4 Welsh health boards (57%) provided both types of IO, one health board provided only supportive IO and one had a formal referral pathway. One Welsh health board did not offer IO or have a referral pathway implemented in the next 12 months.

Only 1 out of 5 health boards in Northern Ireland (Belfast Health and Social Care Trust) provided IO (both types). 4 health boards did not have plans to offer IO or have a referral pathway implemented in the next 12 months.

Out of the 70 English NHS trusts and 3 Scottish/ Welsh Health Boards, which provided only supportive IO, 43 trusts (59%) had a referral pathway to another hospital/ trust for disease-

modifying IO procedures. This was from a local regional cancer network referral initiated following a formal discussion at the multi-disciplinary team meeting or through interventional radiology networks. 30 trusts (41%) did not have a referral pathway for disease-modifying procedures.

The most common barriers to providing disease-modifying IO were insufficient funding, lack of staff, lack of support from other non-radiology clinicians, having a pathway already in place and problems with recruitment into IR.

Discussion

Overall, the provision of IO in the UK is unevenly spread.. Based on the Royal College of Radiologists definition of 'supportive' IO[1], this encompasses many routine procedures that can be carried out by diagnostic radiologists which is reflected in the excellent availability of these procedures throughout the UK. Beyond basic image-guided drainage procedures, the provision of specialist vascular, gastro-intestinal or biliary 'symptomatic' intervention is less routinely available apart from in the larger tertiary centers which were also providing disease-modifying IO. This highlights important areas to target nationally for radiology and IO training.

Given the vital role of IR in the management of critically ill patients, the comprehensive provision of supportive IO in most parts of the UK reflects the drive to train more radiologists with basic interventional skills, which are also transferrable to IO[6]. Only 1 trust without an IR department offered IO. We were unable to capture if most of the IO procedures were done by the IR department or not, with institutions occasionally splitting non-vascular (e.g. ablation) and vascular interventions (e.g. transarterial chemoembolization - TACE) between the diagnostic radiologists and the interventional radiologists who also have to cover the on-call service for non-oncology related emergency procedures such as trauma, bleeding or aortic syndromes. A major recruitment drive currently is the provision of on-call IR services and given the overlap between IO and IR training, emergency IR provision is therefore linked with the provision of IO services not only for maintaining the availability of supportive services in small district hospitals but also for the provision of disease-modifying IO in specialist centres. Additional need for interventional

radiographers and nursing cover for IO services should not be overlooked either to allow a new IO service to be introduced.

We acknowledge that disease-modifying treatments form a smaller proportion of IO workload and centralization of this is happening as part of the current NHS model for cancer services[7]. One argument for this model in the context of IO is to ensure that more complex IO procedures are undertaken by those who carry out a sufficient number of cases to maintain competency however this should not preclude suitable patients from being referred due to their geographic location. There are NHS trusts/ boards, most noticeably in rural Scotland and Northern Ireland where access to disease-modifying IO services appears limited and linking up with neighboring hospitals to set up formal referral pathways should be considered. What also remains unclear is what the current demand for IO services are generally but particularly in these rural regions, as we have no data to suggest current arrangements are sub-optimal. It would not be necessary or appropriate for all providers to liaise with IO services, and these should be facilitated through regional cancer networks with more integrated pathways of care[7]. Currently there appears to be 136 out of 153 acute NHS trusts in England, which are listed to offer acute oncology services[8]. Further work is required to elucidate whether there is any discrepancy in the regional demand and supply of disease-modifying IO.

The perceived barriers to starting up elective disease-modifying services stemmed from shortfalls in funding, staffing and support from other specialties. With tertiary centres undertaking much higher volumes of disease modifying IO procedures, some smaller district general hospitals felt unsupported in starting up their own service, from financial considerations when purchasing the equipment to garnering support from allied specialties such as surgery and oncology. This is an important point as it highlights the need for greater awareness of the role of the interventional radiologist in oncology care and we must strive to work even closer with oncologists given the new evidence suggesting the added value of combination therapies and incorporation of IO procedures into European cancer guidelines[9]. However, with the current model of centralizing cancer services, these barriers would only be an issue if cancer centers were unable to provide IO. To

improve patient selection for complex IO procedures, interventional radiologists should have a regular role in multi-disciplinary team meetings. With only 19 institutions (11%) currently having a formal IO lead clinician, there is a role for dispersed leadership to achieve structural change in established cancer networks.

Local expertise and facilities help determine the IO that is offered. An example is the provision of disease-modifying IO for the liver, which is centred around the national liver transplant units[10]. Clearly image-guided tumour ablation, TACE and SIRT are effective therapies than can be used solely or in combination with chemotherapy or surgery to improve the outcome of such patients. [11 12]. Participation in MDT discussions will also allow interventional radiologists and radiologists familiar with IO Techniques to educate other clinicians on the role of IO in the management of patients and contribute towards improvement and restructuring of services. This will also open opportunities to undertake collaborative research that will be higher impact and wider reaching to the oncology community.

The recurrent issue of lack of staffing within IR remains a barrier. Despite the promising provision of supportive IO, most departments are struggling to cope with the demand for basic vascular, urological and biliary procedures, necessary to provide a sustainable out of hours service, without compounding this with additional workload and need for additional training for disease-modifying IO.

Changes to the delivery of healthcare throughout the UK demands that IO treatments can demonstrate not only a therapeutic benefit but also cost-effectiveness. For units with a referral pathway for disease-modifying IO, there was a common theme that this set-up was more cost effective than starting a service from scratch. Without knowledge of the actual demand for these IO procedures, there is no answer to this currently, and clinical investigators must incorporate measures of cost-effectiveness and patient-reported outcomes into large-scale studies to provide more robust evidence[13]. Even if these IO treatments can be shown to be equally effective compared with the current standard of care but with significantly less morbidity, then it will allow

the specialty to develop further, however current studies have not offered definitive conclusions[14]. Building upon the knowledge of these IO networks will allow better registry data that can be used to derive larger cohorts for future trials and also commissioning of new services.

The limitations of the present study include those inherent in the survey/ questionnaire format such as the subjective element depending on whether a superintendent radiographer or consultant radiologist responded given their underlying experience and knowledge of their radiology services which could impact on the detail of their survey answers. The strengths of the survey include 100% response rate from 179 acute NHS trusts/ health boards which allowed a comprehensive map of both supportive and disease-modifying IO procedures offered in the UK that will help direct radiology/IO training, future planning of new IO services and allow for more integrated cancer pathways.

Conclusion

The provision of IO services in the UK is promising however collaboration and networking is necessary to ensure disease-modifying IO procedures are made accessible to all patients throughout the UK and to facilitate improved registry data collection for research and commissioning or funding of new services.

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Transparency declaration: I affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Data sharing: no additional data available.

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Figure Legends:

Figure 1: UK Map showing the overall provision of interventional oncology (IO) services throughout the UK.

Figure 2: Middle pie chart (A) displaying total number/percentage of trusts which offer IO or have a referral pathway, number which plan to set up IO service or referral pathway in the next 12 months (All English trusts) and those without any plans to set up a IO service pathway. The top (B) and bottom (C) pie charts display the breakdown of healthcare trusts/ health boards by country.

Figure 3: UK Map showing what types of IO procedures (supportive and/ or disease modifying procedures) are undertaken in each NHS trust/ health board.

Figure 4: UK Map showing the provision of ablation services: (A) Renal ablation (B) Liver ablation (C) Bone ablation and (D) Lung ablation.

Figure 5: UK Map showing the provision of (A) Trans-arterial chemoembolization (TACE) and (B) Selective internal radiation therapy (SIRT).

Table Legends

Table 1: Type of supportive/ symptomatic IO procedure and number of trusts that offer each and percentage of total number of trusts that provided information on the types of procedure offered (n=137). 7 out of 144 who offered IO did not include what procedures were offered and were excluded from calculations.

Type of supportive/ symptomatic IO procedure	Number of trusts	Percentage of total (%)
Image-guided biopsy	137	100
Nephrostomy	129	94
Image-guided drainage	128	93
Central venous catheter	125	91
Ureteric stenting	124	91
Biliary drainage and stenting	118	86
Vena caval filtration	88	64
Gastrointestinal stenting	87	64
Percutaneous Trans-hepatic Cholangiography (PTC)	84	61
Enteral tube placement e.g. Radiologically Inserted Gastrostomy (RIG)	81	59
Vena caval stenting	79	58
Ascitic diversion	39	28
Vertebroplasty	6	4
Isolated perfusion chemotherapy	5	4

Table 2: Type of disease-modifying IO procedures and number of trusts that offer each and percentage of total number of trusts (n=179).

Type of disease-modifying IO procedure	Number of trusts	Percentage (%)
Trans-arterial chemoembolization (TACE)	40	22
Liver ablation	39	22
Kidney ablation	39	22
Lung ablation	28	16
Bone ablation	18	10
Selective Internal Radiation Therapy (SIRT)	17	9
Prostate ablation	2	1

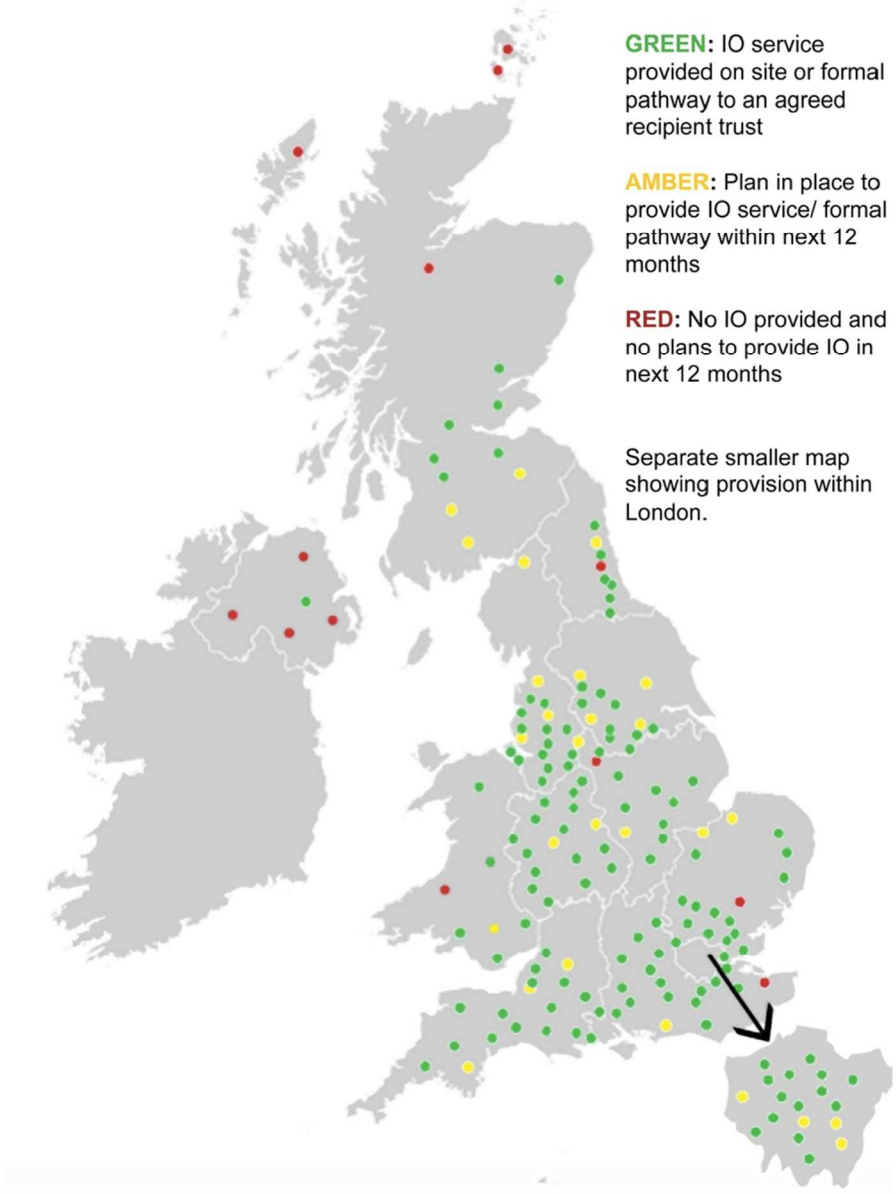

Figure 1: UK Map showing the overall provision of interventional oncology (IO) services throughout the UK.

94x127mm (300 x 300 DPI)

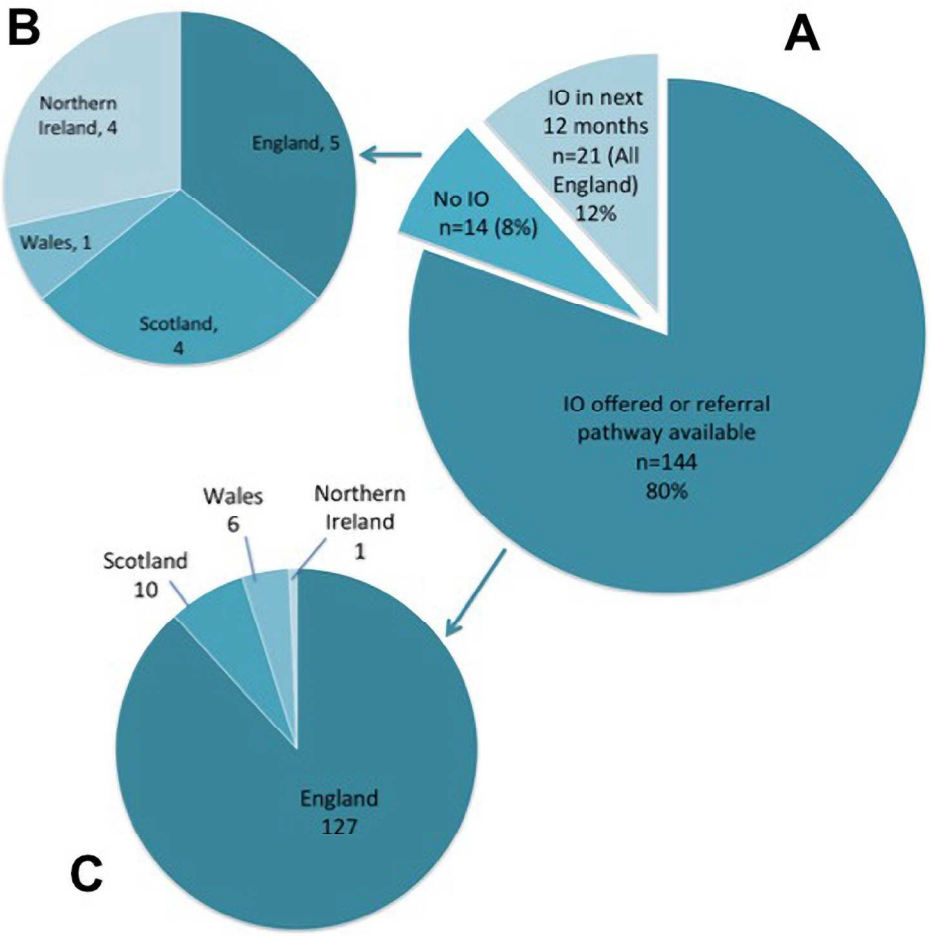

Figure 2: Middle pie chart (A) displaying total number/percentage of trusts which offer IO or have a referral pathway, number which plan to set up IO service or referral pathway in the next 12 months (All English trusts) and those without any plans to set up a IO service pathway. The top (B) and bottom (C) pie charts display the breakdown of healthcare trusts/ health boards by country.

196x187mm (300 x 300 DPI)

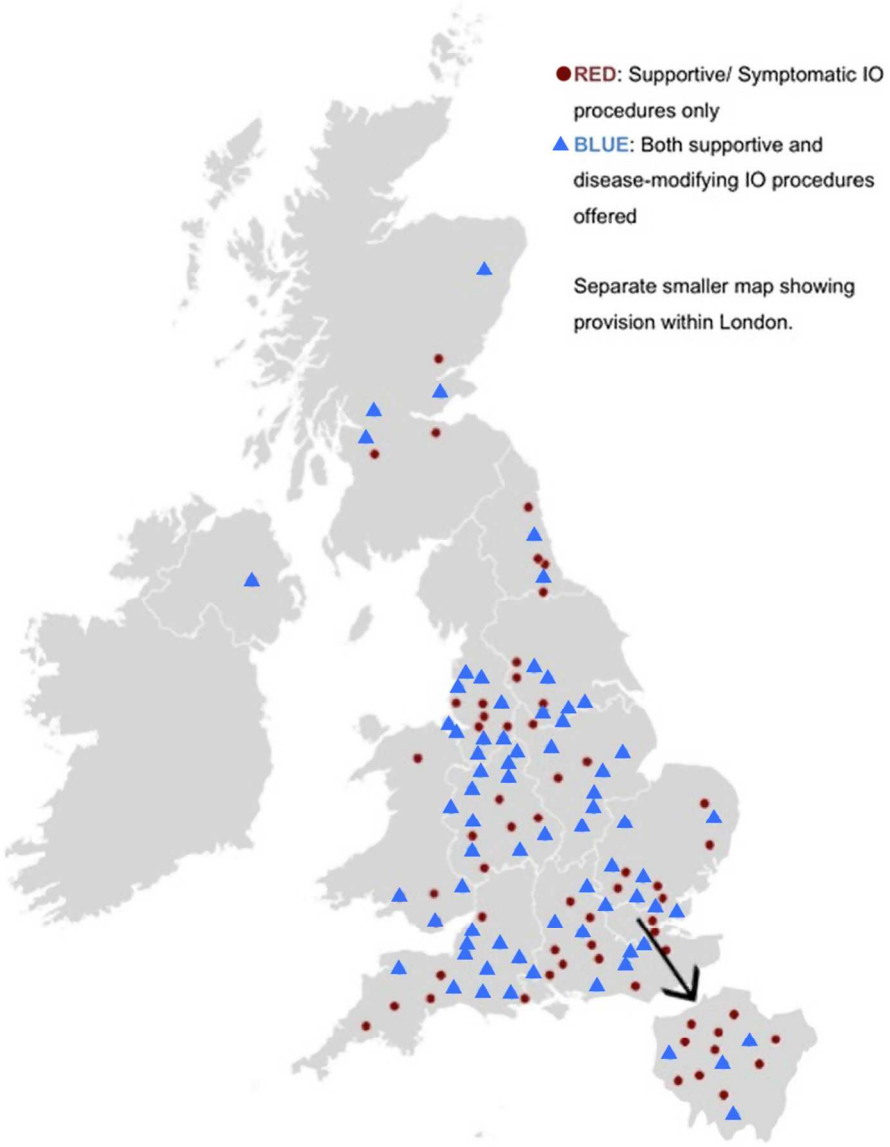

Figure 3: UK Map showing what types of IO procedures (supportive and/ or disease modifying procedures) are undertaken in each NHS trust/ health board.

118x157mm (300 x 300 DPI)

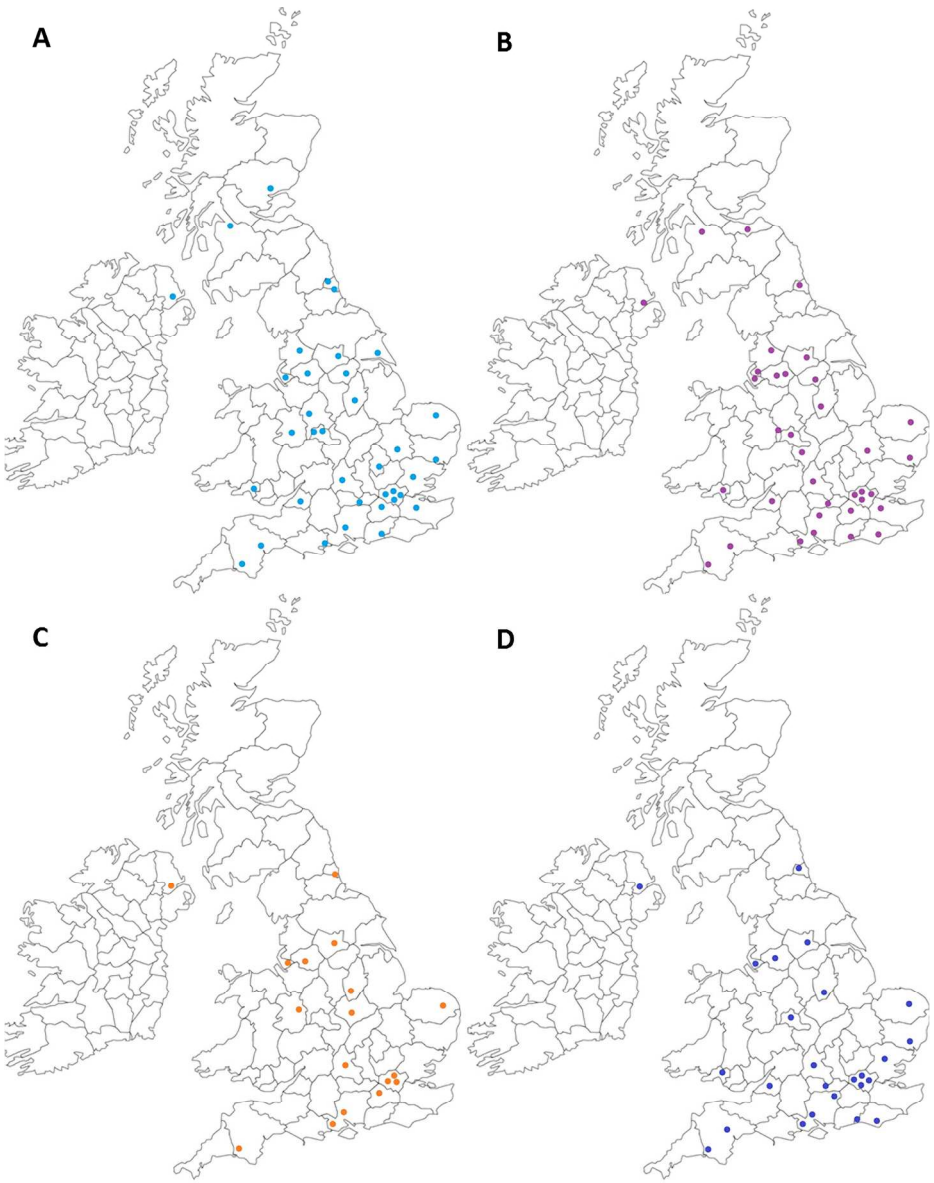

Figure 4: UK Map showing the provision of ablation services: (A) Renal ablation (B) Liver ablation (C) Bone ablation and (D) Lung ablation.

230x299mm (300 x 300 DPI)

Figure 5: UK Map showing the provision of (A) Trans-arterial chemoembolization (TACE) and (B) Selective internal radiation therapy (SIRT).

259x169mm (300 x 300 DPI)

Cross-sectional Study of the Provision of Interventional Oncology Services in the United Kingdom

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page in Manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*7*
Bias	9	Describe any efforts to address potential sources of bias	13
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8

		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	8-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	n/a
		(*b*) Report category boundaries when continuous variables were categorized	8-10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	10-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.