Impact of COVID-19 restrictions on diabetes health checks and prescribing for people with type 2 diabetes: a UK-wide cohort study involving 618,161 people in primary care

Matthew J. Carr†1,3, Alison K. Wright†1,2,4, Lalantha Leelarathna2,4,5, Hood Thabit2,4,5, Nicola Milne2,5, Naresh Kanumilli2,5, Darren M. Ashcroft†1,3, Martin K. Rutter†2,4,5
†Equal contribution

1 Centre for Pharmacoepidemiology and Drug Safety, Division of Pharmacy and Optometry, School of Health Sciences, Faculty of Biology, Medicine and Health, University of Manchester, UK.
2 Manchester Academic Health Science Centre.
3 NIHR Greater Manchester Patient Safety Translational Research Centre, University of Manchester, UK.
4 Division of Diabetes, Endocrinology and Gastroenterology, School of Medical Sciences, Faculty of Biology, Medicine and Health, University of Manchester, Manchester, UK.
5 Diabetes, Endocrinology and Metabolism Centre, Manchester University NHS Foundation Trust, Manchester, UK.

Corresponding Author: Matthew J. Carr, PhD
Division of Pharmacy and Optometry, Faculty of Biology, Medicine and Health, The University of Manchester, 1st Floor, Stopford Building, Oxford Road, Manchester, M13 9PT. Tel: +44 161 287 6880. matthew.carr@manchester.ac.uk

Keywords: COVID-19, Diabetes, Primary Health Care, Prescribing, Health Checks, Care Process, Electronic Health Records

Word Count: 2983
Number of Figures: 4
Number of Tables: 1

NOTE: This preprint reports new research that has not been certified by peer review and should not be used to guide clinical practice.
Abstract (281 words)

OBJECTIVE. To compare rates of performing NICE-recommended health checks and prescribing in people with type 2 diabetes (T2D), before and after the first COVID-19 peak in March 2020, and to assess whether trends varied by age, sex and deprivation.

METHODS. We constructed a cohort of 618,161 people with T2D followed between March and December 2020 from 1744 UK general practices registered with the Clinical Practice Research Datalink (CPRD; Aurum and GOLD databases). We focused on the following six health checks and prescribing: HbA1c, serum creatinine, cholesterol, urinary albumin excretion, blood pressure and BMI assessment, comparing trends using regression models and 10-year historical data.

RESULTS. In April 2020, in English practices, rates of performing health checks were reduced by 76-88% when compared to 10-year historical trends, with older people from deprived areas experiencing the greatest reductions. Between May and December 2020, the reduced rates recovered gradually but overall remained 28% and 47% lower compared to historical trends, with similar findings in other UK nations. In England, rates of prescribing of new medication fell during April with reductions varying from 10% (4-16%) for antiplatelet agents to 60% (58-62%) for antidiabetic medications. Overall, between March and December 2020, the overall rate of prescribing new diabetes medications was reduced by 19% (15-22%) and new antihypertensive medication by 22% (18-26%). Similar trends were observed in other UK nations, except for a reduction in new lipid-lowering therapy prescribing March to December 2020 (reduction: 16% (10-21%)).

CONCLUSIONS. Over the coming months, healthcare services will need to manage this backlog of testing and prescribing. Effective communications should ensure that patients remain engaged with diabetes services, monitoring and opportunities for prescribing, and make use of home monitoring and remote consultations.
INTRODUCTION

The COVID-19 pandemic has had major health and economic effects across the world. So far in the UK, there have been more than 126,000 COVID-related deaths with disproportionate impacts in people with diabetes; in the early phase of the pandemic nearly a third of all COVID-related deaths occurred in people with diabetes.1-3

The impact on the NHS, and in particular on diabetes services, has been enormous, with the suspension of much routine care. As the COVID-19 pandemic continues, there is an urgent need to minimise the harm done through reduction of routine services and to prioritise care and resources to areas of greatest need.

In 2008, the National Institute for Health and Care Excellence (NICE) recommended nine essential ‘health checks’ or so-called ‘care processes’ that define high-quality diabetes care.4 NICE recommended that people with diabetes should have at least annual checks of weight, blood pressure, smoking status, HbA1c, cholesterol, creatinine, urinary albumin, retinopathy and feet. Since 2008, these health checks have been incorporated in National Diabetes Audits and have also been used very effectively in the Quality Outcomes Framework (QOF) to incentivise high-quality primary care services.

The management of type 2 diabetes occurs almost exclusively in primary care.5 Therefore, lower general practice attendance due to COVID-19 would likely restrict the ability to perform these essential health checks. Consequently, this could have adverse effects on patient safety and increase the risk of developing long-term diabetes-related complications.

There is limited data on the indirect consequences of the COVID-19 pandemic on diabetes health checks and prescribing in primary care. Therefore, we used a large primary care longitudinal dataset, broadly representative of the UK population, to compare the frequency of health checks and prescribing in people with type 2 diabetes, before and after the first nationwide COVID-19 lockdown in March 2020. We compared observed and predicted rates using data covering ten years prior to the pandemic.
Since older people and more socially disadvantaged groups have been disproportionately affected by COVID-19 infections, and since the same groups may be more adversely impacted by changes in healthcare delivery imposed by COVID-19, we aimed to study variation in outcomes by gender, age group and deprivation level.

METHODS

Data sources

We conducted a retrospective cohort study using primary care electronic health records obtained from the Clinical Practice Research Datalink (CPRD) Aurum and GOLD databases. The study population consisted of 965,964 patients with a diagnosis of type 2 diabetes; 824,698 patients from 1470 general practices in England, with a further 141,266 patients from 361 practices across Northern Ireland (16,408 patients in 40 practices), Scotland (69,935 patients in 208 practices), and Wales (54,923 patients in 113 practices). From the study population, 934,214 patients (from 1828 UK general practices) contributed to the estimation of the expected rates in the pre-COVID-19 period between January 2010 and February 2020.

The CPRD contains anonymised consultation records and includes patient demographic information, symptoms, diagnoses, medication prescriptions, and date of death. We also examined practice-level Index of Multiple Deprivation (IMD) quintiles, a measure representing an area’s relative level of deprivation, ranked within each UK nation.

Definitions, measurements and clinical coding

To enable comparisons of rates before and after the start of the COVID-19 outbreak, we included patient records from January 2010 to establish long-term trends and patterns of seasonality. We focused primarily on reporting observed versus expected rates from 1st March 2020 to 10th December 2020. For the diabetes monitoring component of the study, we restricted our investigation to the following six care
processes because there was a high level of confidence that they had or had not been performed based on the available primary care records: HbA1c, serum creatinine, cholesterol, urinary albumin excretion, blood pressure, BMI measurement. It seemed possible that smoking status had been assessed and foot checks performed but not recorded in the practice records and therefore we did not report these outcomes. Eye screening for retinopathy is performed in the community and these data are not recorded routinely in the primary care record.

For the medication prescribing component of the study, we focused on medications commonly prescribed to patients with a diagnosis of type 2 diabetes: antidiabetics, antihypertensives, lipid-lowering drugs and antiplatelet agents. To compare prescribing behaviours before and after the start of the pandemic, we applied two distinct definitions: First, we assessed the prescribing of new medication within a three-year window of a first diagnosis of type 2 diabetes. Second, we assessed the overall prescribing rate (new and repeat) among patients with a prior diagnosis.

We also compared the incidence and event rates for eight separate strata by combining attributes of the study cohort via the dichotomisation of gender, age (less than 65 versus greater than or equal to 65), and IMD (quintiles 4 and 5 (most deprived) versus quintiles 1, 2, and 3) as shown in Supplementary Table 1.

Care processes were identified using Read/SNOMED/EMIS codes used in CPRD GOLD and Aurum. Medication prescribing events were identified using CPRD product codes linked to codes from the dictionary of medicines and devices (DM+D) (see https://clinicalcodes.rss.mhs.man.ac.uk).

In line with guidance from the CPRD’s central administration, data from the Aurum and GOLD databases were analysed separately, with data from Aurum restricted to English practices and GOLD providing information on practices in Northern Ireland, Scotland and Wales. The use of two discrete data sources also enabled independent replication of our findings. All code lists and medication lists were verified by two senior clinical academics (a diabetologist: MKR, and a senior academic pharmacist: DMA).
Study design

For each patient, we defined a ‘period of eligibility’ for study inclusion which commenced on the latest of: the study start date (1st January 2010); the patient’s most recent registration with their practice; the date on which data from the practice was deemed to be ‘up-to-standard’ by the CPRD; the patient’s first diagnosis of type 2 diabetes. A patient’s period of eligibility ended on the earliest of: registration termination; the end of data collection from their practice; death. We also applied a ‘look-back’ period during which a patient was required to have been registered for at least a year prior to their diagnosis of type 2 diabetes. The denominator for the incidence and event rates was the aggregate person-months at risk for the whole eligible study cohort.

Statistical Analysis

The data were structured in a time-series format with event counts and ‘person-months at risk’ aggregated (by year and month) with stratification by gender, age group, deprivation quintile and region (or nation in GOLD). Mean-dispersion negative binomial regression models were used to estimate expected monthly event counts from March 2020 onward based on antecedent trends since 2010. The natural logarithm of the denominator (person-months at risk) was used as an offset in each regression model. To account for possible seasonality and long-term linear trends, calendar month was fitted as a categorical variable and time as a continuous variable with the number of months since the start of the study serving as the unit of measurement. For each month studied, observed and expected event counts were converted to rates using the observed person-month denominator. The monthly expected rates, and their 95% confidence intervals, were plotted against the observed rates. As they share a common denominator, differences between expected and observed monthly rates are expressed as a percentage ‘rate reduction (or increase)’.
All data processing and statistical analyses were conducted using Stata version 16 (StataCorp LP, College Station, TX). We followed RECORD (REporting of studies Conducted using Observational Routinely-collected health Data) guidance 10.

RESULTS
Study cohort
Our focus was on the impact of the COVID-19 pandemic between March and December 2020. Using the inclusion criteria described in the Study Design, a mixed cohort was utilised consisting of those patients from the study population whose period of eligibility began before 1st March 2020 and those who became eligible for inclusion between 1st March 2020 and 10th December 2020. The study cohort was comprised of 618,161 people with type 2 diabetes from 1744 UK general practices. The median (IQR) age was 68 (58, 77) years, 44% were female and 25% lived in an area that was in the most deprived quintile compared to the rest of the UK.

Impacts of COVID-19 on care processes in T2D
In April 2020, in English primary care, the rate of performing health checks was reduced by 76-88% when compared to 10-year historical trends (Figure 1), with similar reductions (74-88%) in other UK nations (Supplementary Figure 1).

Although reductions in rates of performing health checks were similar by age, gender and socio-economic group, older people from deprived areas tended to have the greatest reductions in rates due to having higher background testing rates (England, Figure 2; other UK Nations, Supplementary Figure 2).

Between May and December 2020, the reduced rates of performing health checks recovered gradually though rates remained well below expected especially for blood pressure and BMI monitoring (England, Figure 1; other UK Nations, Supplementary Figure 1).

Overall in English practices, between 1st March and 10th December 2020, the rate of performing each of the health checks was reduced by between 28% and 47% compared to historical trends (Table 1); the most affected health check being blood
pressure testing (rate reduction (95% CI): 47% (45-49%)) and the least affected being urine albumin monitoring (reduction: 28% (23-32%)). Similar trends were observed in other UK nations with rate reductions varying between 37-51% across the health checks (Supplementary Table 2); blood pressure monitoring being most significantly reduced (rate reduction: 51% (49-53%)).

Impacts of COVID-19 on diabetes-related prescribing

We assessed changes in rates of prescribing of new diabetes medication along with new antihypertensive, lipid-lowering and antiplatelet medications in people with T2D. In England, prescribing of new medication fell during April with rate reductions varying from 10% (4-16%) for antiplatelet agents to 60% (58-62%) for antidiabetic medications (Figure 3). Similar patterns were observed in other UK nations with rate reductions varying between 26% (15-34%) for antiplatelet agents and 64% (61-66%) for lipid-lowering therapy (Supplementary Figure 3).

In contrast to the data on rates of performing care processes, the largest reductions in rates of prescribing new diabetes medication and new lipid lowering medication in England were seen in younger individuals from deprived and non-deprived backgrounds (Supplementary Figure 4).

Overall in English practices, between 1st March and 10th December 2020, the overall rate of prescribing new diabetes medications was reduced by 19% (15-22%) when compared to historical trends (Table 1); the most affected medication being dipeptidyl peptidase-4 inhibitors (reduction: 34% (29-39%)) and the least affected being insulin which was initiated more frequently during this period compared to historical trends (increase: 18% (10-26%)).

Similarly, the prescribing of new antihypertensive medication was reduced by 22% (18-25%) during this period whereas there was no significant change in the prescribing of new lipid lowering or new antiplatelet therapy (Table 1).

Between 1st March and 10th December 2020, similar reductions in the trends for prescribing of new medication were observed in other UK nations except that
there was a significant reduction in new lipid-lowering therapy prescribing (reduction: 15 (10 to 21)%; Supplementary Table 2).

When considering both new prescribing and repeat prescribing combined, there was no significant change in the prescribing of antidiabetic, antihypertensive, lipid-lowering or antiplatelet therapies between March 2020 and December 2020 (England, Figure 4; other UK nations, Supplementary Figure 5).

DISCUSSION
We used primary care electronic health records from more than 600,000 people with T2D in the UK, and 10-year historical data, to show that during the nine months following the first nationwide ‘lockdown’, the indirect consequences of the COVID-19 pandemic led to clinically significant changes in care quality and prescribing that could adversely impact patient safety. When compared to historical trends, we showed that: i) there were 28-47% reductions in rates of performing a range of health checks including a near halving of blood pressure testing rates; ii) older people with T2D and those from more deprived backgrounds experienced the greatest reduction in health checks; iii) overall rates of prescribing new diabetes and antihypertensive medication were reduced by 19-22%; and iv) reassuringly, when considering rates of new and repeat medication prescribing combined, there were no significant differences.

There are limited data on the impact of the COVID-19 pandemic on rates of performing health checks and prescribing in people with type 2 diabetes. An earlier UK-wide study using primary care data from people with T2D, showed a 31% reduction in HbA1c testing, a 20% reduction in new metformin prescribing and 5% reduction in new insulin prescribing between March and December 2020 compared to historical trends.7 Here we extend these observations by assessing the impact of the COVID-19 pandemic on a much wider range of health checks and a wider range of diabetes-related medication including agents that reduce cardiovascular risk.

Our findings have important clinical implications for diabetes care quality and safety. In early March 2020, GPs were advised to minimise the number of face-to-
face contacts they had with their patients. Our data suggests that this reduction of clinical services has led to major reductions in the monitoring of T2D and the prescribing of new medication, particularly for hypertension. T2D is a progressive condition and therefore without intervention, levels of glucose and associated CVD risk factors such as blood pressure tend to increase over time. There are already concerns about clinical inertia in diabetes management in the UK, and therefore any further reduction in monitoring and related prescribing could increase the risk of mortality and long-term complications.

Our data indicate that reductions in prescribing relate to new prescriptions but not repeat prescriptions. Robust systems for repeat prescribing in the UK appear to have helped minimise the harm done through reductions in face-to-face consultations during the pandemic.

In addition to the reduction in care quality and the potential risks posed by reduced monitoring and prescribing, there is evidence that national lockdowns have had additional detrimental effects on cardiovascular disease (CVD) risk especially in people with T2D. In surveys of UK adults conducted during the first lockdown (April-May 2020), participants reported adverse changes in several behaviours that promote weight gain (adverse changes in diet, physical activity, alcohol consumption, mental health and sleep quality). Other studies in people with T2D have shown worsening of glycaemic control in relation to COVID-19 lockdown.

As engagement with health services increases over the coming months, we predict marked increases in the need for monitoring and prescribing of new medication in people with T2D. Healthcare services will need to manage this backlog of testing and prescribing, and the anticipated greater deterioration of HbA1c and other CVD risk factors such as blood pressure levels. Older people from deprived backgrounds appear to be most adversely affected by reduced monitoring and therefore these individuals may be particular groups to target for early intervention. During this pandemic and its associated lockdowns, effective communications should ensure that patients remain engaged with diabetes services, monitoring and opportunities for prescribing, and make use of home monitoring of blood pressure,
weight and HbA1c (when available), and remote consultations.\textsuperscript{15-17} Investment in such technology and devices would be expected to yield important health benefits.

The COIVD-19 pandemic provides us with a unique opportunity to improve the current care model by providing greater investment in patient education, devices and technology and greater use of remote consultations to deliver the high standards of care that people with diabetes should expect to receive.

Our study had several strengths: this is the first UK-wide study reporting the indirect impact of the COVID-19 pandemic on health checks and prescribing in people with T2D. Our findings in English practices were replicated in other parts of the UK and are likely to be representative of the UK in general. Our study has some limitations: First, we did not report data on retinopathy, smoking and foot checks (the remaining 3 of the 9 health checks recommended by NICE. Retinopathy screening is performed in the community and therefore these data are not available in primary care records. Whist assessments of smoking status and foot checks are performed in primary care, we were less confident in defining whether or not these checks had been performed based on the available data. Second, we do not present data on type 1 diabetes as the majority of care for these individuals is delivered in secondary care centres. Third, ethnicity coding is not adequately captured in primary care and therefore we had limited ability to explore ethnicity-related variation in outcomes. Fourth, we did not assess risk factor levels because our focus was on processes of care and prescribing. Fifth, our data would not capture assessments of weight and blood pressure assessed by patients in their homes. Results of home blood pressure recordings may have had an influence on prescribing between March and December 2020 because the reduction in prescribing of new antihypertensive agents (~13\%) was less than the reduction in BP monitoring performed in primary care (~51\%). Finally, although our results and conclusions are relevant to the UK population, generalisability to other healthcare systems may be limited. However, a pan-European survey of diabetes specialist nurses reported that the level of care provided for people with diabetes had been significantly disrupted during the pandemic.\textsuperscript{25}
In conclusion, we highlight marked reductions in the rate of health checks and new prescribing in people with T2D as indirect consequences of the COVID-19 pandemic. Over the coming months, healthcare services will need to manage this backlog of testing and prescribing, and the anticipated greater deterioration of HbA1c and other CVD risk factors such as blood pressure levels. Older people from deprived backgrounds with T2D may be specific groups to target for early health checks and intervention. During the remainder of this pandemic, effective communications should ensure that patients remain engaged with diabetes services, monitoring and opportunities for prescribing, and make use of home blood pressure, weight and HbA1c monitoring when available. Healthcare planners should seize opportunities provided by the COVID-19 pandemic to improve models, processes and standards of care for people with diabetes.

REFERENCES
1. Raleigh VS. UK's record on pandemic deaths. BMJ 2020;370:m3348. doi: 10.1136/bmj.m3348
2. Holman N, Knighton P, Kar P, et al. Risk factors for COVID-19-related mortality in people with type 1 and type 2 diabetes in England: a population-based cohort study. Lancet Diabetes Endocrinol 2020;8(10):823-33. doi: 10.1016/s2213-8587(20)30271-0
3. Barron E, Bakhai C, Kar P, et al. Associations of type 1 and type 2 diabetes with COVID-19-related mortality in England: a whole-population study. Lancet Diabetes Endocrinol 2020;8(10):813-22. doi: 10.1016/s2213-8587(20)30272-2
4. National Institute for Health and Care Excellence. Type 2 diabetes clinical guidance [CG66] 2008.
5. Alshamsan R, Millett C, Majeed A, et al. Has pay for performance improved the management of diabetes in the United Kingdom? Prim Care Diabetes 2010;4(2):73-8. doi: 10.1016/j.pcd.2010.02.003
6. Padmanabhan S, Carty L, Cameron E, et al. Approach to record linkage of primary care data from Clinical Practice Research Datalink to other health-related patient data: overview and implications. Eur J Epidemiol 2019;34(1):91-99. doi: 10.1007/s10654-018-0442-4

7. Carr MJ, Wright AK, Leelarathna L, et al. Impact of COVID-19 on diagnoses, monitoring and mortality in people with type 2 diabetes: a UK-wide cohort study involving 14 million people in primary care MedRxiv2021 [Available from: https://www.medrxiv.org/content/10.1101/2020.10.25.20200675v2 accessed 19/3/21.

8. NHS England and NHS Improvement. Letter to general practices 2020. Available from: https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/Preparedness-letter_primary-care_NK_5-March2020.pdf.

9. Khunti K, Kosiborod M, Ray KK. Legacy benefits of blood glucose, blood pressure and lipid control in individuals with diabetes and cardiovascular disease: Time to overcome multifactorial therapeutic inertia? Diabetes Obes Metab 2018;20(6):1337-41. doi: 10.1111/dom.13243

10. Robinson E, Boyland E, Chisholm A, et al. Obesity, eating behavior and physical activity during COVID-19 lockdown: A study of UK adults. Appetite 2021;156:104853. doi: 10.1016/j.appet.2020.104853

11. Robinson E, Gillespie S, Jones A. Weight-related lifestyle behaviours and the COVID-19 crisis: An online survey study of UK adults during social lockdown. Obesity Science & Practice 2020;6(6):735-40. doi: 10.1002/osp4.442

12. Karatas S, Yesim T, Beysel S. Impact of lockdown COVID-19 on metabolic control in type 2 diabetes mellitus and healthy people. Prim Care Diabetes 2021 doi: 10.1016/j.pcd.2021.01.003 [published Online First: 2021/01/15]

13. Ruissen MM, Regeer H, Landstra CP, et al. Increased stress, weight gain and less exercise in relation to glycemic control in people with type 1 and type 2 diabetes during the COVID-19 pandemic. BMJ Open Diabetes Res Care 2021;9(1) doi: 10.1136/bmjdrd-2020-002035

13
14. Kanc K, Komel J, Kos M, et al. H(ome)bA1c testing and telemedicine: High satisfaction of people with diabetes for diabetes management during COVID-19 lockdown. Diabetes Res Clin Pract 2020:108285. doi: 10.1016/j.diabres.2020.108285

15. Wake DJ, Gibb FW, Kar P, et al. ENDOCRINOLOGY IN THE TIME OF COVID-19: Remodelling diabetes services and emerging innovation. Eur J Endocrinol 2020;183(2):G67-g77. doi: 10.1530/eje-20-0377

16. Greenhalgh T, Wherton J, Shaw S, et al. Video consultations for covid-19. BMJ 2020;368:m998. doi: 10.1136/bmj.m998

17. Phillip M, Bergenstal RM, Close KL, et al. The Digital/Virtual Diabetes Clinic: The Future Is Now—Recommendations from an International Panel on Diabetes Digital Technologies Introduction. Diabetes Technol Ther 2021;23(2):146-54. doi: 10.1089/dia.2020.0375

**Acknowledgements.** The study is based on data from the Clinical Practice Research Datalink obtained under license from the UK Medicines and Healthcare products Regulatory Agency. The study and use of CPRD data was approved by the Independent Scientific Advisory Committee for Clinical Practice Research Datalink research (protocol number: 20_182R). The data is provided by patients and collected by the NHS as part of their care and support. The interpretation and conclusions contained in this study are those of the authors alone. We would like to acknowledge all the data providers and general practices that made the anonymised data available for research.

**Author Contributions.** DMA conceived the original idea. MKR, MJC and AKW helped develop the idea. MJC and AKW performed the analysis and verified the analytical methods. MKR and DMA also reviewed the clinical code sets. NK and NM (primary care clinicians) and LL, HT (secondary care diabetes clinicians) helped interpret the results. MKR wrote the manuscript with input from all authors. All authors critically reviewed and approved the final version.
The lead authors (MJC and AKW: the manuscript’s guarantors) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained. The corresponding author had full access to all of the data and the final responsibility to submit for publication.

Competing Interests. All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years. DMA reports research funding from AbbVie, Almirall, Celgene, Eli Lilly, Novartis, Janssen, UCB and the Leo Foundation outside the submitted work. MKR has received consulting fees and non-promotional lecture fees from Novo Nordisk in relation to cardiovascular disease and diabetes. The company has had no role in influencing the proposed study and is not expected to benefit from this work. Outside the submitted work, MKR reports receiving research funding from Novo Nordisk, consultancy fees from Novo Nordisk and Roche Diabetes Care, and modest owning of shares in GlaxoSmithKline. NM reports honorarium for presentations from Napp Pharmaceuticals, Novo Nordisk, Sanofi, MyLan, Boehringer Ingelheim, Lilly Diabetes, Abbott, Omnia-Med, Takeda UK and AstraZeneca. All other authors declare no competing interests. There are no other relationships or activities that could appear to have influenced the submitted work.

The funding source had no role in the study design, data collection, data analysis, data interpretation, or writing of the report.

Data sharing. All clinical codes used in the study are published on Clinicalcodes.org. Electronic health records are, by definition, considered “sensitive” data in the UK by the Data Protection Act and cannot be shared via public deposition because of information governance restriction in place to protect patient confidentiality. Access to data are available only once approval has been obtained through the individual constituent entities controlling access to the data. The primary
Care data can be requested via application to the Clinical Practice Research Datalink (www.cprd.com).

**Funding.** This work is funded by the National Institute for Health Research (NIHR) Greater Manchester Patient Safety Translational Research Centre. The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.
Figure 1. Observed and expected care process rates in people with type 2 diabetes during 2019 and 2020, in England

(a) HbA1c
(b) Blood pressure
(c) Cholesterol
(d) Serum creatinine
(e) Urine albumin
(f) BMI
Figure 2. Stratified care process rates in people with type 2 diabetes during 2019 and 2020, in England

(a) HbA1c
(b) Blood pressure
(c) Cholesterol
(d) Serum creatinine
(e) Urine albumin
(f) BMI

Younger, not deprived, male
Younger, deprived, male
Older, not deprived, male
Older, deprived, male
Younger, not deprived, female
Younger, deprived, female
Older, not deprived, female
Older, deprived, female
## Table 1. Comparison of observed and expected rates of diabetes-related care process implementation and new medication initiation in people with type 2 diabetes between March and December 2020 and in April 2020, in England

| Care processes    | Between March and December 2020 | April 2020 |
|-------------------|---------------------------------|-------------|
|                   | Observed Frequency | Expected Frequency (95% CI) | Percentage Reduction (95% CI) | Observed Frequency | Expected Frequency (95% CI) | Percentage Reduction (95% CI) |
| HbA1c             | 573,172             | 833,676 (808,345 to 859,800) | 31.2 (29.1 to 33.3) | 19,365             | 85,075 (82,493 to 87,738)   | 77.2 (76.5 to 77.9) |
| Blood pressure    | 522,907             | 990,146 (956,661 to 1,024,803) | 47.2 (45.3 to 49.0) | 17,652             | 100,551 (97,156 to 104,065) | 82.4 (81.8 to 83.0) |
| Cholesterol       | 321,728             | 462,829 (446,824 to 479,407) | 30.5 (28.0 to 32.9) | 5831               | 47,196 (45,565 to 48,885)   | 87.6 (87.2 to 88.1) |
| Serum creatinine  | 635,863             | 888,188 (857,708 to 919,751) | 28.4 (25.9 to 30.9) | 21,662             | 89,467 (86,399 to 92,645)   | 75.8 (74.9 to 76.6) |
| Urine albumin     | 244,389             | 338,493 (319,151 to 359,007) | 27.8 (23.4 to 31.9) | 4447               | 33,087 (31,197 to 35,092)   | 86.6 (85.7 to 87.3) |
| BMI               | 352,263             | 590,024 (567,077 to 613,899) | 40.3 (37.9 to 42.6) | 12,051             | 58,423 (56,149 to 60,789)   | 79.4 (78.5 to 80.2) |

### New medication

#### Antidiabetic

|              | Observed Frequency | Expected Frequency (95% CI) | Percentage Reduction (95% CI) | Observed Frequency | Expected Frequency (95% CI) | Percentage Reduction (95% CI) |
|--------------|--------------------|-----------------------------|-------------------------------|--------------------|-----------------------------|-------------------------------|
| DPP-4i       | 2722               | 4148 (3847 to 4473)         | 34.4 (29.2 to 39.1)           | 190                | 455 (422 to 490)            | 58.2 (55.0 to 61.2)           |
| GLP-1ag      | 525                | 712 (633 to 800)            | 26.3 (17.1 to 34.4)           | 25                 | 78 (69 to 88)               | 67.9 (63.8 to 71.6)           |
| Insulin      | 1467               | 1245 (1164 to 1331)         | -17.8 (-26.0 to -10.2)        | 126                | 146 (136 to 156)            | 13.7 (7.4 to 19.2)            |
| Metformin    | 15,055             | 18,883 (18,026 to 19,781)   | 20.3 (16.5 to 23.9)           | 845                | 2162 (2065 to 2265)         | 60.9 (59.1 to 62.7)           |
| SGLT2i       | 2852               | 4183 (3856 to 4786)         | 31.8 (22.0 to 40.4)           | 154                | 440 (385 to 504)            | 65.0 (60.0 to 69.4)           |
| Sulphonylurea | 2582               | 2579 (2432 to 2735)         | -0.1 (-6.2 to 5.6)            | 183                | 304 (287 to 322)            | 39.8 (36.2 to 43.2)           |
| Any 1        | 15,652             | 19,261 (18,407 to 20,155)   | 18.7 (15.0 to 22.3)           | 888                | 2219 (2120 to 2321)         | 60.0 (58.1 to 61.7)           |

#### Antihypertensive

|              | Observed Frequency | Expected Frequency (95% CI) | Percentage Reduction (95% CI) | Observed Frequency | Expected Frequency (95% CI) | Percentage Reduction (95% CI) |
|--------------|--------------------|-----------------------------|-------------------------------|--------------------|-----------------------------|-------------------------------|
| ACEi         | 3012               | 3883 (3648 to 4134)         | 22.4 (17.4 to 27.1)           | 153                | 437 (410 to 465)            | 65.0 (62.7 to 67.1)           |
| α-blocker    | 1165               | 1563 (1474 to 1658)         | 25.5 (21.0 to 29.7)           | 101                | 171 (161 to 182)            | 40.9 (37.3 to 44.5)           |
| ARB          | 1076               | 1534 (1433 to 1641)         | 29.9 (24.9 to 34.4)           | 74                 | 177 (166 to 190)            | 58.2 (55.4 to 61.1)           |
| β-blocker    | 1689               | 2009 (1903 to 2121)         | 15.9 (11.2 to 20.4)           | 157                | 224 (212 to 237)            | 29.9 (25.9 to 33.8)           |
| Category          | Count | Lower Limit (Upper Limit) | Mean (95% CI) | Median (95% CI) | Any Lower Limit (Upper Limit) | Any Mean (95% CI) | Any Median (95% CI) |
|-------------------|-------|---------------------------|---------------|----------------|-------------------------------|------------------|-------------------|
| **CC-blocker**    | 2255  | 2994 (2825 to 3172)       | 24.7 (20.2 to 28.9) | 192            | 333 (314 to 353)             | 42.3 (38.9 to 45.6) |
| **Diuretic**      | 1843  | 2101 (1982 to 2226)       | 12.3 (7.0 to 17.2)  | 147            | 238 (225 to 252)             | 38.2 (34.7 to 41.7) |
| **Any**           | 3430  | 4376 (4159 to 4604)       | 21.6 (17.5 to 25.5) | 244            | 491 (467 to 517)             | 50.3 (47.8 to 52.8) |
| **Lipid-lowering**|       |                           |                |                |                               |                  |                   |
| **Statin**        | 8436  | 8041 (7436 to 8695)       | -4.9 (-13.4 to 3.0) | 434            | 868 (803 to 939)             | 50.0 (46.0 to 53.8) |
| **Ezetimibe**     | 224   | 193 (157 to 236)          | -16.1 (-42.7 to 5.1) | 24             | 21 (17 to 26)                | -14.3 (-41.2 to 7.7) |
| **Fibrate**       | 97    | 90 (76 to 107)            | -7.8 (-27.6 to 9.3) | <5             | -                             | -                 |                   |
| **Any**           | 8428  | 8040 (7436 to 8693)       | -4.8 (-13.3 to 3.0) | 434            | 869 (803 to 939)             | 50.1 (46.0 to 53.8) |
| **Antiplatelet**  |       |                           |                |                |                               |                  |                   |
| **Aspirin**       | 1268  | 1163 (1084 to 1247)       | -9.0 (-17.0 to -1.7) | 133            | 133 (124 to 143)             | 0 (-7.3 to 7.0)  |
| **Clopidogrel**   | 888   | 1158 (1038 to 1291)       | 23.3 (14.5 to 31.2) | 82             | 120 (107 to 134)             | 31.7 (23.4 to 38.8) |
| **Other**         | 237   | 239 (193 to 295)          | 0.8 (-22.8 to 19.7) | 17             | 26 (21 to 33)                | 34.6 (19.0 to 48.5) |
| **Any**           | 1592  | 1515 (1419 to 1617)       | -5.1 (-12.2 to -1.5) | 153            | 170 (159 to 181)             | 10.0 (3.8 to 15.5) |

1. Also includes α-glucosidase inhibitors, meglitinides, and thiazolidinediones (glitazones).
2. Also includes central-acting agents, peripheral adrenergic inhibitors, and vasodilators.
3. Also includes cholestyramine, colesvelam, colestipol, niacin, lomitapide, and PCSK9 inhibitors.
4. Includes cangrelor, dipyridamole, glycoprotein inhibitors, prasugrel, and ticagrelor.
**Figure 3.** Observed and expected rates of new medication initiation in people with type 2 diabetes during 2019 and 2020, in England.
**Figure 4.** Observed and expected new and repeat medication prescribing rates in people with type 2 diabetes during 2019 and 2020, in England

(a) Antidiabetic  
(b) Antihypertensive  
(c) Lipid-lowering  
(d) Antiplatelet