Clover Assistant Use and Diagnosis and Progression of Chronic Kidney Disease

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Summary

1. Chronic kidney disease (CKD) is an underdiagnosed, undertreated, and progressively worsening chronic condition that can lead to high blood pressure, heart disease, stroke, dialysis dependence, and death.
2. Primary care provider (PCP) use of Clover Assistant is correlated with earlier diagnosis of CKD stage 3 and higher.
3. When CKD is diagnosed with Clover Assistant, further decline in kidney function is attenuated.

Background

Chronic kidney disease, or CKD, is a common health condition that is frequently [undiagnosed and untreated](), especially in [minority populations](). Without treatment, CKD is more likely to [progress]() and result in irreversible nephron loss, end-stage renal disease requiring dialysis, and premature death. Worsening CKD is also more likely to cause [complications]() in other parts of the body such as high blood pressure, heart disease, and stroke. These adverse outcomes can be prevented with early diagnosis and [appropriate treatment]() of CKD, in particular stage 3 and higher CKD (higher stages denote worse kidney function).

Clover Assistant is a scalable technology platform designed to help doctors diagnose and treat chronic conditions. The platform ingests large amounts of clinical data from disparate sources and surfaces key clinical insights to doctors that are intended to improve patient care and outcomes. Providers submit associated treatment plans for all conditions diagnosed with Clover Assistant.

Improved early diagnosis and treatment of CKD has been a clinical focus area of Clover Assistant since its inception in 2018. This analysis examines if (1) use of Clover Assistant is associated with earlier diagnosis of CKD stage 3 and higher, and (2) if diagnosis of CKD with Clover Assistant is associated with a slower rate of deterioration in kidney function.

Methods

We examined data from Clover Health members who did not have a diagnosis of CKD stage 3 or higher within healthcare claims data in the year after they joined the health plan, but who were subsequently diagnosed with CKD within healthcare claims data after this time. We identified their primary care providers (PCPs) and determined their use of Clover Assistant during the study period.

For each member, we identified all laboratory measurements of glomerular filtration rate (GFR). The GFR is the most common measure of kidney function, with higher GFR levels indicating better kidney function. As kidney disease progresses, GFR declines.

From these data, we calculated (1) GFR at time of first diagnosis of CKD stage 3 or higher, (2) rate of decline in GFR before CKD diagnosis, and (3) rate of decline in GFR after CKD diagnosis. Measurements were calculated separately for patients seeing providers using Clover Assistant and providers not using Clover Assistant, and differences in these measurements were determined for these two groups.

To make these measurements, we paired each GFR to the time between this test result and a first diagnosis of stage 3 CKD or higher. These pairs were then fitted to a kinked line function to identify potential changes in the slope of GFR decline following CKD diagnosis.

To ensure the robustness of our findings, we performed a number of additional "systematics" or "sensitivity" analyses. Importantly, we recalculated findings only including patients of providers who would eventually use Clover Assistant. Specifically, we compared results related to both CKD diagnosis and post-diagnosis GFR decline in the time period before and time period after a provider started using Clover Assistant. In this way, we addressed the potential risk of bias from differences between providers who do and do not use Clover Assistant. All providers in this analysis used Clover Assistant for some time during the observation period.

We also recalculated findings after excluding patients who had a CKD stage 3 or above diagnosis within the first six months of joining Clover, or within the first two years of joining Clover, rather than the one year we used in the primary analysis. Since Clover has access to GFR data starting in 2013, we repeated analyses only looking at data from 2018 onward, when Clover Assistant was launched, to minimize risk of potential temporal biases impacting findings.
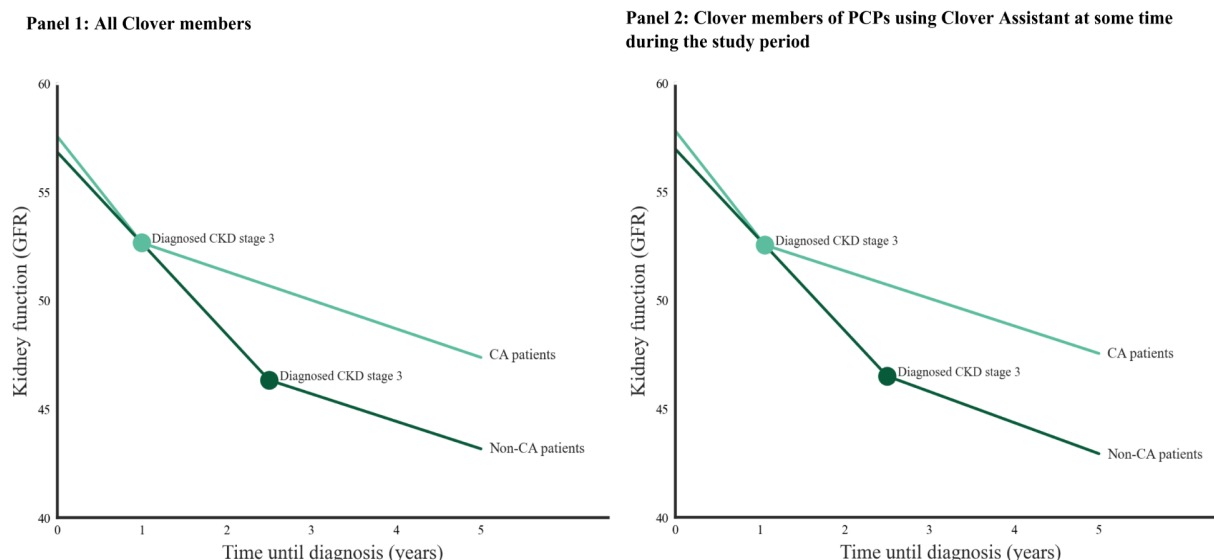
Consistent with Clover Health's focus on improving health equity, we examined the relationships above for members living in neighborhoods with high socioeconomic disadvantage, as measured by the [Area Deprivation Index](link) (ADI). The ADI is a validated measure of neighborhood-level socioeconomic status that includes measures of income, education, employment, and housing quality. The ADI has been used to [inform health policy and health services delivery](link) to drive more equitable health outcomes.

Results

We identified 2,372 PCPs, of whom 1,007 used Clover Assistant during the measurement period. These providers had 7,575 Clover Health members as patients who did not have a diagnosis of CKD stage 3 or higher in the year after joining Clover, but who were subsequently diagnosed with this condition within healthcare claims data. We identified 78,016 GFR measurements for these 7,575 patients, 3,604 of which were diagnosed with CKD stage 3 or higher by a provider using Clover Assistant and 3,971 diagnosed by a provider not using Clover Assistant.

We found that a first diagnosis of CKD stage 3 or higher was made earlier (i.e. at a higher GFR) in patient visits where Clover Assistant was used compared with patient visits without Clover Assistant [**Panel 1 in Figure**].

Figure: GFR and diagnosis of CKD stage 3 or higher with and without Clover Assistant

Panel 1: All Clover members

Panel 2: Clover members of PCPs using Clover Assistant at some time during the study period

Panel 1: Results are presented for all 7,575 Clover members newly diagnosed with CKD stage 3 or higher. Of these members, 3,604 were diagnosed by providers using Clover Assistant and 3,971 were diagnosed by providers not using Clover Assistant at the time of diagnosis.

Panel 2: Results are presented for 6,151 Clover members newly diagnosed with CKD stage 3 or higher among the cohort of 1,007 providers who used Clover Assistant at some time during the study period. Patients being treated by a provider using Clover Assistant ("CA patients") were diagnosed with CKD after the provider started using Clover Assistant. Patients being treated by a provider not using Clover Assistant ("Non-CA patients") were diagnosed with CKD before the provider started using Clover Assistant.

The average GFR at CKD diagnosis was 52.6 mL/min for patients having a visit with Clover Assistant and 46.5 mL/min for patients having a visit without Clover Assistant (difference of 6.1 mL/min at a statistical significance level of $p < 0.00001$).

As shown in Panel 1, we also found that the decline in GFR following a CKD diagnosis was significantly slowed. Before diagnosis of CKD, the decline in GFR is approximately 4.6 mL/min per year. After diagnosis the rate of decline is attenuated to approximately 1.3 mL/min per year.

Results were similar in our additional systematics/sensitivity analyses. For example, when we only included 6,151 patients of the 1,007 doctors who used Clover Assistant at some point during the study period, we found that the average GFR at CKD diagnosis was 52.7 mL/min for patients having a visit with Clover Assistant and 46.3 mL/min for patients having a visit without Clover Assistant (difference 6.4 mL/min at a statistical significance level of $p < 0.00001$) [**Panel 2 in Figure**]. As noted above, this approach eliminated the potential risk of bias from differences between providers who do and do not use Clover Assistant. All providers in this additional analysis used Clover Assistant for some time during the observation period.

Importantly, we found that the association of Clover Assistant with early CKD detection is even more pronounced in populations with high levels of socioeconomic disadvantage, as defined by health plan members living in neighborhoods within the top three Area Deprivation Index deciles (ADI deciles eight to ten). For these patients, the average GFR at CKD diagnosis was 53.4 mL/min for patients having a visit with Clover Assistant and 46.0 mL/min for patients having a visit without Clover Assistant (difference of 7.4 mL/min at a statistical significance level of $p<0.00001$). This difference was higher than for members living in neighborhoods with less socioeconomic disadvantage (ADI deciles one to seven), for whom CKD was diagnosed at a 5mL/min higher GFR on average.

Discussion

Use of Clover Assistant is associated with earlier diagnosis of CKD and an attenuated decline in kidney function following diagnosis. These findings were replicated in our primary analyses as well as multiple sensitivity analyses, including for patients living in areas of high socioeconomic disadvantage as measured by the Area Deprivation Index (ADI). Importantly, early diagnosis and treatment of CKD can reduce patient suffering and healthcare costs from multiple adverse outcomes related to declining kidney function including high blood pressure, heart disease, stroke, dialysis dependence, and death.

The results of this analysis are not surprising, as Clover Assistant ingests large volumes of data from disparate sources and is able to surface key insights to doctors regarding their patients. With regard to CKD in particular, Clover Assistant surfaces multiple markers of kidney function including GFR, urine microalbumin, and others. These markers often come from sources that are traditionally inaccessible to PCPs responsible for preventive care, such as specialist visits and hospital stays. Having PCPs be aware of this information as they care for their patients increases the likelihood that early diagnoses are made and appropriate treatment is initiated. Clover Assistant supports the translation of insights to action by requiring doctors to have a treatment plan for all diagnosed conditions.

To date, Clover Assistant has demonstrated significant impact in spurring early diagnosis and treatment of serious health conditions. The above analysis further illustrates that early diagnosis improves downstream health outcomes. Given the [large burden of chronic disease](#) in the US, early diagnosis and treatment is becoming a progressively important pathway to improve patient health and lower downstream healthcare costs from complications of preventable illness.

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Endnotes

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