





Research and Applications

Examining primary care provider experiences with using a clinical decision support tool for pain management

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ABSTRACT

Objective: To evaluate primary care provider (PCP) experiences using a clinical decision support (CDS) tool over 16 months following a user-centered design process and implementation.

Materials and Methods: We conducted a qualitative evaluation of the Chronic Pain OneSheet (OneSheet), a chronic pain CDS tool. OneSheet provides pain- and opioid-related risks, benefits, and treatment information for patients with chronic pain to PCPs. Using the 5 Rights of CDS framework, we conducted and analyzed semi-structured interviews with 19 PCPs across 2 academic health systems.

Results: PCPs stated that OneSheet mostly contained the right information required to treat patients with chronic pain and was correctly located in the electronic health record. PCPs used OneSheet for distinct subgroups of patients with chronic pain, including patients prescribed opioids, with poorly controlled pain, or new to a provider or clinic. PCPs reported variable workflow integration and selective use of certain OneSheet features driven by their preferences and patient population. PCPs recommended broadening OneSheet access to clinical staff and patients for data entry to address clinician time constraints.

Discussion: Differences in patient subpopulations and workflow preferences had an outsized effect on CDS tool use even when the CDS contained the right information identified in a user-centered design process.

Conclusions: To increase adoption and use, CDS design and implementation processes may benefit from increased tailoring that accommodates variation and dynamics among patients, visits, and providers.

LAY SUMMARY

We evaluated primary care providers' (PCP) experiences with a clinical decision support (CDS) tool called the Chronic Pain OneSheet (OneSheet), designed to assist with the management of patients with chronic pain. Using the 5 Rights of CDS framework, we conducted and analyzed semi-structured interviews with 19 PCPs across 2 academic health systems. PCPs indicated that OneSheet mostly contained the right information required to treat patients with chronic pain and was correctly located in the electronic health record. PCPs reported using OneSheet for specific patient subgroups, such as those prescribed opioids, with poorly controlled pain or new to a provider or clinic. However, OneSheet utilization varied depending on PCPs' workflow preferences and patient population. To address PCPs' time constraints, they recommended expanding OneSheet access to clinical staff and patients for data entry. Our findings highlight the importance of tailoring CDS tools to accommodate differences in patient characteristics, visits, and PCPs' workflow preferences. In conclusion, this study suggests that personalized CDS tools like OneSheet can enhance chronic pain management in primary care settings. By incorporating individualized elements and considering variations among patients, visits, and providers, these tools can better support PCPs in making informed decisions for effective chronic pain management.

Key words: primary care, clinical decision support tool, chronic pain, user experiences

INTRODUCTION

Clinical decision support (CDS), a component of an electronic health record (EHR), is generally defined as tools to enhance clinicians' decision-making by providing task-relevant information at appropriate times.¹⁻⁴ CDS tools can improve certain clinical processes, such as ordering diagnostic tests, prescribing medicines, and patient outcomes, including reductions in adverse events and morbidity.^{2,5} Despite this

potential, CDS tools broadly have shown considerable variability in their effectiveness.² The known predictors of CDS tools' effectiveness are the automatic inclusion as part of the workflow, accessibility to both clinicians and patients, and requiring an overriding reason.^{5,6} Moreover, clinicians' uptake and use are increasingly seen as top barriers to effectiveness. A 2022 meta-analysis found that clinicians use CDS

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tools in less than half of the potential opportunities.⁷ The implementation context and clinician-level factors, including perceived usefulness, social expectations, clinician capacity, and organizational resources, influence CDS tool use. Additionally, in resource-constrained settings such as primary care, the types of conditions and patient populations targeted may also influence clinicians' rate of CDS tool use.⁷

Even with these challenges, CDS tools are perceived by primary care providers (PCPs) as potentially useful in treating chronic conditions, such as chronic pain.^{8–10} Guideline-recommended chronic pain care requires access to diverse and longitudinal data on pain- and opioid-related risks, benefits, treatment options, laboratory results, medication history, and patient preferences and goals. Ultimately, CDS focused on chronic pain could support PCPs in providing safer and more patient-centered care for patients.¹¹ While quantitative evaluations of existing chronic pain CDS tools exist,^{12–14} current work does not assess PCPs' experience and behavior with adopting and using chronic pain CDS tools. Qualitative evaluations support the thorough examination of factors associated with CDS uptake and use, as most CDS tools target user behavior. Such examination provides an in-depth understanding of how the implementation context influences the CDS tool uptake and use for patients with chronic pain. Finally, while developed using expert recommendations, the existing chronic pain CDS tools have yet to be qualitatively evaluated after prolonged use in a real-world implementation.²

The aim of this article is to evaluate PCPs' experiences in using a CDS tool for chronic pain that was originally designed through an extensive user-centered design process.^{8,9} We conducted a retrospective qualitative evaluation with a diverse group of PCPs (internal medicine, family medicine) who practice across 25 primary care clinic locations within 2 health systems (Eskenazi Health and Atrium Health Wake Forest Baptist). We evaluated PCPs' experiences in adopting and using Chronic Pain OneSheet (OneSheet) after 16 months of access to it in their EHR (see [Figure 1](#)). We rooted our evaluation in the 5 Rights of CDS, a widely endorsed framework that guides CDS design, implementation, and evaluation.^{15,16} Uniquely, this study will contribute to the biomedical informatics literature with a rich understanding of PCPs' long-term experiences using a CDS tool that was originally designed based on PCPs' perceived information and decision-making needs when caring for a complex chronic condition.

MATERIALS AND METHODS

Study design and setting

Our qualitative data were collected as part of a multiyear pragmatic randomized controlled trial (RCT) at 25 primary care clinics across 2 academic health centers. OneSheet was first implemented at Eskenazi Health in Indianapolis, IN, and later at Wake Forest Baptist Health (Atrium Health Wake Forest Baptist) in Winston-Salem, NC. OneSheet was built in the Epic EHR using an individual patient dashboard-like tool called a Navigator. PCPs can access OneSheet by navigating to the OneSheet Navigator Activity or clicking on a passive alert (Best Practice Advisory [BPA]), which appears on the chart of patients who meet chronic conditions noncancer pain diagnosis or medication criteria. The RCT took place from October 2020 to May 2022. The RCT aimed to assess whether having access to OneSheet in the EHR affected pain-

related ordering, prescribing, goal setting, risk monitoring, and outcome-measuring behavior in patient visits with chronic pain. We recruited 137 of 218 eligible PCPs practicing at 25 primary care clinic locations associated with Eskenazi Health and Atrium Health Wake Forest Baptist. Participating PCPs were randomly assigned to a treatment group (69, 50.4%) with access to OneSheet or a control group (68, 49.6%). A more detailed description of the RCT design and OneSheet CDS tool is presented elsewhere.¹⁷

For this qualitative evaluation, in the last 2 months of the RCT, we recruited PCPs with access to OneSheet for interviews (treatment group). We used a purposive sampling approach to recruit PCPs with varying levels of OneSheet use (frequent user, occasional user, non-user) to ensure variability of experiences. A research coordinator emailed treatment PCPs and invited them to participate in the qualitative study by signing up for a time slot for a video conferencing interview. Each interview lasted ~45 min, was audio-recorded with consent, and transcribed for analysis. Two team members with qualitative research expertise (PhD and master-level training) were present at each semi-structured Zoom interview. The interviews took place between April 2022 and May 2022. We continued interviews until thematic saturation was reached—when additional interviews did not provide new insights. All participants gave consent to participate in the study and record an interview. We used the consolidated criteria for reporting the qualitative research (see [Supplementary Appendix S1](#)).

Data collection

We developed a semi-structured interview guide based on the CDS literature, the study team's subject-matter experience, and the 5 Rights framework of CDS implementation^{15,18} to probe PCPs' experiences using OneSheet (see [Supplementary Appendix S2](#)). The interview guide was pilot tested with 2 clinicians who were part of our research team. The 5 Rights framework of CDS implementation is a best practice framework that asserts that using CDS interventions to improve targeted care processes and outcomes requires getting the right information, to the right people, in the right formats, through the right channels, at the right times to enhance pertinent decisions, actions, and communication. The *right information* refers to what content is presented to the end-user of the CDS tool. The *right person* refers to the CDS tool reaching the individual who may act based on the information given. This can mean one (or more) of several individuals on the care team, including nurses, physicians, and patients. The *right format* refers to how the CDS tool is presented, whether it be an alert, order set, clinical practice, or any other format. The *right channel* refers to how the CDS tool is delivered. This may be through the EHR, a patient portal, another clinical system (such as a separate computerized physician order entry system or radiology service), a smartphone app, or by paper. Finally, the *right time* in the workflow refers to the fit of the CDS tool into current clinical processes. We mapped the 5 domains to our research questions. Given the semi-structured nature of the interviews, we also explored additional topics if they naturally appeared in the conversation.

Analysis

Three team members analyzed interview transcripts using a modified thematic analysis approach.¹⁹ We conducted

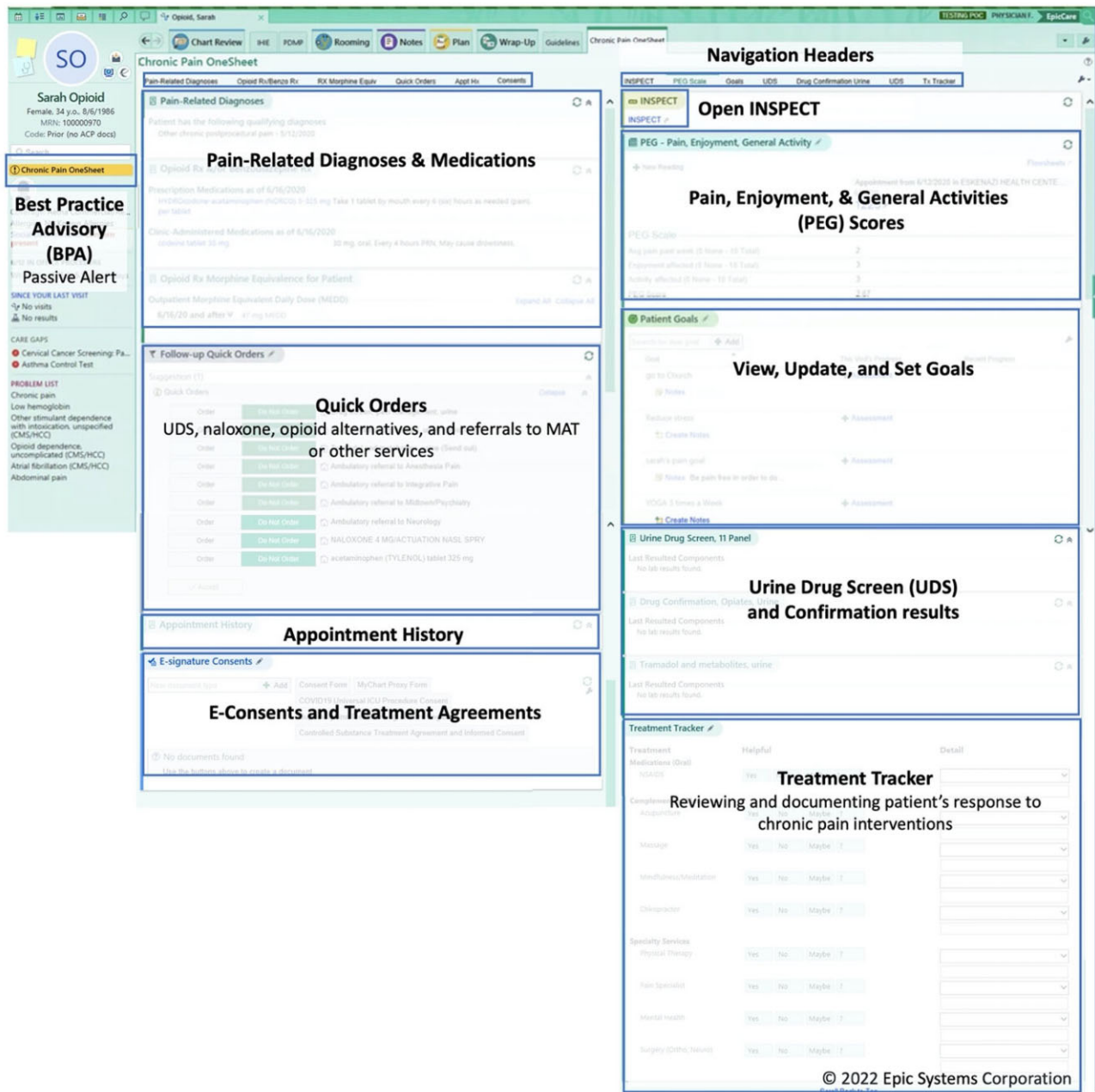


Figure 1. Annotated OneSheet screenshot.

preliminary screenings of 3 interview transcripts to identify initial themes and confirm that interview questions yielded responses informing our study questions. Once all interviews were completed, we screened all interview transcripts to create an initial codebook. We designed the preliminary codes based on the 5 domains of the 5 Rights framework of CDS implementation and additional emergent codes not captured within the framework using an inductive approach.²⁰ Three team members tested the codebook reliability by independently applying the codes to 3 transcripts. They then met and discussed the accuracy and consistency of the codebook and made necessary adjustments. Upon completing the codebook development, we consensus coded each transcript and adjudicated any issues through a discussion to reach a consensus. Next, we analyzed the coded text for themes based on our

research questions. Throughout this process, we employed established procedures in the qualitative methods literature to ensure the rigor and validity of our findings. These procedures included practicing reflexivity (continually questioning interpretations, seeking answers in the data to verify or challenge interpretations, becoming aware of one’s preconceptions and biases), depth of description (seeking out the rich details of participants’ words), and searching for alternative explanations or interpretations.^{21–23} Finally, we agreed on a final set of overarching themes and representative quotes. We conducted the entire analysis using Dedoose qualitative analysis software, version 8.2.6. All team members were involved in the development of the manuscript. The Indiana University Institutional Review Board approved the RCT and this study. The trial is registered with clinicaltrials.gov: [NCT04295135](https://clinicaltrials.gov/ct2/show/study/NCT04295135).

RESULTS

Participant characteristics

Nineteen PCPs completed semi-structured qualitative interviews. Most PCPs were medical or osteopathic physicians (89%), female (53%), White (74%), and not of Hispanic or Latino ethnicity (74%) (see Table 1). On average, interviewed PCPs had spent 14.3 years practicing medicine. The clinical credentials and gender of PCPs who were interviewed were similar to PCPs who were not interviewed. We identified several themes related to the 5 rights of the CDS tool (see Table 2 with illustrative quotes for each theme).

Right care team member

PCPs stated that nurses and medical assistants (MAs) could collect patient information through OneSheet, including prior and current pain treatment, Pain, Enjoyment, and General Activity (PEG) assessments, and goals before a visit to help alleviate their time constraints. Nurses and MAs can also check the Prescription Drug Monitoring Program (PDMP) database and confirm whether e-consents and urinary drug screens (UDS) are up to date. Notably, PCPs were cognizant of an already high burden of clinical tasks placed on nurses and MAs. This is how one of the PCPs described the potential value nurses could bring by accessing OneSheet: “if clinical staff can ask those questions, they have access to it so that they can put [in] that information. Like we do that for things like well child checks, our staff will go in . . . Epic has populated questionnaires [for] the patients and then we’re able to see that information, so if staff can do that, yes, that’d be very helpful for them to have access (#5).”

PCPs also discussed how providing OneSheet access to clinical and ancillary staff can allow the entire care team to be on the same page about treatment.

Right information

PCPs mostly agreed that OneSheet has the right information to treat patients with chronic pain. However, the usefulness of the information presented in OneSheet varied based on the patient population and workflow preferences, which sometimes prevented them from leveraging all information presented in OneSheet. Subsequently, several providers stated that they have only used a subset of OneSheet sections, such

Table 1. Demographic characteristics of primary care providers (PCPs) who participated in qualitative interviews ($n = 19$)

Characteristic	N (%)
Clinical training credentials	
Medical Doctor or Doctor of Osteopathy (MD/DO)	17 (89.5)
Physician Assistant (PA)	2 (10.5)
Sex	
Female	10 (52.6)
Male	9 (47.4)
Ethnicity	
Hispanic or Latino	2 (10.5)
Not Hispanic or Latino	14 (73.7)
Prefer not to answer	3 (15.8)
Race	
Asian	3 (15.8)
Native Hawaiian or Other Pacific Islander	0 (0)
Black or African American	1 (5.2)
White	14 (73.7)
Multiple	1 (5.2)
Years actively practicing medicine (mean, SD)	14.3 (10.7)

as PDMP link, UDS results review, and quick orders. Notably, PCPs sometimes disagreed on what sections and information were useful, as patient- and visit-specific factors influenced the relevance of different OneSheet sections. For example, the PDMP would not be relevant for a patient with chronic pain without any opioid medications unless the patient was seeking opioid medications during that specific visit.

Relatedly, a few PCPs mentioned that OneSheet had too much information and was overwhelming and challenging to use in a short visit with a complex patient. Several PCPs offered modifications to include missing information that may be relevant in making treatment decisions for patients with chronic pain (eg, being able to add PT notes, information on surgeries, etc.). This is how one of the PCPs described her perception of the information contained in OneSheet: *Nice and streamlined and all the basic information that you would want all in an easy view so now I just got the information, and I would want (#5).*

Right patient

PCPs reported that OneSheet is particularly useful for patients on prescribed controlled substances, patients with poorly controlled pain, and new patients with chronic pain. For patients on prescribed controlled substances, including opioids, PCPs appreciated having the ability to check PDMP to see the date of the last prescription filled, check for multiple providers, quickly refill medications, and sign e-consent documents. These actions allow them to adhere to guidelines and state and institutional policies when treating patients with prescribed controlled substances. For patients with poorly controlled pain, not necessarily on opioids, PCPs reported using OneSheet’s Treatment Tracker “Tx Tracker” (a tool to track responses to various chronic pain treatments) to adjust the regimen or think through additional treatment modalities for patients who have exhausted many treatment modalities for pain. Finally, for patients with chronic pain who are new to a provider (both on opioids and not) PCPs appreciated an opportunity to check the PDMP, sign the e-consent, and use the Tx tracker to assess pain management history. This is how a PCP described which patients could benefit from him having access to OneSheet: *I’m filling any type of controlled substances or opioids if patients are taking Lyrica and you’re asking for refills. Patients that I’m seeing [the] first time with chronic pain, not because I’m going to be prescribing anything, but I just want to have an idea history of it, you know emergency department visits or fills or patients that come in as first time patients already on opioids. and saying you know I get this from this and this doctor, so I do need to run an inspect [the state PDMP system] report on them (#6).*

Right workflow

PCPs reported different workflows for using OneSheet. Some PCPs used OneSheet during a visit to inform the conversation with a patient and aid with shared decision-making. For instance, they reported accessing the Tx Tracker to see what other treatment options are available or updating patient history if there were changes (a car accident, surgery, etc.). Other PCPs used OneSheet mainly before the visit to review the patient’s history (current medications, dates of the last UDS, pre-charting) and to prepare for the upcoming visit. A few PCPs accessed OneSheet during a pre-planning phase to review the Tx Tracker information. Finally, a few providers

Table 2. Emergent themes with illustrative quotes

Five rights domain	Illustrative quote
Right care team member	So, I personally think that it should be accessible to all members of the clinical team, including nurses, MAs, etc. (#12) I think it would be very helpful if the nursing staff had access to it. I could see that definitely as even outpatient or like an inpatient basis, just so everybody's kind of on the same page about what's worked and what hasn't, so that way everybody knows which suggestions are made and all team members will be responsible for looking at that. (#15)
Right information	I would say yes, I think you're able to get the right information. It is really useful, and things are there that are needed, and there's not a lot of extraneous information. (#12) I think they [OneSheet sections] were useful. I know there was one section, I think physical therapy, that I did not use that much because they have done it one time or they're not interested in it, so that is the one I haven't done much but I did review the PDMP, UDS, and other stuff. (#11) It's [OneSheet information] very, very thorough which is great. You know if I was a pain specialist and I was doing pain management, certainly it would be pretty awesome. (#8)
Right patient	OneSheet is most useful for patients on chronic opioid therapies for non-cancer because that's the situation where you're really trying to educate and keep track of the different types of therapies that they've tried and failed, and you want to have that one central spot instead of trying to look through the entire chart trying to figure out where everything is. (#9) I'd say uncontrolled chronic pain patients or patients where we're going to make changes to their treatment regimen or there's some adherence issues or different reasons that we might make changes to their treatments. (#13) When I'm starting off with a patient with their chronic pain to be able to get all the historical stuff in there . . . so I definitely find it [OneSheet] most helpful in the beginning. (#10)
Right workflow	I usually use it [OneSheet] once patients arrive and I'm looking through their chart before I go into the room to see them, and then occasionally when I'm in the room, but hardly ever am I looking at it after seeing a patient. (#5) I usually use it during the visit actually with the patient. (#13) I use it for those patients on chronic opioid therapy between visits as well you know during refill processing and things like that. (#12) I think it's just a real struggle to in that moment when you've got a "15-minute appointment time", which we all know, is laughable. To address you know uncontrolled diabetes and hypertension and hyper leukemia and obesity and neuropathy and hepatitis C, etc. I think there's really valuable information in OneSheet, but it's just a matter of like getting out of your routine of what you've done previously, and you feel like you can do efficiently, even though sometimes it's not the most efficient way. (#12) I think it [workflow] changes every day depending on who I'm seeing and what I'm doing. (#2)
Right channel	I think if providers don't have access to it [OneSheet] in Epic, there's no way you're going to get us to use it. (#3) I really like how convenient it [OneSheet] is currently located in Epic. (#15) I think it [questionnaires] is better to have in here than paper just because if we have paper we have to rely on the MA . . . and then the information would get lost, so I think honestly this is [EPIC] is the right place (#1).
Right intervention format	I love that [BPA] alert. (#10) I use the treatment tracker and INSPECT link. (#15) I think the smart phrase and the clinical actions [PDMP check, UDS results] are probably the most valuable (5). I could use goals I just don't . . . maybe I'm just not in the habit of using it . . . that's probably what it is. Opioids is a big trigger for me going to it [OneSheet], if someone who is not on opioids sometimes, I don't have as much of a trigger because from visit to visit there on this, and the next was that there on that. (#9)

reported using OneSheet after or between visits for medication refills or to fill in the information from the notes, such as updating patient goals based on the most recent visit. Several factors, such as the changing nature of patient complaints, patient complexity, limited time dedicated to addressing chronic pain, other competing priorities, and low OneSheet use, were related to variability in the workflows that PCPs reported.

PCPs reported several OneSheet features (quick refills, PDMP link; ease of checking the UDS date; free text in the Tx Tracker), which facilitated incorporating OneSheet into their workflow. PCPs also suggested using a few OneSheet features to build a habit of using OneSheet. PCPs suggested better ways to integrate OneSheet into the workflow, including automatically adding a OneSheet icon to the patient list, visualizing information, having fewer clicks, and training MAs/nurses and patients to fill in some of the information into OneSheet.

Right channel

Most PCPs agreed that OneSheet's ideal channel is the EHR (EPIC, Verona, WI, USA). PCPs reported that EHR is where

providers spend most of their time, so having the tool in a separate system would make it more cumbersome. Furthermore, PCPs stated that having a tool in the EHR is convenient and only requires one click from providers to access information. Finally, PCPs reported that having access to the tool in EHR allows providers to be more directly involved in entering patient data instead of relying on MAs to scan information into the system. This is how one PCP explained why OneSheet should be located in the EHR: *it one hundred percent needs to live in Epic or no one is going to use (#18).*

Right intervention format

PCPs listed several OneSheet features that they found valuable, including the Tx Tracker, PDMP link, Refills/quick orders, PEG, goals, e-consent, appointment history, smart phrase for transferring OneSheet data into the clinical note, and UDS results. A specific OneSheet feature's value depends on a PCP's workflow. For instance, PCPs were less likely to use a certain OneSheet feature, such as smart phrase, quick orders, or goals, if it was not easily incorporated into their workflow. The value of a specific OneSheet feature also depended on a given patient. This is how one PCP described

what functions are helpful: *I use the quick orders and the e-consent . . . just having a button right there (#13).*

DISCUSSION

Due to the substantial chronic disease burden, user-centered design and implementation of CDS tools for chronic conditions are increasingly common yet challenging. Challenges include time and workflow constraints, patients having multiple chronic conditions, evolving evidence and information needs, and poor clinician experiences with EHR usability. In recent years, designing usable CDS for chronic pain has been further complicated by changing guidelines, policies, and laws related to the opioid epidemic. For example, various legislations and guidelines recommend or require PCPs to complete additional tasks when prescribing opioids (eg, PDMP checks and patient goals). Thus, while there is great potential for user-centered design approaches to improve usability, sustained adoption and use are not guaranteed. Developed through a user-centered design process, OneSheet aims to aggregate several PCP-requested information elements in a single EHR view, making it easier for PCPs to take guideline-recommended clinical actions, such as test and medication orders and risk and health outcome assessments.^{24,25}

In this qualitative evaluation conducted 16 months after OneSheet was implemented, PCPs confirmed 2 primary findings from our prior user-centered design work.^{8,9} Specifically, OneSheet was delivered through the right channel, the EHR, and OneSheet contained sections with the right information needed to treat patients with chronic pain comprehensively. At the same time, PCPs reported that characteristics of their patient populations, workflow constraints, and preferences reduced their OneSheet use. These findings align with recent work finding that CDS uptake relates more to contextual and implementation factors than CDS content or system features.⁷ Thus, containing the right information cannot guarantee uptake of the tool by PCPs.

While the user-centered design of CDS content and features is useful, more is needed to address other factors impacting CDS use and its downstream effectiveness in changing behavior and, ultimately, clinical outcomes. These other factors impacting CDS uptake and use are barriers at the system or patient level beyond the provider time and knowledge barriers typically addressed by the CDS tools. Thus, future CDS tool implementation strategies should proactively address clinical capacity, resources, and organizational support, which existing CDS implementation approaches have not traditionally addressed. Notably, we observed wide variation in PCPs' experience with and use of OneSheet even though it was originally designed to support discrete guideline-recommended or policy-required tasks and to meet widely agreed upon PCP-perceived information needs. Therefore, additional work may be needed to guide user-centered design and implementation processes that incorporate but do not overly rely on users' perceived needs and preferences. Alternatively, CDS tools that allow or facilitate user-specific customization may realize greater uptake, given the wide variation in PCP practice patterns.

Workflow integration is one of the keys to success in CDS tool adoption, and one of the most common barriers to CDS use.²⁶ Yet, PCPs demonstrate substantial variability, even with common workflows and documentation.²⁷ Our interviews revealed similarly variable workflows in chronic pain

care. PCPs reported that their selective use of certain OneSheet features was driven by their preferred workflows and different patient populations. This finding highlights that a "one size fits all" approach for integrating chronic pain CDS into primary workflows may not be effective. The "correct" answers to the 5 Rights of CDS, in particular the right intervention format and right workflow, vary by PCP and by patient needs. This variability highlights challenges associated with standardized approaches to implementing CDS, including approaches to training and instructing users and modifying existing workflows during CDS implementation. Our findings support efforts to identify workflow and implementation factors associated with CDS use and to design "precision CDS" or tailored implementation strategies that better accommodate individual differences and dynamics among patients, visits, and providers.

Related to patient dynamics, an important finding is that PCPs saw the value of using the CDS tool for specific subgroups of patients with chronic pain—patients prescribed opioids, patients with poorly controlled pain, and new patients to the provider or clinic. PCPs used OneSheet for different purposes for these sub-groups. For instance, PCPs used OneSheet for patients prescribed opioids to be guideline- or law-compliant by accessing the PDMP and ordering UDS. Also, PCPs used OneSheet for patients with poorly controlled pain and new patients to access additional information that may inform their prescribing or other treatment decisions. These discrete uses illustrate how a CDS tool can support discrete PCP information needs or clinical actions for different patients. Additional research is needed to identify the best ways to tailor CDS implementation and support to match functionalities with PCPs' differing needs with different patients.

One specific potential OneSheet improvement suggested by our evaluation is broadening OneSheet access to other clinical staff or patients for data entry (eg, patient-reported outcomes). This access may increase the frequency with which OneSheet is populated with relevant and timely information. Time constraint is a known barrier to adopting and using new technology, especially in primary care.^{28–30} Notably, semi-automated approaches, such as natural language processing (NLP), machine learning, etc., hold the potential to address PCPs' time constraints by effectively aggregating relevant patient data and averting the need for provider data entry.⁷ Yet, little research has attempted to leverage NLP for information aggregation for patients with chronic pain. Furthermore, consistent with time constraint, the PCPs acknowledged that clinical staff might also have insufficient time to take on additional data entry tasks. Thus, PCPs also suggested more active patient involvement in data collection that would populate OneSheet. That said, evidence on clinician acceptability of patient-generated health data is mixed,^{31–34} highlighting clinician concerns about data quality. This "catch-22" phenomenon may prevent CDS adoption and use and suggests the need for training or workflow interventions that allow PCP-trusted data to be reliably collected. Thus, future studies, involving both PCPs and patients, could focus on approaches to engage patients in reliably reporting data that PCPs ultimately trust in their clinical decision-making process.

Our study has several unique strengths. First, we qualitatively assessed PCPs' experience and behavior after prolonged routine use in a real-world implementation. Second, we used

an established CDS implementation framework to guide our qualitative inquiry. Third, we gathered data from PCPs at 2 health systems with distinct patient populations and environments. Nevertheless, our study has limitations. First, our findings may be influenced by the types of providers who agreed to be interviewed. We attempted to address this limitation by purposefully targeting PCPs with different usage rates and from both health systems. Second, the OneSheet implementation occurred during the COVID-19 pandemic. Thus, the uptake and use may be influenced by additional workload demands placed on PCPs. Third, qualitative research may be subject to researchers' biases. To mitigate this concern, we used an interview guide, followed a structured coding process, and employed established procedures to ensure the rigor and validity of our findings.

CONCLUSIONS

Our study found that differences in patient subpopulations and workflow preferences had an outsized effect on CDS tool use even when the CDS contained PCP-desired information and features identified in a user-centered design process. To increase adoption and use, CDS design and implementation processes may benefit from increased tailoring that accommodates variations and dynamics between patients, visits, and providers.

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AUTHOR CONTRIBUTIONS

OM, NCA, LS, and CAH conceptualized and drafted the article. EM, CM, and OM gathered and analyzed the data. EM, CM, BWM, RWH, JV, and MCBA were major contributors to writing and editing the article. The article has been read and approved by all the authors. Each author believes that the article represents honest work.

SUPPLEMENTARY MATERIAL

[Supplementary material](#) is available at *JAMIA Open* online.

CONFLICT OF INTEREST STATEMENT

CAH discloses past research grant funding for studies of information technology to support pain care to his institution from Security Risk Solutions, Inc. and the Agency for Healthcare Research and Quality. CAH also discloses personal fees from Indiana Health Information Exchange, personal fees from New York eHealth Collaborative, personal fees from RTI International, outside the submitted work. OM discloses past and current research grant funding for studies of information technology to support pain care to her institution from Security Risk Solutions, Inc. and the Agency for

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DATA AVAILABILITY

The datasets generated and analyzed for the current study are available from the corresponding author upon reasonable request.

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