



Review

Prostate mpMRI in the UK: the state of the nation



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The diagnosis of prostate cancer has changed. Improved magnetic resonance imaging (MRI) technology with diffusion-weighted imaging has led to the use of multiparametric MRI (mpMRI) before biopsy in patients suspected of having prostate cancer. This has the advantage that patients with a negative mpMRI may not need biopsy, therefore avoiding the risk of complications. Those in whom mpMRI is positive can have targeted biopsies with a higher probability of diagnosing clinically significant cancer. Prostate Cancer UK (PCUK) and the British Society of Urogenital Radiology submitted a Freedom of Information (FOI) request in 2016 to UK health areas in order to assess the use of mpMRI before biopsy as part of the initial diagnosis pathway. Another request was submitted by PCUK in 2018 to assess the progress made in the UK between these two dates. Both requests had the secondary aim of identifying barriers to the implementation of mpMRI. The FOI requests showed an increase in the use of mpMRI before biopsy with 59% of areas reporting improvement between the two requests. There has been a reduction in the percentage of areas not providing any form of pre-biopsy MRI from 25% in 2016 to 13% in 2018. There remains, however, geographical variation in implementation across the UK nations. Imaging practice also shows variation with some areas performing scans without dynamic contrast enhancement (DCE) and using the findings to guide referral decisions for biopsy. Eligibility criteria for pre-biopsy MRI also vary leading to some restrictive practices. Reported barriers to implementation included scanner capacity and staffing levels. Recent guidelines and recommendations by the National Institute for Health and Care Excellence (NICE) and NHS England for men aged 50–69 years with a prostate-specific antigen (PSA) level between >3 and <30 ng/ml to receive mpMRI before biopsy put further pressure on already understaffed and under-resourced radiology departments.

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Introduction

The standard prostate cancer diagnostic pathway has traditionally seen patients suspected of having prostate

cancer, either due to a raised prostate specific antigen (PSA) or abnormal digital rectal examination (DRE), being referred for transrectal ultrasound (TRUS)-guided prostate biopsy. If this showed the presence of prostate carcinoma, then patients underwent a magnetic resonance imaging (MRI) examination to stage the tumour. Several problems exist with this pathway: (1) a raised PSA is not specific for prostate cancer and has a high false positive rate; (2) DRE

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will only examine the posterior prostate and is particularly poor with larger glands; (3) TRUS biopsy has a high sampling error rate so that clinically significant cancer can be missed and insignificant cancer detected, leading to under- and over-treatment respectively¹; and⁴ a significant proportion of men experience complications from TRUS biopsy including sepsis and haemorrhage.²

Improvements in MRI technology have led to greater spatial resolution, faster scan times, and better diffusion-weighted imaging (DWI). Evidence shows that the combination of standard high-resolution T1/T2-weighted sequences with additional diffusion-weighted sequences and dynamic contrast enhancement (DCE; multiparametric MRI [mpMRI]) prior to biopsy is more effective than the standard of care, increasing confidence in the diagnosis of prostate cancer.^{3,4}

The PROMIS study (Prostate MR Imaging Study)⁵ showed that mpMRI prior to biopsy was more sensitive than TRUS biopsy alone at detecting cancer and could be used as a triage to help decide which men should undergo TRUS biopsy, potentially ruling some men out of this procedure. The PRECISION study⁶ supported these findings showing that the use of risk assessment with mpMRI before biopsy and mpMRI-targeted biopsy was superior to TRUS biopsy, detecting more men with clinically significant cancer and diagnosing fewer men with clinically insignificant cancer compared to the standard-biopsy group.

Since the publication of PROMIS in January 2017, there has been increasing implementation of mpMRI before biopsy across the National Health Service (NHS) in the UK. The National Institute for Health and Care Excellence (NICE) recently issued guidance recommending the use of mpMRI before biopsy in all men with suspected localised disease.⁷ NICE also recommended the use of mpMRI-targeted biopsies on the basis that the PRECISION Study showed it could detect more clinically significant cancers.

The implementation of mpMRI before biopsy has been monitored by Prostate Cancer UK since 2016, enabling an overview of coverage and current practice across the UK both prior to, and since, publication of the PROMIS study. This paper focuses on the extent of implementation and the change since 2016 and provides an overview of current practice and the barriers to further adoption as reported by providers.

Materials and methods

Prostate Cancer UK issued two Freedom of Information (FOI) requests to all Trusts, Health Boards and Health and Social Care Boards (referred to as areas herein) in the UK with the primary aim of finding out the extent to which mpMRI before biopsy is being provided as part of the initial diagnostic process. A FOI request is a useful tool that elicits a high response given the statutory requirement for public bodies to respond to requests within a certain timescale. Although the primary aim of the FOI request was to explore the provision of mpMRI, as per the imaging standards used in the PROMIS and PRECISION trials, the requests also asked

about the use of MRI without DCE (referred to as biparametric MRI [bpMRI]). This allows an assessment of the overall provision of MRI (referring to both mpMRI and bpMRI) before biopsy.

The first FOI request was issued in June 2016 in conjunction with the British Society of Urogenital Radiology. In addition to establishing the extent of current use of mpMRI before biopsy, a secondary aim of the request was to explore whether areas intended to implement or increase the use of mpMRI and what some of the barriers and challenges to further implementation may be. At November 2016, a 100% completion rate (164/164 health areas) was achieved providing an in-depth understanding of the status of mpMRI before prostate biopsy across the UK. A second request was issued in February 2018 to gain a comprehensive picture of what progress had been made in implementation. Although the request had the same primary aim as the first request, further secondary aims meant a number of additional questions were asked. Additional secondary aims were to find out what eligibility criteria were being used, the extent to which men were being ruled out of biopsy, and whether subsequent biopsies were MRI-influenced. Additionally, 21 areas that confirmed in 2016 that they were delivering mpMRI before biopsy to 100% of eligible men were sent a separate set of additional questions to understand the key features of their service with the aim of identifying factors that made this level of provision possible. Following three rounds of e-mail and telephone follow-up, at the censoring date in June 2018, the second request achieved a response rate of 92% (151/161). The reduced number of health areas was due to the merging of some Trusts in England.

Data from both requests were analysed using Microsoft Excel. Not all questions were answered by every respondent and calculation of percentages was based on valid responses only. In areas reporting provision of MRI before biopsy, the extent of access was also measured; areas stating provision of MRI before biopsy to <20% of eligible men were classed as having low access and areas stating provision of MRI before biopsy to >80% of men were classed as having extensive access.

Results

Implementation

In 2018, 86% of UK areas reported that they provided some form of MRI before biopsy in their area; 56% reported using mpMRI and 30% bpMRI. There was marked variation in provision across the nations of the UK, with the majority of Trusts in England (92%) reporting the availability of MRI before biopsy in 2018 and only 10 out of 124 not making it available. By contrast, only three of the seven Welsh Health Boards reported making MRI before biopsy available (another Health Board referred patients to an unspecified area), while it was available in three of the five Health and Social Care Boards in Northern Ireland and in 10 of the 14 Health Boards in Scotland.

The type of MRI provided also varied across UK nations with the majority of areas in England (74/124) and Scotland (8/14) using mpMRI compared to only two out of six areas in Wales and none in Northern Ireland where the three Health and Social Care Boards providing MRI use bpMRI only.

Compared to 2016, there has been an increase in the availability of MRI before biopsy from 75% of areas in 2016 to 86% in 2018, with 125 areas now directly providing it to men with suspected prostate cancer and a further five referring to other areas where it is available. The number of areas not providing MRI before biopsy has decreased from 41/164 (25%) in 2016 to 19/151 (13%) in 2018. Progress in implementation between FOI requests has largely been confined to England and Scotland.

The increase in availability of MRI before biopsy has been in both mpMRI and bpMRI: 56% of areas provided mpMRI in 2018 compared to 51% in 2016 and 30% of areas provided bpMRI in 2018 compared to 24% in 2016 (Fig 1). Figs. 2 and 3 show the geographical availability of different types of MRI before biopsy in 2016 and 2018.

Patient access

Extent of access

A key component of implementation is the extent to which areas providing MRI before biopsy make this available to the entire patient population. The extent of access for men varies across the country with some areas only scanning men on request and others scanning all eligible men.¹ Of the 125 areas providing MRI and reporting the percentage of eligible men receiving a scan, 76% reported extensive access (to >80% of eligible men) in 2018. Areas carrying out mpMRI were slightly more likely to report extensive access than those carrying out bpMRI (80% compared to 70%). Only 5% of areas carrying out MRI reported low access (to fewer than 20% of men) in 2018 and, overall, 17% of areas either reported low access or no access to MRI.

Compared to 2016, the proportion of areas carrying out MRI and reporting extensive access increased, with the increase greater for mpMRI than bpMRI (Fig 4). In addition to an increase in areas reporting extensive access, there has been a decrease in the proportion of areas reporting that they provide MRI but with low access; from 24% in 2016 to 5% in 2018. In total, 78 areas reported an increase in the percentage of men scanned with five reporting an increase of over 100% and 36 areas unable to provide an answer.

Eligibility criteria

In addition to access for eligible men, the 2018 FOI asked areas about their eligibility criteria to understand the extent to which these are being used to manage access to MRI. Of

¹ Eligible refers to all men clinically suspected of having prostate cancer and who meet an area's eligibility criteria for mpMRI.

the 117 areas that shared details of their eligibility criteria, 77 (66%) had no restrictive eligibility criteria. The remaining 40 areas (34%) had at least one restrictive eligibility criteria relating to age ($n=23$), PSA concentration level ($n=23$) or referral route ($n=5$; Table 1). Ten areas restricted patients' eligibility based on both age and PSA level. A further 10 areas stated that they assessed life expectancy when deciding on eligibility, although details on how this was assessed were not provided, so it was unclear whether this practice was restrictive and they were not categorised as so. The most common eligibility criterion was fitness for radical treatment, stated by 48 areas and not classed as a restrictive practice. PSA level was not deemed restrictive if it involved exclusion of those with PSA levels of above 30 ng/ml in line with NHS guidance.⁸

Current practice in MRI reporting

Areas responding to the 2018 request reported variation in practice following MRI in terms of the scoring system used to determine the likelihood of a patient having clinically significant cancer. Of those carrying out MRI before biopsy and indicating the scoring system used, 88 areas reported using the Prostate Imaging-Reporting and Data System (PI-RADS) scoring system, while 19 areas reported using a Likert scale.^{9,10} When ruling men out of biopsy, 31 areas also considered PSA density. Some areas reported considering other clinical factors, such as PSA doubling time, and risk factors, such as family history and ethnicity, with others reporting that the decision to refer for biopsy was taken following discussion by the multidisciplinary team (MDT).

Current practice in the use of biopsy following MRI

Practice related to the use of MRI to rule men out of a biopsy also showed variation. Just over two-thirds (68%) of areas providing MRI before biopsy are ruling men out of biopsy and the proportion is similar for areas carrying out mpMRI and those carrying out bpMRI. Many of the areas not ruling men out of biopsy indicated that they would look to do so in the future with some areas mentioning the need for guidelines on this and further discussions with referring clinicians.

In terms of the type of biopsy provided to the men whose MRI scan indicates an area of suspicion and who are subsequently referred to biopsy, the majority of areas reported using cognitive/visual targeting (70%) while 19% reported the use of image fusion technology and 11% reported using systematic biopsy after the scan.

Barriers to further adoption

One hundred and eight areas provided information on factors that would help with mpMRI adoption or with increasing the use of mpMRI (Table 2). Other barriers to further adoption cited by areas included a need to follow

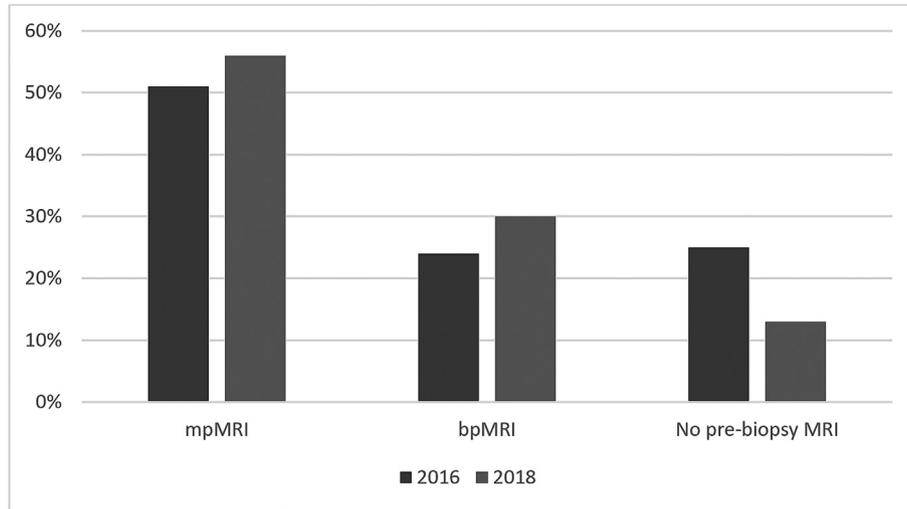


Figure 1 Percentage of areas providing MRI before biopsy in the UK, 2016 and 2018.

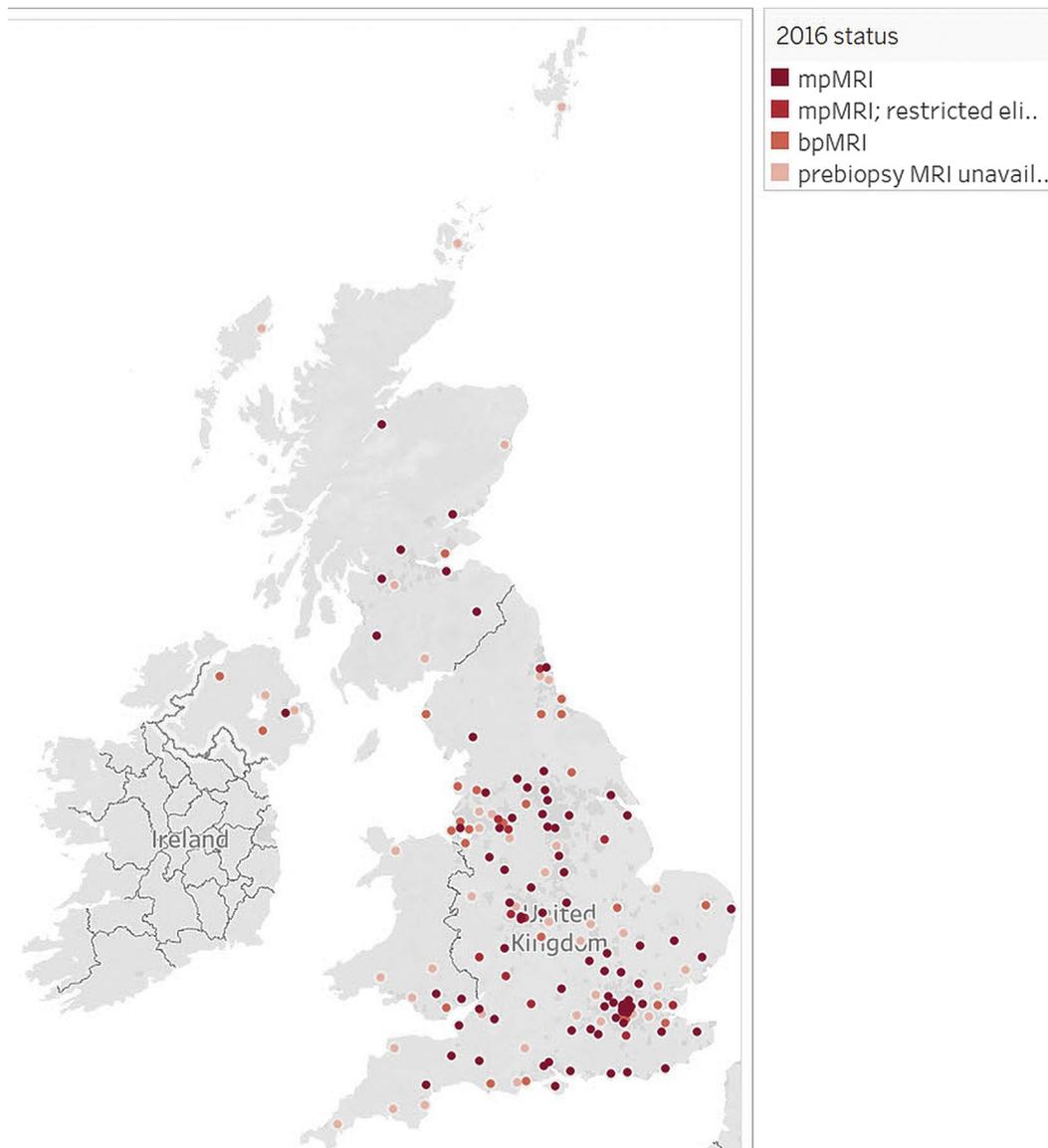


Figure 2 Geographical availability of MRI before biopsy, 2016.

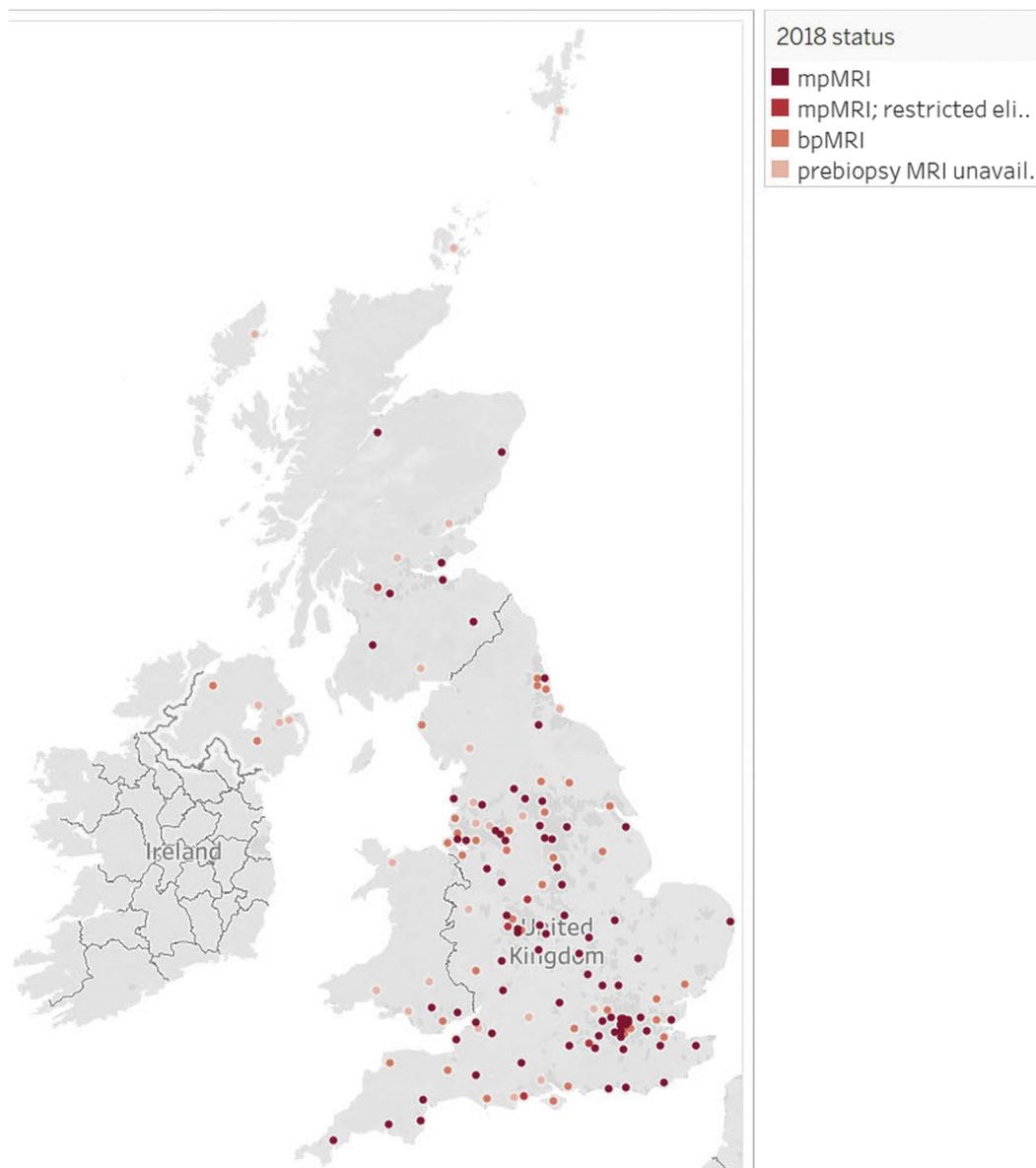


Figure 3 Geographical availability of MRI before biopsy, 2018.

the Cancer Network Guidelines for their region or recommendations for use of mpMRI before biopsy with contrast from NICE Guidelines, software-based fusion and difficulties in the harmonisation of multiple scanners and radiology colleagues.

Discussion

Data collected through Prostate Cancer UK's FOI requests demonstrate an increase in the use of MRI before biopsy in the UK since 2016 with 59% of areas recording some kind of improvement in provision; either adopting MRI, moving from bpMRI to mpMRI, or improving the extent of access to the test; however, the pace and direction of implementation varies across the country with 22 areas (15%) showing signs of a backwards step in implementation, many of these moving from providing mpMRI to bpMRI.

Although the slow progress in Northern Ireland and Wales and within some areas in Scotland and England only equates to 19 non-providers, whether a man has access to high-quality MRI remains determined by his area of residence. The use of restrictive eligibility criteria by some areas creates further inequality of access and means that some men miss out on practice shown to provide more accurate diagnosis, often due to age or because of arbitrary PSA levels.

Following MRI, variation in practice continues with the system used to score the scan's findings, the decision on whether to biopsy and the extent to which the subsequent biopsy is MRI influenced all showing local differences. Whether this variation impacts on patient outcomes is yet to be determined but, in the meantime, standardising practice in line with recent guidance will help ensure that men have equal access to high-quality practice.

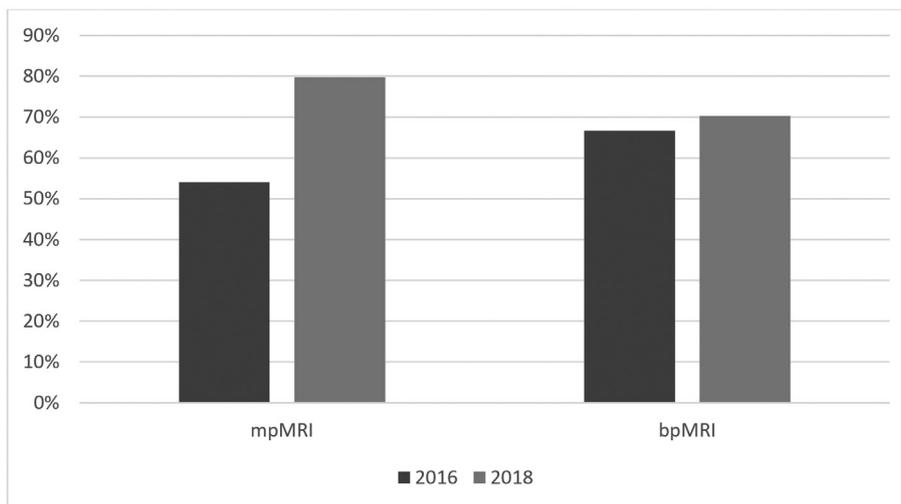


Figure 4 The percentage of areas providing MRI before biopsy reporting extensive access in 2018 compared to 2016.

Table 1

Eligibility criteria stated by areas in 2018.

Eligibility criteria	No. of areas (n)	Details
Age	23	Eligibility criteria ranged from <65 to <80.
PSA	23	Eligibility criteria showed variation: <10, >10, <15, >15, 3–15, <20, <25 ng/ml
Referral route	5	Urgent (2 week wait) referrals only
No restrictive criteria	72	Those with no eligibility criteria or criteria such as fitness for radical treatment, PSA above 30 ng/ml, life expectancy,
Total	117	

PSA, prostate-specific antigen.

Table 2

The number and percentage of areas citing barriers to multiparametric magnetic resonance imaging (mpMRI) adoption or for further increasing the use of mpMRI (108 areas provided information).

	No.	%
Increased MRI scanner availability	77	71%
An additional or new MRI scanner	73	68%
Increased staffing levels	73	68%
Additional training for radiologists	50	46%
Reduced mpMRI scan time	36	33%
Agreement to use DCE	23	21%
Support with scanner optimisation	19	18%
A scanner/magnet upgrade	19	18%

DCE, dynamic contrast enhancement.

Implementing guidance and recommendations

A UK Clinical Consensus published in 2018¹¹ created standards for the implementation of mpMRI before biopsy, recommending that mpMRI before biopsy should be used as a triage to rule some men out of a biopsy and setting out the conditions and circumstances for this. The NICE issued guidelines containing the same recommendations in 2019.⁷ PI-RADS 2.1 suggests that further research is required before DCE is ruled out for “treatment-naive” men and that it provides a “safety net” for men,⁹ which is important when ruling men out of immediate biopsy. The 2018 FOI responses, however, show that 30 areas providing MRI

without the use of DCE are ruling men out of biopsy based on the findings of the scan. Guidance from NICE on re-referral PSA levels for men with a raised PSA who have avoided an immediate biopsy following a negative MRI will help manage this population and may be particularly important for those receiving a bpMRI. Many areas were unable to provide an accurate figure on the number/percentage of men avoiding an immediate biopsy following a negative MRI finding and systems for monitoring this would help assess the impact of the MRI pathway, verify findings from the PROMIS and PREDICT trials, understand the size of the patient population that may require further monitoring and support effective clinical management of this population. Although PROMIS and PRECISION reported similar levels of potential biopsy avoidance (27% and 29% respectively),^{5,6} a recent study from The Netherlands and emerging observational data from UK centres, suggest that this could be higher at around 40–50% of men.¹²

Addressing scanner capacity issues

With national guidance recommending the use of mpMRI before biopsy for all men suspected of having localised prostate cancer, scanner capacity will continue to be a challenge for many areas. The added time to carry out a scan with DCE was mentioned as a barrier to the adoption of mpMRI. Where areas provided information on scan time, this varied across areas with some reporting undertaking

mpMRI in 30 minutes and others reporting a scan time of 50 minutes. Similar variation was reported among areas using bpMRI with scan times of between 20 and 45 minutes with some areas claiming that this could increase to 1 hour should DCE be added. Scan times reported elsewhere suggest an average of 31.33 minutes for bpMRI and 43.33 minutes for mpMRI¹³ with an additional 10–15 minutes reportedly required for the use of DCE.¹⁴

It is possible to optimise protocols to shorten the length of scans. PIRADS 2.1, like previous versions, has attempted to standardise scans and suggests that two T2 scan planes are sufficient, with either the sagittal or coronal being omitted.⁹ A high-resolution T1-weighted scan looking for haemorrhage need also not be performed as a pre-contrast T1-weighted scan is performed as part of the dynamic contrast-enhanced series. Arguments against contrast medium use include the need for cannulation and medical cover; however, cannulation is needed to administer a muscle relaxant as is medical cover. The dynamic post-contrast series also need only extend for 2 minutes to observe contrast enhancement as washout is no longer considered important.⁹

Although a shorter scan time could potentially allow areas to increase the percentage of eligible men they scan, the 2018 FOI found that areas providing bpMRI were less likely to report extensive access than those providing mpMRI. Even with optimised scan times, increased scanner availability is imperative if the NHS is to deliver high-quality, modern prostate cancer diagnosis services. The UK lags behind other countries in terms of the number of MRI machines per 100,000 population, being one of only a few European countries where MRI capacity did not increase between 2011 and 2016.¹⁵ Of the areas that were early adopters of MRI before biopsy, some report the use of mobile scanners to deal with capacity issues while others report the use of dedicated prostate MRI slots. Sharing experiences from these may help struggling areas expand the provision of pre-biopsy MRI.

Radiologist numbers and training

Staffing, particularly radiologist time remained an important issue for areas in 2018; using data from the 2018 FOI and the Royal College of Radiologists, it's estimated that around 50 additional radiologists solely reporting on prostate MRI for diagnostic purposes would be needed by 2028 if every area was to provide mpMRI to all eligible men. In addition, training of existing radiologists is vital if they are to gain confidence in interpreting and reporting mpMRI examinations. This will allow an expansion in the use of the Likert scoring system, recommended by the clinical consensus¹¹ and 2019 NICE guidance.⁷ Its use is recommended once radiologists have gained experience in reporting prostate mpMRI using PI-RADS.¹⁶ One-day training workshops have been made available via the Royal College of Radiologists (RCR) and the British Society of Urogenital Radiology (BSUR), but a more intensive approach is needed if radiologists are to reach the standards set by the UK Clinical Consensus to report independently.¹¹

Resources

Resources are key to achieving an expansion of mpMRI before biopsy and 23 areas reported having secured new funding between 2016 and 2018, six of which were able to start providing mpMRI and three that were not previously providing MRI and now provide bpMRI. Two Trusts reporting having received funding from the NHS England National Cancer Transformation Fund and another stated they had acquired a new MRI machine but did not specify the funding stream, whereas others already providing MRI mentioned some additional funding for radiologist training; however, many did not report receiving funding and with the widespread reporting of barriers to further adoption, there is an urgent need for national investment. The £10 million funding injection to support clinical capacity announced by the Chief Executive of NHS England¹⁷ and the £655 million over the next 3 years from the Scottish Government to deliver a “sustainable and significant step-change on waiting times”¹⁸ may provide an opportunity for gaining that investment. In Wales and Northern Ireland, where provision already lags behind the rest of the UK, there is a strong case for a similar level of investment.

Limitations

FOI requests are an efficient way to obtain data with a high response rate and are increasingly popular with academic researchers although they are not without limitations.¹⁹ Despite a statutory requirement to respond to requests within a set time limit and numerous follow-ups, some areas did not respond to the request; however, the response rate of 92% represents a high coverage of areas and analysis of responses from the 2016 request suggests that non-responders were not skewed towards those with low MRI coverage. The accuracy of the responses depends largely on who was tasked with supplying information and data and this may have differed between the two requests. In addition, some data were approximations rather than derived from administrative records and therefore some level of subjectivity exists.

Not all areas answered every question, particularly around barriers to implementation as this was sometimes felt to be outside of the scope of a FOI request. The main question of whether an area provided MRI and the type of MRI provided was, however, answered by each respondent. Although the questions in the two FOI requests differed limiting comparability for some aspects, the main questions used to determine implementation were the same. One of the main additions to the 2018 FOI request was a question about eligibility criteria. This allowed a more comprehensive assessment of access to MRI but limited comparability with the previous request and increased the complexity of data analysis and presentation.

The information provides a snapshot of practice at the time of the FOI request and with rapid changes in this area—both improvements and, in some cases, decreases in provision—the landscape may well have changed since.

Further monitoring of implementation and practice will be required to ensure that progress is made in this important area.

Conclusion

The recommendation by NHS England for men aged 50–69 years with a PSA level between >3 and <30 ng/ml to receive mpMRI before a biopsy⁸ and the recently published NICE guidance have put intense pressure on the prostate cancer diagnostic pathway. Nevertheless, the guidance provides a clear mandate and recommendation for using mpMRI before biopsy as part of an optimal diagnostic pathway. The fact that only six areas reported practice that fully reflects the best practice recommendations demonstrates that despite clear progress being made between 2016 and 2018, there remains plenty of scope for further improvement.

Conflict of interest

There is no conflict of interest from any of the authors or organisations.

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