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User Requirements for a Chronic Kidney Disease Clinical Decision Support Tool to Promote Timely Referral

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Abstract

Background—Timely referral of patients with CKD has been associated with cost and mortality benefits, but referrals are often done too late in the course of the disease. Clinical decision support (CDS) offers a potential solution, but interventions have failed because they were not designed to support the physician workflow. We sought to identify user requirements for a chronic kidney disease (CKD) CDS system to promote timely referral.

Methods—We interviewed primary care physicians (PCPs) to identify data needs for a CKD CDS system that would encourage timely referral, and also gathered information about workflow to assess risk factors for progression of CKD. Interviewees were general internists recruited from a network of 14 primary care clinics affiliated with Brigham and Women's Hospital (BWH). We then performed a qualitative analysis to identify user requirements and system attributes for a CKD CDS system.

Results—Of the twelve participants, 25% were women, the mean age was 53 (range 37–82), mean years in clinical practice was 27 (range 11–58). We identified 21 user requirements. Seven of these user requirements were related to support for the referral process workflow, including access to pertinent information and support for longitudinal co-management. Six user requirements were relevant to PCP management of CKD, including management of risk factors for progression,

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AUTHORS' CONTRIBUTIONS

LS and PMN were involved in the design of the study. LS conducted interviews and collected data. JG, PMN, DWB, and LS were all involved in the coding and analysis of data. All authors read and approved the final manuscript.

Ethics Approval

This study was approved by Partners HealthCare Humans Research Committee under protocol number # 2013P000748. The committee granted implied consent by voluntary participation in the study.

STATEMENT ON CONFLICTS OF INTEREST

Conflicts of interest: none

interpretation of biomarkers of CKD severity, and diagnosis of the cause of CKD. Finally, eight user requirements addressed user-centered design of CDS, including the need for actionable information, links to guidelines and reference materials, and visualization of trends.

Conclusion—These 21 user requirements can be used to design an intuitive and usable CDS system with the attributes necessary to promote timely referral.

Keywords

Medical Records Systems, Computerized; Primary Health Care; Decision Support Systems, Clinical; Quality of Care; Chronic Kidney Disease; Referral and Consultation

BACKGROUND

Chronic kidney disease is an important and a costly public health issue with high morbidity and mortality.[1–7] Approaches to improving management of CKD must focus on primary care clinics as 95% of patients with early stages of CKD are cared for by primary care physicians (PCPs). Evidence suggests that PCPs are unaware of recent changes in guidelines and that knowledge gaps exist in management of contributing risk factors like diabetes and blood pressure, preferential use of angiotensin converting enzyme inhibitors, and angiotensin II receptor blockers. [8–12] Timely referral has been associated with reduced costs and lower mortality, but patients are often referred later than is optimal.[13–16]

One approach to improving management of early CKD is through the use of electronic health records (EHRs). Studies support the effectiveness of EHR tools for chronic disease management, particularly clinical decision support (CDS).[17, 18] EHRs are already being used to improve diagnosis of CKD by surveillance of serum creatinine results.[19] One study used the facilitated process improvement methodology to gather requirements for a CDS system to support CKD management.[20] To our knowledge, no one has yet successfully designed a CDS system to promote timely referral.

In general, CDS interventions have failed because they were not incorporated into physician workflow.[21] Specific to CKD, one CDS study implemented point-of-care reminders to promote timely referral, but failed to show an improvement.[22] The authors stated that the use of a passive alert led to the low impact, but weighed the advantages of an active alert against the potential for ‘alert fatigue.’ The complex task of clinical decision support design should be addressed through user-centered design.[23]

Few vendors have incorporated user-centered design into EHRs. User centered design is a human factor strategy to design technology that is efficient for the designated user of a system.[24] Our objective was to gather user requirements to inform design of a CKD CDS system to promote timely referral. These findings will be used in a future study to develop and implement a CKD CDS system that will address barriers to timely referral.

METHODS

Briefly, this was an exploratory study using qualitative methods based on grounded theory principles in order to understand how CDS could assist PCPs in the decision making process for referral to nephrology. This study was approved by the Partners HealthCare IRB.

Study Setting and Context

Primary care physicians within 14 primary care clinics affiliated with Brigham and Women's Hospital (BWH) were eligible to participate in the study. Subjects were recruited from suburban or urban primary clinics within the BWH network in the Boston area. We determined that we had the time and resources for a target enrollment of approximately ten interviews. A recruitment letter in the form of an e-mail was sent to 150 primary care physicians. Participants gave informed consent to be interviewed and submitted a brief questionnaire about demographics, clinical experience, and self-report of computer skills as compare to peers.

The EHR used at BWH at the time of data collection was a homegrown system used since 2000. The EHR included a few CDS alerts related to CKD including medication warnings for renal dosing, non-interruptive CDS alerts for patients with CKD whose blood pressure was not under control, and non-interruptive alerts for patients with CKD who were not on an angiotensin converting enzyme inhibitor (ACE).

Data Collection

A physician (LS) developed a semi-structured interview guide with the assistance of an expert in user-centered design (PMN). The guide was created 1) to prompt discussion about evidence-based CKD management, 2) to elicit specific changes in patient status that would prompt referral to nephrology, 3) to identify labs, medications, and other data that PCPs use during the referral decision-making process. All interviews were conducted by a PCP (LS) with coaching on methods to probe for more specific information by the expert in user-centered design (PMN).

Key topics in evidence-based management were taken from KDOQI and KDIGO guidelines and included urine albumin testing and nephrology referral for patients with an estimated glomerular filtration rate (eGFR) < 30 mL/min/1.73m^2.[25, 26] The interview guide was designed to begin with broad questions to elicit interviewees' general thought process and workflow for managing patients with CKD. Interviewees were then specifically asked for numeric thresholds for biomarkers such as serum creatinine, serum eGFR, and urine albumin to creatinine ratio that would prompt a referral. One section of the guide was designed to explore PCP reactions to the provision of a five-year kidney failure risk estimate. This estimate was based upon the hypothesis that awareness of a high risk of kidney failure would prompt PCPs to refer patients to nephrology. In addition, we presented a paper prototype of a risk estimate tool (Figure 1).[27, 28]

All interviews were audio-taped. Interview length ranged from thirty minutes to one hour. At the beginning of each interview, a demographic form was distributed to the interviewees to collect interviewees' general characteristics such as age, gender, and years in practice.

Interview audio was transcribed and identifiable information was removed from the transcripts.

Data Analysis

We used a constant comparative method to analyze data. One researcher (JG) reviewed each transcript in order to identify representative quotes and create initial codes, such as “Labs and other numerical data used to determine severity/progression - interpreting change in the lab” or “PCP referral to nephrology - reason not to refer is low life expectancy.” Two researchers (JG and LS) reviewed the initial codes to confirm the validity and appropriateness of the codes. An initial set of conceptual categories was developed. The coding scheme was refined by three researchers (JG, LS, PMN) throughout the analysis process into codes such as “User should receive suggestion for action.” Four researchers (JG, LS, PMN, and DWB) reviewed the final set of codes. To translate the coded concepts from the interview into user requirements, we first identified quotes from each transcript and assigned appropriate codes such as “User can see a trend in eGFR, blood pressure values” or “User should be able to easily access information about competing hazards.” A final set of conceptual categories was created and then translated to system attributes. The user requirements and system attributes were categorized into major themes.

RESULTS

We interviewed 12 physicians during 2014. Participants included a diverse group of PCPs, ranging in age from 37 to 82 years (mean age: 53 years). Participants had been in practice for 11 to 58 years (mean: 27 years), while the participants’ years at their institution ranged from 3 to 59 years. Overall, 25% of the participants were women. All participants practiced in General Internal Medicine clinics. Two participants were also certified in Infectious Disease. All participants rated their computer skills from average to above average.

In total we identified 21 user requirements and 14 system attributes, which we grouped under three themes: well-designed CDS to promote timely referral, support for PCP CKD management, and support for the referral process.

Well-designed CDS to Promote Timely Referral

We identified six user requirements related to user-centered design of CDS (Table 1).

Participants provided examples of well-designed CDS in their current EHR, such as renal dosing alerts. Most participants said that they follow the recommendations of the alerts because they are accurate and actionable. Participants expressed frustration with CDS alerts that don’t give specific advice for action. Specifically, a number of participants commented on the fact that CDS alerts often identify a problem without suggesting a solution. Participants expressed a desire for direct links to perform a recommended action, such as a ‘one-click’ referral button. To address these issues, the CDS system should include actionable information that is integrated with knowledge resources and computerized order entry (Table 1, requirement 1a–1b).

Participants expressed frustration with inaccurate CDS. Participants also mentioned the lack of accuracy of CDS when CDS fires for patients with a very low risk of CKD progression. They gave examples of CKD CDS alerts triggering for patients with acute kidney injury or for patients with stable CKD over time. Participants discussed various methods to decrease false positives such as identifying medications that could impact kidney disease. To avoid inaccurate CDS alerts, the CDS system should use accurate information with a high signal-to-noise ratio (Table 1, requirement 1c).

Some participants mentioned that they always open reference materials such as UpToDate when reviewing abnormal lab results for certain serum chemistries. Participants expressed a need to be able to rapidly access the guidelines when necessary (Table 1, requirement 1d). Participants generally said they were hesitant to use CDS outside of the EHR, saying it was cumbersome to go in and out of the EHR during a visit. Therefore, we determined that the CDS system should make information available on current guidelines for CKD management and other reference materials, and also should be well integrated with knowledge resources (Table 1, requirement 1d).

As we explored the PCP's workflow during CKD management, participants mentioned several timepoints when they reviewed CKD labs: before the appointment, during the appointment, and after the appointment. Lab results reviewed after the appointment are highly significant because many participants mentioned that they would repeat abnormal CKD labs to rule out lab errors. With this workflow, a decision to refer would occur several days later while reviewing results. Therefore well-designed CDS that promotes timely referral should be integrated into the PCP workflow at times of lab result review and decision-making, both before and after the clinic visit (Table 1, requirement 1e).

Participants often said the decision to refer was concurrent with a change in lab data such as eGFR. Participants said they preferred to see a new lab result in the context of a trend rather than opening a different screen to find prior results. Based on participants' preference for a visualization of a trend, we included a requirement for the CDS system to show trends of change in lab data and contributing risk factors to improve the decision-making process (Table 1, requirement 1f).

Other considerations to improve usability of CDS—We received additional feedback about usability barriers that could limit use of CDS systems in general. Participants referenced 'cluttered screens' that often deter them from finding information necessary for decision making. On the other hand, it is important to provide the evidence base for recommendation. When we showed participants a paper prototype of a risk estimate tool, they said that they would like to see the reference to the journal article.

Support for PCP CKD Management

We identified five user requirements related to support for PCP CKD management (Table 2).

Although we wanted to focus on requirements for well-designed CDS to promote timely referral, our results revealed the requirements for CDS to support PCP management in general. The decision to refer is intertwined with a PCP's understanding of contributing risk

factors and to what extent those risk factors are well-controlled. PCPs believe that managing conditions like diabetes and hypertension is wholly within their domain. When discussing the decision to refer, one participant asked, “Do you become a traffic policeman or do you do any thinking on your own?” Another PCP said, “I just think hypertension is a primary care disease, just like I think type 2 diabetes is a primary care disease.” Some participants explained that a CDS alert to promote referral would lead them to examine the contributing risk factors. Participants mentioned a specific threshold of three to four blood pressure medications or evidence of end organ damage for patients with hypertension. Therefore we identified a user requirement for CDS to help PCPs manage risk factors by determining if the current medication regimen for hypertension or diabetes is optimal (Table 2, requirement 2a).

We asked whether it would be helpful for the system to identify patients with abnormal laboratory markers of CKD (serum creatinine, eGFR, urine albumin or protein) based on the KDIGO guidelines for diagnosis and classification of CKD.[25] However it became clear through the interviews that each PCP chose a slightly different definition of ‘abnormal’ based on both personal practice style and the individual patient’s clinical status. So it may be the case that users prefer a threshold that could be customized by the PCP and tailored to the patient’s situation (Table 2, requirement 2b).

A number of participants discussed the importance of determining the severity of disease in terms of complications such as electrolyte abnormalities (e.g., hyperkalemia), metabolic bone disease, or anemia. We determined that CDS should identify whether a patient has developed complications of CKD (Table 2, requirement 2c).

When asked for reasons to refer patients to nephrology, participants often cited uncommon causes of disease that resulted in a referral. Many participants said their decision to refer patients to nephrology came after they had done their own diagnostic workup. Participants cited instances of patients with glomerulonephritis, severe proteinuria, kidney stones, and other causes that made them more likely to refer to nephrology for a diagnostic workup. These examples led to a requirement for a system to alert a PCP for signs of an unusual cause of CKD (Table 2, requirement 2d).

Many participants discussed the eventual need for intensive therapy, preparation for dialysis, or renal transplantation as a prompt for referral. We developed a user requirement for a CDS alert to use various pieces of clinical data, including abnormal lab values and medication regimen, to prompt the provider to prepare for renal replacement therapy (Table 2, requirement 2e).

Support for the Referral Process

We identified seven user requirements that would ensure that CDS supports an efficient pathway to timely referral (Table 3).

As part of the information gathering process prior to referral, PCPs need to determine whether patient has been referred to nephrology in the past. In some cases, the patient’s prior interaction with a nephrologist may be difficult to ascertain. For example, a patient may have

been asked to return for continuing visits with the specialist, but the subsequent appointments were not made or the patient did not go to the appointments. Access to information on prior nephrology interaction could be improved by a CDS system (Table 3, requirement 3a)

Participants mentioned several other types of information they consider when deciding to refer to nephrology. Participants were hesitant to refer older patients or patients with end-stage conditions. We identified a need for CDS that promotes timely referral to make pertinent information available, such as active cancer diagnosis and life expectancy. It is important to note that if CDS is not embedded in an EHR, the level of interoperability would determine whether this is feasible. We also identified a need for CDS to alert a provider to high risk CKD and to provide information about competing hazards (Table 3, requirement 3b).

A number of participants mentioned the lack of knowledge about specialist availability as another barrier to referral. One participant said that if nephrology appointments are limited, the participant would only send the most severe cases to nephrology. The system should provide information about current specialist availability to assist PCPs in determining when referrals are appropriate (Table 3, requirement 3c). Given the fact that access to nephrologists may be limited, a CDS system which prioritizes patients at the highest risk of poor outcomes would be useful (Table 3, requirement 3d).

Some participants said that they often order a renal ultrasound before referring a patient to nephrology. This discovery led to a discussion about the need to review radiology tests before ordering a renal ultrasound. One participant mentioned that he would review any CT scans even if they were ordered for other purposes. Therefore we determined that to improve the efficiency of computerized order entry systems should encompass relevant diagnostic studies. We translated the attribute into a requirement for CDS to present existing results that are relevant and an order set including commonly ordered tests and information about previous orders (Table 3, requirement 3f).

Participants expressed a desire for CDS to support co-management, as multiple participants recalled times when they were unclear about who was responsible for certain aspects of management. However, other participants mentioned experiences when co-management worked well. Some participants specifically mentioned the need to easily communicate with specialists about diagnosis and management of unusual diagnoses. We determined that a CDS system should include support for communication about clinical decisions (Table 3, requirement 3g–3h).

DISCUSSION

In this study, we attempted to define the requirements for a well-designed CDS system to promote timely referral to nephrology. The main findings of this study are that user-centered design will ensure that the CDS system is integrated within the existing workflow to encourage PCP use, that the CDS system must support PCP management, and that the support for the referral process is just one aspect of a CDS system that would promote

timely referral to nephrology. Support for the referral itself includes displaying relevant information such as specialist availability and past nephrology appointments, but there are many other aspects of PCP decision-making that occur months or years before the referral takes place.

Our findings suggest that there are many care gaps and that there is substantial room for improvement. Analysis of PCP interviews showed that participants did not use various CDS in the current system because it either contained inaccurate information or because alerts were inactionable. On the other hand, the respondents have universally embraced renal dosing alerts in the e-prescribing system, suggesting that they would use CDS which is well-designed and fulfills user requirements. By understanding PCPs' workflow, we are able to determine opportunities for CDS to promote timely referral.

Our original objective, was to understand the decision and workflow for referral and we determined that referral is most likely to occur when the PCP is unable to identify a diagnostic cause or stabilize a patient. Through discussion with the participants, we gathered information on common barriers to referral: lack of information on past nephrology visits, patient barriers to nephrology access, specialist availability, and inability to differentiate low risk from high risk patients. Each of these barriers could potentially be improved through CDS that gives the PCP access to pertinent information prior to decision making.

We discovered that PCPs are unclear about evidence-based guidelines for CKD management. Various studies also show the uncertainty surrounding evidence based guidelines.[9, 10, 29–32] We also gathered additional information on PCPs' reluctance towards CDS that is not actionable or usable. This is supported by prior studies that have questioned the utility of EHRs and CDS for CKD management because CDS can be difficult to learn and overwhelming.[10] Unlike other studies, we have delineated the PCP workflow for CKD management in the interest of designing usable CDS. Generally, the PCP's first reaction to abnormal kidney function is to repeat tests to check for error, perform a diagnostic workup, and then pursue more aggressive medical management. CDS should support this process through the user requirements we have presented.

Our findings are similar to other studies that highlight the importance of integrating CDS with the PCP workflow.[22, 33, 34] In a previous study, Patwardhan et. al conducted a focus group with clinicians and other experts in the field. They developed user requirements including easy access to evidence associated with CKD management, clear identification of patients' current status, and specific actionable recommendations for intensification of antihypertensives. [20]

Similar to other studies, we found a lack of consistency amongst participants about when to refer to nephrology.[31, 35, 36] Notably, there was no consensus on a numeric threshold for referral, though both the 2002 K/DOQI and 2012 KDIGO guidelines set eGFR < 30 mL/min/1.73m^2 as a threshold for referral.[12, 36] In fact, many participants in our study discussed the lack of clarity around using eGFR for CKD staging in general. One study showed that serum creatinine was generally preferred among PCPs, although they expressed the desire for a more accurate test.[31]

Another way to promote timely referral would be to support communication around co-management with nephrology. Our findings are similar to qualitative studies about co-management because some participants mentioned experiences with co-management that were beneficial to care while other participants felt that lack of co-management was a barrier to referral.[20, 34, 37, 38]

CKD is prevalent among elderly patients, and issues around dialysis at the end of life are becoming more common in primary care. Other studies support our findings that PCPs do not refer older patients to nephrology. Campbell et al. found that many elderly CKD patients are not referred to nephrology although they meet the criteria for referral as outlined by the guidelines. [25, 39] Many PCPs face this dilemma of whether to refer older patients, and would likely benefit from support to help guide decision-making and to guide communication with patients about prognosis.[40–42]

Another consideration is the relationship of our findings to other studies that showed that lack of time was a barrier. Surprisingly, respondents did not cite lack of time as a barrier to care, though this has been reported in other studies.[43, 44] Improving efficiency of EHR use is likely to have a positive impact on guideline-based CKD management due to the number of guideline based activities for PCPs and short office visits.[43–46] For example, if the patient's eGFR is < 30 mL/min/1.73m^2, the system could automatically add the diagnosis code for Stage IV CKD to the bills for the visit and lab orders and this gain in efficiency may promote the use of CDS.

The generalizability of these findings may be limited since we only interviewed physicians within one network and others may have different workflows. Also those who agreed to participate may be more motivated to provide guideline-based care for CKD. Therefore the participants may not be representative of the general population of PCPs. Another limitation is a small sample size as we only interviewed 12 participants, but this is in keeping with similar studies.[31, 47]

Our findings highlight requirements of a CDS system to promote timely referral of CKD patients to nephrology. These results show the importance of CDS that is integrated with the PCP workflow for maximal impact on management. Leaders in the field of HIT have proposed a framework to ensure that CDS systems will improve quality of care.[48]Further studies should be conducted to implement and evaluate the effect of CDS systems on referral patterns for CKD patients.

CONCLUSION

As the U.S. population ages and people acquire multiple comorbid chronic diseases, it is important to design CDS which fits into the PCP workflow. Conducting user interviews early in the development process informs design requirements and provides context for how this type of tool would be most useful to providers. Although our original goal was to identify ways for CDS to promote timely referral to nephrology, we also learned how CDS can support longitudinal PCP CKD management, which in turn could promote timely referral. The findings of this study will be used to develop and implement a CKD CDS

system that can address barriers to timely referral. Subsequent studies will evaluate the impact of this system on nephrology referral and other aspects of evidence-based CKD management.

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LIST OF ABBREVIATIONS

CDS	Clinical Decision Support
CKD	Chronic Kidney Disease
PCPs	Primary Care Physicians
EHR	Electronic Health Record
BWH	Brigham and Women's Hospital
ACE	Angiotensin converting enzyme inhibitor
eGFR	Estimated Glomerular Filtration Rate

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SUMMARY TABLE

Already known on Topic	What study added to our knowledge
• Approaches to improving management of chronic kidney disease (CKD) must focus on primary care clinics because 95% of patients with CKD are in early stages of the disease and are cared for by primary care physicians (PCPs)	• Our results suggest that a CKD CDS system should fulfill requirements under three themes: well designed CDS to promote timely referral, support for CKD management, and support for the referral process
• Evidence suggests that PCPs are unaware of recent changes in guidelines and that there are knowledge gaps in CKD management	• We found a lack of consistency amongst participants about when to refer to nephrology
• Timely referral has been associated with reduced costs and lower mortality, but patients are not always referred in a timely manner	• CDS that supports longitudinal CKD management would in turn promote timely referral

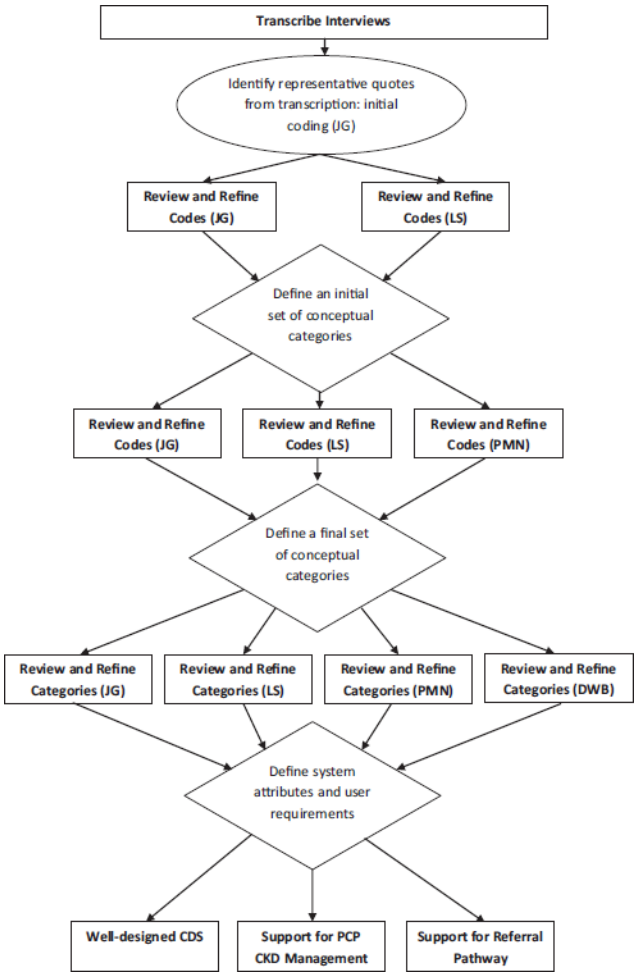

Figure 1.
Development of System Attributes and User Requirements

Table 1

Well-designed CDS to promote timely referral

Number	System attribute	User Requirement	Quote
1a	Actionable information	User should receive suggestion for action	"I definitely do follow those guidelines as far as antibiotic dosing or other renally dosed things…yeah it will say 'this has been calculated [according] to the patient's renal function,' yeah, I do that."-PCP 7
1b	Actionable information	User should be able to take action immediately	"I want a one click referral button"-PCP 3
1c	Accurate diagnosis of CKD	User should be confident that patients are identified accurately	"And the point is I don't need this red [alert] popping up, when I have [a case of] acute renal failure."-PCP 3
1d	Guidelines and other reference materials	User can access information for clinical decision-making and patient education within the workflow	"So if [calcium and phosphate] are really off I end up having to open up UptoDate every time."-PCP 3 "…a little icon that you click on…an info button. It would be nice to go over there so you don't have to jump into Up-to-date. It's cumbersome to go in and out."-PCP 6
1e	Integration with workflow	User receive CDS at times of clinical decision-making	"If it's a new patient I usually review at least five years of data that I put in my notes…And I will do the pre-gathering early on…before I see the patient."-PCP 10 "I would look at the labs and then discuss it with him over the phone…I don't have people come back and just talk about referral" -PCP 6
1f	Data visualization	User can see a trend in eGFR, blood pressure values	"So I look at change over time: over a period of a year or two, how much has their creatinine, but more specifically their [glomerular filtration rate] changed. And certainly if there's been a big delta then I'm going to be more concerned."-PCP 7

Table 2

Support for PCP CKD Management

Number	System Attribute	User Requirement	Quote
2a	Synthesis of clinical information needed to control progression of CKD	User can determine if medication regimen for hypertension or diabetes is optimal	"First of all you need to understand, 'what's the cause for this,' and whether the blood pressure or diabetes is well controlled. If they're not well controlled, I'll first try to stabilize those."-PCP 8
2b	Synthesis of clinical information needed to control progression of CKD	User can identify patients with abnormal laboratory markers of CKD (serum creatinine, eGFR, urine albumin or protein)	"I even like this 3B rather than 3… that kind of really kind of matches my level of worry. 45 and under I'm thinking 'boy, that is getting to the point where the nephrologist is going to say 'I would have liked to see them a little earlier.'"-PCP 2 "Once they start developing proteinuria of a gram or more, I had that in the back of my head that maybe that's the time to send someone to a nephrologist."-PCP 11
2c	Synthesis of clinical information needed to control progression of CKD	User can easily identify whether patient has developed complications of CKD	"If I can't get someone's potassium under control, that obviously will speed up the time where I'll say, 'Okay this kidney disease impacting other things, it's no longer a bystander.'"-PCP 4
2d	Synthesis of clinical information needed to control progression of CKD	User can easily identify signs of an unusual cause of CKD	"Severe proteinuria that I didn't know why, in a non-diabetic. Or some sort of glomerulonephritis picture, blood in the urine, red blood cells casts, worsening renal function."-PCP7
2e	Synthesis of clinical information to indicate that CKD will progress to ESRD soon	User should receive guidance in preparing for renal replacement therapy	"I will refer them if I think that they may require preparation for dialysis or renal transplantation."-PCP 8

Table 3

Support for Referral Process

Number	System attribute	User Requirement	Quote
3a	Pertinent information should be readily available	User can identify if a patient has seen nephrology	"Have they ever seen renal specialist? I look in the notes, but I also look at their appointments scheduled and I kind of see who they've had appointments scheduled with and then I go look on the notes and see who they saw—did they actually go to the appointment? And what was the summary of the appointment?"-PCP 7
3b	Pertinent information should be readily available	User should be able to easily access information about competing hazards	"And then if the patient was 85, I can say based on age, there's a good chance something's going to happen anyhow. It all depends on the comorbidities, breast cancer, lung cancer, severe congestive failure, or so forth."-PCP 6
3c	Integration with scheduling and resource systems	User can access information about current specialist availability	"I would model [our hospital's] population … Because obviously if the wait to see the nephrologist is 6 months you have a limited resource. Don't build this in such a way that you generate more referrals than [our hospital's] nephrology department can handle." –PCP 3
3d	Population management	User can prioritize patients at highest risk of poor outcomes within the CKD population	"I think it's perfectly appropriate to suggest whatever you think is necessary but we shouldn't be doing it on people whose risk is 1% or whatever it is. And I don't know what number I'd cut off at. I guess I would probably try to look at an average panel. I mean let's say we make these cutoffs of 5% risk, how many people are we talking about [referring]?"-PCP 11
3e	Options for flexible documentation	User has access to support for managing patient refusal due to transportation issues	"Patients here are so reluctant to go down to the [specialist practice at the large hospital downtown]."-PCP 6
3f	Improve efficiency of computerized provider order entry system	User can access commonly ordered tests and information about previous orders	"Before I refer patients to renal though, I usually almost always order an ultrasound as well. Just for the size of the kidneys. I feel it will help the nephrologist make a better decision"-PCP 9 "I'd see if at some point somebody did a belly image. So make sure they didn't have hydronephrosis."-PCP 3
3g	Support co-management	PCP user can easily communicate with specialist and access information from multiple providers who are co-managing patient	"It's a good example of where the notion of co-management comes in, and how do we standardize that? Who's managing the blood pressure? Should I not be touching the blood pressure meds? Do you want to own that? Do you want me to own it? Are you going to tell me what to do?"-PCP 4 "I think sequential follow-up is essential, maintaining contact with the specialist if we have made a referral. That patient that I mentioned who had developed nephritis was treated effectively with prednisone. It was an excellent experience to work with the nephrologist and understand his reasoning…We did speak on the phone and we also exchanged emails."-PCP 9