Clover Assistant Use and Medication Adherence for Common Chronic Conditions

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Summary

1. Non-adherence to medications for diabetes, high blood pressure, and high cholesterol is common and associated with worse chronic disease control, increased disease-related complications, and higher healthcare costs.
2. Primary care practitioner (PCP) use of Clover Assistant is correlated with (1) increased medication fills for medications to which the patient was previously non-adherent and (2) higher performance on medication adherence quality measures in the Medicare Advantage Stars program.

Background

Adherence to prescribed medications for diabetes, high blood pressure, and high cholesterol is important for chronic condition management, patient outcomes, and healthcare costs. Data has unsurprisingly shown that higher levels of adherence to medications for diabetes, high blood pressure, and high cholesterol result in lower blood sugar, blood pressure, and cholesterol, respectively. Research has also shown that higher adherence to medications for these conditions can reduce disease-related complications such as hospitalization for heart attacks and death. When medication adherence is high, total healthcare costs can be lower even after accounting for the additional expenses of prescription drugs.

Yet patients' adherence to prescribed medications is often suboptimal and has therefore become a focus of Medicare quality measures. Data suggests that more than 50 percent of patients may not regularly take their medications as prescribed. Non-adherence rates may be particularly high for long-lasting conditions like hypertension that may not have overt symptoms. Many patients may not take prescribed medications in the first place, and adherence often wanes over time even where medications are appropriately started. As a result of these findings and the importance of medication adherence to health outcomes and costs, the Centers for Medicare & Medicaid Services (CMS) has included adherence rates to

medications for diabetes, high blood pressure, and high cholesterol as triple-weighted quality measures in its Medicare Advantage Star Ratings program. Medication adherence rates for these conditions also indirectly impact other quality measures included in the Medicare Advantage Star Ratings program such as those related to control of blood sugar and blood pressure.

Improvement in adherence to prescribed medications is a focus area for Clover Assistant, a scalable technology platform that ingests large amounts of clinical data from disparate sources and surfaces key insights during patient visits to improve care and outcomes. Primary care practitioners (PCPs) and other clinicians are often unaware if patients pick up prescribed medications from the pharmacy. Patients often do not discuss their non-adherence to medications with their physicians. Even when partially adherent to medications, patients are likely to overestimate their adherence rates. To create additional transparency around patients' behaviors related to medication adherence, the Clover Assistant uses medication fills data from pharmacies to notify PCPs when patients have not picked up a prescribed medication. With this knowledge, PCPs are able to identify and address common reasons for non-adherence including fear of side effects, lack of understanding of medications' benefits, and concern about medications' costs.

This analysis examines if the use of Clover Assistant is associated with increased fills for prescribed medications among patients non-adherent to medications for diabetes, high blood pressure, and high cholesterol. Specifically, we investigate if Clover Assistant use is associated with (1) higher rates of medication fills after notifying PCPs that a prescribed medication has not been picked up from the pharmacy and (2) higher performance on medication adherence quality measures used in the Medicare Advantage Star Ratings program.

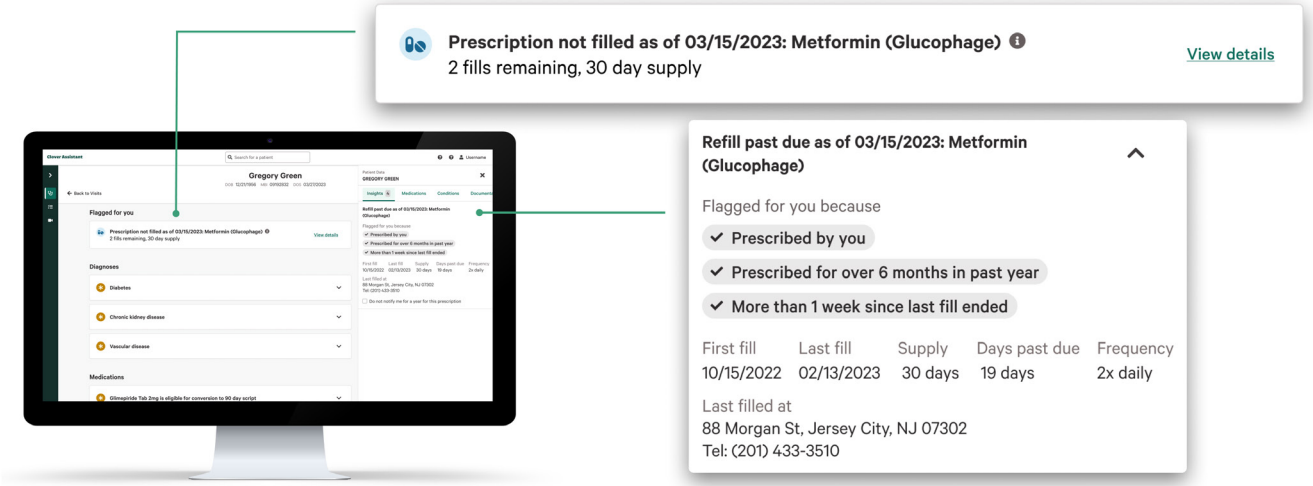
Methods

Clover Assistant medication adherence notification description

In April 2023, the Clover Assistant started notifying PCPs of patients' non-adherence to prescribed medications during primary care visits. Specifically, the platform identified instances where patients had not picked up a prescribed medication for diabetes, high blood pressure, or high cholesterol from the pharmacy after the last fill period ended despite having one or more remaining refills. The missed refill was flagged if (1) the PCP using Clover Assistant was the prescriber of the medication and (2) the time between the end of the last fill period and the Clover Assistant visit was between 4 and 30 days. Clover Assistant

intentionally did not notify PCPs of missed refills less than 4 days after the last fill period ended to give patients up to 3 days to refill their prescription. Additionally, Clover Assistant did not notify PCPs of missed refills more than 30 days after the last fill period ended since medications unfilled for extended time periods are more likely to have been intentionally stopped. A picture of the feature is shown in **Figure 1**.

Figure 1: Clover Assistant medication non-adherence notification



In this example, Clover Assistant identifies a patient who has not refilled his metformin prescription in the 19 days after his previous fill period ended. Metformin, or Glucophage, is a commonly used medication to treat diabetes. For PCPs interested in learning more information about the missed refill, Clover Assistant also provides additional information on the medication's first fill date, last fill date, days past due, and associated pharmacy.

Missed refills are flagged if (1) the PCP using Clover Assistant was the prescriber of the medication and (2) the time between the end of the last fill period and the Clover Assistant visit is between 4 and 30 days. Clover Assistant intentionally does not notify PCPs of missed refills less than 4 days after the last fill period ended to give patients up to 3 days to refill their prescription. Additionally, Clover Assistant does not notify PCPs of missed refills more than 30 days after the last fill period ended since medications unfilled for extended time periods are more likely to have been intentionally stopped.

Study population

Analyses examined data from Clover Health Medicare Advantage plan members from 2018, 2019, 2022, and 2023. We intentionally excluded data from 2020 and 2021 to minimize the impact of the COVID-19 pandemic's disruption of the healthcare system, including medication-related behaviors.

We identified the sample of health plan members who were taking medications to treat diabetes, high blood pressure, and high cholesterol. Since Clover Health is a Medicare Advantage Prescription Drug (MAPD) plan, it pays for medications that treat these and other conditions and has a record of associated pharmacy prescription fills. The list of specific medications was defined using Pharmacy Quality Alliance (PQA) medication tables

associated with CMS medication adherence measures for diabetes, high blood pressure, and high cholesterol. This value set includes but is not limited to (1) diabetic medications including biguanides like metformin, sulfonylureas, DPP-4 inhibitors, GLP-1 receptor agonists, and SGLT2 inhibitors; (2) high blood pressure-reducing medications including angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs); and (3) cholesterol-reducing medications including statins.

We considered members adherent to medications if the number of days since their last fill of a medication was less than the number of days of pills from that fill – most medications have 30 or 90-day fill periods. Conversely, we considered members non-adherent to medications if the time between the end of the last fill period and the Clover Assistant visit was between 4 and 30 days. As noted above, Clover Assistant gives a three-day "grace period" to patients after the last fill period elapses to refill their prescriptions. Additionally, Clover Assistant does not flag missed refills more than 30 days after the last fill period ends since medications unfilled for extended time periods are more likely to have been intentionally stopped by a physician.

Using these definitions, we identified health plan members who were non-adherent between 4 and 30 days after their last medication fill for diabetes, high blood pressure, and high cholesterol and who also had a visit with their PCP prescriber of these medications during this time period. From these members, we identified 3 cohorts for analytic purposes:

(1) Members having a visit where Clover Assistant notified the PCP of the medication non-adherence during the visit (i.e. the period after the April 2023 launch of the notification feature);

(2) Members having a visit where Clover Assistant did not notify the PCP of the medication non-adherence during the visit (i.e. the period prior to the April 2023 launch of the notification feature);

(3) Members having a visit with a PCP not using Clover Assistant during the visit but who subsequently started using Clover Assistant at a later date.

Statistical analysis

For each cohort, we calculated the fraction of lapsed medications that were filled on the day of the PCP visit (day 0) and in each of the 90 days following the visit. A medication was considered 'filled' if any medication from the appropriate PQA list for that condition had been picked up on that day. This definition is consistent with the PQA approach for calculating medication adherence rates.

With this information, we used t-tests to calculate differences in fill rates between (1) members having a visit where Clover Assistant notified the PCP of the non-adherence compared with members having a visit where Clover Assistant did not notify the PCP of the non-adherence and (2) members having a visit where Clover Assistant notified the PCP of the non-adherence compared with members having a visit where Clover Assistant was not used but would be subsequently used by that PCP at a later date.

We also modeled the impact of Clover Assistant on performance in medication adherence quality measures used in the Medicare Advantage Star Ratings program. These measures calculate the "proportion of days covered" (PDC) as the standard metric to evaluate medication adherence. The PDC is the preferred measurement approach for medication adherence per the Pharmacy Quality Alliance and is calculated as the proportion of days in an eligibility period "covered" by prescription claims for the same medication or another in its therapeutic category.

Since our follow-up period is 90 days rather than the full calendar year period over which CMS evaluates Medicare Advantage contract-level medication adherence results, we estimated the contribution of Clover Assistant to the PDC of affected members by calculating (a) the average number of days earlier that a prescription was refilled with the Clover Assistant non-adherence notification; (b) the average number of times an affected member was eligible for the Clover Assistant non-adherence notification during a year; and (c) the average time a member spends in a medication adherence measure denominator during a calendar year. The percentage change in PDC was calculated using these inputs as (a*b)/c.

Sensitivity/systematics analyses

To ensure the robustness of our findings, we performed additional "sensitivity" or "systematics" analyses. Firstly, we recalculated all findings for member visits with PCPs not using Clover Assistant but who eventually started using Clover Assistant at a later date. This approach allowed us to calculate results for the time period before and the time period after a practitioner started using Clover Assistant. In this way, we addressed the potential risk of bias from differences between practitioners who do and do not use Clover Assistant. Secondly, we recalculated results separately for each chronic condition (diabetes, high blood pressure, and high cholesterol) to ensure that any potentially favorable impact associated with Clover Assistant use was not restricted to just one or two conditions. Thirdly, we recalculated results using only 2023 data to minimize any biases resulting from timing differences between cohorts.

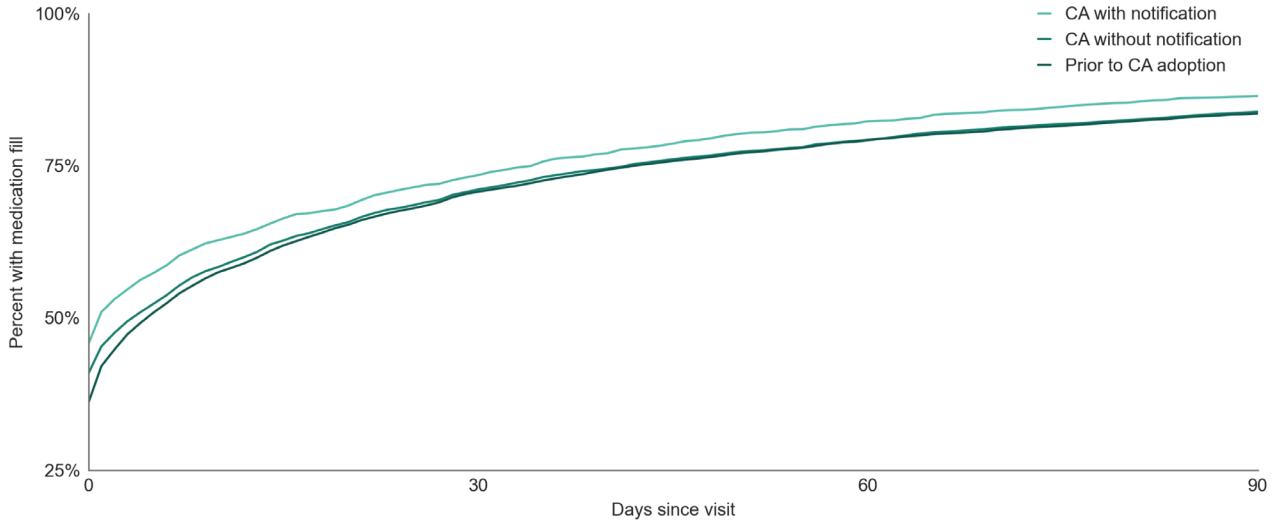
Results

We identified 98,629 health plan members who had pharmacy fills for one or more medications used to treat diabetes, high blood pressure, or high cholesterol in 2018, 2019, 2022, or 2023. Using the definitions of medication non-adherence described above, we identified the subset of 11,270 health plan members who had not refilled their medication between 4 and 30 days after their last medication fill elapsed and who also had a visit with their PCP prescriber of these medications during this time period. As noted above, these PCP prescribers either used Clover Assistant during the visit or used Clover Assistant at a later date with one or more Clover Health plan members. Of these 11,270 members, 1,488 had a visit where Clover Assistant notified the PCP of the medication non-adherence during the visit, 6,130 had a visit where Clover Assistant did not notify the PCP of the medication non-adherence during the visit, and 5,349 had a visit where Clover Assistant was not used but would eventually be used by the prescribing PCP.

Medication fills

Figure 2 shows the proportion of lapsed medications that were filled on the day of the PCP visit (day 0) and in each of the 90 days following the visit for each of these 3 cohorts.

Figure 2: Clover Assistant non-adherence flag is associated with increased medication fills



Results are presented for 1,488 visits where Clover Assistant notified the PCP of medication non-adherence during the visit, 6,130 visits where Clover Assistant did not notify the PCP of medication non-adherence during the visit (prior to the 2023 feature launch), and 5,349 visits where Clover Assistant was not used but would eventually be used by the prescribing PCP. The specific list of flagged medications was defined using Pharmacy Quality Alliance (PQA) medication tables associated with CMS medication adherence measures for diabetes, high blood pressure, and high cholesterol.

For each of the 3 cohorts, we calculated the fraction of lapsed medications that were filled on the day of the PCP visit (day 0) and in each of the 90 days following the visit. A medication was considered 'filled' if any medication from the appropriate PQA list for that condition had been picked up on that day. This definition is consistent with the PQA approach for calculating medication adherence rates.

CA = Clover Assistant

Fill rates were significantly higher where Closer Assistant surfaced evidence of patient non-adherence to medications. For example, fill rates on the day of the visit (day 0) were 45.8% with the Clover Assistant notification and 41.0% without the Clover Assistant notification ($p<0.0001$ for difference). Similarly, respective fill rates on day 10 (63.1% and 58.6%, $p<0.0001$ for difference), day 30 (73.4% and 71.2%, $p<0.02$ for difference), and day 90 (86.4% and 83.8%, $p<0.005$ for difference;) after the visit were higher where Clover Assistant notified the PCP of patients' non-adherence to medications.

Figure 2 also shows that fill rates were higher in visits with the Clover Assistant non-adherence notification compared to visits from the same PCPs prior to their use of Clover Assistant. For example, fill rates on the day of the visit (day 0) were 45.8% with the Clover Assistant notification and 36.2% prior to the PCPs' use of Clover Assistant ($p<0.0001$ for difference). Similarly, respective fill rates on day 10 (63.1% and 57.7%, $p<0.0001$ for difference), day 30 (73.4% and 70.8%, $p<0.02$ for difference), and day 90 (86.4% and 83.6%, $p<0.005$ for difference) after the visit were higher where Clover Assistant notified PCPs of patients' non-adherence to medications, even when restricting results to the same cohort of practitioners. Results are summarized in **Table 1**.

Table 1: Fill rates of unfilled prescriptions in the 90 days after PCP visits

	Visit Day (Day 0)	+10 Days	+30 Days	+90 Days
With CA notifications	45.8%	63.1%	73.4%	86.4%
Without CA notifications	41.0%	58.6%	71.2%	83.8%
Without CA entirely	36.2%	57.7%	70.8%	83.6%

CA = Clover Assistant

In additional sensitivity/systematics analyses, we identified higher prescription fill rates with the Clover Assistant non-adherence notification for each medication category. For example, fill rates for diabetes medications on the day of the visit (day 0) were 46.8% with the Clover Assistant notification and 39.1% without the Clover Assistant notification ($p<0.002$ for difference). Fill rates for high blood pressure medications on the day of the visit were 53.8% with the Clover Assistant notification and 45.3% without the Clover Assistant notification ($p<0.001$ for difference). Fill rates for high cholesterol medications on the day of the visit were 41.7% with the Clover Assistant notification and 38.0% without the Clover Assistant notification ($p<0.05$ for difference).

We also identified a higher rate of fills with the Clover Assistant non-adherence notification when restricting data to just 2023. For example, fill rates for medications on the day of the visit were 45.8% with the Clover Assistant notification and 41.2% without the Clover Assistant notification ($p<0.001$ for difference).

Medicare quality measures

Health plan members having a Clover Assistant visit with the non-adherence notification refilled their prescription an average of 3.1 days earlier compared with Clover Assistant visits without the non-adherence notification (21.5 days vs 24.6 days, respectively; $p<0.0001$). We found that affected members were eligible for the medication adherence notification 1.3 times per year on average and that the average time a Clover Health plan member spends in a medication adherence measure denominator during a calendar year using the Pharmacy Quality Alliance PDC calculation is 294 days. With these inputs, the expected yearly PDC impact of the medication non-adherence notification in affected health plan members is 1.4%. Per 2024 CMS star rating technical notes, the average distance between medication adherence star measure cut points is 3.1%.

Discussion

The use of Clover Assistant is associated with increased fills for prescribed medications among patients previously non-adherent to their medications for diabetes, high blood pressure, and high cholesterol. Medication fills increased by 4.8% on the day of the Clover Assistant visit and remained 2.6% higher 90 days after the visit, suggesting a durable impact. This increased rate of medication fills from this notification feature would be expected to lead to a significant 1.4% increase in the percent of days covered (PDC) metric on an annualized basis, the preferred medication adherence measure used by CMS in the Medicare Advantage Star Ratings program.

Our results demonstrate the value of making patients' medication-related behaviors more transparent to clinicians. PCPs generally do not know if their patients fill and refill their prescription medications on a timely basis. While many practitioners ask patients to bring all of their medications to outpatient visits for comprehensive medication reviews, many times this does not happen. Even when medications are brought in for review, the manual process of comparing the list of intended medications documented in the electronic health record (EHR) with the actual medications brought into the office may fail to identify absent or unfilled prescriptions. Patients moreover may be unwilling to communicate their medication non-adherence to their doctors.

Clover Assistant's potential to improve medication adherence is particularly significant in light of recent changes to the Medicare Advantage Star Ratings program that have resulted in lower average star ratings in Medicare Advantage contracts. In 2023, CMS made a number of major methodological changes in how star ratings are calculated. As a result of these changes, the number of higher-performing plans declined substantially for the second straight year. These lower star rating scores result in reduced quality-related payments, which lowers available resources to invest in additional member benefits and care coordination activities to improve health outcomes.

Moving forward, Clover Assistant is capable of driving further impact on medication adherence through the implementation of additional related features. For example, the platform can surface patients' non-adherence to medications for a long list of conditions beyond diabetes, high blood pressure, and high cholesterol for which regular medication use is especially important, such as HIV and severe mental illness. Non-adherence notifications may also be accompanied by lists of other therapeutically equivalent medications that are less expensive and therefore less likely to cause cost concerns for patients. Clinicians are rarely aware of medications' costs and opportunities to prescribe comparable and less expensive medications. The Clover Assistant platform is also capable of surfacing instances of patient non-adherence to prescribed medications between visits to PCPs and population health teams accountable for engaging patients to support care coordination and management goals.

To date, the use of Clover Assistant has been shown to be strongly correlated with early diagnosis and treatment of serious health conditions. The above analysis demonstrates the platform's additional potential to improve medication adherence, a critical component of chronic disease management. As medication adherence becomes an increasing focus of quality improvement to improve health outcomes and lower medical expenses, platforms that provide transparency into patients' medication-related behaviors in a timely way will be able to generate an outsized impact.

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Endnotes

1. Egede, L.E., et al., Longitudinal Effects of Medication Nonadherence on Glycemic Control, Annals of Pharmacotherapy, May 2014, https://pubmed.ncbi.nlm.nih.gov/24586059/

2. Ho, P.M., et al., Medication Adherence; Its Importance in Cardiovascular Outcomes, Circulation, Vol. 119, No. 23, June 16, 2009, https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.108.768986

3. Ho, P.M., et al., Medication Nonadherence is Associated with a Broad Range of Adverse Outcomes in Patients with Coronary Artery Disease, American Heart Journal, Vol. 155, Issue 4, April 2008, https://pubmed.ncbi.nlm.nih.gov/18371492/

4. Roebuck, M.C., et al., Medication Adherence Leads To Lower Health Care Use And Costs Despite Increased Drug Spending, Health Affairs, Vol.30, No.1, Accountable Care Organizations: Making them Work, January 2011, https://doi.org/10.1377/hlthaff.2009.1087

5. Cutler R.L., et al., Economic Impact of Medication Non-adherence by Disease Groups: A Systematic Review, BMJ Open, January 21, 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5780689/

6. Brown, M.T., et al., Medication Adherence: Truth and Consequences, The American Journal of the Medical Sciences, Vol. 351, Issue 4, April 2016, https://doi.org/10.1016/j.amjms.2016.01.010

7. U.S. Food & Drug Administration, Why You Need to Take Your Medications as Prescribed or Instructed, February 16, 2016, https://www.fda.gov/drugs/special-features/why-you-need-take-your-medications-prescribed-or-instructed

8. Centers for Medicare & Medicaid Services, 2023 Medicare Advantage and Part D Star Ratings, October 6, 2016, https://www.cms.gov/newsroom/fact-sheets/2023-medicare-advantage-and-part-d-star-ratings

9. Rose, J.Z., Contributor: Medication Adherence Is a “Force Multiplier” for Medicare Advantage Profitability, Enrollment, Star Ratings, The American Journal of Managed Care, January 9, 2023, https://www.ajmc.com/view/contributor-medication-adherence-is-a-force-multiplier-for-medicare-advantage-profitability-enrollment-star-ratings

10. Meddings, J., et al. Physician Assessments of Medication Adherence and Decisions to Intensify Medications for Patients with Uncontrolled Blood Pressure: Still No Better Than a Coin Toss. BMC Health Services Research, August 21, 2012, https://doi.org/10.1186/1472-6963-12-270

11. Lapane, K.L., et al., Misperceptions of Patients vs Providers Regarding Medication-related Communication Issues, American Journal of Managed Care, November 13, 2007 https://pubmed.ncbi.nlm.nih.gov/17988186/

12. Krueger, K.P., et al., Medication Adherence and Persistence: A Comprehensive Review, Advances in Therapy, Vol. 22, July 2005, https://pubmed.ncbi.nlm.nih.gov/16418141/

13. Kleinsinger, F., The Unmet Challenge of Medication Nonadherence, The Permanente Journal, July 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6045499/

14. American Medical Association, 8 reasons patients don’t take their medications, February 22, 2023, https://www.ama-assn.org/delivering-care/patient-support-advocacy/8-reasons-patients-dont-take-their-medications

15. Ruksakulpiwat, S, et al., How Does the COVID-19 Pandemic Impact Medication Adherence of Patients with Chronic Disease?: A Systematic Review. Chronic Illness, Vol. 19, Issue 3, August 16, 2022, https://pubmed.ncbi.nlm.nih.gov/35971949/

16. Pharmacy Quality Alliance, Endorsement Consideration: PQA Health Plan & Pharmacy Performance Measures, 2019 PQA Measure Manual, https://www.pqaalliance.org/assets/docs/PQA_Measures_Endorsement_MPT_SP-TAT_PDC-CMP-PH_Specifications.pdf

17. Pharmacy Quality Alliance, PQA Adherence Measures, April 19, 2022, https://www.pqaalliance.org/adherence-measures

18. Department of Health and Human Services, CDC Operationalized 1305 Performance Measure – Medication Adherence, https://dphhs.mt.gov/assets/publichealth/Cardiovascular/cdcperfmeasureguidance1305medicationsdherencedefinition42020.pdf

19. Centers for Medicare & Medicaid Services, Medicare 2024 Part C & D Star Ratings Technical Notes, September 29, 2023, https://www.cms.gov/files/document/2024technotes20230929.pdf

20. Pedersen-Green, S., Repasky, C., Medicare Advantage Star ratings may decline with new methodology, Mckinsey & Company, September 15, 2022 https://www.mckinsey.com/industries/healthcare/our-insights/medicare-advantage-star-ratings-may-decline-with-new-methodology

21. Tong, N., Medicare Advantage plan star ratings decline again in 2024, Fierce Healthcare, October 13, 2023, https://www.fiercehealthcare.com/payers/medicare-advantage-plan-star-ratings-decline-again-2024

22. Rogers, H., et al., Future of Medicare Star Ratings: The reimagined CMS bonus system; What are the changes and how can plans prepare? Milliman, October 2023, https://www.milliman.com/-/media/milliman/pdfs/2023-articles/10-6-23_medicare-star-ratings-white-paper_20231005.ashx

23. Roebuck, M.C., et al., Medication Adherence Leads To Lower Health Care Use And Costs Despite Increased Drug Spending, Health Affairs Vol. 30, No.1, January 2011, https://www.healthaffairs.org/doi/abs/10.1377/hlthaff.2009.1087?journalCode=hlthaff

24. Schaecher, K.L., The Importance of Treatment Adherence in HIV, American Journal of Managed Care, Vol. 19, Issue 12, September 29, 2013, https://www.ajmc.com/view/a472_sep13_schaecher_s231

25. Chapman, S.C.E., Horne, R., Medication Nonadherence and Psychiatry, Current Opinion in Psychiatry, September 2013, https://journals.lww.com/co-psychiatry/fulltext/2013/09000/medication_nonadherence_and_psychiatry.5.aspx

26. Allan, G.M., et al., Physician Awareness of Drug Cost: a Systematic Review, PLoS Medicine, September 2007, https://doi.org/10.1371/journal.pmed.0040283

27. Dharmarajan, K., et al., Clover Assistant Use and Diagnosis, Treatment, and Progression of Diabetes, October 2023, https://cdn.cloverhealth.com/filer_public/de/16/de162c60-de52-46a7-aac7-ce519f4e184d/clover_assistant_use_and_diagnosis_treatment_and_progression_of_diabetes.pdf

28. Dharmarajan, K., et al., Clover Assistant Use and Diagnosis and Progression of Chronic Kidney Disease, August 2023, https://cdn.cloverhealth.com/filer_public/5e/af/5eafb507-6ac4-45a2-8d5d-48bce9758bca/ckd_early_diagnosis_and_outcomes_final.pdf