**National Quality Forum—Evidence (subcriterion 1a)**

**Measure Number** (*if previously endorsed*)**:** 0541

**Measure Title**: Proportion of Days Covered (PDC): 3 Rates by Therapeutic Category

**IF the measure is a component in a composite performance measure, provide the title of the Composite Measure here:** N/A

**Date of Submission**: 4/8/2019

|  |
| --- |
| **Instructions**  *Complete 1a.1 and 1a.2 for all measures. If instrument-based measure, complete 1a.3.*  *Complete* ***EITHER 1a.2, 1a.3 or 1a.4*** *as applicable for the type of measure and evidence.*  *For composite performance measures:*  *A separate evidence form is required for each component measure unless several components were studied together.*  *If a component measure is submitted as an individual performance measure, attach the evidence form to the individual measure submission.*   * All information needed to demonstrate meeting the evidence subcriterion (1a) must be in this form. An appendix of *supplemental* materials may be submitted, but there is no guarantee it will be reviewed. * If you are unable to check a box, please highlight or shade the box for your response. * Contact NQF staff regarding questions. Check for resources at [Submitting Standards webpage](http://www.qualityforum.org/Measuring_Performance/Submitting_Standards.aspx). |

|  |
| --- |
| **Note: The information provided in this form is intended to aid the Standing Committee and other stakeholders in understanding to what degree the evidence for this measure meets NQF’s evaluation criteria.**   1a. Evidence to Support the Measure Focus The measure focus is evidence-based, demonstrated as follows:   * Outcome: [**3**](#Note3) Empirical data demonstrate a relationship between the outcome and at least one healthcare structure, process, intervention, or service. If not available, wide variation in performance can be used as evidence, assuming the data are from a robust number of providers and results are not subject to systematic bias. * Intermediate clinical outcome: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4)that the measured intermediate clinical outcome leads to a desired health outcome. * Process: [**5**](#Note5) a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4) that the measured process leads to a desired health outcome. * Structure: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4) that the measured structure leads to a desired health outcome. * Efficiency: [**6**](#Note6) evidence not required for the resource use component. * For measures derived from patient reports, evidence should demonstrate that the target population values the measured outcome, process, or structure and finds it meaningful. * Process measures incorporating Appropriate Use Criteria: See NQF’s guidance for evidence for measures, in general; guidance for measures specifically based on clinical practice guidelines apply as well.   **Notes**  **3.** Generally, rare event outcomes do not provide adequate information for improvement or discrimination; however, serious reportable events that are compared to zero are appropriate outcomes for public reporting and quality improvement.  **4.** The preferred systems for grading the evidence are the Grading of Recommendations, Assessment, Development and Evaluation [(GRADE) guidelines](http://www.gradeworkinggroup.org) and/or modified GRADE.  **5.** Clinical care processes typically include multiple steps: assess → identify problem/potential problem → choose/plan intervention (with patient input) → provide intervention → evaluate impact on health status. If the measure focus is one step in such a multistep process, the step with the strongest evidence for the link to the desired outcome should be selected as the focus of measurement. Note: A measure focused only on collecting PROM data is not a PRO-PM.  **6.** Measures of efficiency combine the concepts of resource use and quality (see NQF’s [Measurement Framework: Evaluating Efficiency Across Episodes of Care](http://www.qualityforum.org/Publications/2010/01/Measurement_Framework__Evaluating_Efficiency_Across_Patient-Focused_Episodes_of_Care.aspx); [AQA Principles of Efficiency Measures](http://www.aqaalliance.org/files/PrinciplesofEfficiencyMeasurementApril2006.doc)). |

**1a.1.This is a measure of**: (*should be consistent with type of measure entered in De.1*)

Outcome

Outcome: Click here to name the health outcome

Patient-reported outcome (PRO): Click here to name the PRO

*PROs include HRQoL/functional status, symptom/symptom burden, experience with care, health-related behaviors.* (*A PRO-based performance measure is not a survey instrument. Data may be collected using a survey instrument to construct a PRO measure.)*

Intermediate clinical outcome (*e.g., lab value*): Click here to name the intermediate outcome

Process: Adherence to medications leads to improved clinical outcomes and lower healthcare costs

Appropriate use measure: Click here to name what is being measured

Structure: Click here to name the structure

Composite: Click here to name what is being measured

**1a.2** **LOGIC MODEL** Diagram or briefly describe the steps between the healthcare structures and processes (e.g., interventions, or services) and the patient’s health outcome(s). The relationships in the diagram should be easily understood by general, non-technical audiences. Indicate the structure, process or outcome being measured.

This measure evaluates adherence to three therapeutic categories of medications aligned with three common chronic conditions: diabetes agents for diabetes, renin-angiotensin system antagonists for hypertension, and statins for hyperlipidemia. Medication adherence for these conditions remains suboptimal1-3 and multiple interventions may be used to improve adherence.4,5 Recent evidence continues to demonstrate the relationship of medication adherence with improved clinical outcomes and reduced healthcare costs.1

1. Lloyd JT, Maresh S, Powers CA, Shrank WH, Alley DE. How Much Does Medication Nonadherence Cost the Medicare Fee-for-Service Program? Med Care. 2019;57:218-24. PMID: [30676355](https://www.ncbi.nlm.nih.gov/pubmed/30676355).
2. Ritchey M, Chang A, Powers C, et al. Vital Signs: Disparities in Antihypertensive Medication Nonadherence Among Medicare Part D Beneficiaries - United States, 2014. MMWR Morb Mortal Wkly Rep. 2016;65:967-76. PMID: [27632693](https://www.ncbi.nlm.nih.gov/pubmed/27632693).
3. CMS. Part C and D Performance Data. Centers for Medicare & Medicaid Services. Accessed on: 02/08/2019. Available at: <https://www.cms.gov/medicare/prescription-drug-coverage/prescriptiondrugcovgenin/performancedata.html>.
4. Viswanathan M, Golin CE, Jones CD, et al. Interventions to improve adherence to self-administered medications for chronic diseases in the United States: a systematic review. Ann Intern Med. 2012;157:785-95. PMID: [22964778](https://www.ncbi.nlm.nih.gov/pubmed/22964778).
5. Kini V, Ho PM. Interventions to Improve Medication Adherence: A Review. JAMA. 2018;320:2461-73. PMID: [30561486](https://www.ncbi.nlm.nih.gov/pubmed/30561486)**.**

**1a.3** **Value and Meaningfulness:**  **IF** this measure is derived from patient report, provide evidence that the target population values the measured ***outcome, process, or structure*** and finds it meaningful. (Describe how and from whom their input was obtained.)

N/A

**\*\*RESPOND TO ONLY ONE SECTION BELOW -EITHER 1a.2, 1a.3 or 1a.4) \*\***

**1a.2** **FOR OUTCOME MEASURES including PATIENT REPORTED OUTCOMES - Provide empirical data demonstrating the relationship between the outcome (or PRO) to at least one healthcare structure, process, intervention, or service.**

N/A

**1a.3.****SYSTEMATIC REVIEW(SR) OF THE EVIDENCE (for intermediate outcome, PROCESS, or STRUCTURE PERFORMANCE measures, including those that are instrument-based) If the evidence is not based on a systematic review go to section 1a.4) If you wish to include more than one systematic review, add additional tables.**

**What is the source of the systematic review of the body of evidence that supports the performance measure? A systematic review is a scientific investigation that focuses on a specific question and uses explicit, prespecified scientific methods to identify, select, assess, and summarize the findings of similar but separate studies. It may include a quantitative synthesis (meta-analysis), depending on the available data. (IOM)**

☐ Clinical Practice Guideline recommendation (with evidence review)

☐ US Preventive Services Task Force Recommendation

☐ Other systematic review and grading of the body of evidence (*e.g., Cochrane Collaboration, AHRQ Evidence Practice Center*)

X Other

|  |  |
| --- | --- |
| **Source of Systematic Review:**   * **Title** * **Author** * **Date** * **Citation, including page number** * **URL** |  |
| Quote the guideline or recommendation verbatim about the process, structure or intermediate outcome being measured. If not a guideline, summarize the conclusions from the SR. |  |
| Grade assigned to the **evidence** associated with the recommendation with the definition of the grade |  |
| Provide all other grades and definitions from the evidence grading system |  |
| Grade assigned to the **recommendation** with definition of the grade |  |
| Provide all other grades and definitions from the recommendation grading system |  |
| Body of evidence:   * Quantity – how many studies? * Quality – what type of studies? |  |
| Estimates of benefit and consistency across studies |  |
| What harms were identified? |  |
| Identify any new studies conducted since the SR. Do the new studies change the conclusions from the SR? |  |

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**1a.4 OTHER SOURCE OF EVIDENCE**

*If source of evidence is NOT from a clinical practice guideline, USPSTF, or systematic review, please describe the evidence on which you are basing the performance measure.*

The evidence supporting this measure is from published studies.

**1a.4.1** **Briefly SYNTHESIZE the evidence that supports the measure.** A list of references without a summary is not acceptable.

Each medication class included in this measure aligns with a common chronic medical condition: diabetes agents for diabetes, renin-angiotensin system antagonists (RASA) for hypertension, and statins for hyperlipidemia. Medication therapy is recommended as a mainstay of treatment for these conditions and clinical guidelines emphasize the importance of adherence to medications to achieve optimal outcomes.1-6 Evidence correlates medication adherence, most commonly evaluated using the proportion of days covered (PDC) methodology, to improved clinical outcomes and decreased healthcare costs (see evidence summarized below). Adherence to diabetes medications, RASA, and statins remains suboptimal, with demonstrable opportunity for improvement.7-9

**Proportion of Days Covered Methodology for Medication Adherence**

The PDC and medication possession ratio (MPR) are the two most commonly used methodologies to characterize medication adherence in the published literature.10 Compared to other adherence estimates, the MPR and PDC methodologies have the greatest predictive validity (C-statistic, 0.701) in predicting diabetes-specific hospitalizations.11

There have been several criticisms of the MPR methodology, most notably the tendency for this approach to overestimate adherence. A comparison of 11 medication adherence methodologies by Hess et al.12 found MPR and a modified MPR overestimated adherence rates compared to PDC. Furthermore, in a literature review conducted by Raebel et al.10 to evaluate adherence methodologies, MPR was found to have multiple calculation methods (i.e., lack of standardization) and is inflated when medication switching within the same class occurs.

Conversely, the PDC methodology provides a more conservative estimate of adherence in instances of frequent medication switches and concomitant therapy with multiple drugs within a class.10 The International Society of Pharmacoeconomics and Outcomes Research (ISPOR) published a guidance document on medication adherence studies and notes the PDC methodology has an advantage of simultaneously reflecting both compliance and persistence.13

This measure evaluates adherence as a dichotomous variable at a threshold of 80% PDC. The preponderance of studies evaluating medication adherence utilizes a threshold of 80%. A systematic review of adherence studies conducted by Andrade et al.14 found over 90% of published adherence studies used an 80% threshold to classify adherence. This threshold has also been correlated to improvements in clinical outcomes, healthcare resource utilization and costs (as summarized below).

**Medication Adherence Impact on Clinical Outcomes and Healthcare Costs**

Studies included in the 2014 submission are noted in blue font, and more recent studies through March 2019, which were added for the spring 2019 endorsement maintenance submission, are noted in red font.

In 2002, Wei et al.15 conducted a retrospective cohort study to evaluate the effect of adherence to statins on recurrence of MI and all-cause mortality (N=5,590). Compared with those not taking statins, those who had ≥80% adherence to statin treatment had an adjusted relative risk (aRR) of recurrent MI of 0.19 (95% confidence interval [CI], 0.08-0.47) and all-cause mortality of 0.47 (95% CI, 0.22-0.99). There was no significant reduction in either endpoint for those who were less <80% adherent to statins.

In 2004, Lau and Nau16 conducted a retrospective study to examine the association between adherence to oral diabetes medications and subsequent hospitalization the following year among patients with type 2 diabetes (N=900). Compared with patients who were adherent (MPR ≥80%) to oral antihyperglycemic medications, those who were nonadherent were much more likely to have a hospitalization the following year (Odds Ratio [OR], 2.53; 95% Confidence Interval [CI], 1.38-4.64).

In 2005, Sokol et al.17 conducted a retrospective cohort study to evaluate the impact of medication adherence (PDC ≥80%) on healthcare utilization and cost for diabetes, hypertension, hyperlipidemia, and CHF (N=137,277). For all four conditions, hospitalization rates were significantly lower for adherent patients (P<0.0001). Medication adherence was also associated with lower medical costs for diabetes, hypertension, and hyperlipidemia (P<0.05).

In 2006, Ho et al.18 conducted a retrospective study to evaluate the effects of medication nonadherence to cardioprotective medications on hospitalization and mortality among patients with diabetes mellitus and ischemic heart disease (N=3,998). In multivariable analysis, receipt of any angiotensin-converting enzyme (ACE)/angiotensin 2 receptor blockers (ARBs), beta-blockers, or statins was associated with lower all-cause mortality (OR, 0.65; 95% CI, 0.43-0.99). Medication adherence (PDC ≥80%) to any cardioprotective medications was associated with lower all-cause mortality (OR, 0.52; 95% CI, 0.39-0.69) compared with non-adherence. In contrast, there was no mortality difference between patients receiving cardioprotective medications who were non-adherent compared with patients not receiving any medications (OR, 1.01; 95% CI, 0.64–1.61).

In 2011, Roebuck et al.19 conducted a retrospective analysis to evaluate the relationship between medication adherence (MPR ≥80%) and the utilization and cost of health services in patients with CHF (N=16,353), hypertension (N=112,757), diabetes (N=42,080), or hyperlipidemia (N=53,041). Across all conditions, adherence (MPR ≥80%) was associated with significantly lower annual inpatient hospital days and emergency department visits. The additional annual pharmacy spending was offset by the decrease in medical spending.

In 2014, Choudhry et al.20 conducted a retrospective analysis to evaluate the relationship between medication adherence (PDC ≥80%) and post-myocardial infarction adverse coronary events (N=4,117). Compared with patients randomized to usual care, patients who were adherent to statins, beta-blockers, and ACE/ARBs were significantly less likely to experience first major vascular event or revascularization (hazard ratio [HR] range, 0.64-0.81). In contrast, nonadherent patients showed no benefit (HR range, 0.98-1.04; P≤0.01 for the difference in HRs between adherent and nonadherent patients).

Recent evidence continues to demonstrate the relationship of medication adherence with clinical and economic outcomes.

A 2016 study by Korhonen et al.21 evaluated the relationship between statin adherence (PDC ≥80%) and ischemic stroke in patients with diabetes (N=52,868). Adherence to statins was associated with a 23% decreased incidence of ischemic stroke (95% CI, 14–32%) compared to nonadherence.

Boye et al.22 examined the relationship of medication adherence thresholds with clinical outcomes and cost among older adults enrolled in Medicare with type 2 diabetes (N=123,235). A PDC ≥80% was associated with a lower probability of hospitalization (37.4% vs. 56.2%), emergency department visits (54.2% vs. 72.1%), and acute complications (13.0% vs 24.1%) compared to PDC <20% (P<0.001). PDC ≥80% was also associated with lower all-cause acute care and outpatient costs. The mean outpatient and acute-care costs were $17,298 and $13,373 with a PDC ≥80% compared with $28,086 and $32,340 with a PDC <20% (P<0.05), respectively.

These findings are not limited to the Medicare population. A 2018 study by Roebuck et al.23 assessed the impact of medication adherence within seven chronic conditions on health services utilization among Medicaid enrollees (N=656,646 blind/disabled adults; N=704,368 other adults). Full adherence (PDC ≥80%) was associated with 8%–26% fewer hospitalizations and 3%–12% fewer emergency department visits among those with CHF, hypertension, diabetes, and schizophrenia/bipolar. In all analyses, full adherence was associated with up to 15% fewer outpatient physician/clinic visits.

Analyses in commercial populations report similar findings. A 2019 study by Campbell et al.24 investigated the association of diabetes adherence (PDC ≥ 80%) with healthcare utilization and expenditures among commercially-insured adults (N=1,576,112). Adherence was associated with fewer inpatient visits (risk ratio [RR]=0.834, 95% CI, 0.819-0.850) and lower inpatient (cost ratio [CR]=0.833, 95% CI, 0.829-0.836) and total (CR=0.958, 95% CI, 0.954-0.962) healthcare costs.

Similar findings were observed with statin adherence. Chinthammit et al.25 evaluated the association of statin adherence (PDC ≥ 80%) with healthcare utilization and expenditures among commercially-insured adults (N= 4,450,308). Adherence was associated with fewer inpatient visits (RR=0.746, 95% CI=0.739-0.753) and lower inpatient (CR=0.780, 95% CI=0.779-0.782) and total (CR=0.975, 95% CI=0.973-0.977) healthcare costs.

Axon et al.26 analyzed the association of RASA adherence (PDC ≥ 80%) with healthcare utilization and expenditures among commercially-insured adults (N= 4,842,058). Adherence was associated with fewer inpatient (RR=0.612, 95% CI=0.607-0.617) and outpatient visits (RR=0.995, 95% CI=0.994, 0.997); and lower inpatient (CR=0.614, 95% CI=0.613-0.615) and total (CR=0.876, 95% CI=0.874-0.878) healthcare costs.

In 2019, Lloyd et al.7 estimated the cost of medication nonadherence (PDC <80%) among Medicare fee-for-service beneficiaries with diabetes, heart failure, hypertension, and hyperlipidemia (N=14,657,735). Medication nonadherence ranged from 23% for heart failure, 25% for hypertension, 35% for diabetes, to 38% for hyperlipidemia. The authors estimated the avoidable health care costs that could be saved if nonadherent beneficiaries with diabetes became adherent was $4.5 billion (over $5,000 per beneficiary) annually. Similar levels of avoidable health care costs were found among nonadherent beneficiaries with hyperlipidemia and heart failure. If nonadherent beneficiaries with hypertension became adherent, the authors estimated Medicare could save $13.7 billion annually.

**1a.4.2 What process was used to identify the evidence?**

A primary literature search was conducted via PubMed for clinical guidelines, clinical trials, systematic reviews, and observational studies (through March 2019).

**1a.4.3.** **Provide the citation(s) for the evidence.**

**References**

1. American Diabetes Association. 9. Pharmacologic Approaches to Glycemic Treatment: Standards of Medical Care in Diabetes-2019. Diabetes Care. 2019;42(Suppl 1):S90-S102. PMID: [30559235](https://www.ncbi.nlm.nih.gov/pubmed/30559235).
2. American Diabetes Association. 10. Cardiovascular Disease and Risk Management: Standards of Medical Care in Diabetes-2019. Diabetes Care. 2019;42(Suppl 1):S103-S123. PMID: [30559236](https://www.ncbi.nlm.nih.gov/pubmed/30559236).
3. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. J Am Soc Hypertens. 2018;12:579.e1-579.e73. PMID: [30219548](https://www.ncbi.nlm.nih.gov/pubmed/30219548).
4. Grundy SM, Stone NJ, Bailey AL, et al. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol. Circulation. 2018 Nov 10:CIR0000000000000625. doi: 10.1161/CIR.0000000000000625. PMID: [30586774](https://www.ncbi.nlm.nih.gov/pubmed/30586774).
5. Jellinger PS, Handelsman Y, Rosenblit PD, et al. AMERICAN ASSOCIATION OF CLINICAL ENDOCRINOLOGISTS AND AMERICAN COLLEGE OF ENDOCRINOLOGY GUIDELINES FOR MANAGEMENT OF DYSLIPIDEMIA AND PREVENTION OF CARDIOVASCULAR DISEASE. Endocr Pract. 2017; 23(Suppl 2):1-87. PMID: [28437620](https://www.ncbi.nlm.nih.gov/pubmed/28437620).
6. US Preventive Services Task Force, Bibbins-Domingo K, Grossman DC, Curry SJ, et al. Statin Use for the Primary Prevention of Cardiovascular Disease in Adults: US Preventive Services Task Force Recommendation Statement. JAMA. 2016; 316(19):1997-2007. PMID: [27838723](https://www.ncbi.nlm.nih.gov/pubmed/27838723).
7. Lloyd JT, Maresh S, Powers CA, Shrank WH, Alley DE. How Much Does Medication Nonadherence Cost the Medicare Fee-for-Service Program? Med Care. 2019;57:218-24. PMID: [30676355](https://www.ncbi.nlm.nih.gov/pubmed/30676355).
8. Ritchey M, Chang A, Powers C, et al. Vital Signs: Disparities in Antihypertensive Medication Nonadherence Among Medicare Part D Beneficiaries - United States, 2014. MMWR Morb Mortal Wkly Rep. 2016;65:967-76. PMID: [27632693](https://www.ncbi.nlm.nih.gov/pubmed/27632693).
9. CMS. Part C and D Performance Data. Centers for Medicare & Medicaid Services. Accessed on: 02/08/2019. Available at: <https://www.cms.gov/medicare/prescription-drug-coverage/prescriptiondrugcovgenin/performancedata.html>.
10. Raebel MA, Schmittdiel J, Karter AJ, et al. Standardizing terminology and definitions of medication adherence and persistence in research employing electronic databases. Med Care. 2013 Aug;51(8 Suppl 3):S11-21. PMID: [23774515](https://www.ncbi.nlm.nih.gov/pubmed/?term=Standardizing+terminology+and+definitions+of+medication+adherence+and+persistence+in+research+employing+electronic+databases).
11. Karve S, Cleves MA, Helm M, et al. Good and poor adherence: optimal cut-point for adherence measures using administrative claims data. Curr Med Res Opin. 2009;25:2303-10. PMID: [19635045](https://www.ncbi.nlm.nih.gov/pubmed/19635045).
12. Hess LM, Raebel MA, Conner DA, et al. Measurement of adherence in pharmacy administrative databases: a proposal for standard definitions and preferred measures. Annals of Pharmacotherapy. 2006;40(7-8):1280-8. PMID: [16868217](https://www.ncbi.nlm.nih.gov/pubmed/16868217).
13. Peterson AM, Nau DP, Cramer JA, et al. A checklist for medication compliance and persistence studies using retrospective databases. Value in Health. 2007;10:3-12. PMID: [17261111](https://www.ncbi.nlm.nih.gov/pubmed/17261111).
14. Andrade SE, Kahler KH, Frech F, et al. Methods for evaluation of medication adherence and persistence using automated databases. Pharmacoepidemiology and drug safety. 2006;15:565-74. PMID: [16514590](https://www.ncbi.nlm.nih.gov/pubmed/16514590).
15. Wei L, Wang J, Thompson P, et al. Adherence to statin treatment and readmission of patients after myocardial infarction: a six year follow up study. Heart. 2002;88:229-33. PMID: [12181210](https://www.ncbi.nlm.nih.gov/pubmed/12181210).
16. Lau DT, Nau DP. Oral antihyperglycemic medication nonadherence and subsequent hospitalization among individuals with type 2 diabetes. Diabetes Care. 2004;27:2149-53. PMID: [15333476](https://www.ncbi.nlm.nih.gov/pubmed/15333476).
17. Sokol MC, McGuigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. Med Care. 2005;43:521-30. PMID: [15908846](https://www.ncbi.nlm.nih.gov/pubmed/15908846).
18. Ho PM, Magid DJ, Masoudi FA, et al. Adherence to cardioprotective medications and mortality among patients with diabetes and ischemic heart disease. BMC Cardiovasc Disord. 2006;6:48. PMID: [17173679](https://www.ncbi.nlm.nih.gov/pubmed/17173679).
19. Roebuck MC, Liberman JN, Gemmill-Toyama M, et al. Medication adherence leads to lower health care use and costs despite increased drug spending. Health Aff. 2011; 30:91-9. PMID: [21209444](https://www.ncbi.nlm.nih.gov/pubmed/21209444).
20. Choudhry NK, Glynn RJ, Avorn J, et al. Untangling the relationship between medication adherence and post-myocardial infarction outcomes: medication adherence and clinical outcomes. Am Heart J. 2014;167:51-58.e5. PMID: [24332142](https://www.ncbi.nlm.nih.gov/pubmed/24332142).
21. Korhonen MJ, Ruokoniemi P, Ilomäki J, et al. Adherence to statin therapy and the incidence of ischemic stroke in patients with diabetes. Pharmacoepidemiol Drug Saf. 2016;25:161-9. PMID: [26687512](https://www.ncbi.nlm.nih.gov/pubmed/26687512).

Boye KS, Curtis SE, Lage MJ, et al. Associations between adherence and outcomes among older, type 2 diabetes patients: evidence from a Medicare Supplemental database. Patient Prefer Adherence. 2016;10:1573-81. PMID: [27574406](https://www.ncbi.nlm.nih.gov/pubmed/27574406).

Roebuck MC, Kaestner RJ, Dougherty JS. Impact of Medication Adherence on Health Services Utilization in Medicaid. Med Care. 2018;56:266-273. PMID: [29309392](https://www.ncbi.nlm.nih.gov/pubmed/29309392).

Campbell P, Axon D, Mollon L, et al. A retrospective database analysis evaluating the association between Pharmacy Quality Alliance antidiabetic medication measure adherence, healthcare use, and expenditures among commercially insured patients. J Manag Care Spec Pharm. 2019;25:3-a Suppl, S38. PMID: [30854912](https://www.ncbi.nlm.nih.gov/pubmed/30854912).

Chinthammit C, Axon D, Anderson S, et al. A retrospective database analysis evaluating the association between Pharmacy Quality Alliance cholesterol medication adherence measure and economic outcomes for commercially insured patients. J Manag Care Spec Pharm. 2019;25:3-a Suppl, I17. PMID: [30854912](https://www.ncbi.nlm.nih.gov/pubmed/30854912).

Axon D, Chinthammit C, Taylor A, et al. A retrospective database analysis revaluating the relationship between Pharmacy Quality Alliance-defined adherence and healthcare costs and utilization for commercially insured patients on renin-angiotensin system antagonists. J Manag Care Spec Pharm. 2019;25:3-a Suppl, I1. PMID: [30854912](https://www.ncbi.nlm.nih.gov/pubmed/30854912).