Cardiovascular disease treatment among patients with severe mental illness: a data linkage study between primary and secondary care

INTRODUCTION
Patients with severe mental illness (SMI), including schizophrenia, bipolar affective disorder, and schizoaffective disorder or other non-organic psychoses, experience lower life expectancy than the general population. This is largely attributed to common physical disorders, particularly cardiovascular diseases (CVDs). Excess mortality linked to CVDs is attributed to several factors, including elevated risk factors such as smoking; side effects of pharmacological treatment; diagnostic overshadowing; and, suboptimal management of comorbid physical conditions. Previous studies have been unable to investigate associations for varying SMI-related characteristics as data on physical health and clinical management sit mainly within primary care, whereas mental health condition and management records are mainly stored in secondary care.

METHOD
Setting and data sources
Lambeth is a diverse borough in south east London, with a greater proportion of black Caribbean and black African residents but fewer South Asian residents than other areas, and is more deprived than England as a whole. Pseudonymised primary care data were extracted on 31 March 2013 from computerised medical records of all except one GP practice (n = 48) within Lambeth, as part of Lambeth DataNet (LDN) covering a population of 366,317 registered patients.

This was a cross-sectional extract of LDN, but for some records (for example blood pressure [BP]), information on all measures recorded from 31 January 2012 to 31 October 2013 were collected to determine whether Quality and Outcomes Framework (QOF) clinical targets had been met. Secondary care data came from the Case Register Interactive Search (CRIS), an application allowing researchers access to pseudonymised electronic health record (EHR) data from the South London and Maudsley NHS Foundation Trust (SLaM). CRIS provides searchable access to de-identified text [unstructured data] from the clinical record.

Data linkage
Data were linked and stored by the Clinical Data Linkage Service (CDLS), which

Abstract
Background Suboptimal treatment of cardiovascular diseases (CVD) among patients with severe mental illness (SMI) may contribute to physical health disparities.

Aim To identify SMI characteristics associated with meeting CVD treatment and prevention guidelines.

Design and setting Population-based electronic health record database linkage between primary care and the sole provider of secondary mental health care services in south east London, UK.

Method Cardiovascular disease prevalence, risk factor recording, and Quality and Outcomes Framework (QOF) clinical target achievement were compared among 4056 primary care patients with SMI whose records were linked to secondary healthcare records and 270 649 patients without SMI who were not known to secondary care psychiatric services, using multivariate logistic regression modelling. Data available from secondary care records were then used to identify SMI characteristics associated with QOF clinical target achievement.

Results Patients with SMI and with coronary heart disease and heart failure experienced reduced prescribing of beta blockers and angiotensin-converting enzyme inhibitor/angiotensin receptor blockers (ACEI/ARB). A diagnosis of schizophrenia, being identified with any indicator of risk or illness severity, and being prescribed with depot injectable antipsychotic medication was associated with the lowest likelihood of prescribing.

Conclusion Linking primary and secondary care data allows the identification of patients with SMI most at risk of undertreatment for physical health problems.

Keywords cardiovascular diseases; data linkage; health inequalities; primary health care; psychoses.

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provides a safe haven environment with strict governance arrangements. Data were linked using encrypted NHS numbers, which were subsequently removed and destroyed, fully anonymising the linked dataset.

**Measures**

Lambeth DataNet (LDN). Data were extracted on sex, year of birth, ethnic group, and 2011-defined lower super output area (LSOA). LSOA data were used to estimate deprivation on the basis of patient area of residence using the Index of Multiple Deprivation (IMD-2010) and a conversion to 2011 LSOA values. GP clinical register data (lists established and maintained by practices of patients identified with particular clinical outcomes for QOF purposes) were collected for heart failure (HF), coronary heart disease (CHD), hypertension (HYP), and stroke/transient ischaemic attack (STIA). Data were also collected on CVD risk factor recording, for example BP, clinical values and dates, and, mean number of primary care consultations (including GP, nurse, face-to-face, and telephone) between 2010 and 2013. A binary variable was created to distinguish median or below and above median annual number of consultations.

Case Register Interactive Search (CRIS). Diagnostic codes for any primary or secondary diagnosis of schizophrenia, bipolar affective disorder, and schizoaffective disorder or other non-organic psychoses were extracted. An indicator of SMI severity was created, coding patients with SMI as 1 if they ever had a record of: an inpatient stay, being treated under the Mental Health Act, difficulty managing their physical health, or contact with Assertive Outreach, Crisis or A&E liaison team (or 0 if they had not been recorded with any of these). Similarly, an indicator of risk coded patients with SMI as 1 or 0 to indicate if they had ever been identified under the ‘violence and aggression’ subscale of risk assessment with a history of violence, non-compliance, or forensic history. Lastly, binary indicators of antipsychotic medication prescription were extracted, including binary indicators of atypical, typical, and depot injectable medication.

**Statistical analyses**

Pearson’s χ² tests and logistic regression analyses were used to compare CVD prevalence, risk factor recording, QOF target achievement, and primary care consultation frequency by SMI status. Using

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### Table 1. Sociodemographic characteristics and CVD prevalence by severe mental illness (SMI) status

|                      | Non-SMI (N = 270,669), n (%) | SMI (N = 4,056), n (%) | P-value |
|----------------------|------------------------------|------------------------|---------|
| **Sex**              |                              |                        | <0.001  |
| Female               | 137,353 (50.8)               | 1,797 (44.3)           |         |
| Male                 | 133,315 (49.3)               | 2,259 (55.7)           |         |
| **Age group, years** |                              |                        | <0.001  |
| 16–24                | 32,776 (12.1)                | 162 (4.0)              |         |
| 25–34                | 88,062 (32.5)                | 678 (32.5)             |         |
| 35–44                | 59,279 (21.9)                | 907 (22.4)             |         |
| 45-54                | 42,839 (15.8)                | 1,095 (27.0)           |         |
| 55–64                | 23,734 (8.8)                 | 624 (15.4)             |         |
| 65–74                | 14,035 (5.2)                 | 347 (8.6)              |         |
| ≥75                  | 9,944 (3.7)                  | 243 (6.0)              |         |
| **Ethnic group**     |                              |                        | <0.001  |
| British/mixed        | 78,332 (35.0)                | 1,124 (31.6)           |         |
| Irish                | 525 (2.2)                    | 104 (2.9)              |         |
| Indian/Pakistan/ Bangladeshi/mixed | 16,042 (7.2) | 219 (6.2)              |         |
| Caribbean/mixed      | 21,401 (9.6)                 | 840 (23.7)             |         |
| African/mixed        | 27,266 (12.2)                | 545 (15.3)             |         |
| Chinese/other        | 10,871 (4.9)                 | 90 (2.5)               |         |
| Other white          | 54,080 (24.2)                | 373 (10.5)             |         |
| Other black          | 2,662 (2.8)                  | 188 (5.3)              |         |
| Other mixed          | 4,254 (1.9)                  | 69 (1.9)               |         |
| **Deprivation quintile** |                              |                        | <0.001  |
| 1 Most deprived      | 47,162 (18.1)                | 1,004 (25.0)           |         |
| 2                    | 54,656 (21.0)                | 918 (22.9)             |         |
| 3                    | 54,342 (20.9)                | 836 (20.8)             |         |
| 4                    | 57,149 (22.0)                | 713 (17.8)             |         |
| 5 Least deprived     | 47,054 (18.1)                | 543 (13.5)             |         |
| **Consultations**    |                              |                        | <0.001  |
| Mean (SD)            | 4.7 (4.3)                    | 9.4 (8.0)              |         |
| Median/ below        | 123,931 (93.1)               | 813 (90.9)             |         |
| Above median         | 109,286 (47.0)               | 3074 (79.1)            |         |
| **Cardiovascular diseases** |                      |                        | <0.001  |
| Hypertension         | 28,010 (10.4)                | 762 (18.8)             |         |
| Coronary heart disease | 4109 (1.5)                  | 97 (2.4)               | <0.001  |
| Heart failure        | 1,259 (0.5)                  | 45 (1.1)               | <0.001  |
| Stroke/transient ischaemic attack | 2,554 (0.9) | 100 (2.5)              | <0.001  |

SD = standard deviation. SMI = severe mental illness. Patients with SMI are those known to both primary and secondary care, patients without SMI are those known only to primary care and not registered with a SMI.

'Consultations' refers to mean number of GP and nurse telephone, face-to-face and home primary care consultations per calendar year between 2010 and 2013. *One patient recorded as sex ‘unknown’. †P < 0.001.
linked data, comparisons by SMI status in CVD prevalence and prescribing were then examined by individual SMI characteristics. Logistic regression analyses were used to assess whether any differences in CVD prevalence or prescribing could be accounted for by adjustment for sociodemographic characteristics and consultation frequency. $P$-values, unadjusted and adjusted odds ratios (OR), and 95% confidence intervals (CI) are shown. The large number of statistical tests conducted meant that an $\alpha$ level of $P<0.01$ was used to determine statistical significance. All analyses were conducted using Stata (version 12).

**RESULTS**

Data were obtained for LDN patients aged ≥16 years ($n = 295,301$); of these, 8.1% ($n = 23,919$) were linked to secondary mental healthcare records. Among those with linked records, $n = 4056$ (16.9%) were recorded with SMI by their GP in LDN. Analyses compared those with recorded SMI in primary care with linked secondary care records ($n = 4056$) to those not recorded with SMI in primary care or linked to secondary care ($n = 270,669$).

**Sociodemographics, CVD prevalence, and consultation frequency among patients with and without SMI**

SMI status was associated with sex, age, ethnic group, deprivation, consultation frequency, and greater prevalence of CVDs (Table 1). In patients with an established CVD (data not shown) there were no longer associations between SMI status and sex, nor age among patients with CHD or STIA. SMI status was only associated with ethnic group and GP consultation rate among patients with HYP, and SMI status was no longer associated with deprivation among patients with any CVD condition.

**Sociodemographic characteristics of SMI subgroups**

The SMI characteristics extracted from secondary care data are shown in Table 2. Adjusting for all sociodemographic characteristics simultaneously (data not shown), being black African, black Caribbean, other black, and of a younger age were associated with indicators of risk and severity, and with receiving depot injectable antipsychotic medication; male sex was also associated with risk. Being black Caribbean and older was associated with receipt of typical antipsychotics, whereas younger age and being black African was associated with receipt of atypical antipsychotics. Relative to those with a diagnosis of schizophrenia, those diagnosed with bipolar disorder were younger, more likely to be identified as British/mixed British, female, and to consult primary care more frequently ($P = 0.01$). Those diagnosed with schizoaffective disorder/other non-organic psychoses were younger, more likely to be female, and to consult primary care less frequently relative to patients with schizophrenia (except where indicated, all $P$-values <0.001).

**CVD risk factor recording and QOF target achievement**

CVD risk factor recording (for example BP) was, in general, high for patients with and without SMI (Table 3). Among those with established CVDs, patients with SMI were more likely to have a record of their alcohol intake. Among patients with HYP, SMI status was also associated with greater recording of body mass index and glycated haemoglobin levels. Patients with SMI with CHD were less likely to have a BP record, whereas those with STIA were less likely to have a record of BP and smoking status. CVD risk assessment (for example Framingham risk score) was significantly less common among patients with SMI. Despite significantly higher prevalence of CVDs in the SMI group overall, there was little or no difference in the prevalence of comorbid CVDs or diabetes by SMI status among those with established CVDs. Among patients with HYP, diabetes was significantly more common among patients with SMI than without. For most QOF targets, there was no significant difference between patients with SMI and patients without SMI. For patients with SMI as well as HF and CHD, a significant shortfall was observed in prescribing with ACE inhibitors or angiotensin receptor blockers [ACEIs/ARBs] and beta blockers.

**Regression analyses of QOF target achievement**

Regression analyses (Table 4) focused on differences in CVD prescribing by SMI status as these differences have previously been identified as a potential contributor to excess cardiovascular mortality among patients with SMI,\textsuperscript{12} and were the key differences identified in Table 3. Associations between SMI status and beta blocker and ACEI/ARB medication among patients with HF remained after accounting for both sociodemographic characteristics and consultation rates. Among patients with CHD, the association between SMI status and beta blocker prescription was accounted for by ethnic group but the shortfall in ACEI/ARB prescribing among

### Table 2. Indicators of severity and risk identified from secondary care data among patients with severe mental illness

| Indicator                  | Diagnoses                                      | Diagnoses                                      | Diagnoses                                      |
|----------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|
| Schizophrenia              | 1352                                          | 1352                                          | 1352                                          |
| Bipolar affective disorder | 417                                           | 417                                           | 417                                           |
| Other non-organic psychoses| 273                                           | 273                                           | 273                                           |
| Indicative of severity, ever| 2047                                          | 2047                                          | 2047                                          |
| Treated under Mental Health Act | 1416 | 1416 | 1416 |
| Inpatient                  | 1927                                          | 1927                                          | 1927                                          |
| Seen by crisis team        | 26                                            | 26                                            | 26                                            |
| Seen by assertive outreach | 11                                            | 11                                            | 11                                            |
| A&E outpatient episode     | 445                                           | 445                                           | 445                                           |
| Difficulty managing physical health | 674 | 674 | 674 |
| Indicator of risk, ever    | 1751                                          | 1751                                          | 1751                                          |
| History of non-compliance  | 1296                                          | 1296                                          | 1296                                          |
| History of violence        | 1171                                          | 1171                                          | 1171                                          |
| Forensic history           | 620                                           | 620                                           | 620                                           |
| Antipsychotics, ever       | 1112                                          | 1112                                          | 1112                                          |
| Depot injectable           | 3255                                          | 3255                                          | 3255                                          |
| Typical                    | 1506                                          | 1506                                          | 1506                                          |
Table 3. CVD risk factor recording and QOF CVD target achievement by serious mental illness (SMI) status and among patients with CVD conditions

| Risk factor recording | Heart failure | Coronary heart disease | Hypertension | Stroke/transient ischaemic attack |
|-----------------------|---------------|------------------------|--------------|----------------------------------|
|                       | Non-SMI (n = 1259) | SMI (n = 45) | Non-SMI (n = 4109) | SMI (n = 97) | Non-SMI (n = 28 010) | SMI (n = 762) | Non-SMI (n = 2544) | SMI (n = 100) |
| BP record             | 1251 (99.4) | 44 (97.8) | 0.206 | 4079 (99.3) | 94 (96.9) | 0.009<sup>b</sup> | 27 859 (99.5) | 754 (99.0) | 0.061 |
| Smoking status record | 1257 (99.8) | 45 (100.0) | 0.789 | 4099 (99.8) | 96 (99.0) | 0.133 | 27 977 (99.9) | 759 (99.6) | 0.034<sup>a</sup> |
| HbA1c record          | 805 (63.9) | 26 (57.9) | 0.398 | 2728 (66.4) | 67 (69.1) | 0.580 | 16 468 (58.8) | 531 (69.7) | <0.001<sup>c</sup> |
| Cholesterol record    | 1206 (95.8) | 45 (100.0) | 0.160 | 4017 (97.9) | 94 (96.9) | 0.576 | 26 890 (99.0) | 734 (96.3) | 0.618 |
| BMI record            | 1187 (94.3) | 45 (100.0) | 0.099 | 3849 (93.7) | 94 (96.9) | 0.193 | 27 977 (99.9) | 759 (99.6) | 0.034<sup>a</sup> |
| Alcohol record        | 992 (78.8) | 45 (100.0) | 0.001<sup>c</sup> | 3325 (80.9) | 88 (90.7) | 0.015<sup>a</sup> | 22 637 (80.8) | 714 (96.0) | <0.001<sup>c</sup> |
| eGFR record           | 1229 (97.6) | 44 (97.8) | 0.945 | 3987 (97.0) | 94 (96.9) | 0.943 | 16 468 (58.8) | 531 (69.7) | 0.936 |
| CVD risk factor assessment | 236 (18.8) | 10 (22.2) | 0.558 | 727 (17.7) | 11 (11.3) | 0.104 | 2177 (91.1) | 95 (95.0) | 0.174 |
| TSH record            | 1140 (90.6) | 40 (88.9) | 0.709 | 3619 (88.1) | 88 (90.7) | 0.893 | 21 844 (84.2) | 86 (86.0) | 0.627 |
| CHD comorbidity       | 569 (45.2) | 13 (28.9) | 0.031<sup>a</sup> | – | – | – | 2142 (84.2) | 96 (86.0) | 0.613 |
| DM comorbidity        | 428 (34.0) | 17 (37.8) | 0.599 | 1294 (31.5) | 31 (32.0) | 0.922 | – | – | – |
| HYP comorbidity       | 886 (70.4) | 27 (60.0) | 0.136 | 2590 (63.0) | 57 (58.8) | 0.389 | – | – | – |

QOF target achievement<sup>d</sup>

|                      | Last BP record within 9 months | Normal BP<sub>150/90</sub> mmHg in last 9 months | Normal BP<sub>150/90</sub> mmHg in last 15 months | Cholesterol in last 15 months | Cholesterol <5 mmol/l in last 15 months | Anticoagulant/platelet last 15 months | Acute therapy<sup>f</sup> | Beta blocker | ACE/ARB |
|----------------------|--------------------------------|-----------------------------------------------|-----------------------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------|---------|
|                      | –                              | –                                             | –                                             | –                             | –                              | –                              | –                              | –              | –       |
|                      | 18 286 (65.3)                  | 350 (65.6)                                    | 0.849                                         | –                             | –                             | –                              | –                              | –              | –       |
|                      | 20 829 (74.4)                  | 557 (73.1)                                    | 0.430                                         | –                             | –                             | –                              | –                              | –              | –       |
|                      | 19 077 (75.0)                  | 67 (67.0)                                     | 0.073                                         | –                             | –                             | –                              | –                              | –              | –       |
|                      | 1786 (70.2)                    | 69 (69.0)                                     | 0.796                                         | –                             | –                             | –                              | –                              | –              | –       |
|                      | 1477 (56.9)                    | 52 (52.0)                                     | 0.334                                         | –                             | –                             | –                              | –                              | –              | –       |
|                      | 1460 (61.7)                    | 59 (62.8)                                     | 0.840                                         | –                             | –                             | –                              | –                              | –              | –       |

ACE/ARB = angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; BMI = body mass index. BP = blood pressure. CHD = coronary heart disease. CVD = cardiovascular disease. DM = diabetes mellitus. eGFR = estimated glomerular filtration rate. HbA1c = glycated haemoglobin. HYP = hypertension. MI = myocardial infarction. QOF = Quality and Outcomes Framework. TSH = thyroid stimulating hormone. *P<0.05; †P<0.01; ‡P<0.001. Refers to QOF guidelines 2012/13.<sup>c</sup> if non-haemorrhagic (non-SMI n = 2366, SMI n = 94). If registered with MI (non-SMI n = 2951, SMI n = 68). All QOF management guidelines refer to records since registration with outcomes. MI drugs — quadruple therapy including statin, antiplatelet/anticoagulant, beta blocker, and ACE/ARB prescription.
Elevated rates of CVDs were found among patients with SMI; however, there may be underrecording of CVD comorbidities among patients with SMI and with established CVDs. Risk factor recording was high, although significant differences by SMI status were identified. Overall, QOF target achievement was not impaired in patients with SMI but significant consistent associations were found between SMI status and reduced prescribing of ACEI/ARB and beta blocker medication as secondary prevention of CHD and HF. Patients with SMI and with schizophrenia, those identified with any indicator of risk or illness severity, and those ever prescribed depot injectable antipsychotics were least likely to be prescribed ACEI/ARBs and beta blockers.

**DISCUSSION**

**Summary**

Elevated rates of CVDs were found among patients with SMI; however, there may be underrecording of CVD comorbidities among patients with SMI and with established CVDs. Risk factor recording was high, although significant differences by SMI status were identified. Overall, QOF target achievement was not impaired in patients with SMI but significant consistent associations were found between SMI status and reduced prescribing of ACEI/ARB and beta blocker medication as secondary prevention of CHD and HF. Patients with SMI and with schizophrenia, those identified with any indicator of risk or illness severity, and those ever prescribed depot injectable antipsychotics were least likely to be prescribed ACEI/ARBs and beta blockers.

**Strengths and limitations**

This study makes use of a population-based data linkage between primary and secondary care records. It was possible to identify patient and illness-related characteristics associated with recording and treatment of CVDs and to highlight issues warranting further investigation that may best target disparities and reduce inequalities in physical comorbidity and mortality. The main limitation pertains to the generalisability to other geographical areas; however, the present findings are in line with evidence from national and international research, and it is believed that this study is proof of principle of the utility of data linkage, which could be used elsewhere to corroborate the findings. Although the analyses focus on incentivised QOF targets, it is possible that discrepancies in non-QOF targets may differ.

**Comparison with existing literature**

Although patients with SMI were more likely to be recorded with CVDs overall, little evidence was found for elevated rates of CVD comorbid conditions among those with established CVDs. Previous research has found no difference in the pattern of physical health co- and multimorbidities by SMI status and lower than expected rates of CVDs overall and among patients with SMI; however, the present findings are in line with evidence from national and international research, and it is believed that this study is proof of principle of the utility of data linkage, which could be used elsewhere to corroborate the findings. Although the analyses focus on incentivised QOF targets, it is possible that discrepancies in non-QOF targets may differ.

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**Table 4. Differences in QOF CVD prescribing targets by serious mental illness status adjusted for sociodemographic characteristics and primary care consultation frequency**

|                | Reference (non-SMI) | Unadjusted OR (95% CI) | Adjusted for sociodemographics OR (95% CI) | Additionally adjusted for consultation rate OR (95% CI) |
|----------------|---------------------|------------------------|-------------------------------------------|-------------------------------------------------|
| **Beta blocker** |                      |                        |                                           |                                                  |
| After CHD      | 1.00                | 0.62 (0.41 to 0.93)    | 0.68 (0.44 to 1.05)                      | 0.66 (0.42 to 1.01)                              |
| After HF       | 1.00                | 0.29 (0.16 to 0.53)    | 0.29 (0.15 to 0.55)                      | 0.27 (0.14 to 0.52)                              |
| **ACEI/ARB**   |                      |                        |                                           |                                                  |
| After CHD      | 1.00                | 0.59 (0.36 to 0.97)    | 0.66 (0.33 to 0.94)                      | 0.47 (0.27 to 0.80)                              |
| After HF       | 1.00                | 0.33 (0.18 to 0.61)    | 0.34 (0.18 to 0.66)                      | 0.31 (0.16 to 0.60)                              |
| **Antiplatelet/anticoagulant** |                      |                        |                                           |                                                  |
| After CHD      | 1.00                | 0.95 (0.54 to 1.65)    | 1.04 (0.57 to 1.89)                      | 0.94 (0.51 to 1.73)                              |
| After STIA     | 1.00                | 1.04 (0.68 to 1.60)    | 0.99 (0.62 to 1.59)                      | 1.04 (0.64 to 1.69)                              |
| **Statin**     |                      |                        |                                           |                                                  |
| After CHD      | 1.00                | 0.76 (0.45 to 1.28)    | 0.78 (0.45 to 1.36)                      | 0.70 (0.40 to 1.23)                              |
| **Quadruple therapy** |                      |                        |                                           |                                                  |
| After CHD      | 1.00                | 0.65 (0.40 to 1.06)    | 0.62 (0.37 to 1.04)                      | 0.28 (0.14 to 0.57)                              |

ACEI/ARB = angiotensin-converting enzyme inhibitor/angiotensin receptor blocker. CHD = coronary heart disease. CVD = cardiovascular disease. HF = heart failure. OR = odds ratio. QOF = Quality and Outcomes Framework. SMI = severe mental illness. STIA = stroke/transient ischaemic attack. *Refers to QOF guidelines 2012/13.17 Adjusted for age (continuous), sex, ethnic group, and borough-level deprivation. Additionally adjusted for mean annual number of primary consultations. *P<0.05. *P<0.01. *P<0.001. Quadruple therapy indicated in patients with history of myocardial infarction and includes statin, antiplatelet/anticoagulant, beta blocker, and ACEI/ARB medication.
Table 5. Serious mental illness characteristics associated with beta blocker and ACEI/ARB prescribing among patients with coronary heart disease and heart failure

| Characteristic                              | Beta blockers if recorded with CHD or HF (n = 3347) | ACEI/ARB if recorded with CHD or HF (n = 3760) |
|---------------------------------------------|--------------------------------------------------|---------------------------------------------|
| Non-SMI                                     | 3279 (68.3)                                      | 3677 (76.6)                                  |
| SMI overall                                 | 68 (52.7)                                        | 83 (64.3)                                   |
| Mood disorders                               |                                                  |                                             |
| Schizophrenia                               | 30 (50.0)                                        | 36 (60.0)                                   |
| Bipolar affective disorder                  | 8 (40.0)                                         | 11 (55.0)                                   |
| Other non-organic psychoses                 | 8 (61.5)                                         | 12 (92.3)                                   |
| Depressed                                   | 42 (56.4)                                        | 48 (64.9)                                   |
| No                                          | 11 (36.8)                                        | 18 (60.0)                                   |
| Typical antipsychotic                       | 28 (53.9)                                        | 34 (61.8)                                   |
| Atypical antipsychotic                      | 25 (51.0)                                        | 18 (60.0)                                   |
| Any indicator of severity                   | 42 (57.0)                                        | 56 (70.9)                                   |
| No                                          | 23 (46.0)                                        | 27 (54.0)                                   |
| Any indicator of risk                       | 54 (59.3)                                        | 64 (70.3)                                   |
| No                                          | 14 (36.8)                                        | 19 (50.0)                                   |

ACEI/ARB = angiotensin-converting enzyme inhibitor/angiotensin receptor blocker. CHD = coronary heart disease. HF = heart failure. OR = odds ratio. SMI = severe mental illness.

*Adjusted for age (continuous), sex, ethnic group, and recorded CHD/HF.

+Additionally adjusted for mean annual number of primary consultations.

P < 0.05.

P < 0.01.

P < 0.001.

Includes any of: ever had an inpatient stay, any record of being treated under the Mental Health Act, any record of difficulty managing their physical health, or any record of an Assertive Outreach/Crisis/A&E episode.

Includes any of: recorded history of violence, recorded history of non-compliance, and any record of a forensic history.

British Journal of General Practice, June 2016
because of excess mortality. In line with previous findings,19,23,24 this study found evidence for reduced prescription of ACEI/ARB and beta blocker medications for CVD secondary prevention. Underprescribing in CVDs has been linked previously with excess mortality among patients with SMI19,23,24 and therefore may contribute to disparities in life expectancies. Reduced ACEI/ARB prescribing in CHD among patients with SMI could partly reflect differences in the effectiveness of these drugs as hypotensive agents among black Caribbean and black African patients.27 National Institute for Health and Care Excellence (NICE) HYP guidelines28 indicate prescribing of ARBs rather than ACEIs among black patients; however, the associations remained after adjustments for ethnic group and were robust when ACEI and ARB prescriptions were analysed separately. Reduced prescribing is also unlikely to be linked to reduced attendance at primary care as greater consultation frequency was found among patients with SMI, and adjustments strengthened negative associations with prescribing.

There may, however, be reluctance to prescribe certain CVD medications because of concerns about adherence. Adherence may be lower for drugs where the dose has to be up-titrated to maximally tolerated doses as for beta blockers and ACEI/ARBs; these medications require monitoring, and thus adherence to a monitoring regimen to assess for side-effects. Monitoring also involves regular blood tests; such a commitment may be perceived as too demanding for GPs assessing patients with SMI, and/or patients with SMI may be less willing to commit themselves to such monitoring. However, a recent US study assessing adherence in patients with and without schizophrenia found no evidence for reduced adherence to ACEI/ARB medication.29 One reason previously suggested for reluctance to prescribe certain cardiovascular medications is the potential for harm in overdose.14,21 Although research does not support an association between cardiovascular medication and excess suicide,30,31 practitioners could conceivably have concerns around correct adherence among patients with SMI, for example, leading to accidental overdose.

Further quantitative and qualitative work may usefully further explore these explanations. Qualitative evidence suggests that primary care physicians may view patients with SMI as harder to manage31,32 and be less willing to intervene when cardiovascular risk factors are identified.33 Further, there may be reluctance among patients with SMI to accept prescriptions because of mistrust or lack of adequate communication between physician and patient.34 For patients with greater illness severity, the role of secondary care physicians may be more pertinent in managing physical health.

Lastly, QOF exception rates (for example, because of informed dissent or treatment unsuitability) are higher in patients with SMI,29,36 potentially inflating QOF achievement. The present analyses did not exclude exception reported patients, however, so the reported achievement rates were not influenced by exception reporting among patients with SMI.

Beta blocker and ACE/ARB prescription was reduced in patients with SMI with CHD or HF overall, but the reduction was greatest in patients with SMI identified with any indicator of risk, prescription of depot injectable antipsychotics, schizophrenia diagnosis, and any indicator of SMI severity. To the authors' knowledge, these associations have not been previously investigated; however, Laursen et al25 reported that rates of ‘unnatural’ deaths were elevated among patients with SMI who were not prescribed cardiovascular medication, also indicating an association with illness severity. The subgroups identified as most at risk of underprescribing may be those most likely to be seen as the ‘hardest to treat’ by GPs and those least likely to commit to the monitoring and follow-up as implied before. Further qualitative work should explore these associations among clinicians and patients who have been identified as at risk of underprescribing.

**Implications for practice**

These findings deepen the understanding of disparities in morbidity and health care among individuals with SMI and help to build possible explanations for these discrepancies by identifying characteristics of patients with SMI associated with the lowest likelihood of optimal treatment. The results underline the value of closer working between primary and secondary care in improving outcomes for patients with SMI.

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**Competing interests**
The authors have declared no competing interests.

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