Research article

Improving Detection and Management of Impaired Kidney Function in Primary Care via Diagnostic Management Team Approach

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***PURPOSE*. Chronic kidney disease (CKD) is a growing public health challenge with substantial morbidity, mortality, and cost. Early detection is critical, yet abnormal kidney function results in primary care are often lacking timely follow-up.**
***MATERIALS AND METHODS*. This study evaluated a Diagnostic Management Team (DMT) intervention in which a Doctor of Clinical Laboratory Science (DCLS) and an internal medicine physician provided patient-specific laboratory recommendations to primary care providers for abnormal glomerular filtration rate (GFR) results. A post-test control group design included 199 primary care patients without known CKD. Follow-up and laboratory utilization were assessed for four months post-intervention using chi-square analysis.**
***RESULTS*. Compared to controls, DMT-guided patients showed significantly higher laboratory test utilization ($p = 0.001$), follow-up rates ($p < 0.001$), and adherence to kidney disease: Improving Global Outcomes (KDIGO) guidelines ($p < 0.001$).**
***DISCUSSION*. A DCLS supported DMT improved recognition and management of early CKD indicators in primary care. Embedding laboratory professionals in multi-disciplinary care teams may enhance early intervention, reduce progression to end-stage disease, and decrease healthcare costs.**

Abbreviations: CKD = chronic kidney disease; DMT = diagnostic management team; GFR = glomerular filtration rate

Keywords: Chronic kidney disease, Doctor of Clinical Laboratory Science, diagnostic management team, glomerular filtration rate, laboratory test utilization

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Introduction

Chronic kidney disease (CKD) is a substantial public health burden associated with significant morbidity, mortality, and associated healthcare costs. Current studies estimate the global prevalence to be 8-16%, with over 850 million people affected by some stage of CKD.[1] The rising prevalence of CKD is most often associated with increasing rates of associated risk factors such as diabetes mellitus and hypertension. According to the Centers for Disease Control and Prevention (CDC), approximately 37 million U.S. adults, or one in seven, are estimated to bear some stage of CKD.[2,3] It is estimated that up to 90% of individuals with CKD are unaware of having the diagnosis, as it is normally asymptomatic in early stages. Delayed detection of CKD until a person reaches symptomatic stages comes with a multitude of downstream effects such as increased risks for cardiovascular disease, end stage renal disease requiring dialysis, and kidney transplantation. The Global Burden of Disease study remains the most comprehensive effort to track epidemiological trends across both diseases and injuries that is used by clinicians and policy makers worldwide to make informed decisions.[4] Information in this study revealed that addressing the detection and management of CKD is necessary to meet the United Nation's goal of decreasing premature mortality from non-communicable diseases by a third by 2030.[4]

Along with the downstream effects of morbidity and mortality, the United States Renal Data System (USRDS) also reports that the healthcare cost burden of CKD to be approximately 114 billion dollars annually in the United States.[5] The early detection, management, and slowing of progression of CKD to later stages and end-stage renal disease (ESRD) have large economic implications for potential cost savings in the amount spent annually towards treating this disease. Approximately one third of the total cost of CKD treatments is focused on patients with ESRD.[6]

Despite the importance of early detection and management of CKD, recent studies show that follow up on abnormal glomerular filtration rate (GFR) values in asymptomatic patients in a primary care setting are not common.[7,8] The lack of timely detection is likely a multifactorial issue. In-depth study of laboratory medicine is largely neglected in the U.S. medical schools leaving a knowledge gap between healthcare providers and the thousands of complex laboratory tests currently available.[9] The lack of equitable access to routine primary care across socioeconomic statuses remains a major contributor to most preventable public health issues. This causes disproportional burdens especially among minorities and vulnerable populations. Another contributing factor is the sheer number of clinical guidelines that rapidly change over time for healthcare professionals to understand and follow.

To address these issues effectively, a multidisciplinary approach is needed such as that of a diagnostic management team (DMT). A DMT is a group of diagnostic experts in a certain specialty working together to ensure the appropriate performance of diagnostic tests in a timely manner and provide patient specific interpretations of the tests. At Vanderbilt University, a coagulation DMT review was implemented for pulmonary embolism and intracranial hemorrhages and successfully decreased the hospital length of stay from 4 to 2 days.[9] In the same hospital system, a leukemia and lymphoma DMT improved diagnostic turnaround time and resulted in an annual savings of approximately $1M USD.[10] In 2008, the Institute for Healthcare Improvement (IHI) described the way forward in healthcare improvement as a "Triple Aim. The IHI Triple Aim consists of "improving the individual experience of care; improving the health of the population; and reducing the per capita costs of care for population".[11] This study conducted at an academic medical center sought to determine whether implementing a DMT would improve follow up on abnormal kidney function results in a primary care setting.

Materials and Methods

DCLS Supported Diagnostic Management Team Intervention

Using a multidisciplinary approach, a DMT was developed for this study's intervention. A Doctor of Clinical Laboratory Sciences (DCLS) student developed a DMT which included a practicing DCLS professional and a board-certified internal medicine physician at UTMB. The DMT reviewed charts and determined what recommendations to provide for PCPs. The PCPs who were taking care of patients in the intervention group received DMT reports via email which included brief medical and family history, current medications, laboratory values interpretations relevant to kidney function, and recommendations for additional testing in line with the kidney disease: Improving Global Outcomes (KDIGO) clinical guidelines. No action was taken on the control group participants.

Subjects

This post-test control group consisted of 199 total patients from UTMB primary care clinics across a five-week period beginning in January of 2021. Patients were sampled based on convenience approximately twice per week and then placed randomly into the intervention group or the control group. The intervention group was provided patient specific laboratory testing interpretations and recommendations regarding follow up to the abnormal GFR, and no further action was taken on the control group. Patients were filtered in UTMB's electronic health record EPIC by age, clinic, and eGFR value. The eGFR value was filtered to the abnormal level, which described possible CKD stage II, between 60-90 mL/min/1.73m^2. Exclusion criteria included patients with a diagnosis of CKD or under the care of nephrology. Inclusion criteria included no prior CKD diagnosis and no prior nephrology referrals.

Data Collection

The data was extracted from UTMB's electronic health records (EHR) from January 2021 through early March of 2021. An extensive and thorough chart review of potential patients was performed to ensure they met the inclusion criteria. Spreading the collection across five weeks allowed the preparation of recommendations and interpretations followed by a thorough review from the internal medicine provider. The data collected following the intervention and four-month waiting period included proper follow-ups, laboratory test utilization, and adherence to clinical guidelines. For this study, proper follow up is defined as a basic metabolic panel (BMP) ordered three months to four months from the date of the original appointment to establish chronicity and a test for proteinuria ordered to determine any tubular damage present. Tests incorporated in laboratory test utilization included a repeat BMP, which include GFR, and proteinuria assays such as urine protein dipstick, random urine creatinine/protein ratios and urine microalbumin assays. A post-intervention chart review was performed in the EHR four months post appointment for both patients in the control and intervention groups. The UTMB Institutional Research Board (IRB) deemed the study a quality improvement project.

Statistics

All variables were compared between the intervention and control groups using chi-square analysis to assess for statistically significant differences between groups. Statistical significance was defined as $P < 0.05$.

Results

Of the initial 236 participants recruited for this study, 37 (15.6%) were excluded due to previous diagnosis of CKD or being currently under the care of a nephrologist. A total of the remaining 199 participants were included in the study. Participant demographic characteristics are summarized in **Table 1**. Of the 199 participants, 27% were between 40–50 years old, 35% between 51-60 years, and 38% between 61–70 years. The racial/ethnic distribution included 59% Caucasian/White, 6% Black/African American, 31% Hispanic/Latino, and 4% Asian or Native American. The gender

Table 1. Demographic Data of Study Population

Category	Sub-Category	Control Group (n=102)	Intervention Group (n=97)	Total Percent (%)
Age	40-50	26	29	27
	51-60	35	34	35
	61-70	41	34	38
Gender	Male	47	43	46
	Female	55	54	54
Race/Ethnicity	Caucasian	63	53	59
	Hispanic/Latino	29	33	31
	African American	5	7	6
	Asian	2	1	1
	Native American	3	2	3

Table 2. DMT Impact

	Control N (%)	Intervention N(%)	P Value
Lab Tests Ordered			0.001
Zero	95 (93.1)	71 (73.2)	
One	3 (2.9)	13 (13.4)	
Two	4 (3.9)	13 (13.4)	
Follow Up Performed			< 0.0005
No	95 (93.1)	71 (73.2)	
Yes	7 (6.9)	26 (26.8)	
Clinical Guidelines Adherence			< 0.0005
No	97 (95.1)	76 (78.4)	
Yes	5 (4.9)	21 (21.6)	

Note. P values were determined by performing a chi-square analysis.

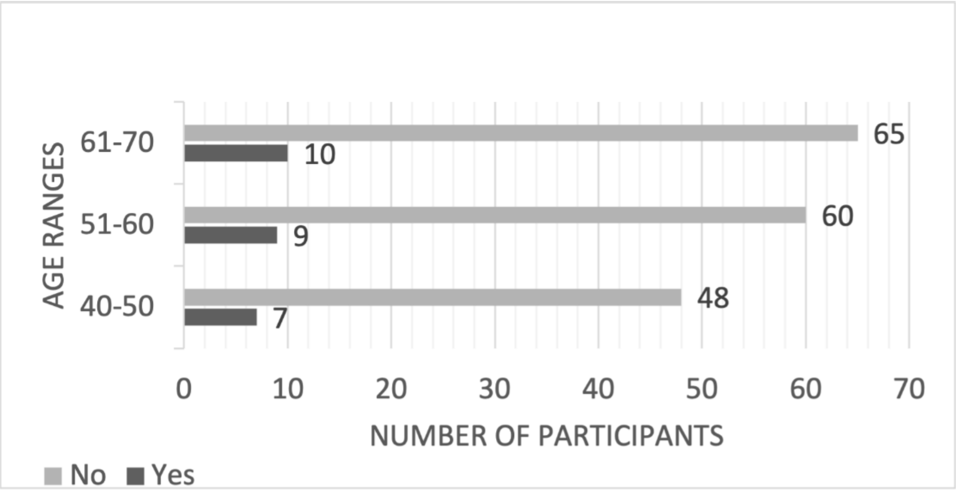

Figure 1. Guidelines Followed by Patient's Age Group
Graph showing number of participants who had follow ups adhering to clinical guidelines stratified by age. P=0.995

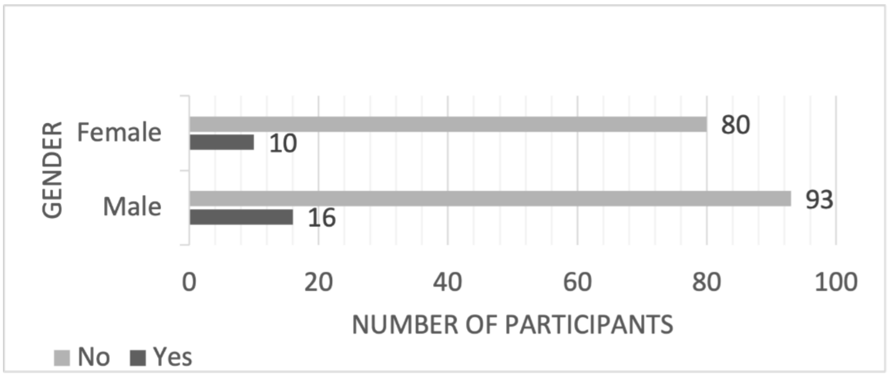

Figure 2. Guidelines Followed by Patient's Gender
Graph showing number of participants who had follow ups adhering to clinical guidelines stratified by gender. P=0.457

distribution was 54% female and 46% male. Participants were distributed randomly between UTMB primary care clinics.

To test the hypothesis on whether the DMT intervention improved proper laboratory test utilization, the control group was compared to the intervention group using the chi-square statistical test. Across the participants, there were zero, one, or two laboratory tests ordered to assess kidney function of the participants. The tests included albumin/ createinine ratio, BMP, or serum creatinine. These categories are summarized in **Table 2**. Of the 199 participants, zero laboratory tests were ordered on 95 (47.7%) of the control group participants and 71 (35.7%) from the intervention group. One laboratory test was ordered on 3 (1.5%) of the control group and 13 (6.5%) of the intervention group. Two laboratory tests were ordered on 4 (2%) of the control group and 13 (6.5%) of the intervention group. Each of the three categories showed statistical significance (x^2 (2, N=199) = 14.368, p = 0.001).

To test the hypothesis that DMT intervention improved provider follow-up and adherence to the current KDIGO clinical guidelines, a chart review was performed after the predetermined 4-month interval. Any participant who had mention of kidney function assessment as a reason for the follow up was marked "Yes" and the others "No" for follow-up. For follow-up for abnormal GFR scores, there was a significantly higher proportion of individuals from the intervention group 26 (26.8%) compared to the control group 7 (6.8%) (x^2(1, N=199) = 14.293, p < 0.0005). Adherence to the current clinical guidelines showed a similar pattern with 21 (21.6%) of participants from the intervention group and only 5 (4.9%) from the control group adhering to the guidelines (x^2(1, N=199) = 12.277, p < 0.0005) (Table 2). Age group and gender further stratified the analysis of adherence. There was no effect of age ranges of 40-50, 51-60, and 61-70 (*p*=0.995). (Figure 1) There was also no significant effect of gender (*p*=0.457). (Figure 2)

Discussion

In this study, the DMT approach was associated with a statistically significant improvement in primary care provider ordering and follow-up of abnormal GFR results compared with usual care. In addition to improved laboratory utilization, statistically significant differences were observed between groups in physician follow-up and adherence to clinical guidelines. The laboratory's input into the ordering behaviors of providers is a relatively novel concept in healthcare. Studies reveal that such multidisciplinary groups, as seen with DMTs, are more effective at preventing diagnostic error and improving patient outcomes.[12] Adherence to clinical guidelines was also stratified by age ranges and gender in the total study population, but there was no difference between the groups.

It is evident that there is a need to focus more on detection and management of CKD, as reflected by the inclusion of screening for CKD in the United Nation's Sustainable Development Goal to decrease deaths due to non-communicable diseases by one third by the year 2030. A potential tool to address this is clinical decision-making software to help identify and properly manage individuals requiring CKD related follow-ups.[13] However, additional research is required in this field as to how DMTs can be effectively and efficiently integrated in the implementation of these types of electronic interventions. Another area needing further research where the expertise of DCLS is vital is the developing and testing of novel biomarkers for kidney function. With the well-known limitations to creatinine and cystatin C values making the eGFR formulas difficult to interpret, more stable biomarkers to identify kidney dysfunction are required to standardize diagnosis and management.[14] Beta-trace protein and B-microglobulin are two of the more promising candidates.[15] DCLS are uniquely suited for helping to test these analytes for clinical utility and help to integrate them into clinical practice.

While the results of this study demonstrate the potential impact of DMTs on laboratory utilization and guideline adherence, several limitations should be considered. The short four-month follow-up period may not adequately capture long-term effects on provider behavior or patient outcomes. Also, while the sample was racially and ethnically diverse, the small number of participants from certain subgroups may limit subgroup analysis and broader applicability. Future studies should consider multi-center designs, longer follow-up durations, and expanded outcome measures to better assess the clinical utility and scalability of DMT interventions.

As highlighted by the Institute of Medicine in its landmark report "To Err is Human," medical errors are more common than perceived and has led to healthcare systems striving for improvements including the Triple Aim framework.[16] This study demonstrates the inclusion of DCLS within Diagnostic Management Teams has the potential to significantly improve laboratory test utilization, provider follow-up, and adherence to clinical guidelines for patients with early signs of impaired kidney function in primary care settings. By integrating laboratory expertise into frontline care decisions, the intervention helped close a well-documented gap between abnormal GFR findings and appropriate clinical follow-up. These findings support the value of diagnostic stewardship and interdisciplinary collaboration in enhancing patient safety and reducing the risk of delayed diagnosis. Broader implementtation of DMT models may offer scalable, cost-effective strategies to improve chronic disease management, particularly in high-burden conditions like chronic kidney disease. Future research should assess long-term outcomes and explore integration into health systems at scale.

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Declaration of Interest

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