Comparing Detection, Treatment, Outcomes, and Spending for Patients with Type 2 Diabetes Between Medicare Advantage and Fee-For-Service Medicare

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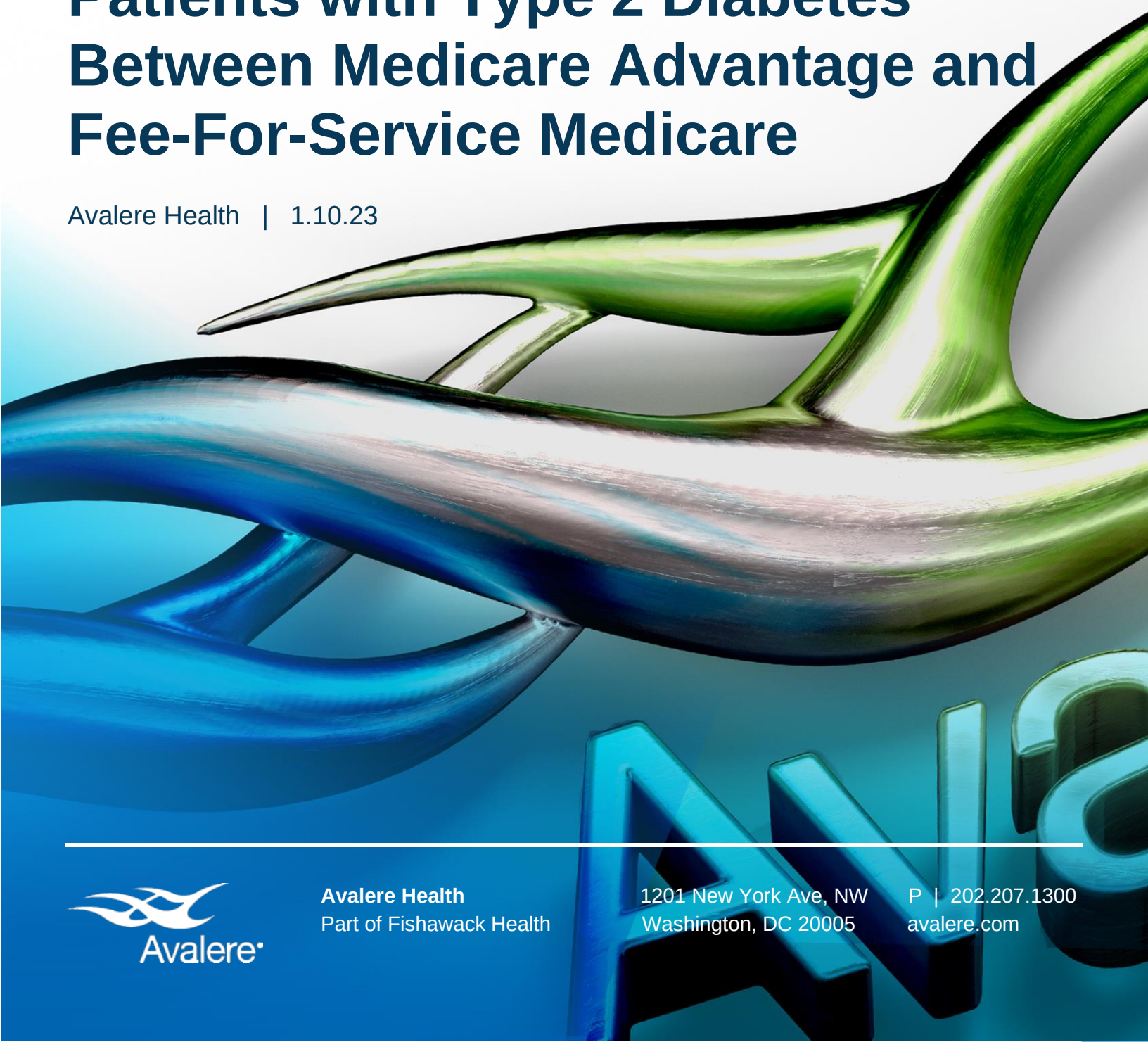

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Avalere

Executive Summary

Nearly one third of people aged 65 and older have type 2 diabetes—a chronic condition that significantly worsens health status.[1] With half of those eligible now enrolled in a Medicare Advantage (MA) plan, policymakers are focused on assessing the clinical impact of the MA model on diseases such as diabetes. [2] In this research, Avalere examined differences in type 2 diabetes detection, treatment, outcomes, and spending between matched patients in MA and Fee-for-Service (FFS) Medicare at three distinct disease phases:

1. **prediabetes**, when a patient has a prediabetes diagnosis,
2. **incident diabetes**, when a patient is first diagnosed with type 2 diabetes, and
3. **chronic diabetes**, when a patient has had type 2 diabetes for more than one year.

Avalere created cohorts for each disease phase, comprised of matched comparison groups of MA and FFS patients.

Findings

- Among patients with prediabetes who developed type 2 diabetes:
  - MA patients received a type 2 diabetes diagnosis earlier (relative to the date of the prediabetes diagnosis) than FFS patients, and
  - MA patients had a lower diabetes severity score at diagnosis than FFS patients.
- Among patients with incident diabetes, MA patients were more likely than FFS patients to fill prescriptions for medications to treat diabetes and related conditions within the first year of diagnosis.
  - Similarly high shares of MA and FFS patients filled prescriptions for blood pressure and cholesterol medications.
- Among patients with chronic diabetes:
  - Similarly high shares of MA and FFS patients visited primary care providers,
  - MA patients were more likely than FFS patients to receive preventive care, including diabetes-related office visits and testing for kidney disease, and
  - MA patients were less likely than FFS patients to require dialysis.
- Among patients with prediabetes and diabetes:[3]
  - MA patients had fewer emergency department visits and hospital admissions than FFS patients,
  - Both MA and FFS patients rarely had avoidable hospital admissions, and
  - Total medical spending was lower for MA patients than FFS patients. However, among patients with diabetes, MA patients had higher diabetes-related spending than FFS patients.
- Among dual eligible patients with diabetes (i.e., patients who are enrolled in both Medicare and Medicaid), MA patients were more likely than FFS patients to visit a primary care provider and fill prescriptions for diabetes medications. Total medical spending was lower for these MA patients than these FFS patients.

[1] Diabetes Disparities in Medicare Fee-For-Service Beneficiaries. CMS. November 2021: https://www.cms.gov/About-CMS/Agency-Information/OMH/Downloads/Data-Snapshots-Diabetes.pdf
[2] 2022 Medicare Trustees Report, Table IV.C1.—Private Health Plan Enrollment, p. 157. https://www.cms.gov/files/document/2022-medicare-trustees-report.pdf
[3] Patients with diabetes include patients with incident diabetes and patients with chronic diabetes.

Report Organization

First, the report provides background on the prevalence of type 2 diabetes in Medicare. Then, the report describes the methodology used to create the cohorts, along with descriptions of the data sample. Key results are presented in the following five categories: 1) Disease detection and severity, 2) Medications and treatment, 3) Office visits, 4) Acute care, and 5) Medical spending. Given that patients with both Medicare and Medicaid coverage (dual eligible beneficiaries) have higher average spending than those with Medicare only, the next section then focuses on outcomes among dual eligible patients with diabetes. Finally, the appendices hold more detailed methodologies, the full set of results, and the standardized mean differences to provide details on effect size.

Introduction/Background

Over the last 20 years the prevalence of type 2 diabetes among adults in the US has increased considerably. The prevalence of diabetes in the Medicare population (ages 65+) is even higher than in younger adults (ages 18 – 64). The spending on care for diabetes is significant at over $240 billion annually, with the Medicare program responsible for nearly 60% of that spending.[4] Additionally, patients with diabetes typically have greater healthcare needs and higher spending leading up to their diabetes diagnosis, highlighting the need to focus on treatment of patients with prediabetes and those at risk for diabetes.[5]

In addition to early detection, diabetes progression can be effectively managed through early and active pharmaceutical treatment. A 2020 meta-analysis of cost-effective treatments for diabetes found routine screening for diabetes and taking angiotensin-converting enzyme inhibitors (ACEs)/angiotensin receptor blockers (ARBs) to be cost saving in managing hypertension and preventing kidney disease in patients with diabetes. This same study also found lipid-lowering medications (i.e., statins) to be cost-effective in prevention of cardiovascular complications in patients with diabetes.[6] Multiple studies have found an association between medication adherence and fewer emergency department visits and inpatient admissions among patients with diabetes.[7,8,9,10,11]

Care coordination and management also impact outcomes for patients with diabetes. Without proper management, adverse events such as amputations and kidney disease can occur more frequently. The Centers for Disease Control and Prevention (CDC) reports that 85% of diabetes-related amputations could be prevented through routine healthcare services such as foot exams and patient education.[12] Provision of care coordination and care management services may differ depending on whether a patient has Medicare Advantage (MA) or Fee-For-Service (FFS) coverage. For example, MA patients in managed care plans often have a central provider (i.e., a primary care provider) to coordinate and

[4] American Diabetes Association. Economic costs of diabetes in the US in 2017. Diabetes Care. 2018;41:917–928. https://diabetesjournals.org/care/article/41/5/917/36518/Economic-Costs-of-Diabetes-in-the-U-S-in-2017

[5] Khan T, Yang J, Wozniak G. "Trends in Medical Expenditures Prior to Diabetes Diagnosis: The Early Burden of Diabetes." Popul Health Manag. 2021 Feb;24(1):46-51. doi: 10.1089/pop.2019.0143. Epub 2020 Feb 3. PMID: 32013762; PMCID: PMC7875131.

[6] Siegel KR, Ali MK, Zhou X, Ng BP, Jawanda S, Proia K, Zhang X, Gregg EW, Albright AL, Zhang P. Cost-effectiveness of interventions to manage diabetes: has the evidence changed since 2008? Diabetes Care 2020;43:1557–1592

[7] Singh N, Armstrong DG, Lipsky BA. "Preventing foot ulcers in patients with diabetes." JAMA Vol 293, 2 (2005):217–228 https://doi.org/10.1001/jama.293.2.217

[8] Hahr AJ, Molitch ME, "Management of diabetes mellitus in patients with chronic kidney disease." *Clin Diabetes Endocrinol* Vol 1, 2 (2015) https://doi.org/10.1186/s40842-015-0001-9

[9] Hepke KL, Martus MT, Share DA, "Costs and utilization with pharmaceutical adherence in a diabetic population." Am J Manag Care, Vol 10 (2004):144–51. PMID: 15005507

[10] Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. Patient Prefer Adherence. 2016 Jul 22;10:1299-307. doi: 10.2147/PPA.S106821. PMID: 27524885; PMCID: PMC4966497.

[11] Landon BE, Zaslavsky AM. Souza J, Ayanian JZ, "Use of Diabetes Medications in Traditional Medicare and Medicare Advantage," The American Journal of Managed Care, Vol (2021):27, no. 3 https://www.ajmc.com/view/use-of-diabetes-medications-in-traditional-medicare-and-medicare-advantage

[12] Cost-Effectiveness of Diabetes Interventions; 2022. National Center for Chronic Disease Prevention and Health Promotion. Accessed at: https://www.cdc.gov/chronicdisease/programs-impact/pop/diabetes.htm

manage their care and the capitated payment model in MA further incentivizes coordination and active management. In contrast, while patients in traditional FFS Medicare may have access to a broader set of providers than those in MA plans, there is not always a central provider with strong incentives to coordinate care.[13]

With half of those eligible now enrolled in MA plans, policymakers are focused on assessing the effectiveness of the MA model and understanding the differences in service use and outcomes in MA compared to FFS. MA enrollment more than doubled between 2012 and 2022, from 13.1 million to 29.1 million beneficiaries, and the Medicare Trustees project that by 2031 53% of Medicare beneficiaries will be in an MA plan.[14,15] Given the growth in MA enrollment and the prevalence and financial burden of diabetes, this study focuses on differences in time to diagnosis (detection), treatment, outcomes, and spending on diabetes among Medicare beneficiaries in MA compared to those in FFS.

[13] Landon BE, Zaslavsky AM, Saunders RC, Pawlson LG, Newhouse JP, Ayanian JZ. Analysis Of Medicare Advantage HMOs compared with traditional Medicare shows lower use of many services during 2003-09. Health Aff (Millwood). 2012 Dec;31(12):2609-17. doi: 10.1377/hlthaff.2012.0179. PMID: 23213144; PMCID: PMC3587962.

[14] CMS, "Medicare Advantage/Part D Contract and Enrollment Data," enrollment as of July 2012 and July 2022. https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/mcradvpartdenroldata.

[15] The Board of Trustees, "2022 Annual Report of the Board of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds," June 2022, https://www.cms.gov/files/document/2022-medicare-trustees-report.pdf

Definitions

To streamline verbiage across populations, cohorts, and time periods, common language used throughout the report is outlined here.

- **Index date:** The index date is the first inpatient or outpatient qualifying diabetes (or prediabetes for prediabetes cohort) event (diagnosis or filled prescription) within the study period. The pre-period refers to the 12-months preceding that index date (pre-index) and the post-period refers to either: 1) the 24-months following the index date for patients identified with prediabetes or 2) the 36-months following the index date for patients identified as having incident or chronic type 2 diabetes (post-index).
- **Type 2 diabetes disease cohorts**: Separate, disease phase based, cohorts of patients with type 2 diabetes were investigated. Propensity score matching (PSM) between MA and FFS patients was performed separately for each disease phase. More detail on matching is described in the Methods section.
  1. **Prediabetes**: when a patient has a prediabetes diagnosis. These patients were evaluated for 1 year (12 months) pre-index and 2 years (24 months) post-index in this study.
  2. **Incident diabetes**: when a patient is first diagnosed with type 2 diabetes. These patients were evaluated for 1 year (12 months) pre-index and 3 years (36 months) post-index in this study.
  3. **Chronic diabetes**: when a patient has had type 2 diabetes for more than one year. These patients were evaluated for 1 year (12 months) pre-index and 3 years (36 months) post-index in this study.
- **Full sample:** This refers to the entire matched sample of prediabetes, incident, and chronic diabetes patients for both MA and FFS Medicare. The full sample includes both dual eligible beneficiaries (eligible for both Medicare and Medicaid) and non-dual eligible beneficiaries. For example, a sentence that describes the incident cohort in the full sample refers to the matched patients with incident type 2 diabetes for MA and FFS including dual eligible beneficiaries and non-dual eligible beneficiaries. All results in the Key Findings are shown for the full sample, unless otherwise noted. Specifically, all results concentrated on the sub-population of dual eligible beneficiaries are found in the last section of Key Findings, called Dual Eligible Beneficiaries.
- **Post-index results:** When discussing results in the post-index period, these will be referred to as “on average post-index” or “averaged across post-index,” unless otherwise noted. This means that the results are averaged across the entire post-index period, which is 24 months for the prediabetes cohort and 36 months for the incident and chronic cohorts.
- **Medical spending:** Total and diabetes-related medical spending (referred to as total medical spending and diabetes-related medical spending, respectively in this report) for MA enrollees was calculated based on FFS spending to ensure that any differences between MA and FFS Medicare are reflective of differences in utilization rather than differences in contracted amounts.[16]

[16] To calculate spending for MA enrollees, a model was developed from the FFS cohorts to predict total medical spending (both Medicare program spending plus beneficiary responsibility). FFS spending estimates from the model were then applied to MA patients to estimate what the Medicare FFS spending would have been for services received under MA.

Methods

The data for this study have multiple sources. FFS data were sourced from a 100% sample of Medicare Part A and Part B Medicare FFS claims and enrollment data, accessed by Avalere via a research collaboration with Inovalon, Inc., and governed by a research-focused CMS Data Use Agreement (DUA). The MA data were sourced from the MORE^2 Registry®, accessed by Avalere via a research collaboration agreement with Inovalon, Inc. and were supplemented with data from 2 large MA insurers. In total, the MA data included in this analysis comprise over half of MA enrollment nationwide.

Inclusion criteria required beneficiaries to have prediabetes, as identified by a diagnosis code on 1 inpatient or 2 outpatient claims; or type 2 diabetes, identified either by a diagnosis code on 1 inpatient or 2 outpatient claims with ICD-10-CM code E11.x or 1 fill of a diabetes related medication. The data were used to create 6 cohorts, 2 for each disease phase, based on whether a beneficiary was prediabetic (presence of ICD-10-CM codes R73.01, R73.02, or R73.03), newly (incident) diabetic (presence of ICD-10-CM code E11.x), or previously diagnosed (chronic) diabetic (**Appendix A**).

The index year for type 2 diabetes (incident and chronic cohort) was calendar year 2016 with a pre-index period of the prior 12 months and a 3-year follow-up (2017-2019). Because prediabetes codes were new in 2017, the index year for the prediabetic cohort was calendar year 2017 with a 12-month pre-period and a 2-year post-index follow-up (2018-2019). Continuous enrollment was required for the entire 12-month pre-period for all cohorts.

Matched Study Population

Avalere constructed matched comparison groups of MA and FFS patients using propensity score models (PSM) within each phase (patients with prediabetes, incident type 2 diabetes, and chronic type 2 diabetes); the chronic cohort, comprising of patients with previously diagnosed type 2 diabetes, was the largest (Table 1). Variables used in the PSM included demographic characteristics (age, sex, dual status), components of the Diabetes Complications Severity Index (DCSI) score (a measure of diabetes related complications identified through medical claims from the previous 12 months)[17], prior physician visit in the previous 12 months, and area level descriptive measures from the surrounding hospital referral region (HRR)[18] (Appendix B). Mean values of the post-matching sample characteristics are shown in Table 1, and standardized mean differences for all matching variables are shown in Appendix C. The RxRisk score, which is a validated instrument to identify chronic conditions based on pharmacy data was also used in the PSM. [19,20]

[17] Young BA, Lin E, Von Korff M, et al. Diabetes complications severity index and risk of mortality, hospitalization, and healthcare utilization. Am J Manag Care. 2008;14(1):15-23

[18] CMS, "Medicare Geographic Variation – by Hospital Referral Region," 2020. https://data.cms.gov/summary-statistics-on-use-and-payments/medicare-geographic-comparisons/medicare-geographic-variation-by-hospital-referral-region.

[19] Fishman PA, Goodman MJ, Hornbrook MC, Meenan RT, Bachman DJ, O'Keeffe Rosetti MC. Risk adjustment using automated ambulatory pharmacy data: the RxRisk model. Med Care. 2003 Jan;41(1):84-99. doi: 10.1097/00005650-200301000-00011. PMID: 12544546.

[20] Sales AE, Liu CF, Sloan KL, Malkin J, Fishman PA, Rosen AK, Loveland S, Paul Nichol W, Suzuki NT, Perrin E, Sharp ND, Todd-Stenberg J. Predicting costs of care using a pharmacy-based measure risk adjustment in a veteran population. Med Care. 2003 Jun;41(6):753-60. doi: 10.1097/01.MLR.0000069502.75914.DD. PMID: 12773841.

Table 1: Post-Matching Sample Characteristics by Cohort

Description	Prediabetes Cohort		Incident Type 2 Diabetes Cohort		Chronic Type 2 Diabetes Cohort	
	MA	FFS	MA	FFS	MA	FFS
Sample Size (N)	198,518	198,518	162,496	162,496	1,118,221	1,118,221
Age: 0-54	3%	4%	5%	7%	4%	5%
Age: 55-64	7%	6%	11%	9%	10%	9%
Age: 65-69	19%	22%	20%	23%	18%	21%
Age: 70-74	29%	29%	25%	23%	26%	25%
Age: 75-79	21%	20%	18%	16%	20%	19%
Age: 80-84	12%	11%	12%	11%	12%	12%
Age: 85+	8%	8%	10%	11%	9%	10%
Sex: Male	43%	43%	47%	45%	46%	46%
Dual Status: Dual	14%	16%	23%	26%	20%	21%
Has Physician Visit Within 12 Months Prior to Index Date	97%	97%	84%	84%	98%	97%
Acute Myocardial Infarction	1%	1%	2%	2%	2%	2%
Cancer	22%	23%	17%	18%	19%	20%
Pneumonia	3%	3%	6%	6%	5%	5%
Stroke	5%	5%	7%	7%	8%	8%
Transplant	0%	0%	0%	0%	0%	0%
HRR Adjusted Ambulatory Care—Sensitive Condition (ACSC) Discharges per 1,000 Medicare Beneficiaries	48.33 (10.31)	48.15 (10.10)	49.08 (10.89)	48.67 (10.60)	49.72 (10.86)	49.94 (10.46)
HRR Observed /Expected ACSC Adjusted Discharge Ratio	0.98 (0.21)	0.97 (0.20)	0.99 (0.22)	0.98 (0.21)	1.01 (0.22)	1.01 (0.21)
HRR Adjusted Annual Medicare Payments (Parts A&B)	$ 10,694 ($1,531)	$ 10,671 ($1,504)	$ 10,673 ($1,677)	$ 10,704 ($1,657)	$ 10,415 ($1,565)	$ 10,347 ($1,484)
HRR Observed /Expected Adjusted Medicare Payments (Parts A&B)	$ 1.02 ($0.15)	$ 1.02 ($0.14)	$ 1.05 ($0.16)	$ 1.05 ($0.16)	$ 1.02 ($0.15)	$ 1.02 ($0.15)
RX Risk Score	4.58 (2.74)	4.66 (2.71)	4.63 (3.27)	4.70 (3.30)	6.38 (3.00)	6.46 (2.97)

Notes: continuous outcomes are shown as mean (standard deviation); all propensity score modeling results are shown in Appendix C.

Outcomes

This study examined more than 20 measures across 5 outcome types: disease detection and severity at diagnosis, medications and testing, primary care office visits, acute care use, and medical spending **(Table 2)**. All outcomes were measured in 6-month intervals starting with the 6 months prior to the index date and extending 36 months post-index for patients with diabetes (chronic and incident), and 24 months for patients with prediabetes, except when there was a reason for a different time interval for a specific outcome (e.g., preventive care visits recommended to occur annually or examining filled prescription for a medication within 9 months of diagnosis).

Results presented in this report are for the full sample of patients analyzed. All results are statistically significant at the $p \leq 0.05$ level, unless otherwise noted. To further demonstrate effect size, standardized mean differences (SMD) were calculated for all outcomes and these values can be found in **Appendix E**.

Table 2: Outcomes

Outcome	Description of Measures
Disease Detection and Severity	Diabetes related blood tests (such as A1C testing). Diabetes Complications Severity Index (DCSI) [21] score to measure disease severity at type 2 diabetes diagnosis in patients with prediabetes. A higher score means a more severe disease.
Medications and Testing	Oral anti-diabetes medications, insulin, metformin, and ACE/ARBs use, and kidney testing
Office Visits	Primary care visits and evaluation & management (E&M) visits with diabetes diagnosis.
Acute Care	All-cause emergency department (ED) visits, all-cause inpatient admissions, diabetes-related avoidable admissions
Medical Spending	Total medical spending and diabetes-related medical spending.[22]

[21] DCSI is a measure of diabetes related complications identified through medical claims from the previous 12 months. Young BA, Lin E, Von Korff M, et al. Diabetes complications severity index and risk of mortality, hospitalization, and healthcare utilization. Am J Manag Care. 2008;14(1):15-23. For more information on the DCSI see Appendix B

[22] The study calculates MA spending based on average FFS payments per health care event. For a full description of this methodology, see Appendix D

Key Findings

Disease Detection and Severity

Among patients with prediabetes who developed type 2 diabetes, the diagnosis occurred earlier (relative to the date of the prediabetes diagnosis) in MA patients compared to a matched sample of patients in FFS.

- The average time between prediabetes index date and type 2 diabetes diagnosis was 401 days for MA patients compared to 543 days for FFS patients. MA patients in this cohort generally had higher rates of diabetes-related lab tests and office visits with a diabetes diagnosis compared to matched patients in FFS.
- Using medical claims, the observed prevalence of type 2 diabetes during the 24-month follow-up period in the cohort of patients with prediabetes was slightly higher in MA patients compared to the matched sample of patients in FFS (13% in MA vs. 11% in FFS).

Among patients with prediabetes who developed type 2 diabetes during the study period, MA patients had a lower diabetes severity score than a matched sample of patients in FFS.

- Among patients with prediabetes who developed type 2 diabetes, the DCSI score at the time of type 2 diabetes diagnosis was 21% lower in MA patients compared to matched patients in FFS (1.30 in MA vs. 1.65 in FFS). DCSI scores can range from 0 to 13, a higher score represents a higher severity.

When compared to a matched sample of patients in FFS, the percentage of patients with diabetes related testing and visits involving testing, and the rate of E&M visits with a diabetes diagnosis was similar for MA patients with prediabetes but more common in the period before diabetes diagnosis for incident diabetes patients in MA. Diabetes testing, such as fasting glucose, A1C, renal function, and insulin sensitivity tests should be conducted routinely on patients exhibiting symptoms of diabetes and those 45 or older.[23]

- In the prediabetes cohort, on average post-index, diabetes testing rate was similar between MA and the matched FFS sample (61% in MA vs. 60% in FFS).
- Among the incident cohort, in the 6 months before type 2 diabetes diagnosis, 38% of patients in MA compared to 30% of matched patients in FFS had diabetes-related lab tests.
- In the prediabetes cohort, the average post-index rate of office visits with an A1C test was similar between MA and the matched FFS sample (79% in MA vs. 78% in FFS).
- In the incident cohort,12-months pre-index, the rate of office visits with an A1C test was 9 percentage points higher for patients in MA (46% in MA vs. 37% in FFS).
- In the prediabetes cohort, on average post-index, the rate of E&M visits with a diabetes diagnosis was 3 percentage points higher for patients in MA (7% in MA vs. 4% in FFS).
- In the incident cohort, in the first 12 months post-index, the rate of E&M visits with a diabetes diagnosis was 15 percentage points higher for patients in MA (73% in MA vs. 58% in FFS).

[23] National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK): https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

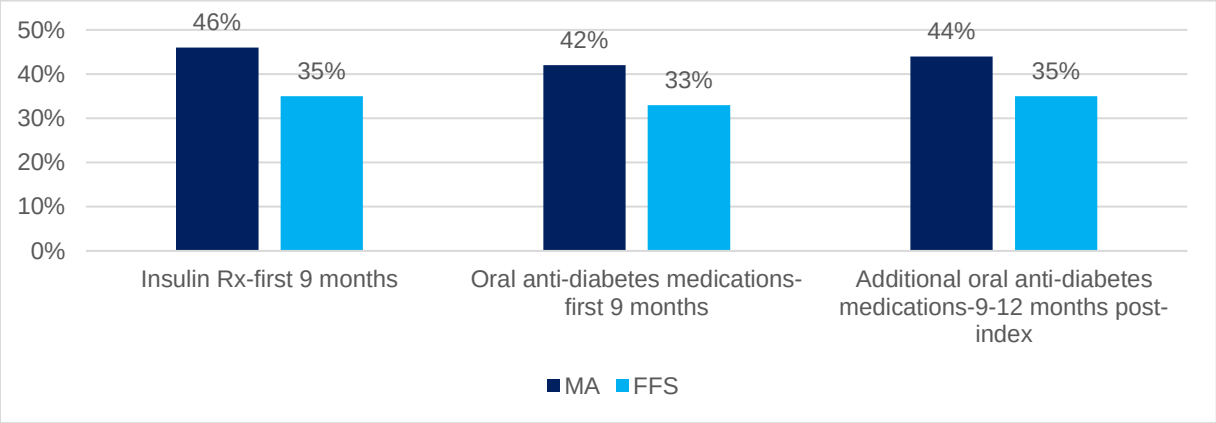
Medications and Testing

A greater share of MA patients than matched FFS patients filled prescriptions for medications for diabetes and other related conditions (e.g., cardiovascular conditions) to prevent or delay diabetes progression and exacerbations in the long term.

Medications for Diabetes Management

- In the first 9 months after diagnosis (incident cohort), patients in MA filled a prescription for insulin more often than those in the matched FFS sample (46% in MA vs. 35% in FFS), and patients in MA more frequently filled a prescription for an oral anti-diabetes medication (42% in MA vs. 33% in FFS).
- Compared to a matched sample of patients in FFS, a greater share of patients in MA with incident type 2 diabetes filled a prescription for an additional oral anti-diabetes medication[24] within 3 months of the initial oral medication (44% in MA vs. 35% in FFS) (**Figure 1**).

Figure 1: Filled Prescriptions Among Patients with Incident Diabetes Within First Year of Type 2 Diabetes Diagnosis



- On average post-index, the percentage of patients who filled insulin prescriptions was higher in MA than a matched sample in FFS in the incident cohort (42% in MA vs. 33% in FFS) and the same (not statistically significantly different) in the chronic cohort (76% in MA and FFS).
- Across all cohorts, prescription fills for metformin, a drug used to lower blood sugar levels, were generally more common for patients in MA compared to a matched sample of patients in FFS. Among patients in the prediabetes cohort, the rate was similar (5% in MA vs. 4% in FFS), whereas the differences were much greater in MA for patients with incident diabetes in the 6 months prior to index (21% in MA vs. 13% in FFS) and the 36 months post-index (32% in MA vs. 27% in FFS). Among patients with chronic diabetes in the 36 months post-index, the percentage of patients with a prescription filled for metformin was slightly higher in MA (49% in MA vs. 47% in FFS).

Medications to Prevent Other Conditions

Because diabetes can lead to cardiovascular and nephropathic comorbidities, patients with diabetes are often prescribed blood pressure reducing medications and angiotensin-converting enzyme inhibitors (ACE)/angiotensin receptor blockers (ARBs).[25]

[24] Anti-diabetes medications include GLP-1 Agonists, Biguanides, DPP-4 inhibitors, and Thiazolidinediones
[25] Grossman, A., Grossman, E. Blood pressure control in type 2 diabetic patients. Cardiovasc Diabetol 16, 3 (2017). https://doi.org/10.1186/s12933-016-0485-3

- Across all cohorts, on average post-index, similarly high shares of MA and matched FFS patients filled prescriptions for blood pressure lowering medications[26] (no statistically significant differences). On average post-index, 74% of patients with prediabetes in both MA and FFS filled prescriptions for a blood pressure lowering medication, 76% of patients with incident diabetes in MA and 75% in the matched FFS sample, and 87% of patients with chronic diabetes in MA and 88% in the matched FFS sample filled prescriptions for blood pressure medications.
- Lipid lowering medications (i.e., statins) are also recommended for those at risk for cardiovascular complications.[27] The percentage of patients with filled prescriptions for lipid lowering medications was slightly higher for people with incident diabetes in MA than the matched sample of patients in FFS; on average post-index, among patients with incident diabetes, 59% of patients in MA and 57% of patients in FFS, and among patients with chronic diabetes 72% of patients in MA and 73% of patients in FFS filled prescriptions for lipid lowering medications (difference not statistically significant in the chronic cohort).
- The percentage of patients with filled prescriptions for ACE/ARBs was slightly higher in MA than in the matched FFS sample; on average post-index, 86% of patients with prediabetes in MA compared to 84% in FFS, 81% of patients with incident diabetes in MA compared to 78% in FFS, and 81% of patients with chronic diabetes in MA compared to 78% in FFS had filled prescriptions for ACE/ARBs.

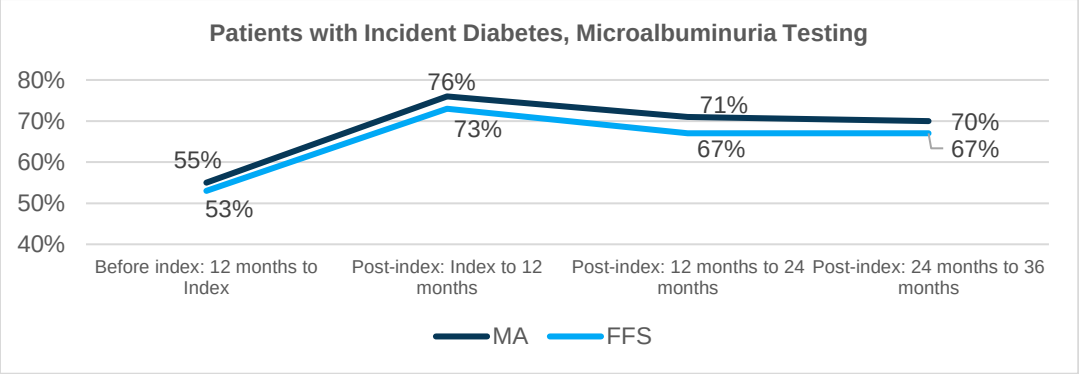
MA patients received more frequent tests for diabetes complications upon type 2 diabetes diagnosis.

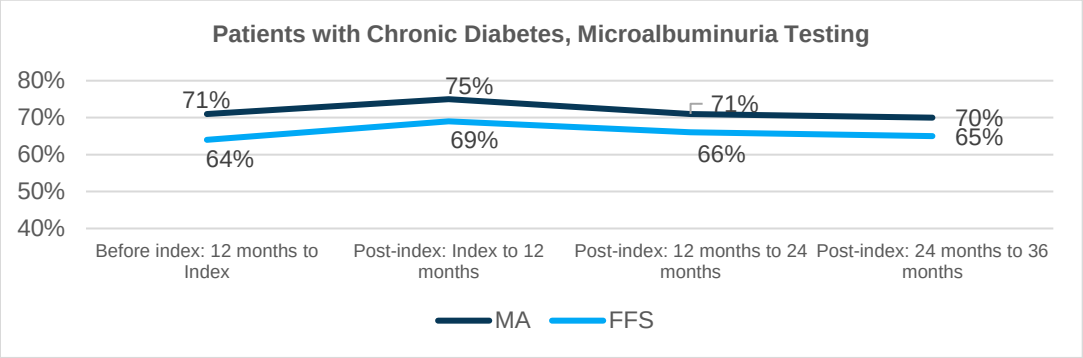
Patients with type 2 diabetes are at higher risk of kidney disease which can lead to end stage renal disease (ESRD) if left untreated; therefore, testing patients with diabetes for kidney disease is important, especially for patients with chronic diabetes.[28]

- Among patients with incident diabetes, patients in MA received testing for microalbuminuria (a urine test to detect early signs of kidney damage) at a slightly higher rate compared to a matched sample of FFS at all time periods both pre- and post-index. These differences in testing rates were greater in the chronic cohorts (**Figure 2**).
- Patients with diabetes are at high risk of kidney disease which can lead to ESRD and, eventually, require dialysis.[29] On average post-index, for the incident cohort, dialysis use was the same (no statistically significant differences) between MA and the matched sample of patients in FFS (0.9%), but in the chronic cohort, dialysis use was lower in the sample of patients in MA (0.9% in MA vs. 1.5% in FFS).[30]

[26] For the incident diabetes and chronic diabetes cohorts, the blood pressure medications measure includes filled prescriptions for antiplatelet medications.
[27] García-Ulloa AC, Lechuga-Fonseca C, Del Razo-Olvera FM On behalf of Group of Study CAIPaDi, et al. Clinician prescription of lipid-lowering drugs and achievement of treatment goals in patients with newly diagnosed type 2 diabetes mellitus BMJ Open Diabetes Research and Care 2021;9:e001891. doi: 10.1136/bmjdrc-2020-001891
[28] Centers for Disease Control and Prevention. Chronic Kidney Disease in the United States, 2021. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2021.: https://www.cdc.gov/kidneydisease/publications-resources/CKD-national-facts.html
[29] Ibid.
[30] This study excluded enrollees with ESRD from the sample, though there was some baseline dialysis in the cohorts (approximately 0.5% in MA and 0.75% in FFS) which could suggest acute kidney disease, rather than ESRD, was leading to dialysis events in this study.

Figure 2: Microalbuminuria Testing by Cohort and Time Period





While use of advanced technology was rare for MA and FFS, a higher percentage of patients in MA used advanced technologies for medication delivery (e.g., pumps and monitoring systems) compared to a matched sample of patients in FFS. Advanced technologies, such as insulin infusion pumps and continuous blood glucose monitoring systems, can improve diabetes management and possibly adherence by making it easier to take and dose medication appropriately.[31]

- Although use of these technologies was rare (they are only relevant to diabetes patients using insulin and similar medications), in the chronic cohort, use of advanced technologies was more common for patients in MA. The percentage of patients using advanced technologies was twice as high in MA compared to a matched sample of FFS patients in the first 6 months post-index (1.03 per 1,000 patients in MA and 0.51 per 1,000 patients in FFS), and the difference increased to a factor of 4 between 30-36 months post-index (3.11 per 1,000 patients in MA and 0.74 per 1,000 patients in FFS).

[31] Landau, Zohar et al. "The role of insulin pump therapy for type 2 diabetes mellitus," Diabetes Metab Res Rev, 2016; 33:e2822. https://doi.org/10.1002/dmrr.2822.

Office Visits

In addition to higher medication use to prevent progression and exacerbations, the percentage of patients with a primary care provider visit[32] was similar in MA and FFS; however, the percentage of patients with E&M visits with a diabetes diagnosis[33] was higher in MA. Overall, the percentage of patients with a primary care provider visit was similar between MA and FFS, except in the incident cohort, where it was lower in MA.

- Among patients with prediabetes, on average post-index, a similar percentage of patients in MA and FFS had a primary care visit (91% for MA vs. 92% for FFS).
- Among patients with incident diabetes, in the 12 months pre-index, a similar percentage of patients in MA and FFS had a primary care visit (69% in MA vs.70% in FFS). On average post-index, a lower percentage of patients with incident diabetes in MA compared to a matched sample of patients with incident diabetes in FFS had a primary care visit (79% in MA vs. 82% in FFS).
- Among patients with chronic diabetes, on average post-index, a similar percentage of patients in MA and FFS had a primary care visit (86% in MA vs. 87% in FFS).

A higher percentage of patients in MA in the incident and chronic diabetes cohorts had E&M visits with a diabetes diagnosis compared to matched patients in FFS.

- Among patients with incident diabetes, on average post-index, a higher percentage of patients in MA had an E&M visit with a diabetes diagnosis compared to FFS (65% in MA vs. 50% in FFS).
- In the chronic diabetes cohort, on average post-index, the percentage of patients in MA with an E&M visit with a diabetes diagnosis was higher than those in FFS (88% in MA vs. 83% in FFS) **(Table 3)**.

Table 3: E&M Visits with a Diabetes Diagnosis, by Cohort and Time Period

Cohort	Prediabetes Cohort		Incident Diabetes Cohort		Chronic Diabetes Cohort	
	MA	FFS	MA	FFS	MA	FFS
Post-index: Index to 12 months	5%	2%	73%	58%	91%	85%
Post-index: 12 months to 24 months	8%	6%	62%	46%	88%	82%
Post-index: 24 months to 36 months	N/A	N/A	60%	46%	86%	82%

[32] Primary care provider visits were defined as an E&M claim with a provider with one of the following specialties: General Practice; Family practice; Internal medicine; Obstetricians & Gynecologists; Geriatric medicine; Nurse practitioner; Multispecialty clinic or group practice; Preventive medicine; Physician assistant

[33] E&M visits with a diabetes diagnosis were defined as a provider specialty agnostic E&M claim with a diabetes diagnosis (E11.X) in any position

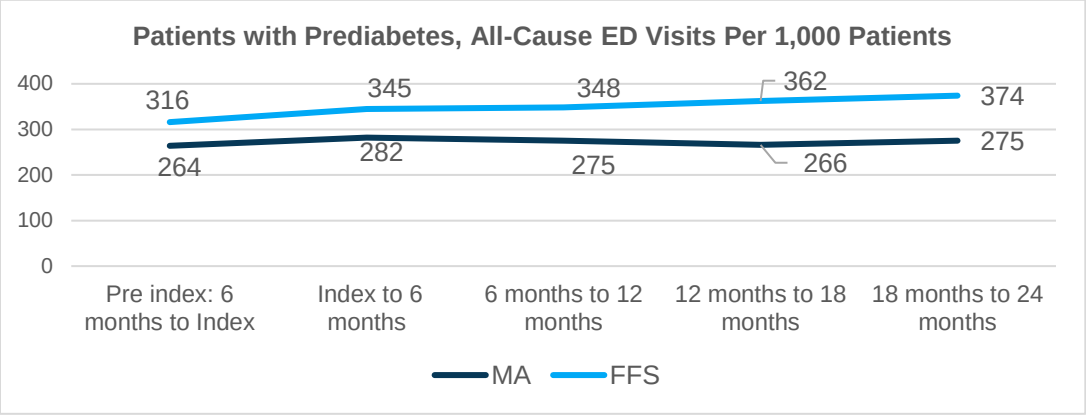
Acute Care

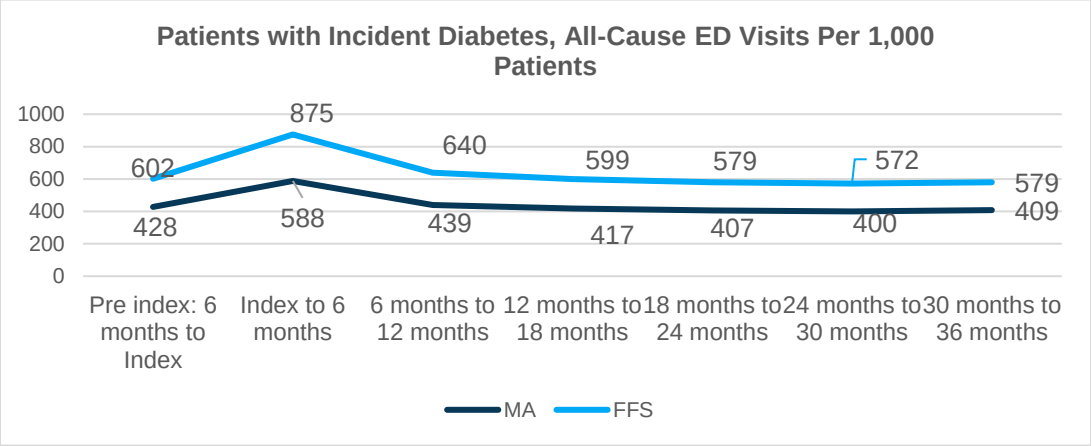
Prediabetes and diabetes patients in MA had fewer all-cause ED visits and inpatient admissions across all time periods, and the difference in visits and admissions for chronic diabetes patients between MA and matched patients in FFS increased across the post-index period.

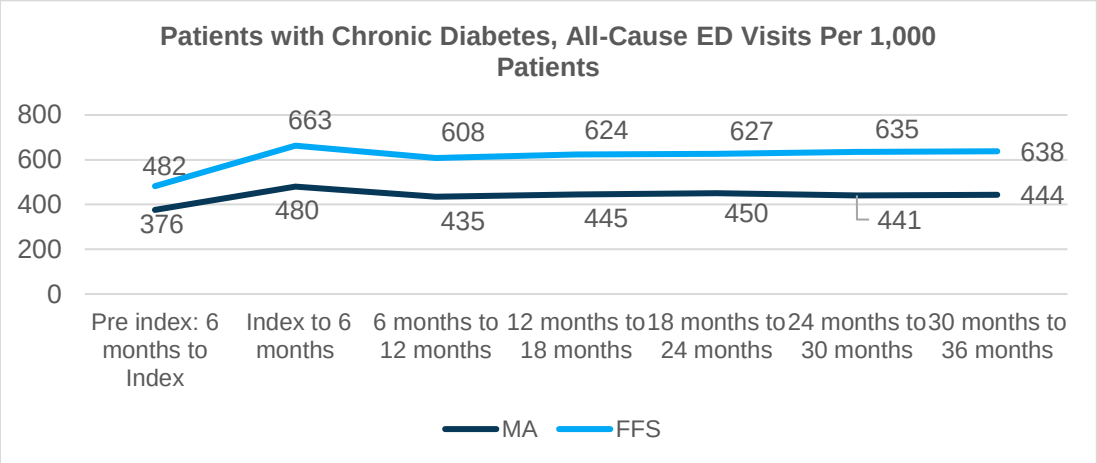
ED Visits

- Among patients with prediabetes, from index to 24 months post-index, the difference in the number of all-cause ED visits in MA relative to the matched FFS sample increased; in the 6 months post-index, there were 63 fewer visits per 1,000 patients in MA compared to FFS, and in the last 6 months of the study (18 to 24 months post-index), there were 99 fewer visits per 1,000 patients in MA than FFS.
- For patients with incident diabetes, the difference in the number of ED visits between MA and FFS peaked in the 6 months post-index with 287 fewer visits per 1,000 patients in MA compared to the matched FFS sample. Over the last 6 months of the post-index period (30 to 36-months) there were still fewer ED visits in MA compared to FFS (170 fewer visits per 1,000 patients in MA) **(Figure 3)**.
- For patients with chronic diabetes, the difference in the number of ED visits from index to 36 months post-index increased from 183 fewer visits per 1,000 patients in MA vs. FFS to 194 fewer visits per 1,000 patients in MA vs. FFS **(Figure 3)**.
- For the incident and chronic cohorts, on average post-index, the rate of all-cause ED visits was 2 percentage points lower among patients in MA compared to the matched FFS sample (23% in MA vs. 25% in FFS).

Figure 3: Number of All-Cause ED Visits Per 1,000 Patients, by Cohort







Inpatient Admissions

- In the prediabetes cohort, on average post-index, the rate of all-cause inpatient hospitalizations was similar between MA patients and the matched patients in FFS (7% in MA vs.8% in FFS).
- In the incident diabetes cohort, in the 6 months pre-index, the rate of all-cause inpatient hospitalizations was slightly lower among MA patients than the matched patients in FFS (15% in MA vs.17% in FFS).
- For both incident and chronic diabetes cohorts, on average post-index, the percentage of patients with an inpatient hospitalization was slightly lower in MA compared to a matched FFS sample (11% in MA vs. 13% in FFS).
- In the chronic diabetes cohort, on average post-index, inpatient visits with diabetes as the primary diagnosis were rare in both the MA and FFS samples (1.1% in MA vs. 0.6% in FFS).

Avoidable hospitalizations were rare events in both MA and FFS. Only 0.6% of both the MA and matched FFS chronic diabetes patients (not statistically significantly different) had an avoidable hospitalization, on average post-index, as defined by the Prevention Quality Indicators (PQI) measure #93 the Prevention Quality Diabetes Composite.[34] The PQI indicators are designed by the Agency for Healthcare Research and Quality to identify admissions as "preventable" if they could have been avoided through high-quality ambulatory care.[35]

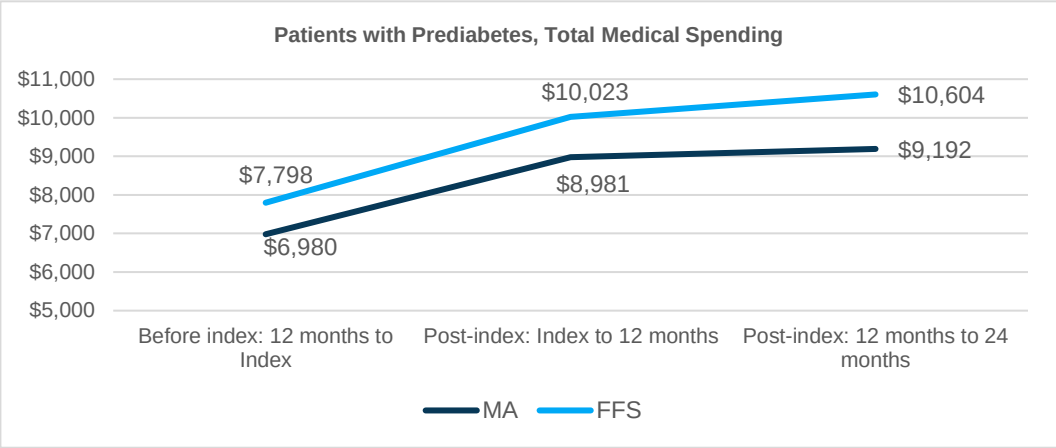
Medical Spending

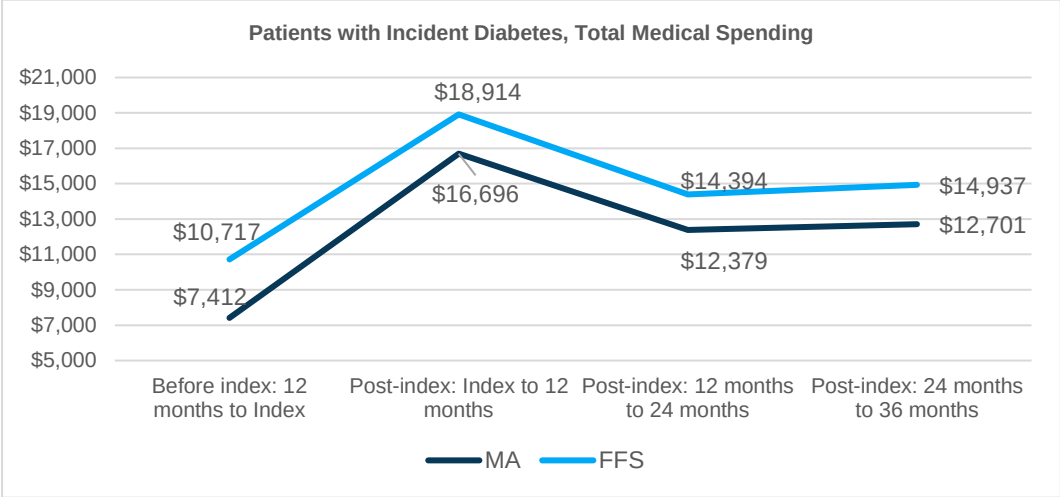
Prediabetes and diabetes patients in MA had lower total medical spending compared to the matched sample of patients in FFS across all time periods.

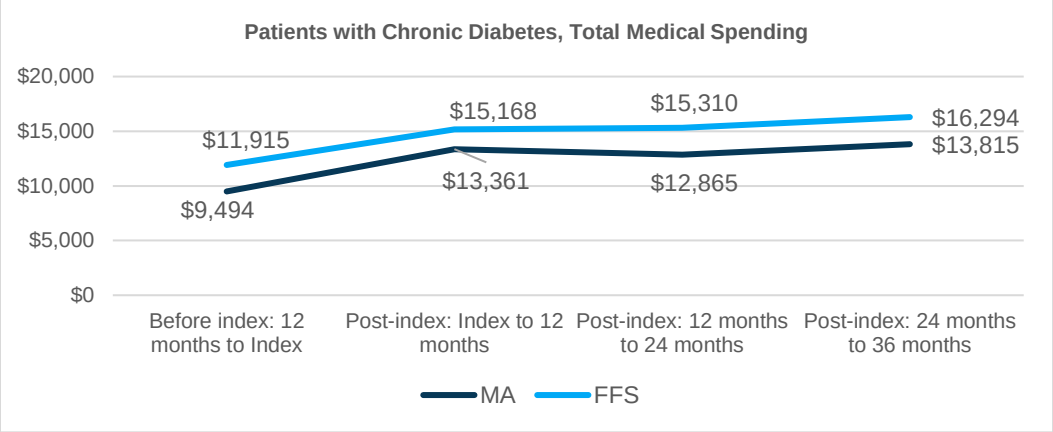
- For patients with prediabetes, average total medical spending per patient per year was 10% lower in MA ($6,980) than for the matched patients in FFS ($7,798) pre-index and 13% lower in MA ($9,192) than for the patients in FFS ($10,604) in the 12-24 months post-index.
- In the incident diabetes cohort, the difference in average total medical spending per patient per year between MA and FFS decreased over time from MA being 31% lower pre-index (MA: $7,412 vs. FFS: $10,717) to 15% lower in the 24-36 months post-index (MA: $12,701 vs. FFS: $14,937).
- In the chronic diabetes cohort, average total medical spending per patient per year in MA was 20% lower than matched patients in FFS pre-index (MA: $9,494 vs. FFS: $11,915) and 15% lower in the 24-36 months post-index (MA: $13,815 vs. FFS: $16,294) **(Figure 4)**.
- Healthcare spending for patients with diabetes have been shown to accelerate immediately after diagnosis.[36] Total medical spending per patient per year for all cohorts increased over the study period, with a spike in the year after initial diagnosis of diabetes (defined as index date in the incident cohort). Increased medical spending around index date in the incident cohort is likely due to increased utilization (more ED use and inpatient visits, and—in the case of patients in MA—higher medication fills and testing) at the time of first diabetes diagnosis. Notably, in the incident cohort, in the first 12 months post-index, average diabetes-related medical spending per patient was higher in MA than FFS (MA: $1,000 vs. FFS: $457).

[34] PQI #93 measures admissions for any of the following: diabetes with short-term complications, diabetes with long-term complications, uncontrolled diabetes without complications, diabetes with lower-extremity amputation.
[35] AHRQ. "Prevention Quality Indicators Overview." https://qualityindicators.ahrq.gov/measures/pqi_resources
[36] Khan T, Yang J, Wozniak G. "Trends in Medical Expenditures Prior to Diabetes Diagnosis: The Early Burden of Diabetes." Popul Health Manag. 2021 Feb;24(1):46-51. doi: 10.1089/pop.2019.0143. Epub 2020 Feb 3. PMID: 32013762; PMCID: PMC78751

Figure 4: Average Total Medical Spending per Patient over a 12-Month Period







Dual Eligible Beneficiaries

Medicare beneficiaries dually eligible for Medicaid are low income and have higher rates of disability and multiple co-morbidities.[37] While comprising 20% of the Medicare population, dual eligible beneficiaries account for 34% of total Medicare spending.[38] Understanding treatment, outcomes, and spending on type 2 diabetes in the dual eligible population is especially important because limited research has focused specifically on this prevalent disease in this population.

Outcome differences observed between MA and matched patients in FFS in the full sample (which includes dual eligible and non-dual eligible beneficiaries) and the subset of the sample that are only dual eligible for Medicare and Medicaid were similar in direction and magnitude, with a few exceptions. The biggest differences between the full sample and dual eligible beneficiary sample were seen in filled prescriptions for insulin, primary care provider visits, E&M visits with a diabetes diagnosis, all-cause ED visits, and total calculated medical spending, where differences between MA and FFS were more pronounced for the dual eligible sample. The direction of the difference in primary care provider visits (between MA and FFS) switches from a slightly lower percentage of primary care provider visits in MA, in the full sample, to a higher percentage of primary care provider visits in MA, among duals. See **Table 4** below for more details.

[37] MACPAC. "Dually Eligible Beneficiaries." https://www.macpac.gov/topics/dually-eligible-beneficiaries/#:~:text=Dually%20eligible%20beneficiaries%20accounted%20for%20a%20disproportionate%20share,which%20Medicaid%20accounted%20for%20%24164.3%20billion%20%2837%20percent%29.

[38] CMS Fact Sheet. People Dually Eligible for Medicare and Medicaid https://www.cms.gov/Medicare-Medicaid-Coordination/Medicare-and-Medicaid-Coordination/Medicare-Medicaid-Coordination-Office/Downloads/MMCO_Factsheet.pdf

Table 4: Outcomes with Greatest Difference Between Full Sample and Dual Eligible Beneficiaries

Outcome (averaged across post-index period)	Prediabetes Cohort			Incident Cohort			Chronic Cohort		
	MA	FFS	Difference (MA-FFS)	MA	FFS	Difference (MA-FFS)	MA	FFS	Difference (MA-FFS)
Full Sample (Dual Eligible + Non-dual Eligible Beneficiaries)									
E&M Visit with Diabetes Dx	18%	4%	14 pp	65%	50%	15 pp	88%	83%	5 pp
Primary Care Provider Visit	91%	92%	-1 pp	79%	82%	-3 pp	86%	87%	-1 pp
Prescription for Insulin	5%	4%	1 pp	42%	33%	9 pp	76%	76%	0 pp
All Cause ED visits	16%	17%	-1 pp	23%	25%	-2 pp	23%	25%	-2 pp
Total Medical Spending (mean)	$9,087	$10,314	-$1,227	$13,925	$16,082	-$2,157	$13,347	$15,591	-$2,244
Dual Eligible Beneficiaries Only									
E&M Visit with Diabetes Dx	12%	5%	7 pp	63%	42%	21 pp	81%	73%	8 pp
Primary Care Provider Visit	89%	83%	6 pp	75%	71%	4 pp	80%	77%	3 pp
Prescription for Insulin	8%	6%	2 pp	46%	34%	12 pp	80%	77%	3 pp
All Cause ED visits	23%	26%	-3 pp	29%	33%	-4 pp	29%	34%	-5 pp
Total Medical Spending (mean)	$10,780	$11,622	-$842	$16,045	$19,867	-$3,822	$15,764	$19,568	-$3,804

pp = percentage point

Among dual eligible beneficiaries, the following findings were observed:

- **In all cohorts, prescriptions filled for lipid lowering medications and blood pressure lowering medication were higher in MA dual eligible beneficiaries than in FFS dual eligible beneficiaries. Prescription fills for these medications were similar between MA and FFS among the full sample.**
  - On average post-index, in the full sample, the percentage of patients with prescriptions filled for lipid lowering agents were similar between MA and FFS (1-2 percentage point difference across all cohorts). In the same time period, among dual eligible beneficiaries, a higher percentage of MA patients filled prescriptions for lipid lowering agents compared to FFS across all cohorts, with the greatest differences among patients with prediabetes (60% in MA dual eligible beneficiaries vs. 55% in FFS dual eligible beneficiaries) and incident diabetes (57% in MA dual eligible beneficiaries vs. 53% in FFS dual eligible beneficiaries).
  - Among the full sample, within the first 12 months post-index, the percentage of prediabetes patients with a filled prescription for blood pressure lowering medication was the same in MA and FFS (74% for both MA and FFS). However, among dual eligible beneficiaries with prediabetes in MA, the percentage of patients with a filled prescription for blood pressure lowering medication was higher compared to dual eligible beneficiaries with prediabetes in FFS (75% in MA dual eligible beneficiaries vs. 71% in FFS dual eligible beneficiaries).

- **A higher percentage of MA patients filled a prescription for insulin than the matched sample of patients in FFS across all cohorts, in both the full sample and among dual eligible beneficiaries, with the differences more pronounced among dual eligible patients with incident and chronic diabetes**.
  - In the full sample, in the incident cohort, on average post-index, the percentage of patients who filled insulin prescriptions was 9 percentage points greater in MA when compared to FFS (42% in MA vs. 33% in FFS). The difference was more pronounced for dual eligible beneficiaries in the incident cohort for the same time period (12 percentage points greater for MA dual eligible beneficiaries than FFS dual eligible beneficiaries: 46% in MA dual eligible beneficiaries vs. 34% in FFS dual eligible beneficiaries).
  - Among the full sample with chronic diabetes, on average post-index, the percentage of patients who filled insulin prescriptions was the same between MA and FFS (76%), but among dual eligible beneficiaries in the chronic diabetes cohort, the percentage of patients who filled insulin prescriptions was 3 percentage points higher in MA (80% in MA dual eligible beneficiaries vs. 77% in FFS dual eligible beneficiaries).

- **For dual eligible beneficiaries across all cohorts, the percentage of patients with a primary care visit was higher in MA compared to patients in FFS, while the percentage of patients with a primary care visit was similar in MA and FFS among the full sample.**
  - In the full sample, for the incident diabetes cohort, across the post-index period, the percentage of patients in MA with a primary care visit was 3 percentage points lower than matched patients in FFS (79% in MA vs. 82% in FFS). However, for dual eligible beneficiaries with incident diabetes in the same time period, there was a higher percentage of MA dual eligible beneficiaries with a primary care visit compared to FFS dual eligible beneficiaries (4 percentage points higher: 75% in MA dual eligible beneficiaries vs. 71% in FFS dual eligible beneficiaries).
  - Among the full sample, in the chronic diabetes cohort, across the post-index period, there was a similar percentage of patients with primary care visits between MA and matched patients in FFS (86% in MA vs. 87% in FFS). However, among dual eligible beneficiaries with chronic diabetes, a higher percentage of MA dual eligible beneficiaries had a primary care visit compared with FFS dual eligible beneficiaries (80% in MA dual eligible beneficiaries vs. 77% in FFS dual eligible beneficiaries).

- **Similar to the full sample, E&M visits with a diabetes diagnosis occurred more frequently among MA dual eligible beneficiaries compared to FFS dual eligible beneficiaries, but with greater differences between MA and FFS for dual eligible patients with incident and chronic diabetes.**
  - In the full sample, among patients with incident diabetes, on average post-index, a higher percentage of MA patients had E&M visits with a diabetes diagnosis than FFS patients (65% in MA vs. 50% in FFS). Among dual eligible beneficiaries with incident diabetes, the difference in percentage of MA and FFS patients with E&M visits with a diabetes diagnosis was even greater (63% in MA dual eligible beneficiaries vs. 42% in FFS dual eligible beneficiaries).
  - In the full sample, among chronic diabetes patients, on average post-index, a higher percentage of MA patients had E&M visits with a diabetes diagnosis than FFS patients (88% in MA vs. 83% in FFS). Among dual eligible beneficiaries with chronic diabetes, the difference in percentage of MA and FFS patients with E&M visits with a diabetes diagnosis was even greater (81% in MA dual eligible beneficiaries vs. 73% in FFS dual eligible beneficiaries).

- **Similar to the full sample, there were fewer all-cause ED visits and inpatient visits in MA dual eligible beneficiaries than in FFS dual eligible beneficiaries; the difference between MA and FFS in ED visits was more pronounced for dual eligible beneficiaries in the chronic diabetes cohort.**
  - In the full sample, among those in the chronic diabetes cohort, on average post-index, 23% of patients in MA had an ED visit compared to 25% in FFS.
  - For dual eligible beneficiaries in the chronic diabetes cohort, in the same time period, 29% of patients in MA had an ED visit compared to 34% of patients in FFS. Among dual eligible beneficiaries in the incident and chronic diabetes cohorts, on average post-index, the percentage of patients with a hospital admission was 14% in MA compared to 16% in FFS and 13% in MA compared to 16% in FFS, for respective cohorts. These differences between MA dual eligible beneficiaries and FFS dual eligible beneficiaries are similar to those observed in the full sample.

- **In the full sample across all cohorts, in the post-index period, average total medical spending per patient per year was lower for MA patients compared to FFS and the difference in total medical spending per patient per year between MA and FFS becomes more pronounced among dual eligible beneficiaries in the incident and chronic cohorts.**
  - Among the full sample, in the incident cohort, on average post-index, patients in MA had $2,157 lower average total medical spending per patient per year compared to matched patients in FFS. For dual eligible beneficiaries in the incident cohort MA patients had $3,822 lower average total medical spending per patient per year compared to FFS patients.
  - Similarly, in the full sample, in the chronic diabetes cohort, on average post-index, patients in MA had $2,244 lower average total medical spending per patient per year compared to matched FFS patients. For dual eligible beneficiaries with chronic diabetes, in the same time period, MA patients had $3,804 lower average total medical spending per patient per year compared to FFS patients.

Discussion and Conclusion

Discussion

This study examined differences in type 2 diabetes detection, treatment, outcomes, and spending between MA and FFS Medicare by comparing matched cohorts of patients in each of the three distinct disease phases: (1) prediabetes, when a patient has a prediabetes diagnosis, (2) incident diabetes, when a patient is first diagnosed with type 2 diabetes, and (3) chronic diabetes, when a patient has had the disease for more than one year. Similar cohorts were created between MA and FFS patients using PSM methods on observable characteristics in the claims data. More than 20 outcomes were compared for each set of matched cohorts.

Among patients with prediabetes who were identified with type 2 diabetes in the study period, the diagnosis occurred earlier (relative to the date of the prediabetes diagnosis) in MA compared to a matched sample of patients in FFS. At diagnosis, the MA patients in this cohort had a lower diabetes severity score than those in FFS. Overall, among patients with prediabetes or type 2 diabetes, those enrolled in MA had higher utilization of preventive medications and testing, lower acute care utilization (ED and inpatient visits), and lower total medical spending compared to a matched sample of FFS patients.

Also, among all patients in the prediabetes cohort, a higher percentage of MA patients filled prescriptions for ACE/ARBs in the first year post-index (86%) than FFS patients (83%). Compared to the matched FFS sample, in the first 12 months post-index, a higher percentage of MA patients with incident diabetes filled prescriptions for medications recommended for diabetes and related conditions. In the same time period, a higher percentage of MA patients with incident diabetes had E&M visits with a diabetes diagnosis compared to matched FFS patients. In this study, a higher percentage of MA patients with chronic diabetes filled prescriptions for medications and received tests designed for preventing diabetes complications and managing related comorbidities, such as ACE/ARBs prescriptions and testing for kidney failure, compared to matched patients in FFS. The study further suggests that MA patients with chronic diabetes required dialysis less frequently than patients in FFS.

For some metrics and cohorts, on average post-index, MA patients had similar rates of utilization as compared to FFS. For example, in the prediabetes cohort, the rate of all-cause inpatient hospitalizations was similar between MA patients and the matched patients in FFS (7% in MA vs. 8% in FFS). Among the incident cohort, on average post-index, similar shares of MA and FFS patients filled blood pressure medications. Prescriptions to address potential comorbidities commonly associated with diabetes (e.g., cardiovascular conditions) were highly prevalent among patients in both MA and FFS in the chronic cohort.

More preventive care and disease management throughout three common phases of diabetes progression (i.e., prediabetes, incident diabetes, and chronic diabetes) among patients in MA may have led to the observed more favorable outcomes, including lower all-cause inpatient admissions, fewer ED visits, and lower total medical spending compared to matched patients in FFS.[39] Among patients in MA with incident and chronic diabetes, average post-index total medical spending was approximately $2,200 lower per patient per year compared to matched cohorts of patients with type 2 diabetes in FFS. This difference in total medical spending per patient per year between MA and FFS almost doubles for dual eligible beneficiaries with diabetes (on average post-index, approximately $3,800 per patient per year), with MA dual eligible beneficiaries consistently having lower total medical spending per patient per year

[39] Sungchul Park et al., "Differences in Health Care Utilization, Process of Diabetes Care, Care Satisfaction, and Health Status in Patients With Diabetes in Medicare Advantage Versus Traditional Medicare," Medical Care 58, no. 11 (November 2020): 1004-1012, doi: 10.1097/MLR.0000000000001390

compared to FFS dual eligible beneficiaries across all cohorts. Despite lower total medical spending in the full sample, across the post-index period, patients with diabetes in MA had higher diabetes-related spending compared to matched patients in FFS.

Even small differences at an individual patient level translate to meaningful differences in population-level health outcomes and aggregate Medicare spending. For example, in this study, among those with chronic diabetes, 81% of patients in MA compared to 78% in FFS filled prescriptions for ACE/ARBs. Three percentage points, when considered in the context of the 10.5 million FFS beneficiaries with diabetes (27.5% of 38.2 million Medicare FFS beneficiaries), may represent over 300,000 FFS patients who could have filled prescriptions for evidence-based medications. Similarly, in this study, among those with incident diabetes, in the first 9 months after diabetes diagnosis, 46% of patients in MA compared to 35% in FFS filled prescriptions for insulin. This difference may represent over one million FFS patients who could have filled prescriptions for insulin.

MA plans can employ care coordination activities, which may reduce acute care events for patients with chronic conditions. Managed and coordinated care can steer patients towards the most appropriate setting or treatment, especially for conditions with evidence-based care guidelines as highly protocolized as diabetes. Care management in MA can ensure that patients are being screened and tested early and often, seeing providers when needed, and receiving appropriate preventive care. This care management may explain some of the differences in outcomes and medical spending observed among patients with diabetes in MA compared to FFS.

Limitations

This observational study has limitations. First, although the analysis used rigorous propensity score methods to select appropriate matched cohorts, the characteristics selected for matching and the specificity of claims data may not adequately account for all differences between beneficiary and provider behavior between MA and FFS. Second, the analysis is limited to a set of outcomes that are observable in the claims; lab, patient satisfaction, or other survey data were not available. Third, actual health care spending is not observed in the MA data. Instead, the study uses a model to calculate spending for patients in MA based on the spending from FFS data. This model takes into account the number of spending events as well as the spending per event. Finally, no information on provider participation in advanced alternative payment models (APM) was available for either FFS beneficiaries or for MA beneficiaries. Beneficiaries treated by providers in an APM may receive enhanced care coordination and management services. [40] Future analyses could explore the differential effects of APM in FFS and MA.

Conclusion

Diabetes is a highly prevalent condition in the Medicare population, and evidence-based care for this condition includes early detection and continuous maintenance to avoid or limit disease progression and future adverse events. Findings from this study suggest that the care delivered to patients with prediabetes and type 2 diabetes in MA show patterns of care that are more indicative of early detection and active care management for patients than those experienced by similar patients in FFS. On average, in MA, type 2 diabetes is diagnosed and treated earlier, more frequently monitored for complications, and patients more often have claims for medications recommended for diabetes and related conditions compared to similar patients in FFS. In this study, for patients in MA, preventive care (testing and filled prescriptions) was higher, and visits for acute care, such as ED visits and inpatient admissions were lower, as was total medical spending. Although some of the differences between the matched cohorts

[40] Advanced APMs that beneficiaries are enrolled in may include the Comprehensive Primary Care Plus Model, Accountable Care Organization Realizing Equity, Access, and Community Health (ACO REACH), and the Medicare Shared Savings Program among others."

were modest, the size of the affected population (people with type 2 diabetes in Medicare) indicates that even small differences at an individual patient level may translate to meaningful differences in population-level health outcomes and aggregate Medicare spending.

Appendix A: Cohort Construction

The data for this study came from multiple sources. FFS data was sourced from a 100% sample of Medicare Part A and Part B Medicare FFS claims data, accessed by Avalere via a research collaboration with Inovalon, Inc. and governed by a research-focused CMS Data Use Agreement (DUA). The MA data came from the MORE^2 Registry®, accessed by Avalere via a research collaboration agreement with Inovalon, Inc. and was supplemented with claims from 2 large MA insurers.

Inclusion criteria required type 2 diabetes identified either by 1 inpatient or 2 outpatient claims with a diagnosis code for diabetes or prediabetes or 1 fill of a diabetes related medication. The data were used to create 3 cohorts of type 2 diabetes based on whether a beneficiary was prediabetic (presence of ICD-10-CM codes R73.01, R73.02, or R73.03), newly (incident) diabetic (1 inpatient or 2 outpatient claims with ICD-10-CM code E11.x or 1 fill of a diabetes related medication with no evidence in the previous 12 months), or previously diagnosed (chronic).

The index year for diabetes (incident and chronic) was 2016 with a pre-index period of the prior 12-months and a 3-year follow-up (2017-2019). Because prediabetes codes were new in 2017, the base year for the prediabetic cohort was 2017 with a 12-month follow-up and a 2-year post-index period (2018-2019).

Cohort	Inclusion Criteria	Exclusion Criteria
Prediabetes	1 inpatient or 2 outpatient claims with the presence of ICD-10-CM R73.01, R73.02, or R73.03 in **2017**. The 2 outpatient claims must be at least 30 days apart but within 12 months. At least 12 months of continuous enrollment prior to the prediabetes index date (first inpatient or outpatient prediabetes claim in 2017). Up to a 45-day break will be allowed in continuous enrollment.	Members living in Puerto Rico or any US territory in any year analysis year (2015-2019). Members where Medicare is the secondary payer Members with ESRD as current reason for Medicare entitlement at the index date.
Incident Type 2 Diabetes	1 inpatient or 2 outpatient claims with ICD-10 clinical modification code E11.x or 1 fill for a hyperglycemia drug in **2016**. If the fill was for metformin, a diagnosis of E11.x is also required. The 2 outpatient claims must be at least 30 days apart but within 12 months. No type 2 diabetes claim (ICD-10 diagnosis or hyperglycemia prescription) in the 12 months prior to their index date At least 12 months of continuous enrollment prior to the type 2 diabetes index date (first diabetes or prescription claim in 2016). Up to a 45-day break will be allowed in continuous enrollment.	Members living in Puerto Rico or any US territory in any year analysis year (2015-2019). Members where Medicare is the secondary payer Members with ESRD as current reason for Medicare entitlement at the index date.
Chronic Type 2 Diabetes	1 inpatient or 2 outpatient claims with ICD-10 clinical modification code E11.x or 1 fill for a hyperglycemia drug in **2016**. If the fill was for metformin, a diagnosis of E11.x is also required. The 2 outpatient claims must be at least 30 days apart but within 12 months. Has any type 2 diabetes claim (ICD-10 diagnosis or hyperglycemia prescription) in the 12 months prior to their index date in 2016 At least 12 months of continuous enrollment prior to the type 2 diabetes index date (first diabetes or prescription claim in 2016). Up to a 45-day break will be allowed in continuous enrollment	Members living in Puerto Rico or any US territory in any year analysis year (2015-2019). Members where Medicare is the secondary payer Members with ESRD as current reason for Medicare entitlement at the index date.

Appendix B: Matching Methodology

To account for differences in health status and utilization at index-date, this study used propensity score models (PSM) to match FFS to patients in MA within each cohort (prediabetes, type 2 diabetes - incident, type 2 diabetes -chronic). A logistic regression model was used to estimate the probability that a member belongs to the treatment group (MA), conditional on a set demographic, clinical, drug and service utilization metrics observed in the data during the 12 months of continuous enrollment prior to the index date (pre-index). The following table lists the factors used to calibrate propensity score models for each matching cohort.

Matching Factor	Propensity Score Logit Model Parameterization
Age	Piecewise Linear Spline
Sex	Categorical Indicator
Dual Status	Categorical Indicator (Any Dual vs. Non-Dual)
Pre-index Physician Visit	Categorical Indicator (Yes vs. No)
Pre-index AMI Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index Cancer Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index Pneumonia Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index Stroke Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index Transplant Procedure	Categorical Indicator (Yes vs. No)
Pre-Index RxRisk V Score	Piecewise Linear Spline
Pre-Index RxRisk V Anticoagulant	Categorical Indicator (Yes vs. No)
Pre-Index RxRisk V Antiplatelet Agent	Categorical Indicator (Yes vs. No)
Pre-Index RxRisk V CHF-Hypertension Agent	Categorical Indicator (Yes vs. No)
Pre-Index RxRisk V Antidepressive Agent	Categorical Indicator (Yes vs. No)
Pre-Index RxRisk V Antihyperlipidemic Agent	Categorical Indicator (Yes vs. No)
Pre-Index RxRisk V Antihypertensive Agent	Categorical Indicator (Yes vs. No)
Pre-Index DCSI Score	Piecewise Linear Spline
Pre-Index DCSI Cardiovascular Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index DCSI Cerebrovascular Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index DCSI Metabolic Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index DCSI Nephropathy Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index DCSI Neuropathy Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index DCSI Peripheral Vascular Disease Diagnosis	Categorical Indicator (Yes vs. No)
Pre-Index DCSI Retinopathy Diagnosis	Categorical Indicator (Yes vs. No)
HRR Expected Medicare ACSC Rate	Piecewise Linear Spline

Matching Factor	Propensity Score Logit Model Parameterization
HRR Observed/Expected Medicare ACSC Ratio	Piecewise Linear Spline
HRR Expected Medicare Expenditures per Beneficiary	Piecewise Linear Spline
HRR Observed/Expected Expenditures Per Beneficiary Ratio	Piecewise Linear Spline

Continuous metrics for baseline age, RxRisk V score, and DCSI score included in the PSM are parameterized using a linear B-spline basis. For each of these three effects, Avalere identified a set of interior knots at which the piecewise linear spline would be allowed to have an inflection point/point at which it is nondifferentiable.

RxRisk V score

The RxRisk score is a reliable and validated instrument based on pharmacy data to identify chronic conditions in a population.[41,42] The score is comprised of 45 Rx-Risk categories identified by medications commonly used during treatment for the conditions represented.[43] The score has been used in risk-adjustment and to predict health care spending in the peer reviewed literature. It is especially useful when healthcare utilization claims or condition groupers (such as Diagnosis-Related Groups; DRGs) may be unavailable and pharmacy-based case-mix are less subject to differences in coding practices. Sloan et. al. found pharmacy-based case detection highly predictive for diabetes.[44]

DCSI score

For type 2 diabetes, disease progression among cohorts was measured using the Diabetes Complications Severity Index (DCSI), a 13-point scale based on diagnostic and laboratory data. The DCSI score is built on the identification of 7 types of complications. The 7 categories are retinopathy, nephropathy, neuropathy, cerebrovascular, cardiovascular, peripheral vascular disease, and metabolic. Although originally designed based on ICD-9 codes, the measure has been updated for ICD-10. Within each category, the presence of any code will lead to that category being scored as 0, 1, or 2 with 0 meaning patients had none of the conditions, 1 meaning patients had at least 1 non-severe condition (and no severe conditions), and 2 meaning patients had at least 1 severe condition. The exception is the nephropathy category which can only be scored as either 0 or 1. The presence of any of the complications in a category is noted at a single point in time and the scores from each category are added to create the final score, which can range from 0 to 13. For example, patients with retinal edema would score a 1 for retinopathy while patients with vitreous hemorrhage would score a 2. If patients had vitreous hemorrhage and stroke, they would score a 2 for retinopathy and a 2 for cerebrovascular,

[41] Fishman PA, Goodman MJ, Hornbrook MC, Meenan RT, Bachman DJ, O'Keeffe Rosetti MC. Risk adjustment using automated ambulatory pharmacy data: the RxRisk model. Med Care. 2003 Jan;41(1):84-99. doi: 10.1097/00005650-200301000-00011. PMID: 12544546.

[42] Sales AE, Liu CF, Sloan KL, Malkin J, Fishman PA, Rosen AK, Loveland S, Paul Nichol W, Suzuki NT, Perrin E, Sharp ND, Todd-Stenberg J. Predicting costs of care using a pharmacy-based measure risk adjustment in a veteran population. Med Care. 2003 Jun;41(6):753-60. doi: 10.1097/01.MLR.0000069502.75914.DD. PMID: 12773841.

[43] Farley JF, Harley CR, Devine JW. A comparison of comorbidity measurements to predict healthcare expenditures. Am J Manag Care. 2006 Feb;12(2):110-9. PMID: 16464140.

[44] Sloan KL, Sales AE, Liu CF, Fishman P, Nichol P, Suzuki NT, Sharp ND. Construction and characteristics of the RxRisk-V: a VA-adapted pharmacy-based case-mix instrument. Med Care. 2003 Jun;41(6):761-74. doi: 10.1097/01.MLR.0000064641.84967.B7. PMID: 12773842.

bringing their score to a 4. Higher scores are indicative of more diabetic acuity and complications compared to lower scores.

The DCSI utilizes 12 months of claims data to calculate a score. The DCSI is measured at baseline (using 12 months of claims prior to index, including the index), and then on a rolling 12-months basis. Progression will be measured both by relative increases in the DCSI scores as well as comparing absolute scores (average score between cohorts) at various points.

Appendix C: Propensity Score Modeling Results

About 99% of patients in the MA cohorts were matched to a FFS patient. The average mean difference (SMD) between the cohorts was 0.01 and there were no matching variables with mean differences above 0.2.

The table below includes matched means for FFS and MA on propensity score matching variables and the differences between the matched means.

Matching Variable	Prediabetes			Incident			Chronic		
	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched
Age: 0-54	3%	4%	-0.0690	5%	7%	-0.0670	4%	5%	-0.0396
Age: 55-64	7%	6%	0.0575	11%	9%	0.0422	10%	9%	0.0599
Age: 65-69	19%	22%	-0.0791	20%	23%	-0.0597	18%	21%	-0.0706
Age: 70-74	29%	29%	0.0139	25%	23%	0.0436	26%	25%	0.0195
Age: 75-79	21%	20%	0.0270	18%	16%	0.0287	20%	19%	0.0181
Age: 80-84	12%	11%	0.0419	12%	11%	0.0237	12%	12%	0.0258
Age: 85+	8%	8%	0.0000	10%	11%	-0.0290	9%	10%	-0.0191
Sex: Male	43%	43%	0.0045	47%	45%	0.0333	46%	46%	0.0072
Dual Status: Dual	14%	16%	0.0656	23%	26%	0.0767	20%	21%	0.0424
Has Physician Visit Within 12 Months Prior to Index Date	97%	97%	0.0024	84%	84%	-0.0045	98%	97%	0.0445
Acute Myocardial Infarction	1%	1%	-0.0062	2%	2%	-0.0055	2%	2%	-0.0083
Cancer	22%	23%	-0.0339	17%	18%	-0.0327	19%	20%	-0.0284
Pneumonia	3%	3%	-0.0043	6%	6%	-0.0214	5%	5%	-0.0087
Stroke	5%	5%	0.0052	7%	7%	-0.0053	8%	8%	0.0014
Transplant	0%	0%	-0.0014	0%	0%	-0.0075	0%	0%	-0.0011
HRR Adjusted Ambulatory Care—Sensitive Condition (ACSC) Discharges per 1,000 Medicare Beneficiaries	48.33	48.15	0.0173	49.08	48.67	0.0385	49.72	49.94	-0.0200
HRR Observed /Expected ACSC Adjusted Discharge Ratio	0.98	0.97	0.0173	0.99	0.98	0.0385	1.01	1.01	-0.0200
HRR Adjusted Annual Medicare Payments (Parts A&B)	$10,694	$10,671	0.0156	$10,673	$10,704	-0.0187	$10,415	$10,347	0.0444
HRR Observed /Expected Adjusted Medicare	$1.02	$1.02	0.0163	$1.05	$1.05	-0.0176	$1.02	$1.02	0.0454

Matching Variable	Prediabetes			Incident			Chronic		
	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched
Payments (Parts A&B)									
RX Risk Score	4.58	4.66	-0.0278	4.63	4.70	-0.0225	6.38	6.46	-0.0266
RxRisk V: Anti-Coagulation Agents	0.07	0.08	-0.0124	0.08	0.09	-0.0158	0.10	0.10	-0.0258
RxRisk V: Anti-Platelet Agents	0.06	0.06	0.0134	0.07	0.07	0.0050	0.11	0.11	-0.0028
RxRisk V: CHF-Hypertension Agents	0.42	0.42	-0.0028	0.43	0.43	0.0015	0.65	0.66	-0.0077
RxRisk V: Anti-Depressants	0.24	0.25	-0.0179	0.24	0.24	-0.0184	0.28	0.28	-0.0155
RxRisk V: Anti-Hyperlipidemia Agents	0.59	0.60	-0.0223	0.50	0.50	0.0040	0.74	0.75	-0.0129
RxRisk V: Anti-Hypertension Agents	0.33	0.34	-0.0047	0.31	0.30	0.0112	0.40	0.40	0.0039
Pre-Index DCSI: Has Cardiovascular Condition	--	--	--	50%	51%	-0.0175	63%	63%	0.0025
Pre-Index DCSI: Has Cerebrovascular Condition	--	--	--	30%	31%	-0.0180	39%	39%	0.0008
Pre-Index DCSI: Has Metabolic Condition	--	--	--	14%	14%	-0.0154	18%	18%	0.0022
Pre-Index DCSI: Has Nephropathy	--	--	--	7%	8%	-0.0251	9%	10%	-0.0056
Pre-Index DCSI: Has Neuropathy	--	--	--	0%	0%	-0.0006	2%	2%	0.0149
Pre-Index DCSI: Has Peripheral Vascular Disease	--	--	--	0%	0%	0.0000	1%	1%	0.0020
Pre-Index DCSI: Has Retinopathy	--	--	--	16%	16%	-0.0174	36%	35%	0.0139
Pre-Index DCSI: Cardiovascular Score	--	--	--	13%	13%	0.0096	29%	27%	0.0566
Pre-Index DCSI: Cerebrovascular Score	--	--	--	9%	10%	-0.0234	30%	28%	0.0412
Pre-Index DCSI: Metabolic Score	--	--	--	9%	10%	-0.0234	30%	28%	0.0412

Matching Variable	Prediabetes			Incident			Chronic		
	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched	Mean MA Matched	Mean FFS Matched	Std. Diff MA Matched vs. FFS Matched
Pre-Index DCSI: Nephropathy Score	--	--	--	11%	12%	-0.0255	22%	21%	0.0116
Pre-Index DCSI: Neuropathy Score	--	--	--	9%	10%	-0.0189	19%	18%	0.0173
Pre-Index DCSI: Peripheral Vascular Disease Score	--	--	--	6%	6%	-0.0176	19%	18%	0.0153
Pre-Index DCSI: Retinopathy Score	--	--	--	4%	5%	-0.0173	15%	15%	0.0113
Pre-Index DCSI: Score	--	--	--	1.043	1.094	-0.0337	1.900	1.854	0.0244
Pre-Index DCSI: Score 0	--	--	--	56%	55%	0.0157	30%	32%	-0.0339
Pre-Index DCSI: Score 1	--	--	--	14%	14%	0.0051	20%	20%	0.0050
Pre-Index DCSI: Score 2	--	--	--	15%	15%	0.0117	18%	18%	0.0124
Pre-Index DCSI: Score 3	--	--	--	7%	8%	-0.0181	13%	12%	0.0097
Pre-Index DCSI: Score 4	--	--	--	5%	5%	-0.0143	8%	8%	0.0113
Pre-Index DCSI: Score 5	--	--	--	2%	2%	-0.0190	5%	5%	0.0110
Pre-Index DCSI: Score 6	--	--	--	1%	1%	-0.0182	3%	3%	0.0029
Pre-Index DCSI: Score 7	--	--	--	0%	0%	-0.0135	1%	1%	0.0001
Pre-Index DCSI: Score 8	--	--	--	0%	0%	-0.0079	1%	1%	-0.0036
Pre-Index DCSI: Score 9	--	--	--	0%	0%	-0.0058	0%	0%	-0.0012
Pre-Index DCSI: Score 10	--	--	--	0%	0%	-0.0023	0%	0%	0.0001
Pre-Index DCSI: Score 11	--	--	--	0%	0%	0.0035	0%	0%	0.0015
Pre-Index DCSI: Score 12	--	--	--	0%	0%	0.0000	0%	0%	0.0020
Pre-Index DCSI: Score 13	--	--	--	0%	0%	0.0000	0%	0%	0.0014

Appendix D: Methodology for Calculating Medical Spending

To calculate total medical spending to the payer for patients in MA, Avalere developed statistical models of total Medicare payments (program spending plus beneficiary responsibility) for Medicare patients in FFS that were then applied to the patients in MA. Models were calculated separately for each patient cohort (i.e., prediabetes, incident, and chronic) and each post-index year (i.e., 0 through 3). These models, in turn, identified the variation, among the patients in Medicare FFS, in total payments that are associated with the following patient characteristics and outcomes:

- Age, sex, and dual status
- HRR-level Medicare risk-adjusted and observed-versus-expected payments[45]
- Patient-specific outcomes for the current period

This model was applied based on Medicare FFS payments to the patients in MA because payment information for the patients in MA was not available for this study. This approach also has the beneficial effect of removing differences in payments that are due to differences in contracted amounts. Instead, these calculate payment differences are more directly affected by utilization differences.

The specific statistical models used were Tweedie models specified so that the effects of the explanatory factors are multiplicative. The underlying assumptions for these models imply a data generating process featuring both a count of the number of spending events as well as the spending per event. Because a count can equal zero, these models can properly deal with zero payment amounts.

45 Dartmouth. “Dartmouth Atlas Project,” 2019. https://data.dartmouthatlas.org/

Appendix E: Outcomes and Full Results

Full Sample

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
Sample Size	12 months to index	198,518	198,518	N/A	162,496	162,496	N/A	1,118,221	1,118,221	N/A
	6 months to index	198,518	198,518	N/A	162,496	162,496	N/A	1,118,221	1,118,221	N/A
	index to 9 months	194,758	193,577	N/A	150,987	149,413	N/A	1,072,413	1,065,520	N/A
	index to 12 months	191,301	189,606	N/A	146,749	144,696	N/A	1,041,367	1,030,325	N/A
	index to 24 months	176,580	175,507	N/A	131,613	127,969	N/A	947,818	916,840	N/A
	index to 36 months	--	--	--	118,518	114,059	N/A	867,284	814,181	N/A
Outcome Variable		**MA**	**FFS**	**SMD**	**MA**	**FFS**	**SMD**	**MA**	**FFS**	**SMD**
Diabetes related lab test, %	6 months to index	39%	33%	0.130	38%	30%	0.174	67%	68%	-0.024
	index to 12 months	68%	68%	0.003	65%	66%	-0.011	80%	82%	-0.052
	index to 24 months	61%	60%	0.022	61%	60%	0.036	78%	80%	-0.054
	index to 36 months	--	--	--	60%	58%	0.046	77%	79%	-0.061
Blood pressure medicine[1], %	6 months to index	71%	72%	-0.014	--	--	--	--	--	--
	index to 12 months	74%	74%	-0.008	--	--	--	--	--	--
	index to 24 months	74%	74%	-0.009	--	--	--	--	--	--
	index to 36 months	--	--	--	--	--	--	--	--	--
Lipid lowering agents, %	6 months to index	56%	57%	-0.028	45%	45%	0.000	66%	67%	-0.022
	index to 12 months	60%	60%	-0.017	58%	55%	0.044	71%	72%	-0.008
	index to 24 months	60%	61%	-0.016	58%	56%	0.039	72%	72%	-0.010
	index to 36 months	--	--	--	59%	57%	0.037	72%	73%	-0.009

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
Prescriptions for antiplatelet or blood pressure medications [2]%	6 months to index	--	--	--	66%	66%	0.003	84%	85%	-0.022
	index to 12 months	--	--	--	76%	75%	0.028	86%	87%	-0.023
	index to 24 months	--	--	--	76%	75%	0.018	86%	87%	-0.031
	index to 36 months	--	--	--	76%	75%	0.011	87%	88%	-0.034
Insulin Rx, %	6 months to index	3%	2%	0.053	21%	14%	0.201	76%	74%	0.050
	index to 9 months	5%	4%	0.062	46%	35%	0.207	80%	77%	0.062
	index to 12 months	5%	4%	0.059	43%	33%	0.207	78%	76%	0.047
	index to 24 months	5%	4%	0.053	42%	33%	0.190	77%	76%	0.031
	index to 36 months	--	--	--	42%	33%	0.180	76%	76%	0.021
Metformin Rx, %	6 months to index	3%	2%	0.055	21%	13%	0.203	49%	46%	0.051
	index to 12 months	5%	3%	0.065	33%	27%	0.133	50%	48%	0.047
	index to 24 months	5%	4%	0.059	33%	27%	0.128	50%	48%	0.041
	index to 36 months	--	--	--	32%	27%	0.121	49%	47%	0.036
Evidence of testing for microalbuminuria, %	12 months to index	73%	71%	0.040	55%	53%	0.046	71%	64%	0.132
	index to 12 months	78%	76%	0.052	76%	73%	0.070	75%	69%	0.143
	index to 24 months	77%	75%	0.045	74%	70%	0.074	73%	67%	0.129
	index to 36 months	--	--	--	73%	69%	0.072	72%	67%	0.117
Oral anti-diabetes medications, %	index to 9 months	5%	4%	0.064	42%	33%	0.193	70%	67%	0.060
Additional oral anti-diabetes medications, %	from 3 months after initial oral diabetic medication	6%	4%	0.065	44%	35%	0.192	72%	69%	0.059
Evidence of ACE/ARB	6 months to index	84%	82%	0.056	73%	72%	0.035	78%	75%	0.076

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
medication, %	index to 12 months	86%	83%	0.068	81%	78%	0.084	82%	78%	0.094
	index to 24 months	86%	84%	0.064	81%	78%	0.079	81%	78%	0.088
	index to 36 months	--	--	--	81%	78%	0.074	81%	78%	0.083
Use of advance technologies, 1 or more (i.e., insulin pumps, continuous blood glucose monitors), %	6 months to index	0%	0%	0.000	0.0%	0.0%	0.012	0.1%	0.1%	0.020
	index to 12 months	0%	0%	0.002	0.0%	0.0%	0.012	0.1%	0.0%	0.019
	index to 24 months	0%	0%	0.007	0.0%	0.0%	0.016	0.1%	0.0%	0.016
	index to 36 months	--	--	--	0.1%	0.0%	0.033	0.1%	0.1%	0.027
Dialysis, %	6 months to index	0.3%	0.1%	0.041	0.8%	0.9%	-0.015	0.7%	1.3%	-0.060
	index to 12 months	0.4%	0.1%	0.048	0.9%	1.0%	-0.005	0.8%	1.4%	-0.058
	index to 24 months	0.4%	0.1%	0.047	0.9%	0.9%	-0.008	0.9%	1.5%	-0.057
	index to 36 months	--	--	--	0.9%	0.9%	-0.007	0.9%	1.5%	-0.052
All-cause ER visits, %	6 months to index	16%	16%	-0.005	23%	25%	-0.044	20%	21%	-0.012
	index to 12 months	16%	17%	-0.015	26%	28%	-0.058	23%	25%	-0.041
	index to 24 months	16%	17%	-0.027	24%	26%	-0.049	23%	25%	-0.045
	index to 36 months	--	--	--	23%	25%	-0.047	23%	25%	-0.050
Count of all-cause ER visits (per 1,000 enrollees), mean (std)	6 months to index	264 (861)	316 (1,004)	-0.056	428 (1,238)	602 (1,650)	-0.120	376 (1,142)	482 (1,409)	-0.083
	index to 12 months	279 (895)	346 (1,066)	-0.069	514 (1,359)	757 (1,905)	-0.147	458 (1,281)	636 (1,626)	-0.122
	index to 24 months	275 (875)	357 (1,089)	-0.084	463 (1,285)	673 (1,805)	-0.134	452 (1,272)	630 (1,611)	-0.123
	index to 36 months	--	--	--	443 (1,256)	640 (1,746)	-0.130	449 (1,261)	632 (1,612)	-0.127
All-cause inpatient visits, %	6 months to index	7%	8%	-0.017	15%	17%	-0.044	9%	10%	-0.040
	index to 12 months	7%	7%	-0.017	15%	15%	-0.019	11%	13%	-0.056
	index to 24 months	7%	8%	-0.046	12%	14%	-0.042	11%	13%	-0.066

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
	index to 36 months	--	--	--	11%	13%	-0.051	11%	13%	-0.073
Count of all-cause inpatient visits (per 1,000 enrollees), mean (std)	6 months to index	93 (457)	96 (381)	-0.007	202 (584)	250 (687)	-0.075	129 (519)	149 (527)	-0.037
	index to 12 months	95 (493)	98 (400)	-0.006	217 (659)	243 (716)	-0.038	158 (550)	197 (619)	-0.066
	index to 24 months	93 (480)	102 (412)	-0.020	177 (604)	211 (666)	-0.053	152 (539)	196 (618)	-0.076
	index to 36 months	--	--	--	163 (598)	199 (645	-0.057	150 (537)	197 (619)	-0.082
Diabetes-related Medical Spending[1] ($) per enrollee, mean (std)	*12 months to index	--	--	--	--	--	--	$852 ($1,630)	$723 ($2,539)	0.061
	index to 12 months	$60 ($915)	$5 ($163)	0.084	$1,000 ($3,220)	$457 ($2,542)	0.187	$1,044 ($2,300)	$870 ($3,080)	0.064
	index to 24 months	$58 ($953)	$14 ($353)	0.061	$834 ($3,113)	$382 ($2,311)	0.165	$1,013 ($2,440)	$876 ($3,218)	0.048
	index to 36 months	--	--	--	$776 ($3,192)	$363 ($2,276)	0.149	$1,017 ($2,576)	$900 ($3,344)	0.039
All-cause Medical Spending[1] ($) per enrollee, mean (std)	12 months to index	$6,980 ($12,953)	$7,798 ($15,648)	-0.057	$7,412 ($12,998)	$10,717 ($24,719)	-0.167	$9,494 ($14,094)	$11,915 ($23,866)	-0.124
	index to 12 months	$8,981 ($12,530)	$10,023 ($19,491)	-0.064	$16,696 ($23,832)	$18,914 ($35,362)	-0.074	$13,361 ($18,922)	$15,168 ($28,758)	-0.074
	index to 24 months	$9,087 ($12,769)	$10,314 ($20,338)	-0.072	$14,538 ($37,585)	$16,654 ($33,999)	-0.059	$13,113 ($18,712)	$15,239 ($28,873)	-0.087
	index to 36 months	--	--	--	$13,925 ($33,384)	$16,082 ($32,812)	-0.065	$13,347 ($18,926)	$15,591 ($29,311)	-0.091
E&M Visit with Diabetes Dx, %	*12 months to index	--	--	--	--	--	--	89%	83%	0.177
	index to 12 months	5%	2%	0.194	73%	58%	0.302	91%	85%	0.190
	index to 24 months	7%	4%	0.144	67%	52%	0.306	90%	84%	0.170
	index to 36 months	--	--	--	65%	50%	0.303	88%	83%	0.151
Office visit with A1C claim, %	12 months to index	61%	57%	0.085	46%	37%	0.189	88%	90%	-0.050
	index to 12 months	86%	86%	0.003	81%	81%	-0.007	91%	93%	-0.054
	index to 24 months	79%	78%	0.030	77%	75%	0.040	90%	92%	-0.058
	index to 36 months	--	--	--	76%	74%	0.047	89%	91%	-0.073
Primary Care	12 months to index	88%	89%	-0.051	69%	70%	-0.013	88%	86%	0.066

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
Provider Visit, %	index to 12 months	93%	93%	-0.019	84%	83%	0.023	90%	87%	0.081
	index to 24 months	91%	92%	-0.042	80%	82%	-0.041	87%	87%	0.019
	index to 36 months	--	--	--	79%	82%	-0.069	86%	87%	-0.016

Note: any measures with missing values are not applicable for respective cohort or time period.
[1]Blood pressure medicines include beta blockers, calcium channel blockers, antihypertensives, diuretics, and vasopressors. This measure is only applicable to the prediabetes cohort.
[2]This measure is only applicable to the incident and chronic cohorts.

Dual Eligible Beneficiaries

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
Sample Size	12 months to index	27,154	31,786	N/A	37,660	43,067	N/A	219,282	238,529	N/A
	6 months to index	27,154	31,786	N/A	37,660	43,067	N/A	219,292	238,529	N/A
	index to 9 months	26,170	30,381	N/A	33,976	39,160	N/A	204,004	221,041	N/A
	index to 12 months	25,587	29,453	N/A	32,693	37,804	N/A	196,440	213,458	N/A
	index to 24 months	23,386	25,965	N/A	28,045	32,307	N/A	171,398	184,500	N/A
	index to 36 months	--	--	N/A	24,480	27,482	N/A	152,651	156,062	N/A
Outcome Variable		**MA**	**FFS**	**SMD**	**MA**	**FFS**	**SMD**	**MA**	**FFS**	**SMD**
Diabetes related lab test, %	6 months to index	44%	35%	0.182	39%	26%	0.274	68%	67%	0.019
	index to 12 months	64%	65%	-0.017	62%	61%	0.022	76%	77%	-0.027
	index to 24 months	58%	57%	0.014	59%	55%	0.070	73%	76%	-0.063
	index to 36 months	--	--	--	58%	54%	0.078	71%	75%	-0.095
Blood pressure medicine[1], %	6 months to index	72%	68%	0.083	--	--	--	--	--	--
	index to 12 months	74%	70%	0.089	--	--	--	--	--	--
	index to 24 months	75%	71%	0.093	--	--	--	--	--	--
	index to 36 months	--	--	--	--	--	--	--	--	--
Lipid lowering agents, %	6 months to index	55%	50%	0.105	41%	40%	0.011	69%	66%	0.047
	index to 12 months	59%	54%	0.103	56%	52%	0.083	73%	70%	0.063
	index to 24 months	60%	55%	0.106	57%	52%	0.081	73%	71%	0.057
	index to 36 months	--	--	--	57%	53%	0.082	74%	71%	0.056
Prescriptions for antiplatelet or blood pressure	6 months to index	--	--	--	61%	62%	-0.013	87%	84%	0.064
	index to 12 months	--	--	--	74%	73%	0.038	89%	87%	0.062

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
medications [2]%	index to 24 months	--	--	--	74%	72%	0.032	88%	87%	0.046
	index to 36 months	--	--	--	74%	72%	0.026	88%	87%	0.037
Insulin Rx, %	6 months to index	5%	3%	0.105	20%	11%	0.245	81%	76%	0.118
	index to 9 months	8%	6%	0.091	49%	37%	0.250	84%	79%	0.125
	index to 12 months	7%	5%	0.081	47%	34%	0.274	83%	78%	0.116
	index to 24 months	8%	6%	0.067	46%	34%	0.256	81%	78%	0.091
	index to 36 months	--	--	--	46%	34%	0.246	80%	77%	0.075
Metformin Rx, %	6 months to index	5%	3%	0.110	20%	11%	0.247	46%	44%	0.044
	index to 12 months	7%	5%	0.090	33%	27%	0.142	47%	45%	0.034
	index to 24 months	8%	6%	0.075	32%	26%	0.138	46%	45%	0.028
	index to 36 months	--	--	--	32%	26%	0.134	45%	44%	0.022
Evidence of testing for microalbuminuria, %	12 months to index	69%	68%	0.028	58%	55%	0.068	72%	65%	0.156
	index to 12 months	73%	72%	0.011	75%	72%	0.069	74%	67%	0.160
	index to 24 months	72%	71%	0.007	72%	69%	0.074	71%	65%	0.128
	index to 36 months	--	--	--	71%	67%	0.066	68%	64%	0.098
Oral anti-diabetes medications, %	index to 9 months	8%	6%	0.095	44%	33%	0.220	70%	66%	0.099
Additional oral anti-diabetes medications, %	from 3 months after initial oral diabetic medication	9%	6%	0.091	46%	35%	0.216	72%	68%	0.101
Evidence of ACE/ARB medication, %	6 months to index	82%	81%	0.027	70%	69%	0.032	77%	73%	0.156
	index to 12 months	83%	83%	0.022	80%	77%	0.096	80%	76%	0.160
	index to 24 months	84%	83%	0.025	80%	76%	0.088	79%	76%	0.128

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
	index to 36 months	--	--	--	79%	76%	0.083	79%	75%	0.098
Use of advance technologies, 1 or more (i.e., insulin pumps, continuous blood glucose monitors), %	6 months to index	0%	0%	--	0.0%	0.0%	0.010	0.1%	0.1%	0.019
	index to 12 months	0%	0%	--	0.0%	0.0%	0.020	0.1%	0.0%	0.022
	index to 24 months	0%	0%	0.011	0.0%	0.0%	0.025	0.1%	0.0%	0.020
	index to 36 months	--	--	--	0.1%	0.0%	0.038	0.2%	0.1%	0.034
Dialysis, %	6 months to index	1.3%	0.3%	0.117	2.1%	1.5%	0.046	2.2%	2.4%	-0.016
	index to 12 months	1.5%	0.3%	0.133	2.3%	1.6%	0.051	2.2%	2.6%	-0.024
	index to 24 months	1.6%	0.3%	0.132	2.3%	1.6%	0.050	2.1%	2.6%	-0.035
	index to 36 months	--	--	--	2.3%	1.6%	0.051	2.1%	2.7%	-0.037
All-cause ER visits, %	6 months to index	24%	26%	-0.033	30%	34%	-0.073	28%	30%	-0.043
	index to 12 months	24%	26%	-0.035	33%	38%	-0.109	31%	35%	-0.083
	index to 24 months	23%	26%	-0.052	30%	34%	-0.096	30%	34%	-0.100
	index to 36 months	--	--	--	29%	33%	-0.095	29%	34%	-0.114
Count of all-cause ER visits (per 1,000 enrollees), mean (std)	6 months to index	477 (1,368)	606 (1,635)	-0.086	620 (1,742)	932 (2,297)	-0.153	593 (1,593)	824 (2,064)	-0.126
	index to 12 months	461 (1,265)	613 (1,633)	-0.104	711 (1,731)	1,159 (2,605)	-0.203	676 (1,708)	1,018 (2,297)	-0.169
	index to 24 months	445 (1,249)	615 (1,645)	-0.116	642 (1,631)	1,032 (2,475)	-0.186	645 (1,666)	998 (2,262)	-0.178
	index to 36 months	--	--	--	611 (1,582)	980 (2,381)	-0.182	623 (1,639)	991 (2,257)	-0.187
All-cause inpatient visits, %	6 months to index	11%	11%	0.016	22%	21%	0.019	13%	14%	-0.018
	index to 12 months	10%	9%	0.032	18%	19%	-0.037	15%	17%	-0.046
	index to 24 months	9%	9%	0.004	15%	17%	-0.058	14%	17%	-0.070
	index to 36 months	--	--	--	14%	16%	-0.071	13%	16%	-0.086
Count of all-cause inpatient	6 months to index	167 (741)	148 (514)	0.030	301 (734)	330 (834)	-0.038	207 (669)	218 (675)	-0.017

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
visits (per 1,000 enrollees), mean (std)	index to 12 months	153 (698)	128 (487)	0.041	286 (814)	325 (876)	-0.047	234 (731)	268 (760)	-0.046
	index to 24 months	141 (654)	132 (501)	0.015	235 (742)	283 (819)	-0.062	217 (699)	266 (754)	-0.068
	index to 36 months	--	--	--	215 (757)	267 (793)	-0.068	207 (692)	265 (754)	-0.080
Diabetes-related Medical Spending[1] ($) per enrollee, mean (std)	*12 months to index	--	--	--	--	--	--	$1,437 ($2,633)	$1,071 ($3,729)	0.113
	index to 12 months	$259 ($1,955)	$12 ($323)	0.176	$1,711 ($3,931)	$609 ($3,393)	0.300	$1,672 ($3,458)	$1,225 ($4,195)	0.116
	index to 24 months	$225 ($1,926)	$31 ($730)	0.133	$1,428 ($3,895)	$515 ($3,076)	0.260	$1,597 ($3,620)	$1,236 ($4,351)	0.090
	index to 36 months	--	--	--	$1,333 ($4,022)	$491 ($3,034)	0.236	$1,576 ($3,762)	$1,268 ($4,493)	0.074
Total Medical Spending[1] ($) per enrollee, mean (std)	12 months to index	$9,918 ($23,467)	$9,366 ($20,533)	0.025	$9,188 ($15,809)	$14,157 ($30,726)	-0.203	$12,809 ($18,719)	$16,359 ($30,584)	-0.140
	index to 12 months	$11,106 ($15,124)	$11,413 ($23,793)	-0.015	$19,775 ($24,852)	$23,552 ($41,923)	-0.110	$16,848 ($22,023)	$19,320 ($34,753)	-0.085
	index to 24 months	$10,780 ($15,100)	$11,622 ($24,505)	-0.041	$16,878 ($22,509)	$20,594 ($38,870)	-0.117	$15,912 ($21,228)	$19,232 ($34,698)	-0.115
	index to 36 months	--	--	--	$16,045 ($21,825)	$19,867 ($38,190)	-0.123	$15,764 ($21,089)	$19,568 ($35,287)	-0.131
E&M Visit with Diabetes Dx, %	*12 months to index	--	--	--	--	--	--	83%	73%	0.261
	index to 12 months	10%	2%	0.325	69%	49%	0.426	85%	75%	0.254
	index to 24 months	12%	5%	0.256	65%	44%	0.439	83%	74%	0.222
	index to 36 months	--	--	--	63%	42%	0.438	81%	73%	0.187
Office visit with A1C claim, %	12 months to index	64%	58%	0.135	47%	33%	0.300	86%	86%	-0.014
	index to 12 months	82%	83%	-0.027	77%	76%	0.035	88%	89%	-0.031
	index to 24 months	76%	75%	0.009	74%	70%	0.080	86%	88%	-0.079
	index to 36 months	--	--	--	72%	69%	0.083	83%	88%	-0.130
Primary Care Provider Visit, %	12 months to index	88%	82%	0.163	65%	61%	0.082	83%	76%	0.184
	index to 12 months	92%	85%	0.216	80%	73%	0.148	84%	77%	0.188
	index to 24 months	89%	83%	0.164	77%	72%	0.109	82%	77%	0.121

Metric	Time Period	Prediabetes			Incident			Chronic		
		MA	FFS	SMD	MA	FFS	SMD	MA	FFS	SMD
	index to 36 months	--	--	--	75%	71%	0.087	80%	77%	0.068

Note: any measures with missing values are not applicable for respective cohort or time period.
[1]Blood pressure medicines include beta blockers, calcium channel blockers, antihypertensives, diuretics, and vasopressors. This measure is only applicable to the prediabetes cohort.
[2]This measure is only applicable to the incident and chronic cohorts.

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