CKD Quality Improvement Intervention With PCMH Integration: Health Plan Results

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ABSTRACT

OBJECTIVES: To execute a chronic kidney disease (CKD) intervention to assess feasibility and preliminary outcomes for a health plan.

STUDY DESIGN: This CKD quality improvement study was incorporated into an existing CareFirst primary care patient-centered medical home cohort with a pre- and postintervention assessment from July 1, 2015, to June 30, 2017.

METHODS: The study targeted the population at risk for CKD with diabetes and/or hypertension by implementing a care plan according to the stratification by estimated glomerular filtration rate (eGFR) and urinary albumin-creatinine ratio (uACR) or CKD heat map class.

RESULTS: The population included 7420 individuals (51.8% female) with a mean age of 55.9 years; 19.1% had diabetes only, 42.2% had hypertension only, and 38.2% had both conditions. Overall, there was no change in eGFR testing among risk groups (84.8%), but a small significant increase in uACR testing occurred (from 31.3% to 33.0%; $P = .0020$). Reductions in admissions per 1000 patients were from 362.5 to 249.0 for class 3, 311.7 to 219.2 for class 4, and 590.9 to 323.5 for class 5. Lastly, there were reductions in 30-day readmissions per 1000 patients, from 51.9 to 13.7 for class 4 and 45.5 to 0 for class 5. Although there were increases in many of the per-member per-month costs assessed pre- versus post intervention, net savings in medical costs were $276.80 and $480.79 for CKD classes 3 and 5, respectively.

CONCLUSIONS: This scalable CKD intervention demonstrated feasibility. For advanced CKD, decreased hospitalization and a reduction in several important costs were observed. These preliminary results support the stratification of laboratory data for CKD population health innovation in commercial health plans.

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Gaps in the implementation of clinical practice guidelines for the testing, recognition, and management of chronic kidney disease (CKD) in primary care are common and represent opportunities for quality improvement and patient safety interventions.[1-4] CDC population surveys show that CKD affects 37 million (15%) adults in the United States, and the at-risk population includes 156 million with hypertension and 114 million with diabetes or prediabetes.[5] A CDC analysis demonstrated that CKD screening among patients with these conditions was cost-effective.[6] Additionally, CKD is a disease multiplier that often occurs with other chronic comorbidities and also increases the risk of emergency department (ED) visits, hospitalizations, cardiovascular events, kidney failure, and death.[7,8] In 2016, total Medicare expenditures for kidney disease were more than $114 billion, including $79 billion for all stages of diagnosed CKD (an annual increase of 23%) and $35 billion for end-stage renal disease (ESRD), which is treated with dialysis or kidney transplant.[9] In addition to the Medicare expenditures, commercial insurance costs for kidney disease greatly exceed Medicare's costs of $114 billion annually, supported by a recent study that showed differences in mean per-patient per-year costs, which were $76,969 versus $46,178 for advanced CKD stages and $121,948 versus $87,339 for ESRD in the commercial and Medicare groups, respectively.[10] Thus, CKD is common, identifiable, and associated with high morbidity, mortality, and cost. Addressing the existing gaps in the timely recognition and management of CKD should improve outcomes[11-13] and limit costs.[9,10] Because the core elements of CKD testing and risk stratification are quantifiable electronically, previous studies have demonstrated the effectiveness of transforming practices to a population health model for CKD.[14-21]

In general, improvements in care quality, patient outcomes, and the cost-effectiveness of care can arise through the process of continuous quality improvement and the implementation of population health management models that leverage health informatics, team-based care, and strategies for organizational change.[22] CareFirst BlueCross BlueShield (CareFirst) is a nonprofit health plan serving as the largest healthcare insurer in the mid-Atlantic

region with more than 3.2 million beneficiaries. CareFirst initially determined CKD as frequently underdiagnosed and elevated serum creatinine as the most significant laboratory cost driver across the member population compared with other laboratory tests, including hyperglycemia, hypercholesterolemia, and liver function test abnormalities (**eAppendix A** [eAppendices available at **ajmc.com**]). CareFirst then began collaborating with CKD*intercept*, the CKD primary care initiative of the National Kidney Foundation (NKF), to design a quality improvement study to test the impact of a CKD intervention in the primary care setting.

TAKEAWAY POINTS

- Previous studies show underdiagnosis of chronic kidney disease (CKD) in primary care.
- The CKD major risk groups include patients with diabetes and patients with hypertension.
- The severity of CKD is assessed by tests for kidney function and kidney damage that predict hospitalization, adverse cardiovascular and kidney disease outcomes, and expenditures.
- A CKD quality improvement study designed to implement care based on test result severity in a health plan's patient-centered medical home adult population confirmed incomplete testing for CKD but still reduced hospitalizations and lowered selected expenditures over 24 months of follow-up.
- Commercial health plans should consider CKD population health innovations.

METHODS

The collaboration resulted in a quality improvement study design with 3 key elements: testing the at-risk population with diabetes and/or hypertension, detection of CKD, and care plan implementation individualized to the risk stratification by estimated glomerular filtration rate (eGFR) and urinary albumin-creatinine ratio (uACR) based on clinical practice guidelines. The study objectives were to determine feasibility of implementation and preliminary outcomes. Long-term aims included promoting CKD diagnosis, reducing cardiovascular risk, slowing CKD progression, increasing timely and appropriate nephrology consultation, and reducing costs.

The intervention was integrated into CareFirst's patient-centered medical home (PCMH) model, developed in 2011 to control the rising healthcare costs in Maryland, northern Virginia, and the District of Columbia (DC). At the time of the study, approximately 1.2 million CareFirst beneficiaries and about 4500 primary care physicians (PCPs) were enrolled in the CareFirst PCMH program. The PCPs are incentivized for providing, arranging, coordinating, and managing quality, efficient, and cost-effective healthcare services for members. The program provides a combination of data sharing, clinical support, and incentives with the goal of improving quality of care and reducing costs over time.

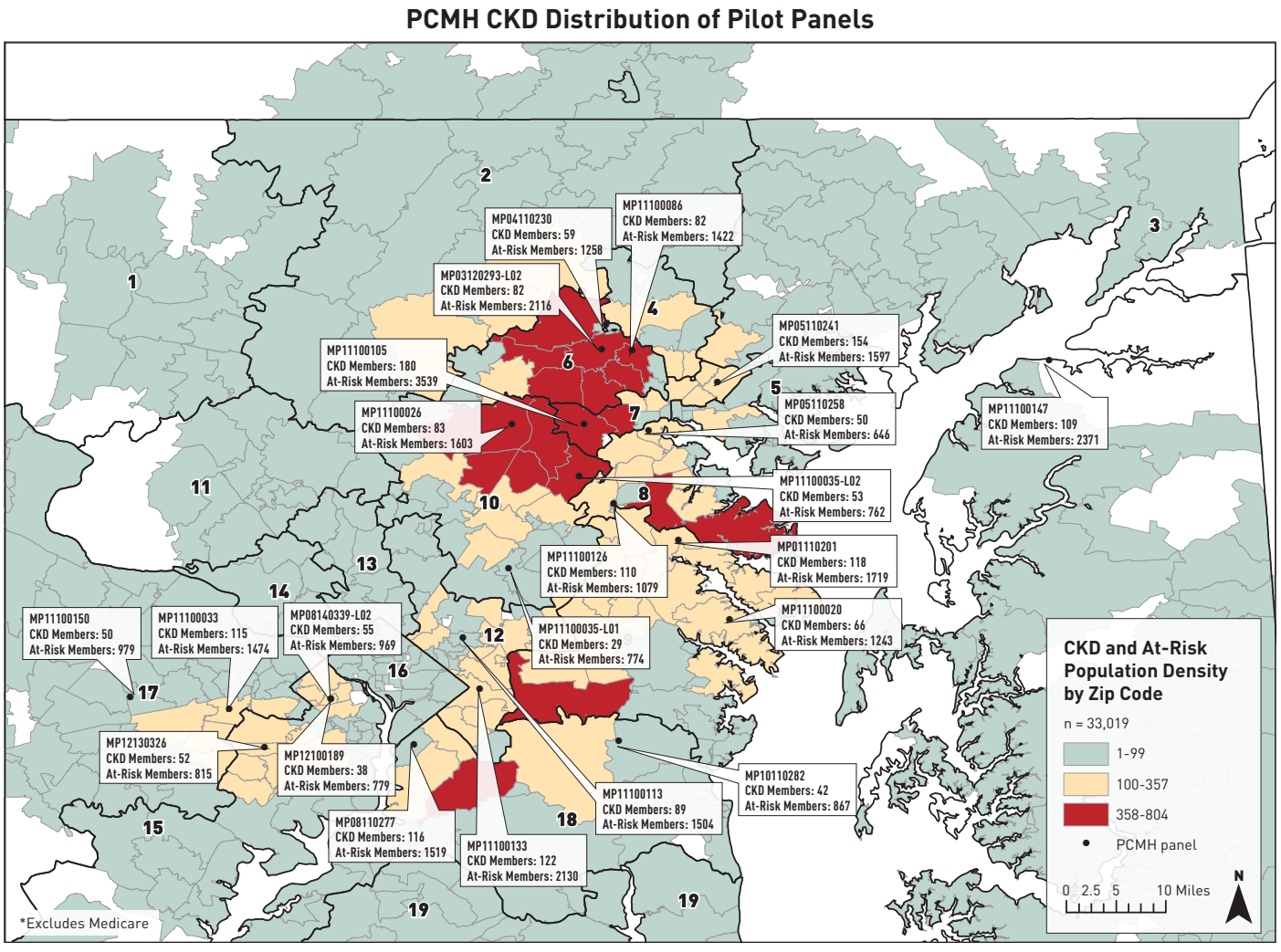
PCPs voluntarily participate in the PCMH program, which is characterized by registered nurse care coordinator support, analytical support including a registry function, web-based tools for care coordination, and upside-only incentives for achieving quality and cost containment. Local care coordinators (LCCs) work closely with PCPs to identify, screen, and monitor CareFirst members who have indicators of CKD. Each LCC reviews the laboratory results of identified members with the attributed PCP to assign each to the appropriate CKD class, as defined by the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines.[11,12] The assigned CKD class aids the PCP to decide on an appropriate course of treatment, the need for a care plan, the frequency of kidney function monitoring, and the timing of referral to kidney care specialists and other related community-based resources.

There is also a component of PCP education to ensure that all members with CKD follow the appropriate recommendations at every stage of their disease. The study selected 21 PCP panels (each included 5 to 15 PCPs) located in 10 CareFirst regions with the highest rates of identified CKD in Maryland (**Figure 1**). PCPs were educated on the importance of early CKD screening, and members at risk for CKD were identified as needing screening. The PCPs have the freedom to refer to any specialist, such as a nephrologist, but a preferred list is utilized based on availability for prompt consultation, quality standards, and expected costs.

The CareFirst care plan integrated the NKF's KDOQI heat map classification based on these laboratory results, using eGFR less than 60 mL/min/1.73 m^2 and uACR 30 mg/g or greater to define CKD (**Figure 2**[11-13]), and integrated clinical practice guideline interventions in a stepwise fashion based on severity (**Figure 3**). The KDOQI CKD G stages[11,12] are based on the level of kidney function or eGFR (G1, ≥90; G2, 60-<90; G3a, 45-<60; G3b, 30-<45; G4, 15-<30; G5, <15 mL/min/1.73 m^2), whereas the A stages are based on the level of kidney damage or uACR (A1, <30; A2, 30-<300; A3, ≥300 mg/g). Urine dipstick proteinuria equivalent assumptions are negative and +trace for A1, +1 for A2, and +2 or greater for A3. The heat map classes by colors used in Figures 2[11-13] and 3 stratified the CKD stages by risk for adverse cardiovascular and kidney outcomes: class 1 (green), G1 and G2 with A1 or at risk for CKD; class 2 (yellow), G1 and G2 with A2, or G3a with A1; class 3 (orange), G1 and G2 with A3, G3a with A2, or G3b with A1; class 4 (red), G3a with A3, G3b with A2 or A3, or G4 with A1 or A2; and class 5 (deep red), G4 with A3 or G5 with any A stage.[11-13]

The NKF trained PCMH leadership, case managers, and care coordinators on CKD evidence-based testing and interventions using population results (eGFR and uACR). Training and continuing medical education regarding CKD recognition and management was also offered by NKF for the CareFirst clinicians engaged in the quality improvement intervention. Criteria for participant inclusion in the evaluation included being 18 years or older with (1) a diagnosis of CKD, hypertension, and/or diabetes; and (2) continuous enrollment and attribution to the CKD project and PCMH panel during the 24-month study period from July 1, 2015, to June 30, 2017. Study exclusions were Medicare primary health insurance, any history of kidney transplantation, or dialysis treatment

FIGURE 1. Maryland Distribution of the 21 CKD PCMH Study Panels Selected by the CareFirst Prevalence of Diagnosed CKD[a]



CKD indicates chronic kidney disease; PCMH, patient-centered medical home.
[a]Of the 22 panels shown, 1 panel (MP01110201) dropped out of study participation.

during the study period. In addition to the CKD stratification, assessments and outcomes included illness burden score (IBS), ED visits, hospitalizations, readmissions, angiotensin-converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB) use for hypertension with A3 albuminuria,[11-13,23,24] statin therapy for CKD with age older than 50 years,[13] medical nutrition therapy,[25,26] nephrology consultation,[11-13] and unadjusted per-member per-month (PMPM) costs. The IBS uses diagnostic cost grouper (DxCG) by diagnosis codes (*International Classification of Diseases, Tenth Edition, Clinical Modification*) and demographic information to assess the level of illness. The groups include condition categories that are hierarchical for numerically weighted relative importance. Because the DxCG categories are based on diagnosis codes, rather than procedure codes, they describe morbidity or illness level, not treatment or cost patterns. They are less sensitive to variations in local practice styles or location of healthcare services. This quality improvement analysis using deidentified subject-level data did not require institutional review board approval. Statistical tests were performed using SAS Enterprise Guide 7.1 (SAS Institute Inc; Cary, North Carolina).

RESULTS

Characteristics of the CareFirst quality improvement study population of 7420 individuals included a mean age of 55.9 years and a gender composition of 51.8% female, with the following risk

factors for CKD: diabetes only, 19.1%; hypertension only, 42.2%; both conditions, 38.2%; and neither condition with a CKD diagnosis code, 0.5% (**Table 1**). Overall, eGFR testing among risk groups was more common than uACR testing, with no change pre- and post intervention for eGFR (6289/7420 [84.8%]), but there was a small but significant increase in uACR screening (pre-, 2321/7420 [31.3%] and post, 2448/7420 [33.0%]; $P = .0020$. All risk groups—diabetes alone, hypertension alone, or both conditions—showed more common eGFR testing than uACR testing, with small and variably significant increases in uACR testing pre- versus post intervention. For the diabetes-only risk group, there was a small but significant increase in individuals who had eGFR testing with the intervention, from 1143 (82.6%) to 1187 (85.8%) ($P = .0098$).

Assessments of evidence-based interventions revealed no significant increase in ACE inhibitor or ARB use for hypertension with A3 albuminuria or statin use for CKD in the population older than 50 years, although complete pharmacy benefit data were only available in a subpopulation of 2034 (27.4%). The high levels of preintervention implementation—94.7% for ACE inhibitor or ARB use and 69.6% for statin use—may have contributed to the absence of an intervention impact (**eAppendix B**). Relatively low rates of albuminuria testing additionally contributed to a small denominator for the population eligible for ACE inhibitor or ARB evidence-based therapy assessment. There were small variably significant increases in medical nutrition therapy for CKD (eAppendix B), as assessed by Current Procedural Technology codes in **eAppendix C**. Nephrology services were significantly increased for patients with advanced CKD (class 5), from 63.0% to 83.3%, with a corresponding increase in the intensity of services or mean visits from 4.4 to 12.8 pre- to post intervention, respectively ($P < .05$) (eAppendix B).

There were reductions in admissions per 1000 patients: 362.5 versus 249.0 for class 3, 311.7 versus 219.2 for class 4, and 590.9 versus 323.5 for class 5 (**Table 2**). Lastly, there were reductions in 30-day readmissions per 1000 patients: 51.9 versus 13.7 for class 4 and 45.5 versus 0 for class 5. Analysis of diagnosis-related groups (DRGs) revealed reductions in most

FIGURE 2. CKD Heat Map or Population Health Risk Assessment by eGFR and uACR With the Recommended Frequency of Monitoring per Year by CKD Heat Map G and A Stage or Class 1 to 5 in Colors[a]

Class and Treatment Recommendations for CKD

Class	Category	Treatment Recommendations
0	NEEDS SCREENING	• Set up an appointment with the member • Order lab work: › uACR › eGFR • Determine the member's classification based on the lab values
1	GREEN	• Provide member education • Schedule annual follow-up visits for regular kidney function testing • Manage the underlying risk factors for CKD, such as diabetes and hypertension *In addition to:* recommendations listed in **CLASS 0**
2	YELLOW	• Schedule annual follow-up visits for regular kidney function testing • Consider instituting automated appointments and testing reminders • Consider a comprehensive medication review • Order the following services as necessary: › Nutrition consultation › Home-based assessment (only if in an active care plan) › Smoking cessation › Diabetes education › Enhanced monitoring (blood glucose, hypertension) › Wellness/disease management *In addition to:* recommendations listed in **CLASS 1** and **CLASS 0**
3	ORANGE	• Conduct semiannual kidney function screening • Initiate a PCMH care plan • Consider an expert consult • Consider enhanced monitoring • Begin PCP-to-nephrologist consultations about the patient's status and collaborate on best practices • Referral to nephrologist if the uACR is severely increased *In addition to:* recommendations listed in **CLASS 2**, **CLASS 1**, and **CLASS 0**
4	RED	• Kidney function screening 3 times per year › Refer member to a nephrologist or a nephrology group • Expect preferential appointments for these referrals and additional patient support programs (nutrition, emotional support, community resources) • Use the local care coordinator to coordinate communication with the nephrologist • Collaborate with the nephrologist and member to discuss kidney replacement preparation *In addition to:* recommendations listed in **CLASS 3**, **CLASS 2**, **CLASS 1**, and **CLASS 0**
5	DEEP RED	• Kidney function screening 4 times per year • Work jointly with a nephrologist to manage the patient's care • With nephrologist and member, discuss peritoneal dialysis/home dialysis, hemodialysis access, and transplant options • Establish kidney replacement access early to minimize the need for emergent dialysis access placement *In addition to:* recommendations listed in **CLASS 4**, **CLASS 3**, **CLASS 2**, **CLASS 1**, and **CLASS 0**
–	GRAY	Not stratified • Review the medical record for lab values • Determine the member's classification based on the lab values

CKD indicates chronic kidney disease; eGFR, estimated glomerular filtration rate; PCMH, patient-centered medical home; PCP, primary care physician; uACR, urinary albumin-creatinine ratio.

[a]CKD is classified based on eGFR and uACR. Green, low risk (if no other markers of kidney disease, no CKD); yellow, moderately increased risk; orange, high risk; red, very high risk; deep red, extremely high risk.

Source: Adapted for CareFirst program.[11-13]

FIGURE 3. CKD Risk Stratification Determines the Care Plan: Stepwise Care Plan by Heat Map Classification or Class as Determined by the Combination of eGFR and uACR

				uACR CATEGORIES Description and range		
				A1	A2	A3
				Normal to mildly increased <30 mg/g <3 mg/mmol	Moderately increased 30-299 mg/g 3-29 mg/mmol	Severely increased ≥300 mg/g ≥30 mg/mmol
eGFR CATEGORIES Description and range (in mL/min/1.73 m²)	G1	Normal or high	≥90	1	2	3
	G2	Mildly decreased	60-89	1	2	3
	G3a	Mildly to moderately decreased	45-59	2	3	4
	G3b	Moderately to severely decreased	30-44	3	4	4
	G4	Severely decreased	15-29	4	4	5
	G5	Kidney failure	<15	5	5	5

CKD indicates chronic kidney disease; eGFR, estimated glomerular filtration rate; uACR, urinary albumin-creatinine ratio.

categories with several exceptions. For patients with CKD class 4, heart failure was the most common DRG for admissions (169.0 to 95.9 per 1000) and readmissions (39.0 to 13.7 per 1000) pre- and post intervention, respectively. The PMPM costs and IBS increased in a stepwise fashion for G stages G1, G2, G3a, G3b, G4, and G5, as well as heat map classes 1 through 5, for both study phases, as shown in Table 2.

There were increases in medical PMPM expenditures (institutional and professional) as albuminuria stage progressed; pre- and postintervention expenditures were $628.38 versus $592.17 in A1, $787.67 versus $1154.52 in A2, and $1164.55 versus $1881.93 in A3, respectively (**eAppendix D**). The incremental expenditures of the intervention were not precisely quantified, because the CKD intervention was integrated in a preexisting PCMH program. Although there were increases in many of the costs assessed pre- versus post intervention, there were important reductions in expenditures for several areas, particularly for the population with more complex illness, as represented by advanced heat map classes and IBS (Table 2). Savings in medical PMPM costs were $276.80 for CKD class 3 (from $1306.10 to $1029.30) and $480.79 for CKD class 5 (from $2362.75 to $1881.96). There were increases of $267.27 in medical PMPM expenditures for CKD class 4 (from $1172.79 to $1440.06). Savings for CKD class 3 were composed of decreases in institutional PMPM (from $815.18 to $582.90) and professional PMPM (from $490.92 to $446.40) costs. For CKD class 5, there was an increase in professional expenditures of $111.62 (from $439.38 to $551.00) that was offset by institutional PMPM savings of $592.42 (from $1923.38 to $1330.96).

DISCUSSION

This CKD quality improvement study demonstrated the feasibility of integrating CKD care processes within a health plan's existing mature PCMH program with voluntary clinician participation. As shown in other data for Medicare and commercial insurance plans, CKD screening for eGFR among major risk groups was high—approximately 85%—whereas recommended albuminuria or uACR testing was much less common at 33% post intervention. The high prevalence of kidney function testing is explained by the inclusion of serum creatinine and eGFR in laboratory panels commonly used for general health monitoring by clinicians, such as the basic metabolic panel and the comprehensive metabolic panel. However, uACR is more specific to kidney disease testing and, unfortunately, less commonly ordered. This study confirmed increases in comorbidities (IBS), adverse outcomes, and expenditures as G stages and CKD heat map classes progressed. In addition, these are the first data, to our knowledge, to show that expenditures increase by albuminuria classification alone or A stages consistently both pre- and post intervention. Although albuminuria associations with expenditures may be intuitively obvious, they support the need for improved uACR screening. Efforts to increase albuminuria screening of the population with diabetes and/or hypertension

should be emphasized for risk prediction, quality improvement, and cost containment. In addition, high albuminuria levels (A3) support clinical decision making for aggressive diabetes control,[24] use of ACE inhibitors or ARBs to treat hypertension,[23,24] and identification of patients who benefit from nephrology services in the context of high risk for CKD progression and cardiovascular events.[11-13]

As a result of these preliminary findings, CareFirst expanded the CKD study intervention to all CareFirst members attributed to the PCMH program in Maryland, northern Virginia, and DC, and sought to strengthen relationships between PCPs and the regional nephrology practices. More complete uACR testing would likely have increased the impact of the intervention. Accordingly, in collaboration with the NKF, CareFirst is supporting the Lab Engagement Initiative (Kidney Profile: uACR and eGFR testing),[27,28] working to establish a long-term evaluation methodology and continuing the partnership with the NKF to educate PCPs. The NKF has collaborated with the American Society for Clinical Pathology and other organizations to offer a Kidney Profile, which will simplify ordering both eGFR and uACR for the clinician. This has been implemented by leading laboratory organizations nationwide.

CareFirst has also introduced kidney care testing quality measures within the PCMH program to evaluate physician performance, which encourages physicians to order both laboratory tests for the population with diabetes. The NKF has developed a kidney health evaluation measure that includes both CKD tests for the adult population with diabetes in collaboration with the National Committee for Quality Assurance and the Physician Consortium for Performance Improvement.[29] CareFirst has participated in the development of this measure with the ultimate goal of it being included as an electronic clinical quality measure for both commercial and federal quality improvement programs, Healthcare Effectiveness Data and Information Set and Merit-based Incentive Payment System, respectively. Lastly, in 2019, CareFirst included uACR annual testing in the PCMH quality measure program for the diabetes population.[11-13,24,27,28] Granted the study limitations, this space is crying out for more insights. The 2021 Medicare Advantage coverage for ESRD is on the horizon. Commercial payer costs for advanced CKD and dialysis continue to escalate and absorb an increased amount of healthcare resources despite these patients representing a small proportion of the population. This study demonstrates that in a distributive primary care workspace, leveraging PCMH tools for CKD risk, the attention of clinicians can be captured for screening, identifying, prioritizing, and referring at-risk patients using this simple, scalable tool. Future investigation should be designed to more precisely quantify the return on investment for CKD population

TABLE 1. Characteristics of the CKD Pilot Population

Characteristic	Result		
N	7420		
Age in years, mean (SD)	55.9 (9.2)		
Female, n (%)	3844 (51.8)		
Male, n (%)	3576 (48.2)		
Hypertension and diabetes, n (%)	2851 (38.2)		
Hypertension only, n (%)	3149 (42.2)		
Diabetes only, n (%)	1383 (19.1)		
No hypertension or diabetes with a CKD diagnosis, n (%)	37 (0.5)		
	Preintervention	**Post Intervention**	***P*[a]**
All patients (N = 7240)			
Completed eGFR, n (%)	6289 (84.8)	6289 (84.8)	1.0000
Completed uACR, n (%)	2321 (31.3)	2448 (33.0)	.0020
Completed eGFR and uACR, n (%)	2285 (30.8)	2424 (32.7)	.0007
Completed neither screening, n (%)	1095 (14.8)	1107 (14.9)	.7551
Hypertension and diabetes (n = 2851)			
Completed eGFR, n (%)	2519 (88.4)	2499 (87.7)	.3542
Completed uACR, n (%)	1373 (48.2)	1415 (49.6)	.1545
Completed eGFR and uACR, n (%)	1354 (47.5)	1401 (49.1)	.1100
Completed neither screening, n (%)	313 (11.0)	338 (11.9)	.2391
Hypertension only (n = 3149)			
Completed eGFR, n (%)	2595 (82.4)	2570 (81.6)	.3616
Completed uACR, n (%)	257 (8.2)	302 (9.6)	.0118
Completed eGFR and uACR, n (%)	247 (7.8)	297 (9.4)	.0050
Completed neither screening, n (%)	544 (17.3)	574 (18.2)	.2708
Diabetes only (n = 1383)			
Completed eGFR, n (%)	1143 (82.6)	1187 (85.8)	.0098
Completed uACR, n (%)	685 (49.5)	724 (52.3)	.0766
Completed eGFR and uACR, n (%)	678 (49.0)	719 (52.0)	.0632
Completed neither screening, n (%)	233 (16.8)	191 (13.8)	.0124
	Preintervention	**Post Intervention**	***P*[a]**
Classified, n (%)	3373 (45.5)	3515 (47.4)	.0194
Class 1, n (%)	2602 (77.1)	2636 (75.0)	.5592
Class 2, n (%)	390 (11.6)	447 (12.7)	.0425
Class 3, n (%)	273 (8.1)	304 (8.6)	.1880
Class 4, n (%)	81 (2.4)	80 (2.3)	.9368
Class 5, n (%)	27 (0.8)	48 (1.4)	.0151
Not classified, n (%)	4047 (54.5)	3905 (52.6)	.0194

CKD indicates chronic kidney disease; eGFR, estimated glomerular filtration rate; uACR, urinary albumin-creatinine ratio.

[a]*P* value calculated by Pearson's χ^2 test.

TABLE 2. Costs, ED Visits, Admissions, Readmissions, and Score by CKD Classification

Preintervention Costs[a] By CKD Class (calculated from lab results and/or CKD diagnosis code stage)								
Class	n	Medical PMPM	Institutional[b] PMPM	Professional[c] PMPM	ED Visits/ 1000	Admissions/ 1000	Readmissions/ 1000	IBS
1	2052	$650.33	$317.59	$332.75	311.4	95.0	9.3	2.49
2	327	$932.01	$494.28	$428.73	388.4	165.1	24.5	3.49
3	251	$1306.10	$815.18	$490.92	350.6	362.5	67.7	4.93
4	77	$1172.79	$660.48	$512.32	532.5	311.7	51.9	5.33
5	22	$2362.75	$1923.38	$439.38	363.6	590.9	45.5	8.03
Postintervention Costs[a] By CKD Class (calculated from lab results and/or CKD diagnosis code stage)								
Class	n	Medical PMPM	Institutional[b] PMPM	Professional[c] PMPM	ED Visits/ 1000	Admissions/ 1000	Readmissions/ 1000	IBS
1	1998	$656.48	$319.3	$337.18	265.8	103.6	18.0	2.41
2	358	$1052.04	$501.00	$551.05	298.9	167.6	39.1	3.18
3	257	$1029.30	$582.90	$446.40	400.8	249.0	77.8	3.89
4	73	$1440.06	$604.99	$835.07	575.3	219.2	13.7	4.94
5	34	$1881.96	$1330.96	$551.00	411.8	323.5	0.0	8.84

CKD indicates chronic kidney disease; ED, emergency department; IBS, illness burden score; PMPM, per member per month.

[a]Expenditures are not adjusted for inflation during the study period.

[b]Institutional or hospitalization expenditures.

[c]Professional or physician service costs.

health interventions. Also needed are clinical decision support or other tools to integrate uACR testing into busy clinician workflows for at-risk populations, as well as those with established low eGFR.

Limitations and Strengths

Overall, this is a pre–post quality improvement study without a control group. Other limitations of this study include short-term assessment, incomplete CKD testing (particularly for uACR), and limited generalizability to existing PCMH programs. Low uACR testing is not unique to this population; US data for 2016 show only 41.8% and 49.0% testing for those with only diabetes and 6.6% and 7.1% assessment for those with only hypertension in the Medicare 5% sample and commercial insurance (Optum Clinformatics) populations, respectively.[9] Additionally, blood pressure control is not available with health plan administrative data collection. Finally, although the savings in this quality improvement study support additional intervention in CKD, this study was also not designed or powered to precisely quantify return on investment for the intervention. Thus, the cost or utilization savings may not be reproducible or generalizable, particularly in the absence of a PCMH model.

Because long-term changes in the rates of patients receiving new or incident dialysis take years to accrue in the population, improvements in hospitalization and readmission are important short-term benefits to demonstrate for the patient and the payer. These results show that cost savings can be realized after only 1 year of intervention by improvements in admission for CKD classes 3 through 5 and in readmission for classes 4 and 5. Data showing heart failure as the most common DRG for admission and readmission for CKD class 4 with reductions post intervention are important to note. Longitudinal data support that heart failure admissions and readmissions are associated with advanced CKD by both lower levels of eGFR and higher levels of uACR.[30] Heart failure prevention and treatment should be a population health priority for CKD.[30] Although there were increases in many of the costs assessed pre- versus post intervention, there were reductions in expenditures for several important areas, particularly for the population with more complex illness, as represented by advanced heat map classes and corresponding IBS. Given the relatively modest changes in testing and evidence-based therapies associated with the intervention in the data presented, other interventions (eg, increased medical nutrition therapy use, the selection of nephrology consultants [according to efficient availability, quality measure achievement, and cost containment] by the PCMH practitioners, increased intensity of nephrology visits for advanced CKD) may have contributed to the findings in a way that is difficult to quantify with the available data. There were significant increases in medical nutrition therapy for CKD class 1 and class 2 and insignificant increases for the more advanced classes that may have played a small contributory role to the improved outcomes and reduced costs. Use of the heat map classification was associated with more intensive nephrology services and increased professional PMPM costs that were offset by institutional PMPM savings for CKD class 5. The numbers are admittedly small, but the risk stratification isolated a small, costly population. Risk factor control for hypertension or diabetes could also have contributed to improved outcomes. Strengths of this

population health study include real-world experience with a feasible, simple, scalable intervention incorporated into an existing PCMH program. The pre- and postintervention study design avoids the ethical challenges of a randomized trial with a control group. Learnings include feasibility assisted by integration within an existing PCMH program, and allocation of nephrology services based on laboratory risk stratification has potential to reduce hospitalization and readmission in the short term for a small population at high risk for adverse outcomes.

CONCLUSIONS

This simple, scalable CKD quality improvement intervention among the Maryland beneficiaries of a health plan's PCMH program showed decreased admissions and readmissions, as well as reductions in several important costs, particularly for advanced CKD. The contributors to this improvement include modest changes in evidence-based testing and therapies, among others, such as medical nutrition therapy, informed selection of nephrology practitioners, and increasing nephrology services for advanced CKD. These preliminary results support ongoing intervention within the current study population, as well as innovation in CKD for commercial health plans. ■

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