Diagnosing cancer in primary care: results from the National Cancer Diagnosis Audit

INTRODUCTION
The timeliness of cancer diagnosis in patients who present with symptoms has long been a cause of public, professional, and political concern. The result has been an increasing focus on achieving earlier diagnosis,1,2 supported by growing evidence for associations between time to diagnosis and clinical and patient experience outcomes.3,4 and evidence of substantial variation in clinical primary care practice.5 Differences in cancer outcomes between the UK and other comparable health systems are thought to partly reflect differences in diagnostic timeliness, and insights into processes that might underpin these differences have been generated through the International Cancer Benchmarking Partnership.6

Forming part of the National Awareness and Early Diagnosis Initiative,7 the first English National Audit of Cancer Diagnosis in Primary Care (NACDPC) was undertaken in 2009–2010 in order to gain an understanding of the diagnostic process in primary care for patients subsequently diagnosed with cancer.8 It included information on 18 879 patients diagnosed with cancer, identified from the registers of nearly 1200 practices, and provided detailed information on the primary care pathways to cancer diagnosis.

The Achieving World Class Cancer Outcomes cancer strategy 2015–2020 contained a commitment to a second national audit of cancer diagnosis, alongside specific recommendations for clinical practice and the organisation of diagnostic services.9 It suggested that precautionary ‘safety netting’10,11 becomes more established and that direct access for GPs to diagnostic tests be increased, additionally including a target for achieving diagnostic resolution (cancer diagnosed or ruled out) in most patients within 28 days of referral.9 Building on the 2009–2010 NACDPC, a National Cancer Diagnosis Audit (NCDA) was formulated as a collaborative initiative between the key UK agencies in cancer diagnosis.

The aim of the NCDA was to generate a detailed understanding of the diagnostic processes in primary care for patients who were diagnosed during 2014. At a national level, it would provide a baseline against which the impact of large-scale interventions could be measured.
scale interventions, such as the revised 2015 National Institute for Health and Care Excellence (NICE) guidance for recognition and referral of patients with suspected cancer and the new national cancer strategy, could be re-audited in future.9,11 At a practice level, the indicators selected would map to cancer standards and guidelines in order to support quality improvement initiatives.

**METHOD**

**Data**

After excluding non-melanoma skin cancer, all incident malignant cancer cases among England residents in 2014 (n = 296 231) were assigned to the general practice in which they were registered at the time of their cancer diagnosis, using information from the Hospital Episodes Statistics and Cancer Waiting Times datasets (which hold patient administration and cancer target compliance data, respectively).

Participation in the NCDA was voluntary and promoted through the Royal College of General Practitioners’ (RCGP) website and e-newsletters to its members, and through Cancer Research UK and Macmillan Cancer Support primary care engagement processes. Once registered and verified, practices had access, via a secure web portal developed by Public Health England’s (PHE) National Cancer Registration and Analysis Service (NCRAS), to a list of all patients who were diagnosed with cancer in 2014 while registered at their practice. Verified GPs and other practice health professionals could then enter primary care data on the patient’s characteristics, place of presentation and symptoms presented, primary care-led investigations, the number of pre-referral consultations, the referral pathway, whether there was evidence of safety netting, and any diagnostic delays incurred. The audit portal remained open from September 2016 to February 2017.

Except for dates, all responses were selected from drop-down menus with predefined answers. Categories of avoidable delay were based on a taxonomy previously generated through analysis of free-text responses contained in the NACDPC.12 Practices could verify screening-detection status but were not required to provide data on these cases. A payment of £10 per tumour record was given to participating practices that returned information on 95% or more of their NCDA patients [365 practices]. Some clinical commissioning groups (CCGs) had encouraged participation through local incentive schemes before this funding became available and were later reimbursed.

**Analysis**

The authors describe key variables by sex, age group (0–24, 25–49, 50–64, 65–74, 75–84 and ≥85 years), and cancer site (for the 20 sites comprising >1% of the sample: bladder, brain, breast, cancer of unknown primary, colon, endometrial, leukaemia, liver, lung, lymphoma, melanoma, multiple myeloma, oesophageal, oral/oropharyngeal, ovarian, pancreatic, prostate, rectal, renal, stomach [all n ≥265]). The distribution of sex, age, stage at diagnosis, and cancer site of the NCDA cohort was compared with the 2014 national cancer registration statistics.13 Similarly, participating and non-participating practices were compared in respect of their key characteristics, key aspects of patients’ experience of primary care (access, continuity, satisfaction, and doctor communication) as reported by the 2013–2014 NHS General Practice Patient Survey (GPPS), https://gp-patient.co.uk, and rates of use of the 2-week wait (TWW) referrals for suspected cancer and related metrics [in England, clinical guidelines enable GPs to refer patients for specialist assessment within 2 weeks when certain symptoms are present and cancer is a suspected diagnosis].11 Primary care-led investigations were grouped into blood, urinary, imaging, endoscopy, and other tests. The number of pre-referral consultations and also the number of comorbidities were categorised as 0, 1, 2, and ≥3. The data from patients with screen-detected cancers are reported separately (given in tables as ‘Screening’, n = 1006).

The authors focus on three diagnostic intervals: the primary care interval (PCI), the diagnostic interval (DI), and the time from referral to the date the patient was
informed they had cancer, calculated for patients with available-date data. The PCI was defined as the number of days from first presentation with symptoms deemed to be relevant to the subsequent diagnosis of cancer to the date of first referral from primary care for suspected cancer, and the DI as the number of days from first relevant presentation to the date of diagnosis, as registered by NCRAS.

Interval times of <0 and >730 days were excluded, consistent with previous literature,14 or ‘interval’ hereafter. The median (50th), together with the 25th and 75th centiles are described, along with the percentage of patients who had a primary care interval or diagnostic interval >60 or 90 days (for PCI and DI), or >28 days (for time from referral to the date the patient was informed).

**RESULTS**

The authors report key results in this paper, with more detailed tables provided at www.ncin.org.uk/collecting_and_using_data/.

**Sample characteristics**

A total of 439 practices submitted data during the audit period, representing 5% of all (approximately 8000) English practices. During quality assurance, 22 patient records were excluded, chiefly because they represented duplicates or pre-2014 diagnoses. The final sample included 17 042 patients (6% of all cancers diagnosed in 2014 in England). Of those, 50% of patients were male, the median age was 69 years, and the most numerous cancer sites were female breast (16%), lung (13%), prostate (13%), and colon/rectal cancer (12%) (Table 1). Completeness of

**Table 1. Sample composition and referral type that led most directly to the cancer diagnosis (N = 17 042)**

| Total of NCCDA n(%) | TWW n(%) | Urgent* n(%) | Routine n(%) | Screening n(%) | Emergency* n(%) | To private care n(%) | Other n(%) | Not known n(%) |
|---------------------|---------|-------------|-------------|---------------|-----------------|---------------------|-----------|---------------|
| Total               | 17 042  | 8820 (51.8) | 745 (4.4)   | 1344 (7.7)    | 1237 (7.3)      | 2818 (16.5)        | 315 (1.8) | 1004 (5.9)    |
| Male                | 8544    | 4482 (52.5) | 436 (5.1)   | 829 (9.7)     | 145 (1.7)       | 1474 (17.3)        | 187 (2.2) | 549 (6.4)     |
| Female              | 8498    | 4338 (51.0) | 309 (3.6)   | 517 (6.1)     | 1092 (12.9)     | 1344 (15.8)        | 128 (1.5) | 455 (5.4)     |

**Age group, years**

| Age group, years | Total | Male | Female | Median (50th) | 25th | 75th |
|------------------|-------|------|--------|---------------|------|------|
| 0–24             | 198(1.2) | 46 (23.2) | 41 (8.6) | 14 (7.1) | 8 (4.0) | 21 (10.5) |
| 25–49            | 1705 (10.0) | 951 (55.8) | 73 (4.3) | 142 (9.5) | 113 (6.6) | 208 (12.2) |
| 50–64            | 4144 (24.3) | 2144 (51.7) | 152 (3.7) | 318 (7.7) | 561 (13.5) | 509 (12.3) |
| 65–74            | 4877 (28.6) | 2532 (51.9) | 228 (4.7) | 423 (8.7) | 473 (9.7) | 655 (13.4) |
| 75–84            | 4213 (24.7) | 2274 (54.0) | 198 (4.7) | 326 (7.7) | 79 (1.9) | 797 (18.9) |
| ≥85              | 1905 (11.2) | 873 (45.8) | 79 (4.1) | 101 (5.3) | 9 (0.5) | 555 (29.1) |

**Cancer site**

| Cancer site | Total | Male | Female | Median (50th) | 25th | 75th |
|-------------|-------|------|--------|---------------|------|------|
| Bladder     | 490 (2.9) | 306 (62.9) | 39 (8.0) | 2 (10.4) | 61 (12.4) | 7 (1.4) |
| Brain       | 265 (1.6) | 23 (8.7) | 19 (7.2) | 11 (4.2) | 0 (0.0) | 172 (64.9) |
| Breast      | 2714 (15.9) | 1533 (56.5) | 41 (1.5) | 46 (1.7) | 918 (33.8) | 56 (2.1) |
| Colon       | 1320 (7.7) | 543 (41.1) | 63 (4.8) | 100 (7.6) | 122 (9.2) | 350 (26.5) |
| Endometrial | 400 (2.3) | 311 (77.8) | 14 (3.5) | 23 (5.8) | 1 (0.2) | 24 (6.5) |
| Leukaemia   | 470 (2.8) | 96 (20.4) | 30 (6.4) | 79 (16.8) | 4 (0.9) | 165 (35.1) |
| Liver       | 272 (1.6) | 87 (32.0) | 14 (5.1) | 23 (8.5) | 7 (2.6) | 86 (31.6) |
| Lung        | 2132 (12.5) | 976 (45.8) | 95 (4.3) | 89 (4.2) | 14 (0.7) | 629 (29.3) |
| Lymphoma    | 739 (4.3) | 347 (47.0) | 57 (7.7) | 81 (11.0) | 2 (0.3) | 143 (19.4) |
| Melanoma    | 836 (4.9) | 611 (73.4) | 22 (2.6) | 113 (13.5) | 2 (0.2) | 4 (0.5) |
| Multiple myeloma | 272 (1.6) | 84 (30.9) | 24 (8.8) | 39 (14.3) | 3 (1.1) | 76 (27.9) |
| Oesophageal | 447 (2.6) | 281 (62.9) | 19 (4.3) | 36 (7.8) | 8 (1.8) | 65 (14.5) |
| Oral/oropharyngeal | 268 (1.6) | 160 (59.7) | 12 (4.5) | 20 (7.5) | 0 (0.0) | 17 (6.3) |
| Other       | 1582 (9.3) | 728 (46.0) | 93 (5.9) | 194 (12.3) | 72 (4.6) | 240 (15.2) |
| Ovarian     | 332 (1.9) | 192 (57.8) | 15 (4.1) | 11 (3.3) | 1 (0.3) | 81 (24.8) |
| Pancreatic  | 460 (2.7) | 185 (40.2) | 26 (5.7) | 30 (6.5) | 0 (0.0) | 156 (33.9) |
| Prostate    | 2130 (12.5) | 976 (45.8) | 95 (4.3) | 89 (4.2) | 14 (0.7) | 629 (29.3) |
| Rectal      | 648 (3.8) | 374 (57.7) | 28 (4.3) | 66 (10.2) | 69 (10.6) | 58 (9.0) |
| Renal       | 557 (3.3) | 290 (52.1) | 27 (4.8) | 39 (7.0) | 5 (0.9) | 94 (16.9) |
| Stomach     | 308 (1.8) | 156 (50.6) | 18 (5.8) | 30 (9.7) | 0 (0.0) | 71 (23.1) |

*Urgent referrals are not for suspected cancer. Includes instances of patient self-referral. NCCDA = National Cancer Diagnosis Audit. TWW = 2-week wait, urgent referral for suspicion of cancer.
### Table 2. Patient characteristics

| Characteristic | n  | (%) |
|----------------|----|-----|
| **Union for International Cancer Control (UICC) cancer stage group** |    |     |
| 0              | 13 | (0.1) |
| 1              | 4255 | (32.6) |
| 2              | 2872 | (22.0) |
| 3              | 2412 | (18.5) |
| 4              | 3506 | (26.8) |
| Not known      | 5984 |     |
| **Ethnicity**  |    |     |
| White          | 13 850 | (95.0) |
| Asian          | 385  | (2.6) |
| Black          | 156  | (1.1) |
| Mixed          | 134  | (0.9) |
| Other          | 49   | (0.3) |
| Not known      | 1462 |     |
| **Language**   |    |     |
| Is a native English speaker | 14 251 | (95.3) |
| English is not the patient’s mother tongue but they are very fluent in English | 452 | (3.0) |
| English not mother tongue and patient not fluent in English | 154 | (1.0) |
| English not mother tongue and communication only possible through translator | 91 | (0.6) |
| English not mother tongue but communication possible because of mother tongue concordance with GP | 10 | (0.1) |
| Is a native Welsh speaker | 2 | (0.0) |
| Not known      | 1076 |     |
| **Communication difficulty** |    |     |
| No difficulty  | 12 326 | (89.6) |
| Cognitive impairment | 495 | (3.6) |
| Hearing impairment | 440 | (3.2) |
| Vision impairment | 194 | (1.4) |
| Language barrier | 149 | (1.2) |
| Speech impairment | 97 | (0.7) |
| Learning difficulty | 94 | (0.7) |
| Severe longstanding mental illness | 86 | (0.6) |
| Other          | 45   | (0.3) |
| Not known      | 2276 |     |
| **Housebound status** |    |     |
| The patient is not considered housebound | 12 997 | (89.0) |
| The patient is considered housebound | 1263 | (8.7) |
| Lives in residential/nursing care home | 340 | (2.3) |
| Not known      | 1436 |     |
| **Living arrangements** |    |     |
| Cohabiting     | 8749 | (72.2) |
| Living alone   | 2834 | (23.4) |
| In residential or nursing home | 530 | (4.4) |
| Not known      | 3923 |     |
| **Number of comorbidities** |    |     |
| 0              | 3801 | (24.3) |
| 1              | 4721 | (30.2) |
| 2              | 3756 | (24.0) |
| ≥3             | 3355 | (21.5) |
| Not known      | 403  |     |
| Screened       | 1006 |     |

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stage at diagnosis (0–IV) was 77%.

Most patients were white (95%) and native English speakers (95%). Among all patients, 23% were reported as living alone, 11%

Table 2 continued. Patient characteristics

| Type of comorbidity                        | n (%)     |
|-------------------------------------------|-----------|
| No comorbidity                            | 3801 (24.3) |
| Hypertension                              | 5914 (37.8) |
| Cardiovascular disease                    | 3230 (20.7) |
| Arthritis/musculoskeletal disease         | 2769 (17.7) |
| Diabetes                                  | 2463 (15.8) |
| Chronic obstructive pulmonary disease     | 2342 (15.0) |
| Previous cancer                           | 1763 (11.3) |
| Cerebrovascular disease                   | 1083 (6.9)  |
| Cognitive impairment                      | 688 (4.4)  |
| Severe longstanding mental illness        | 385 (2.5)  |
| Longstanding physical disability          | 257 (1.6)  |
| Other comorbidity                         | 3094 (19.8) |
| Not known                                 | 403        |
| Screening                                 | 1006       |

*UICC cancer stage group as recorded by NCRAS. **Values in italics are for variables where multiple answers could have been selected and the percentages will add up to more than 100%. Percentages are calculated after removal of ‘not known’ and ‘screening’ groups from the total (n = 17 042) in each category. NCRAS = National Cancer Registration and Analysis Service.

Table 3. Comparison of key attributes of English general practices participating in the NCDA (N = 439) with non-participating practices

| Median (IQR) | NCDA participating practices | Non-participating practices | P-value |
|--------------|------------------------------|-------------------------------|---------|
| List size (number of patients)       | 8318 [5370–11 174]           | 6197 [3703–9528]             | <0.001  |
| % of patients ≥65 years              | 16.9 [12.4–20.9]             | 16.9 [12.1–20.9]             | 0.697   |
| % of patients ≥85 years              | 2.1 [1.5–3.0]                | 2.1 [1.4–2.8]                | 0.055   |
| Number of GPs                        | 6.5 [4–9]                    | 4–7                          | <0.001  |
| Number of GP FTE                     | 5.6 [3.5–8.0]                | 3.8 [2.0–6.1]                | <0.001  |
| Patients per GP FTE                  | 1464 [1253–1824]             | 1673 [1337–2119]             | <0.001  |
| Patient experience (GPPS scores)     | Access 85.0 [80.8–89.8]       | 85.2 [80.7–89.2]             | 0.671   |
|                                         | Continuity 66.2 [58.6–73.7]   | 67.8 [59.7–75.5]             | 0.002   |
|                                         | Doctor–patient communication 82.7 [79.9–84.7] | 81.7 [78.7–84.2] | <0.001 |
|                                         | Satisfaction with primary care 84.7 [80.8–87.8] | 83.8 [80.0–87.0] | 0.001  |
| Urgent (2-week-wait TWW) referrals for suspected cancer | 2758.1 [2009.1–3315.0] | 2531.7 [1864.9–3278.6] | 0.0136 |
| % of TWW-referred patients found to have cancer (conversion rate) | 8.1 [6.3–10.4] | 8.1 [5.9–10.6] | 0.564 |
| % of treated cancer patients who were diagnosed after a TWW referral (detection rate) | 47.5 [40.2–56.0] | 47.8 [39.1–56.0] | 0.737 |

| Practice population IMD score         | n (%)     | n (%)     | P-value |
|---------------------------------------|-----------|-----------|---------|
| 1 — least deprived                    | 82 [18.7] | 1474 [20.1] |         |
| 2                                     | 105 [23.9] | 1450 [19.8] |         |
| 3                                     | 111 [25.3] | 1445 [19.7] | <0.001  |
| 4                                     | 85 [19.4]  | 1470 [20.0] |         |
| 5 — most deprived                    | 56 [12.8]  | 1499 [20.4] |         |

| Setting                               | n (%)     | n (%)     | P-value |
|---------------------------------------|-----------|-----------|---------|
| Urban                                 | 374 [85.2] | 6367 [85.7] | 0.792   |
| Rural                                 | 65 [14.8]  | 1027 [14.4] |         |

*Excluding practices with <1000 registered patients. The exact number of non-participating practices varies by the characteristic compared given different sources and operational definitions, but is generally >7000. **From Mann–Whitney U-test.  1. Based on GPPS item regarding ability to book an appointment. 2. Based on GPPS item about doctor’s interpersonal skills. 3. Based on GPPS item about overall satisfaction with primary care. 4. From χ² test. TWW = two-week wait. 5. IMD = index of multiple deprivation. IQR = interquartile range. NCDA = National Cancer Diagnosis Audit.
were housebound or lived in a care home, and 10% had communication difficulties. Only 24% of all patients had no recorded comorbidities before diagnosis, while 21% had ≥3. The most common comorbidities were hypertension, cardiovascular disease, and arthritis/musculoskeletal disease (38%, 21%, and 18%, respectively [Table 2]).

Patient and practice comparisons

Patients included in the NCDA were representative of the 2014 national incident cohort in respect of sex, age, and cancer site. Participating and non-participating practices were similar regarding the age profile of registered patients, but participating practices were somewhat larger (median 8318 versus 6197 listed patients) and had slightly fewer patients per full-time equivalent GP (median 1466 versus 1673) [Table 3]. There were relatively fewer participating practices in the least and most deprived quintiles. Participating and non-participating practices had similar patient experience scores, though differences were significant given the large sample size. The median rate of TWW referrals for suspected cancers (n per 100 000 population per year) was higher in participating practices compared with non-participating ones, though conversion and detection rates were similar.

Presentation, consultations, and referrals

Most patients [72%] first presented at the GP surgery or had a home visit. Of these patients, Table 4. The distribution of the primary care interval (n = 10 493) and the diagnostic interval (n = 12 929) by patient characteristic and cancer diagnosis groups

| Cancer site | Primary care interval | Diagnostic interval |
|-------------|-----------------------|---------------------|
|             | n = 10 493            | n = 12 929          |
|             | 25th centile | Median, days | 75th centile | % >60 days | % >90 days | n | 25th centile | Median, days | 75th centile | % >60 days | % >90 days |
| Total       | 10 493 | 0 | 5 | 27 | 12.5 | 8.3 | 12 929 | 15 | 40 | 85 | 35.8 | 24 |
| Male        | 5478 | 0 | 8 | 30 | 13.7 | 9.2 | 6178 | 21 | 47 | 95 | 39.9 | 26.6 |
| Female      | 5015 | 0 | 1 | 11 | 12.2 | 7.3 | 6161 | 13 | 31 | 77 | 31.3 | 21.2 |
| Age group years |          |          |          |          |          |          |          |          |          |          |          |          |
| 0–24          | 112 | 0 | 5 | 34.2 | 14.3 | 7.1 | 170 | 6.2 | 26.5 | 68.5 | 28.2 | 17.1 |
| 25–49         | 1131 | 0 | 0 | 20 | 10.9 | 8.2 | 1326 | 13 | 30 | 81 | 32.7 | 23.0 |
| 50–64         | 2485 | 0 | 4 | 28 | 13.6 | 8.6 | 2954 | 17 | 42 | 87 | 37.7 | 26.1 |
| 65–74         | 2999 | 0 | 7 | 29 | 13.9 | 9.1 | 3610 | 19 | 44 | 92 | 38.8 | 25.7 |
| 75–84         | 2693 | 0 | 5 | 27 | 12.6 | 8.0 | 3378 | 16 | 41 | 89 | 35.8 | 24.7 |
| ≥85          | 1083 | 0 | 5 | 24 | 11.1 | 6.6 | 1491 | 13 | 30 | 71 | 30.3 | 20.2 |
| Cancer site |                   |          |          |          |          |          |          |          |          |          |          |          |
| Bladder      | 344 | 0 | 6 | 28 | 13.7 | 9.6 | 405 | 35 | 56 | 97 | 44.2 | 28.7 |
| Brain        | 85  | 0 | 3 | 19 | 12.9 | 9.4 | 221 | 10 | 29 | 67 | 27.1 | 16.7 |
| Breast       | 1399 | 0 | 0 | 2.6 | 2.1 | 1.5 | 1354 | 10 | 14 | 19 | 7.2 | 5.0 |
| Cancer of unknown primary | 212 | 0 | 8 | 33 | 15.6 | 9.0 | 312 | 11.8 | 35 | 81.2 | 30.8 | 21.5 |
| Colon        | 773 | 0 | 6 | 29 | 14.9 | 10.7 | 1010 | 21 | 49 | 105 | 41.5 | 29.1 |
| Endometrial  | 317 | 0 | 0 | 14 | 7.6 | 6.0 | 335 | 14 | 34 | 86.5 | 34.3 | 23.9 |
| Leukaemia    | 253 | 0 | 6 | 26 | 11.5 | 6.7 | 340 | 6 | 30 | 82.5 | 32.6 | 23.8 |
| Liver        | 137 | 0 | 5 | 22 | 13.9 | 9.5 | 207 | 11 | 31 | 91 | 36.7 | 25.6 |
| Lung         | 1148 | 2 | 14 | 45.2 | 17.9 | 10.8 | 1748 | 20 | 43 | 86.2 | 38.5 | 23.5 |
| Lymphoma     | 473 | 0 | 11 | 35 | 14.8 | 9.3 | 581 | 23 | 50 | 100 | 41.1 | 27.7 |
| Melanoma     | 649 | 0 | 0 | 3 | 6.0 | 4.8 | 723 | 14 | 32 | 56 | 22.4 | 14.5 |
| Multiple myeloma | 150 | 4.2 | 23.5 | 56.8 | 23.3 | 15.3 | 202 | 24 | 53.5 | 107.5 | 47.5 | 31.7 |
| Oesophageal  | 327 | 0 | 1 | 32 | 12.8 | 7.6 | 383 | 12 | 28 | 65.5 | 28.5 | 18.0 |
| Oral/oropharyngeal | 158 | 0 | 1 | 27.2 | 15.2 | 7.0 | 189 | 17 | 39 | 74 | 33.9 | 20.1 |
| Other        | 999 | 0 | 7 | 32.5 | 13.7 | 8.9 | 1212 | 24 | 56 | 114.2 | 46.9 | 33.1 |
| Ovarian      | 240 | 0.8 | 13 | 28 | 9.6 | 6.2 | 285 | 29 | 55 | 85 | 45.6 | 22.8 |
| Pancreatic   | 303 | 1 | 11 | 36 | 14.5 | 9.2 | 386 | 15 | 42.5 | 93 | 37.3 | 26.4 |
| Prostate     | 1551 | 2 | 11 | 31.5 | 14.6 | 9.9 | 1678 | 29 | 55.5 | 126 | 46.4 | 33.4 |
| Rectal       | 455 | 0 | 1 | 22 | 14.3 | 10.5 | 496 | 21 | 42 | 88.2 | 34.7 | 24.6 |
| Renal        | 309 | 0 | 14 | 38 | 15.2 | 9.4 | 422 | 33.2 | 66 | 114 | 54.5 | 35.3 |
| Stomach      | 211 | 0 | 11 | 38 | 19.4 | 15.6 | 260 | 17 | 42 | 89.2 | 37.3 | 24.6 |

*Intervals are restricted to 0–730 days. Patients with a cancer diagnosed through screening are excluded. Primary Care Intervals and Diagnostic Intervals are available for patients where the relevant valid dates were entered. Any intervals that were not within 0–730 days were excluded.
11,539 (94%) had at least one recorded symptom. A small proportion (n = 1176, 7%) of patients first presented to A&E.

Among patients with a consultation (n = 12,369, 73% of all patients), 74% had fewer than three consultations and 26% had three or more. The most common recorded reason for multiple (>3) consultations was symptoms suggestive of a different initial diagnosis (n = 1684, 11%) or comorbidity ‘blurring the picture’ (n = 851, 5%).

Approximately 52% of patients were referred through the TWW route: this percentage was lowest in the 0–24 age group (Table 1), and varied greatly by cancer site, ranging from 9% (brain cancer) to 78% (endometrial cancer).

In total, 2818 patients had an emergency referral (17% overall, but ranging from 0.5% for melanoma to 65% for brain cancer [Table 1]). Of those patients, 1326 (48%) had self-referred to A&E/hospital (26% of 2818 patients without any previous relevant GP consultations, 11% while waiting for referral/investigation arranged by the GP, and 11% having previously consulted the GP but not awaiting previously arranged tests or referrals) and 1286 patients (47%) were referred to A&E/hospital as an emergency by the GP or out-of-hours service (20% of 2818 patients without previous relevant GP consultations, 8% while awaiting to be assessed in hospital following referral, and 19% having previously consulted the GP but not awaiting previously arranged tests or referrals) (5% other reason). The results for the emergency referrals are not in a table within the main paper but will be supplied in the supplementary tables hosted on the following webpage: www.ncin.org.uk/collecting_and_using_data/.

Intervals and avoidable delays

The median PCI was 5 days (interquartile range [IQR] 0–27 days), with 8% of patients having a primary care interval longer than 90 days (Table 4). Females with breast cancer had the shortest PCI (median 0 days, IQR 0–0 days), whereas patients with multiple myeloma had the longest (median 23.5 days, IQR 4–57 days). The median DI for all patients was 40 days (IQR 15–86 days). Patients with breast cancer also had the shortest DI (median 14 days, IQR 10–19 days), whereas those with prostate cancer had a median DI of 55.5 days (IQR 29–126 days). The time from referral to being told the diagnosis of cancer exceeded 28 days in 54% of patients: 19% of patients with breast cancer having an interval longer than 28 days compared with 74% of melanoma patients.

For one in five patients the GP considered there to be an avoidable delay in the patient receiving their diagnosis, varying from 7% (breast) to 34% (stomach) (Table 5). Delays were most frequently attributed to the patient, primary/secondary care clinician, and system factors (26%, 28%, and 34%, respectively).

Investigations and safety netting

Primary care-led investigation before referral was used in 45% of all patients, ranging from 3% (breast cancer) to 76% (prostate cancer) (Table 6). For 44% of patients, there was evidence in the clinical record that safety netting had been used, with limited variation by patient

| Table 5. Avoidable delays (n = 15,369) |
|--------------------------------------|
| Avoidable delay, n (%) | Not known, n |
|------------------------|--------------|
| Total                  | 3380 (22.0)  | 1673 |
| Male                   | 1839 (24.0)  | 897  |
| Female                 | 1541 (20.0)  | 776  |
| Age group, years       |              |      |
| 0–24                   | 39 (22.9)    | 28   |
| 25–49                  | 338 (21.6)   | 140  |
| 50–64                  | 764 (28.3)   | 379  |
| 65–74                  | 937 (21.2)   | 448  |
| 75–84                  | 951 (24.6)   | 436  |
| ≥85                    | 369 (22.2)   | 242  |
| Cancer site            |              |      |
| Bladder                | 109 (24.4)   | 43   |
| Brain                  | 38 (16.9)    | 40   |
| Breast                 | 178 (6.9)    | 146  |
| Cancer of unknown primary | 95 (28.3)   | 64   |
| Colon                  | 339 (28.7)   | 139  |
| Endometrial            | 92 (24.2)    | 20   |
| Leukaemia              | 60 (14.7)    | 62   |
| Liver                  | 48 (19.5)    | 26   |
| Lung                   | 447 (24.0)   | 267  |
| Lymphoma               | 171 (26.3)   | 90   |
| Melanoma               | 151 (18.9)   | 38   |
| Multiple myeloma       | 63 (27.3)    | 41   |
| Oesophageal            | 112 (27.2)   | 35   |
| Oral/oropharyngeal     | 63 (28.5)    | 47   |
| Other                  | 387 (28.2)   | 209  |
| Ovarian                | 89 (29.6)    | 31   |
| Pancreatic             | 129 (31.6)   | 52   |
| Prostate               | 429 (22.0)   | 183  |
| Rectal                 | 177 (29.2)   | 41   |
| Renal                  | 110 (22.2)   | 61   |
| Stomach                | 93 (34.4)    | 38   |

a If there was a perceived avoidable delay in the patient receiving their diagnosis, the following questions gathered information about the nature of that delay, considering three key dimensions: where it occurred, the stage of the diagnostic process during which it occurred, and to whom or what factor it was attributable. Delay was defined as an unnecessary prolongation of the time to reach a diagnosis that has potentially adverse consequences on outcomes. b Screening and not applicable cases are excluded from the avoidable delay category. Percentage values relate to observations with non-missing information (that is, excluding ‘not-known’). This is to prevent under-reporting of the proportion of the known categories by assuming that the not known cases are missing at random and therefore evenly distributed among the known groups.
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Ethical approval
This study uses data collected as part of a clinical audit and collated by the National Cancer Registration and Analysis Service under regulation 2 of the Health Service (Control of Patient Information) Regulations 2002.

Provenance
Freely submitted; externally peer reviewed.

Competing interests
The authors have declared no competing interests.

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The NCDA data provide information on referral type; this is analogous but not directly comparable with diagnostic route as described by the Routes to Diagnosis data. Nonetheless, the proportion of patients with an emergency referral type in the NCDA was of similar order to that of patients being diagnosed through an emergency presentation according to the Routes to Diagnosis data for 2014 (17% and 20%, respectively). In about one in four emergency referrals the patient had not previously consulted with a GP, a finding consistent with other evidence, and 19% were missed opportunities for earlier diagnosis (associated predictor: no prior GP contact (OR = 3.89; 95% CI 2.14 to 7.09). In the NCDA population, 52% of all patients were diagnosed following a TWW referral. The total number of TWW referrals increased by 71% in the relevant 5-year period 2009/2010 to 2014/2015, though the proportion of those receiving a cancer diagnosis decreased from 10.8% to 8.2%.

Implications for research and practice
For policymakers, this audit provides a baseline against which the impact of
Table 6. Number of primary care-led investigations ordered by the GP as part of the diagnostic assessment prior to referral

| Investigation group (N = 16 762, excluding not knowns) | Percentage of patients investigated by test type (N = 16 762) |
|-----------------------------------------------------|--------------------------------------------------|
| No investigations, n (%) | Blood tests, n (%) | Urinary tests, n (%) | Imaging, n (%) | Endoscopy, n (%) | Other, n (%) |
| Total 9160 (54.6) | 280 | 5795 (34.6) | 212 (1.3) | 3289 (19.6) | 267 (1.6) | 446 (2.7) |
| Male 3662 (43.7) | 156 | 3773 (45.0) | 152 (1.8) | 1780 (21.2) | 139 (1.7) | 250 (3.0) |
| Female 5498 (65.7) | 124 | 2022 (24.1) | 60 (0.7) | 1509 (18.6) | 126 (1.5) | 196 (2.3) |
| Age group, years | | | | | | |
| 0–24 131 (68.6) | 7 | 38 (19.9) | 0 (0.0) | 31 (16.2) | 31 (16.2) | 1 (0.5) | 6 (3.1) |
| 25–49 1105 (66.4) | 40 | 353 (21.2) | 12 (0.7) | 97 (5.5) | 73 (4.2) | 250 (1.5) | 47 (2.8) |
| 50–64 2362 (57.8) | 60 | 1275 (31.2) | 44 (1.1) | 781 (19.1) | 77 (1.9) | 101 (2.5) | 101 (2.5) |
| 65–74 2465 (51.1) | 52 | 1820 (37.7) | 66 (1.4) | 997 (20.7) | 73 (1.5) | 132 (2.7) | 132 (2.7) |
| 75–84 2079 (50.3) | 83 | 1602 (38.8) | 67 (1.6) | 848 (20.5) | 78 (1.9) | 118 (2.9) | 118 (2.9) |
| ≥85 1018 (54.5) | 38 | 707 (37.9) | 2 (0.1) | 307 (16.4) | 15 (0.8) | 42 (2.2) | 42 (2.2) |

Cancer site

- Bladder 208 (43.1) | 7 | 171 (35.4) | 61 (12.6) | 60 (12.4) | 4 (0.8) | 58 (12.0) |
- Brain 192 (74.7) | 8 | 50 (19.5) | 4 (1.6) | 24 (9.3) | 1 (0.4) | 3 (0.7) | 3 (0.7) |
- Breast 2602 (47.9) | 16 | 621 (47.6) | 7 (0.5) | 168 (12.9) | 52 (4.0) | 31 (2.4) | 31 (2.4) |
- Colon 624 (47.9) | 16 | 421 (47.4) | 7 (0.8) | 166 (19.1) | 50 (6.0) | 25 (2.7) | 25 (2.7) |
- Endometrial 247 (62.7) | 6 | 72 (18.3) | 3 (0.8) | 82 (20.8) | 4 (1.0) | 26 (6.3) | 26 (6.3) |
- Leukaemia 182 (40.0) | 15 | 266 (58.5) | 2 (0.4) | 36 (7.9) | 3 (0.7) | 2 (0.4) | 2 (0.4) |
- Liver 121 (44.8) | 2 | 122 (45.2) | 4 (1.5) | 80 (29.6) | 8 (3.0) | 2 (0.7) | 2 (0.7) |
- Lung 844 (40.1) | 29 | 602 (28.6) | 5 (0.2) | 1100 (52.3) | 16 (0.8) | 50 (2.4) | 50 (2.4) |
- Lymphoma 305 (42.4) | 19 | 324 (45.0) | 6 (0.8) | 247 (33.4) | 12 (1.7) | 16 (2.2) | 16 (2.2) |
- Melanoma 779 (94.3) | 10 | 9 (1.1) | 0 (0.0) | 7 (0.8) | 0 (0.0) | 37 (4.3) | 37 (4.3) |
- Multiple myeloma 89 (53.7) | 8 | 162 (61.4) | 1 (0.4) | 72 (27.3) | 4 (1.5) | 10 (3.8) | 10 (3.8) |
- Gastrointestinal 239 (54.6) | 8 | 162 (34.9) | 0 (0.0) | 55 (12.5) | 37 (8.4) | 10 (2.3) | 10 (2.3) |
- Oral/oropharyngeal 197 (75.8) | 8 | 49 (18.8) | 1 (0.4) | 27 (10.4) | 1 (0.4) | 5 (1.9) | 5 (1.9) |
- Other 839 (54.1) | 30 | 395 (25.5) | 15 (1.0) | 452 (29.1) | 26 (1.7) | 61 (3.9) | 61 (3.9) |
- Ovarian 100 (30.9) | 8 | 170 (52.5) | 6 (1.9) | 159 (49.1) | 4 (1.2) | 11 (3.4) | 11 (3.4) |
- Pancreatic 145 (32.2) | 10 | 267 (59.3) | 6 (1.3) | 166 (36.9) | 23 (5.1) | 9 (2.0) | 9 (2.0) |
- Prostate 503 (24.0) | 33 | 1555 (74.2) | 70 (3.3) | 166 (7.9) | 4 (0.2) | 44 (2.1) | 44 (2.1) |
- Rectal 360 (52.6) | 7 | 260 (46.6) | 3 (0.3) | 27 (4.7) | 28 (4.4) | 19 (3.0) | 19 (3.0) |
- Renal 262 (48.2) | 13 | 174 (32.0) | 17 (3.1) | 175 (32.2) | 5 (0.9) | 32 (5.9) | 32 (5.9) |
- Stomach 132 (43.6) | 5 | 147 (48.5) | 1 (0.3) | 39 (12.9) | 29 (9.6) | 6 (2.0) | 6 (2.0) |

a Patients could have had >1 investigation. Each investigation group has been counted once, therefore multiple blood tests are counted as blood test x1. b Number of investigations include not applicable and screening patients. Percentage values relate to observations with non-missing information (that is, excluding ‘not-known’). This is to prevent under-reporting of the proportion of the known categories by assuming that the not-known cases are missing at random and therefore evenly distributed among the known groups.

Individual practice feedback has already been provided along with quality improvement initiatives including the Quality Improvement toolkit from the RCGP and Cancer Research UK, specifically targeted at the NCDA, and completion of cycles of audit. The novel methodology developed for this audit also permits continuous large-scale participation by practices in the future.

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Subsequent initiatives to improve cancer diagnosis, such as the 2015 NICE guidance on recognition and referral of suspected cancer, and the implementation of the Achieving World Class Cancer Outcomes Cancer Strategy 2015–2020, can be assessed. It provides pointers to where implementation efforts might best be directed, for example, in achieving the 28-day standard from referral to diagnosis. It appears that, despite efforts since 2012 to increase access to specialist investigations such as imaging or endoscopy, these are not widely ordered by GPs for patients subsequently diagnosed with cancer, who are however investigated after a specialist referral.

Individual practice feedback has already been provided along with quality improvement initiatives including the Quality Improvement toolkit from the RCGP and Cancer Research UK, specifically targeted at the NCDA, and completion of cycles of audit. The novel methodology developed for this audit also permits continuous large-scale participation by practices in the future.
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