A clinician-centred programme for behaviour change in the optimal use of staging investigations for newly diagnosed prostate cancer

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Objectives
To improve imaging utilisation and reduce the widespread overuse of staging investigations, in the form of computed tomography (CT) and whole-body bone scans for men with newly diagnosed prostate cancer in the Hunter region of NSW, Australia, by implementation of a multifaceted clinician-centred behaviour change programme.

Patients and Methods
Records of all patients with a new diagnosis of prostate cancer were reviewed prior to the intervention (July 2014 to July 2015), and the results of this audit were presented to participating urologists by a clinical champion. Urologists then underwent focused education based on current guidelines. Patterns of imaging use for staging were then re-evaluated (November 2015 to July 2016). Patients were stratified into low-, intermediate- and high-risk groups as described by the D’Amico classification system.

Results
A total of 144 patients were retrospectively enrolled into the study cohort. The use of diagnostic imaging for staging purposes significantly decreased in men with low- and intermediate-risk disease post intervention. In low-risk patients, the use of CT decreased from 43% to 0% (P = 0.01). A total of 21% of patients underwent bone scans in the pre-intervention group compared with 18% in the post-intervention group (P = 0.84). In intermediate-risk patients, the use of CT decreased from 89% to 34% (P < 0.001), whilst the use of bone scan decreased from 63% to 37% (P = 0.02). In high-risk patients, the appropriate use of imaging was maintained, with CT performed in 87% compared with 85% and bone scan in 87% compared with 65% (P = 0.07).

Conclusion
Our results show that a focused, clinician-centred education programme can lead to improved guideline adherence at a regional level. The assessment of trends and application of such a programme at a state-based or national level could be further assessed in the future with the help of registry data. This will be particularly important in future with the advent of advanced imaging, such as prostate-specific membrane antigen positron-emission tomography.

Keywords
#PCSM, #ProstateCancer, prostatic neoplasms, patient safety, neoplasm metastasis, diagnostic imaging, quality improvement

Introduction
It has been widely demonstrated that clinicians over-utilize diagnostic imaging investigations in staging for patients with newly diagnosed low- to intermediate-risk prostate cancer [1–8]. This leads to patient fear and anxiety [9], financial cost [3,5], unnecessary radiation exposure and a cascade of further investigations and procedures as a result of incidental findings [10]. It would clearly be desirable to modify clinician behaviour in this regard, as the metastatic yield of such investigations is negligible [11–13] and places an increased burden on the health system [11,12], and hence the harm far outweighs the possible benefits.
The aim of imaging in the staging of these patients is to identify those patients with advanced disease at presentation in order to guide the most appropriate ongoing treatment. This necessitates a delicate balance between the risk of over-investigation and the risk of missing significant disease. Current available guidelines, published by major specialty societies, recommend imaging in the form of abdominopelvic CT and whole-body bone scan for the purposes of staging [14–17]. These guidelines emphasize the risk stratification of patients according to biochemical, pathological and clinical criteria to allow treatment and imaging decisions based on each patient’s individual risk of metastatic disease.

There are a number of risk stratification systems in use, one of which is the D’Amico system, based on the three classic prognostic factors of pre-treatment PSA, clinical T stage and biopsy Gleason score [18]. Although many other risk stratification systems have been explored, such as the University of California, San Francisco CAPRA score, the D’Amico system is the most widely used and, with subgroup refinements, has recently been endorsed by AUA/American Society for Radiation Oncology (ASTRO)/Society of Urologic Oncology (SUO) guidelines [19]. The recommendations contained within imaging guidelines are based on population-level data that demonstrate the expected low yield of advanced imaging in men with low-risk disease [14,20].

Despite numerous efforts, behaviour change in this area in the community setting has been unsuccessful [21]. In the present study, we explored whether a multifaceted programme in health behaviour change might be successful in changing clinicians’ imaging practices.

Materials and Methods

Intervention

The behaviour change intervention was primarily delivered as part of the local genito-urinary oncology multidisciplinary team (MDT). It began with a clinical champion in the form of a local practising urologist chairing an educational meeting attended by colleagues, where the evidence underpinning guidelines dissuading the use of staging investigations for patients with low-risk and most patients with intermediate-risk disease was presented. The AUA and European Association of Urology guidelines were the primary guidelines referenced [22,23].

The staging practices of participating urologists were audited during the initial phase of the study. These results were presented, in a de-identified fashion, to the group, highlighting the overuse of staging investigations in men at low risk of metastatic disease.

An education programme was then employed. This involved presentations at regular MDT meetings on current guidelines for management and investigation of patients with newly diagnosed prostate cancer, as well as the results of the initial audit. Written information detailing audit findings, current guidelines and imaging recommendations was distributed at the conclusion of clinical MDT meetings. The participating clinicians were not blinded to the process.

Feedback was provided to all participating urologists on staging practices and changes in referral patterns post-intervention.

Opinion leaders within the MDT provided ongoing information regarding the rationale of staging guidelines and feedback about current practices to participating urologists.

Outcomes

The primary outcome measure was the use of CT and bone scan imaging, for staging purposes, in both the pre-intervention and post-intervention study periods.

Study Population

The study was approved by the University of Newcastle Human Research Ethics Committee (H-2015-0170). We performed a retrospective cohort review of all consecutive patients diagnosed with prostate cancer in the Newcastle and Hunter region of NSW, Australia. This encompasses a population of >900 000 and an area of >130 000 km². Patients were identified by operative records of prostate biopsies undertaken in the three major public hospitals in the region: the John Hunter Hospital; Belmont District Hospital; and the Maitland Hospital. In the Australian public hospital setting, none of these patients incur an out-of-pocket expense for imaging or diagnostic testing, and no fee for service is received by the treating urologist.

The initial data collection comprised those patients diagnosed between July 2014 and July 2015, as the pre-intervention group. Post-intervention data collection comprised those patients diagnosed between November 2015 and July 2016.

Data were collected from hospital medical records, records at participating urologists’ rooms, and the local pathology providers. Data extraction was performed separately for the initial and follow-up periods. Data elements included age, treating urologist, PSA prior to biopsy, date of biopsy, number of locations and cores taken, number of locations and cores positive, primary and secondary Gleason patterns, overall Gleason score, clinical T stage, and performance of CT, whole-body bone scans or any other imaging for staging purposes. All patients were classified according to the D’Amico risk classification [18].

Statistical Analysis

Descriptive statistics were calculated, consisting of a median and interquartile range for the continuous variables of age.
and PSA, and frequencies and proportions for the categorical variables.

A t-test was used to compare continuous variables and the chi-squared test was used to compare the differences in proportions for categorical variables of pre- and post-intervention groups. All statistical testing was performed with a P value < 0.05 taken to indicate statistical significance. All analyses were performed using Excel (Microsoft, Seattle, WA, USA).

**Results**

A total of 144 consecutive patients were included in the study: 75 in the pre-intervention group and 69 in the post-intervention group. They were managed by one of nine participating urologists.

Patient characteristics in the pre- and post-intervention groups were similar (Table 1). Distribution of patients among risk-stratified groups was also similar (Table 1). In all, 52 (69%) and 48 patients (71%) in the pre- and post-intervention groups, respectively, were categorized as low- or intermediate-risk, and thus candidates for limitation of staging imaging.

Adherence to imaging recommendations increased significantly in low- and intermediate-risk patients in the post-intervention group (Fig. 1).

In the pre-intervention period, six of 14 patients classified as low-risk underwent CT imaging. In the post-intervention period, no patients in this risk category underwent CT imaging (0/14; P = 0.01). In the group of patients classified as

| Table 1 Characteristics of patients with newly diagnosed prostate cancer. |

<table>
<thead>
<tr>
<th></th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>75</td>
<td>69</td>
<td>0.43</td>
</tr>
<tr>
<td>Median (IQR) age</td>
<td>67 (61–70.5)</td>
<td>67 (63–72)</td>
<td>0.39</td>
</tr>
<tr>
<td>Median (IQR) pre-biopsy PSA, ng/mL</td>
<td>7.8 (5.2–12)</td>
<td>8.52 (5.58–15)</td>
<td></td>
</tr>
<tr>
<td>Gleason score sum, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16 (21.3)</td>
<td>15 (21.7)</td>
<td>0.95</td>
</tr>
<tr>
<td>3 + 4 = 7</td>
<td>33 (44.0)</td>
<td>28 (40.6)</td>
<td>0.68</td>
</tr>
<tr>
<td>4 + 3 = 7</td>
<td>7 (9.3)</td>
<td>10 (14.5)</td>
<td>0.34</td>
</tr>
<tr>
<td>8–10</td>
<td>19 (26.7)</td>
<td>16 (23.2)</td>
<td>0.63</td>
</tr>
<tr>
<td>ISUP grade group, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>16 (21.3)</td>
<td>15 (21.7)</td>
<td>0.95</td>
</tr>
<tr>
<td>2</td>
<td>33 (44.0)</td>
<td>28 (40.6)</td>
<td>0.68</td>
</tr>
<tr>
<td>3</td>
<td>7 (9.3)</td>
<td>10 (14.5)</td>
<td>0.34</td>
</tr>
<tr>
<td>4</td>
<td>11 (14.7)</td>
<td>3 (4.3)</td>
<td>0.04</td>
</tr>
<tr>
<td>5</td>
<td>8 (10.7)</td>
<td>13 (18.4)</td>
<td>0.17</td>
</tr>
<tr>
<td>D’Amico classification, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low risk</td>
<td>14 (18.7)</td>
<td>11 (15.9)</td>
<td>0.66</td>
</tr>
<tr>
<td>Intermediate risk</td>
<td>38 (50.7)</td>
<td>38 (55.1)</td>
<td>0.60</td>
</tr>
<tr>
<td>High risk</td>
<td>23 (30.7)</td>
<td>20 (29.0)</td>
<td>0.82</td>
</tr>
<tr>
<td>Positive cores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5</td>
<td>5</td>
<td>0.96</td>
</tr>
</tbody>
</table>

IQR, interquartile range; ISUP, International Society of Urological Pathology.
having intermediate-risk prostate cancer, 89% (34/38) underwent CT imaging in the pre-intervention period, which decreased to 34% (13/38) in the post-intervention period (P < 0.001; Table 2).

An appropriately high proportion of patients with high-risk disease underwent CT imaging; 87% (20/23) in the pre-intervention group and 85% (17/20) in the post-intervention group. This proportion did not change significantly over the course of the study (P = 0.63).

Similar but less striking results were noted in the trends of utilization of bone scan over the study period. In patients with low-risk disease, three of 14 patients pre-intervention and two of 11 patients post-intervention underwent a bone scan (P = 0.84). There was a significant decrease in the proportion of patients with intermediate-risk disease undergoing a bone scan; 63% (24/38) compared with 37% (14/38; P = 0.02). There was a subtle and nonsignificant trend towards decreased use of bone scan in high-risk patients; 87% (20/23) in the pre-intervention group and 65% (13/20) in the post-intervention group (P = 0.07; Table 2).

Results confirmed that imaging use in accordance with guidelines yielded few positive results for metastatic disease in low- and intermediate-risk patients; there were no positive results in patients with low- or intermediate-risk disease who underwent either CT or bone scan. In patients with high-risk disease at diagnosis, two out of 17 CT scans were positive and three out of 13 bone scans were positive (Table 3).

### Discussion

Efforts have been made over the past two decades to reduce the over-imaging of men with localized, low-risk prostate cancer, with multiple groups reporting persistent high rates of imaging utilization [1–8,21]. The Michigan Urological Surgery Improvement Collaborative has reported extensively on their state-wide quality improvement collaborative [24,25]; they report a decrease in unnecessary imaging, with a marked decrease in variability between practices [26]. The National Prostate Cancer Register of Sweden has reported the results of their nationwide programme to reduce inappropriate imaging requests [27]. They report a significant decrease in the imaging of men with low-risk disease, but with a concomitant decrease in the imaging of men with high-risk disease to such a degree that the majority of these patients were not undergoing appropriate staging investigations [28].

The present results show similar trends to those of the above-mentioned studies. As expected, our rates of imaging for patient with low- and intermediate-risk disease did not reach zero. It is probable that this is partly attributable to imperfect penetration of the interventions used, or ‘leakage’, where patients were referred on to either radiation oncologists or other clinicians outside of the region. Additionally, there is some discordance between guidelines on the use of staging imaging for men with intermediate-risk disease [19,22], particularly in the International Society of Urological Pathology grade group 3 cohort. In the low-risk group, bone scans are not recommended for asymptomatic men [22], but men with symptoms suggestive of metastasis, such as lower back pain, may have been referred for bone scans.

Patients in the high-risk category underwent CT imaging at similar rates in the pre- and post-intervention groups; however, there was a decrease in the rates of bone scan imaging. Although this decrease did not reach statistical significance and the majority of patients did receive appropriate bone scan staging, there was a notable trend. The reasons for this are probably multi-factorial, including the presence of metastatic disease on other modes of imaging or on modes of imaging ordered by other clinicians. More pertinent may be the difficulty in risk-adapting the message carried in the intervention, leading to blanket application of reduced imaging.

The reasons behind clinicians’ non-adherence to clinical guidelines are numerous. Intentional non-adherence may relate to patient or clinician factors [29]; clinicians may be influenced by patients requesting further imaging [27], or by external environmental factors such as availability of advanced imaging facilities [9]. A key issue is likely to be the difficulty of changing a routine behaviour, with some data suggesting a new finding can often take a decade or longer to enter wider practice [30].

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### Table 2 Use of staging CT and bone scan pre- and post-intervention among patients with newly diagnosed prostate cancer.

<table>
<thead>
<tr>
<th></th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
<th>P</th>
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<tbody>
<tr>
<td>CT, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>6 (42.9)</td>
<td>0 (0)</td>
<td>0.01</td>
</tr>
<tr>
<td>Intermediate</td>
<td>34 (89.5)</td>
<td>13 (34.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>High</td>
<td>20 (87.0)</td>
<td>17 (85.0)</td>
<td>0.63</td>
</tr>
<tr>
<td>Bone scan, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>3 (21.4)</td>
<td>2 (18.2)</td>
<td>0.84</td>
</tr>
<tr>
<td>Intermediate</td>
<td>24 (63.2)</td>
<td>14 (36.8)</td>
<td>0.02</td>
</tr>
<tr>
<td>High</td>
<td>20 (87.0)</td>
<td>13 (65.0)</td>
<td>0.07</td>
</tr>
</tbody>
</table>

### Table 3 Positive results of staging CT and bone scan pre- and post-intervention in patients with newly diagnosed prostate cancer.

<table>
<thead>
<tr>
<th></th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CT, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>3 (15.0)</td>
<td>2 (11.8)</td>
<td></td>
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<tr>
<td>Bone scan, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1 (5.0)</td>
<td>3 (23.1)</td>
<td></td>
</tr>
</tbody>
</table>
Imaging practices are variable between clinicians; it has been demonstrated that clinicians’ use of clinical guidelines are positively influenced by a more recent completion of training [31] and by practice in a larger hospital or health service [31,32]. They are also influenced by the practice of colleagues, particularly those who are fellowship trained in urological oncology [9].

Unintentional non-adherence arises from lack of knowledge regarding the existence and content of clinical guidelines [33]. Even when clinicians use guidelines in regular practice, the specific details of the recommendations within may not be well known [9], and many do not agree that recommendations are based on valid interpretations of the evidence [34]. Our results would appear to show that unintentional non-adherence has been a major contributor to guideline-discordant imaging in our region.

The components employed as part of our intervention have been demonstrated as effective in improving clinicians’ implementation of clinical guidelines [30,35]. It is important that any guideline does not rely on passive dissemination only, but rather employs active learning techniques in a multi-faceted approach, as these techniques are more effective when used in combination rather than isolation [36]. Similar work using a single one-time education presentation showed a decrease in bone scan staging, but the majority of patients still underwent inappropriate imaging post intervention [37].

Limitations of the present study include the retrospective and non-randomized nature of the data; as such, causation cannot be proven from our results. The temporal relationship of changes in imaging practice, and the significance of this would suggest that changes were in response to our intervention rather than external factors alone. The patients included were all treated in the public health system, and thus a large number of patients treated in the private health system, albeit by the same clinicians, were not considered. The involved clinicians were not blinded to the process, and thus our results may be biased by the effects of observation. The results were not analysed by clinician or stratified by fellowship training, because of the small numbers of patients treated by each clinician.

Although guidelines recommend CT and bone scan, the evidence for prostate MRI as part of the diagnostic evaluation continues to grow [16]. There was no significant use of MRI in the present cohort, with fewer than 20% of all included patients undergoing this imaging method. Prostate-specific membrane antigen (PSMA) positron-emission tomography (PET) is also emerging as a single highly sensitive and specific investigation for metastatic disease [38,39]. PSMA-PET was not available in our region at the time of this study.

The difference in imaging practices between patients with low- and high-risk disease emphasizes the need to focus not only on reduction of unnecessary imaging, but also on improved concordance with guidelines across risk categories. With newer technologies, such as PSMA-PET and genomic testing, use of and adherence to available guidelines will be integral to clinicians’ management of men diagnosed with prostate cancer. When transitioning to new technologies we need to ensure that these are understood and used in appropriate circumstances [40]. Registry data on a state-wide and national basis [41] will be a valuable tool to assess trends in diagnosis and staging in the future.

In conclusion, the results of the present study show that a focused, clinician-centred behaviour change programme can result in significant quality improvement in the management of men with newly diagnosed prostate cancer and in the implementation of evidence-based guidelines, reducing inappropriate imaging of men with low-risk disease whilst not compromising patient safety and appropriate imaging of high-risk disease. A programme of this type could be implemented at a state or national level, using registry data to monitor results. With the advent of advanced diagnostic and imaging techniques, using clinical guidelines will be of vital importance to ensure optimal care of men with newly diagnosed prostate cancer.

Acknowledgements

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Conflict of Interest

Dr Martin reports grants from the Hunter Cancer Research Alliance during the conduct of the study. Dr Rutledge, Dr McLeod, Dr Mehan, Dr Regan, Dr Ainsworth, Dr Chong, Dr Doyle, Dr White and Prof Sanson-Fisher have nothing to disclose.

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Abbreviations: MDT, multidisciplinary team; PSMA-PET, prostate-specific membrane antigen positron-emission tomography.