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# Barriers to dental providers' use of a clinical decision support tool for pain management following tooth extractions

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## Abstract

### Background

De-implementing non-effective or even harmful practices in healthcare is sometimes necessary, as has been the case with opioid prescribing in dentistry over the past decade. One approach to practice transformation is to deploy clinical decision support (CDS) tools. This qualitative study examined barriers to CDS use as part of a cluster randomized trial that aimed to decrease opioid prescribing for pain management following tooth extractions across a large dental practice.

### Method

Twenty dental providers who took part in the larger randomized trial were purposively selected to complete a semi-structured qualitative interview. Participants represented a broad range in terms of years of practice, dental specialization, and CDS use patterns. Interviews were conducted via Zoom, audio recorded, transcribed, and analyzed using a content analysis approach in ATLAS.ti following participation in the cluster randomized trial.

### Results

Reasons for not using the CDS fell generally into two broad categories: unintentional (i.e., forgetting to use the CDS) and intentional. Providers who forgot to use the CDS after training and implementation either were not sure where to look for the alert on the screen or did not remember to look for it because its use was never incorporated into their workflow. Reasons for deciding not to use the CDS included feeling that it slowed down their workflow, thinking that the information it provided would not be useful, and not trusting the functionality of the system.

### Conclusions

There were numerous, interdependent human, organizational, and technological factors that influenced the intentionally and unintentionally low CDS use rates observed in the study. Findings highlight issues to be aware of and address in future implementation efforts that utilize CDS.

### Trial registration

Clinicaltrials.gov NCT03584789.

## Plain Language Summary Title

Dental providers' reasons for not using a clinical decision support tool to optimize patient pain management

## Plain Language Summary

Overprescribing of opioids across healthcare, including dentistry, contributed to the ongoing opioid epidemic. Clinical decision support (CDS) tools built into electronic health records (EHR) bring in health information to help improve

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clinical care, but several factors are known to be associated with low use rates by providers. This study examined reasons why providers did not use the CDS more often during a randomized trial aiming to decrease opioid prescribing for pain management following tooth extractions performed in a large mid-west dental practice. In some cases, the dental providers forgot to use the CDS because they could not remember where to find it or that they were supposed to use it, often because they had not built its use into their typical clinical workflow. Other providers decided not to use the CDS either because they felt that clicking the link to access the new information slowed them down, because they did not think the information it provided would be useful, or because they found the system to be unreliable in its functioning. EHR system changes following CDS training along with COVID practice disruptions likely interrupted the ability of providers to build CDS use into their typical workflow. Additional provider training and support and regular check-ins with providers to identify problems with its use early on might have overcome some of the provider and organizational barriers that were identified.

**Keywords**
opioids, dentistry, de-implementation, clinical decision support

## Introduction

The lag between the development of evidence-based practices and their implementation in healthcare is well documented (Greenhalgh et al., 2004; Grol & Grimshaw, 1999). Conversely, de-implementing non-effective or even harmful practices is sometimes required, as has been the case with opioid prescribing in dentistry over the past decade (Chua et al., 2023; Norton & Chambers, 2020; Suda et al., 2020; Thornhill et al., 2019). Regardless of the aim, changing healthcare practice to better align with emerging or improving practice guidelines can be fraught with difficulties.

## Implementing Clinical Decision Support in Healthcare Settings

Clinical decision support (CDS) leverages health information technology, usually at point of care, to improve health care by bringing in additional patient information (e.g., reminding the provider of a specific health issue or alerting them of potential problems; Agency for Healthcare Research and Quality, 2023; Sutton et al., 2020). CDS may be developed to handle routine tasks more efficiently, improve the care processes, or enhance care surrounding a specific health issue, such as HIV or diabetes management. But building a CDS and actually having healthcare providers or patients use it are two very different things. The usability of different types of health information technology, like CDS, has been the focus of prior research. Factors known to affect usability include things like not understanding on-screen instructions, not knowing how to navigate to or through the screens, or not seeing an alert (Kushniruk & Borycki, 2023; Ross et al., 2016). A recent mixed-methods systematic review of barriers and facilitators to CDS use by primary care providers examined findings in terms of human, organizational, and technological factors (Meunier et al., 2023; Yusof et al., 2008). Human factors include aspects such as whether the provider believed the information was useful or remembered to perform the desired action (Asan & Carayon, 2017; Kushniruk & Borycki, 2023). Organizational factors include aspects such as workflow disruptions and institutional support of the tool. Technological factors include functionality aspects of the CDS, including ease of use and system reliability.

## Parent Study: De-implementing Opioids for Dental Extractions

To help curb the U.S. opioid crisis, healthcare providers, including dentists, were encouraged to change practice and reduce the use of opioids for pain management (DHHS, 2014; Moore et al., 2006). Despite dental practice changes occurring at the national, state, and organizational levels as far back as 2016, including new professional trainings on the short and long-term risks of opioids, state and regional prescription monitoring activities, and leadership messaging (Gryczynski et al., 2023; Gupta et al., 2018; Minnesota Dental Association, 2019; Rindal et al., 2023a, 2023b), more is needed to be done. In response, our team conducted a cluster-randomized trial examining the use of CDS for dental pain management across a large multi-clinic dental system in the Midwestern United States to de-implement reliance on opioids for pain management and increase more patient-centered evidence-based pain management practices using CDS (Gryczynski et al., 2023; Rindal et al., 2021).

The CDS framework has been described in detail elsewhere (Rindal et al., 2021; Rindal et al., 2023a). The development process occurred over approximately 18 months and included technical tool development, systematic on-site clinical observations and provider debriefings regarding EHR use (e.g., patient health history referencing and documentation) prior to and during dental extractions, and regular updates with organizational leadership in order

to develop the implementation training protocol. When the CDS was initially developed, the organization was using a dental EHR but it transitioned to an integrated medical/dental EHR mid-way through baseline data collection in 2019. Implementation strategies included dissemination via messaging from organizational leadership to increase dental provider awareness and knowledge concerning opioid prescribing and integration of the tool by modifying the EHR and providing training to dental providers on its role and functionality.

Dental providers across 22 clinics were randomized to either treatment-as-usual, CDS alone, or CDS with additional patient education materials. Provider randomization occurred in December 2019 with the intervention phase starting in February 2020; however, by March there were profound disruptions to typical clinical care due to the COVID-19 pandemic, which lasted for several months. Planned provider observations early in the intervention implementation phase had to be abandoned due to mandated social distancing practices and the limitations being placed on the number of individuals permitted to participate in clinic visits.

Trial results indicated that while there were significant decreases in opioid prescribing during the study intervention period across all study arms, there were no significant differences in opioid prescribing between dental providers randomized to treatment-as-usual and those randomized to CDS, either alone or enhanced with a patient handout concerning pain medications following dental extractions (Gryczynski et al., 2023). Findings indicated that CDS use rates were low, especially among oral surgeons. The purpose of this qualitative sub-study is to examine barriers to the dental providers' use of the CDS, from their own perspective.

# Method

Data for this qualitative sub-study were collected from July through September 2021. A co-investigator in the study, who served as the primary point of contact, emailed a notification letter along with the study information sheet to all selected providers to notify them of the qualitative interviews and invite them to participate. Research staff then followed up with phone calls to determine interest in study participation, conducting and documenting verbal consent by phone. If a provider did not respond within 4 weeks, another provider was selected and invited to participate until a total of 20 participants had been recruited. Immediately prior to conducting the scheduled interview, the interviewer (SGM, one of the study PIs) reviewed the information sheet and confirmed verbal consent for both participation in and recording of the Zoom-based interview. Participants were not financially compensated for completing the interview. Human subject oversight was provided by the HealthPartners IRB.

## Participants

In-depth, semi-structured interviews were conducted with a sub-sample of 20 providers ($n = 18$ dentists; $n = 2$ oral surgeons) who practiced across the range of participating clinics and who were involved in an intervention arm of the study. Participants were purposively selected to include a range in terms of demographics (e.g., age/years of experience as a dental provider, gender, and dental clinic size), intervention condition exposure (e.g., CDS, CDS-E), and CDS use over the course of the project. The final qualitative sample represents 41% of the main study sample ($N = 49$) and closely resembles it in terms of the dentist/oral surgeon participant ratio.

## Interviews

Interviews averaged 45 min in length and followed a semi-structured interview guide (see Supplementary Material) to examine the dental provider's analgesic prescribing practices, their interactions with patients concerning pain management, their use and views of the CDS, and recommendations for improving the CDS and its uptake.

## Analysis

The interviews were audio-recorded, transcribed, reviewed for accuracy, and entered into the ATLAS.ti qualitative software (Version 8.4) for analysis. A content analysis approach (Hsieh & Shannon, 2005) was used to analyze emergent themes associated with why a provider did not use the CDS, which were then grouped by whether the behavior was intentional (deciding not to use it) versus unintentional (forgetting to use it). While the range of respondents included in the study sample enhanced the diversity, depth, and nuances of the issues studied, thematic saturation did not drive our sampling or analytic processes.

# Results

Participants identified several barriers to CDS use during the study period, including system functionality aspects, organizational factors, and human factors. Oftentimes these factors intersected to compound the lack of CDS use that was observed in the study and were associated with the dental provider either forgetting to use the CDS or actively deciding not to use it.

## Forgetting to Use the CDS

### *Visual Display: Hard to Find*

Several participants mentioned that the way in which the CDS was presented in the electronic health record (EHR) made it difficult to find. Participants described how even colorful alerts can be difficult to spot when

they appear within an already colorful screen display and are placed in a screen position that the provider did not typically visually scan during point of care. This point is illustrated in the following provider quote:

> I think the information was informative it was just visually, the banner, remembering to do it is, everything is kind of bannered off to the side and so it's on the bottom of, you know, multiple things that we're looking through. (Provider 12)

As this provider mentioned, the location of the alert on the screen in relation to the other fields that they were visually scanning at point of care was problematic. Necessary periodic updates to the EHR appear to have exacerbated this issue since the updates sometimes affected where content appeared on the screen. The following provider describes how these types of visual changes affected their CDS utilization following system updates.

> So, I think at one point it moved, and that may have been when we went from just the dental [EHR] and combined it into the, the other records [EHR]. So, it had moved from one to another and it took me a while before I was, "Oh, that button is down here now!" (Provider 13)

System functionality factors—especially things like having the CDS move in its placement on the screen or being difficult to find—become organizational factors, as the CDS was hard to integrate into their typical workflow. In such cases, the providers eventually forgot to look for it.

#### *Visual Display: Not "Active" Enough*

Some participants indicated that because they were not required to click on the CDS alert it did not become a regular part of their workflow, also contributing to them eventually forgetting to look for it. The following provider describes how they might have benefited from the CDS being more active, such as requiring them to open it before proceeding during the visit.

> But I tried to get it done at some point, so I did look at it, but it would have been nice if we couldn't have moved forward with our charting until we hit that little box. I think it was orangeish or something. But it wasn't that way. If you missed it, you could still move on. (Provider 16)

The potential benefits of having the CDS be more active were echoed by another provider, who said:

> I hate to say we want any more pop-ups and blocking that whole, yeah. But, I mean, it's highlighted orange and it's visually, and you know something's different in that chart if you're looking. I think the thing is, sometimes we just, it usually seems like it was kind of, when I was actually wrapping up the extraction is when I would notice [the CDS] more. (Provider 18)

This participant indicates that they never adjusted their workflow to incorporate the CDS during the patient encounter. Maybe if there had been more ways in which it had gotten their attention, they might have remembered to use it during the visit.

#### *Timing/Frequency of CDS Being Triggered*

Another aspect of the CDS that made it difficult for some providers to remember to use and build it into their workflow was that it was only triggered for certain types of procedures, such as planned tooth extractions. The following dental provider clearly articulated this point.

> Right, because it was mostly, they were like just do it, you know, you're doing it for extractions. Well, I mean I do extractions, but the majority of my treatment is probably restorative. So, you know I, the less you use it the less you think about it. So, you know, if I do an extraction once a week out of a hundred patients it doesn't have a chance to really sink in. (Provider 13)

Having the CDS limited to planned extractions also meant that during the COVID-19 pandemic, when only patients with acute dental needs were being seen, the CDS may not have been triggered, further disrupting the ability of the dentists and oral surgeons to integrate CDS use into their workflow or remember to use it.

> 'Cause it just was out of sight, out of mind, especially when we hit COVID and everything was different and I came to a different clinic to work on emergency patients only. (Provider 14)

The difficulty finding the CDS due to these visual display aspects, either when they were first trained to use the tool or after system updates to the EHR, impacted its integration into the providers' workflow, and they eventually forgot to look for the alert when performing a planned tooth extraction.

## Deciding Not to Use the CDS

While some of the visual display and CDS frequency/timing issues contributed to providers not remembering to use the CDS, there were other factors that led some providers to decide not to use the tool.

#### *Slowing Workflow*

When providers tried using the system and felt that it slowed their workflow, some decided that the potential new information it generated was not worth the extra time it was taking, as illustrated in the following quote.

> Right, sometimes [EHR] just goes a little slow so I get stuck on it but anyone of the, you know, laundry list of medications or complicated health history where we are going to do the

> extraction, naturally we'd go in there and review that because, I think it was presented nicely and maybe just if [EHR] was going slow and I didn't have the patience, but then I would just go in to do that. (Provider 3)

The provider acknowledges that those patients with especially complicated health histories are likely the very same patients whose information might take longer to populate when the CDS was clicked on, but still felt that sometimes it slowed the operational flow down to an unacceptable level and they intentionally did not use the CDS.

### *Content Not of Value: Limited to Guidance on Opioid Prescribing*

Several participants mentioned that they decided not to click on the CDS alert when it came up because they believed the information only related to opioid prescribing. Several dental providers mentioned that because they were either not planning to prescribe an opioid or were not planning to prescribe many opioids for pain management, they decided not to use the CDS.

> And because I was prescribing so few tablets and not very frequent, I honestly would see that notice but then I'd override it anyway. Or maybe, I can't honestly say if this happened or not, but maybe I would see that notice and then decide okay my prescription number of tablets will be even less because there's just even more risk for this particular patient but four tablets would be, you know I'd feel better about prescribing four tablets than eight tablets because of this notice from this other chronic condition that this person has. (Provider 4)

> But now that we don't find that we need to prescribe it [opioids] I don't use it as much anymore because I don't prescribe it, so I don't need to go in and look at their history of where they're all getting things from, but I'd say early on it was a valuable tool. (Provider 5)

Comments such as these reflect a misunderstanding of the type of content being pulled in by the CDS and the potential value of the health information with respect to optimizing pain management for any specific patient. While the CDS did include information pulled in from the regional prescription drug monitoring program, it also included information from the EHR concerning other medications and health issues for the patient that could impact the appropriateness of using even common analgesics, such as acetaminophen.

Even providers that prescribed opioids frequently, such as oral surgeons, stated that they did not believe the CDS would be informative because they were prescribing opioids at far lower levels (e.g., fewer pills) than they had in the past and believed that to be a safe course of treatment.

### *Content Not of Value: Not Informative if Already Familiar With Patients*

Some providers described not using the CDS because they did not believe it would inform them about their patient's health beyond what they already knew. Some of the general dentists who participated in the study had been practicing in the same health system and treating the same patients for many years, as illustrated in the following quote.

> And as you mentioned earlier many, many of my patients have stayed with me for decades, so I know them pretty well and even remember, there's some things I don't remember in life …, but I remember things like teeth and medications and other strange facts about them, so I'm pretty good at just knowing what to expect when I go into it [the EHR]. So, the module that you have here isn't as helpful to me as it might be to somebody who's maybe, there are two new dentists here in this clinic right now and it would probably be more helpful to them because it would give them a baseline for each person who comes in. (Provider 14)

This provider believed that although they were highly familiar with their patients' health, the information might be helpful to other providers who were newer to the practice and less knowledgeable regarding patient health history.

### *Unreliable Functionality*

Some participants described trying to use the system but experiencing difficulty with the system not launching or information not loading properly. The following participants describe different types of functionality issues they encountered and how those issues negatively affected their continued use of the CDS.

> Yeah, so I did not find the user interface to be real predictable. So sometimes it wouldn't work and then sometimes it would come up and everything would just be blank or no data. And so, I wasn't sure if the no data meant there's no history of any prescribing use or if it was really a, trouble actually in connecting to the data. And so it wasn't, for me it wasn't as reliable of a source of information…. (Provider 4)

> I'm trying to pull, of course the first patient I clicked on it said it failed to load. I'm like, oh great! (Provider 6)

> So, I tried to use your tool a couple of times. I didn't get it to work and I'm just like, I'm not going to worry about it because it wasn't intuitive enough for me and it's like I'm too busy. (Provider 10)

All of these providers mentioned giving the tool one or two tries and then giving up on using the CDS when they found it either didn't open properly or wasn't displaying the content they expected.

## Discussion

Findings indicate that there were numerous interdependent factors that influenced the intentional and unintentional low CDS use rates observed in the study (Gryczynski et al., 2023). The providers themselves pointed to the potential benefits of requiring the CDS to be more active and requiring that they click on the alert before proceeding with the visit. These types of changes would have to be weighed against the potential nuisance factor it might cause for some providers. Also, it still might not ensure that the content was read by the provider, who might just click the link but not read the content. Active alerts are the most common type in EHRs and can lead to alert fatigue or annoyance if a provider gets too many or is unable to proceed until clicking on the alert notification (Haase et al., 2017; Kane-Gill et al., 2017; Kesselheim et al., 2011). Choosing to ignore potentially important information regarding drug interactions is not just a health risk for the patient but a liability risk for the provider and the health system as well (Kesselheim et al., 2011).

Even providers who said they intended to use the CDS mentioned that it was difficult to find, especially when its location in the EHR changed as a result of system updates. Booster trainings and email updates from the implementation team to draw practitioners' attention to these types of changes might have helped improve CDS use in these cases. Booster trainings might have been especially beneficial for those providers who only did occasional tooth extractions and who forgot to look for the CDS or didn't remember exactly how it was supposed to be helpful for them and their patients with tooth extractions. While a booster training was offered to dental providers when they returned to more normal clinic practice following the COVID-19 pandemic-related disruptions for several months during the implementation period in the study, no one opted to receive the refresher training.

Findings indicate that both technology and human factors contributed to poor workflow integration. This is a fatal flaw in many eHealth integration efforts (Bowens et al., 2010; Granja et al., 2018; Staras et al., 2021). While our study did involve initial workflow mapping with respect to when a provider would most benefit from seeing the CDS alert during tooth extractions, it may be that provider workflows varied more than was considered/observed in our implementation planning phase and a more tailored approach should have been taken when training individual providers. Of course, even if the CDS had been integrated into their workflow, a provider still may choose not to use it if the system loads slowly, or they do not trust the information that is provided. Providers seemed to indicate that even if they were willing to use the CDS, they weren't willing to wait if they felt that getting the information slowed down their work because it loaded too slowly or conveyed too much information for them to quickly process and resume their work with the tooth extraction visit. Perhaps some of the technical system-related slowness could have been fixed in the CDS. Or perhaps, if the providers felt more confident that the CDS would give relevant and actionable information, they would have been more willing to take the extra time to use it.

A significant amount of time and care was taken in ensuring that the CDS pulled in highly relevant health information that was potentially relevant to optimizing pain management and seamlessly incorporating information about controlled substances for the patient from the prescription drug monitoring program. This type of information might have been quite useful beyond tooth extractions. If the CDS had been developed to populate for other types of dental clinical encounters beyond extractions, perhaps the CDS would have been better integrated into the workflow. Several providers mentioned that they did not use the CDS because they believed the information provided was only going to be useful if they were planning to prescribe opioids or prescribe more than a few doses of opioids. This perception misses the mark, as care was taken to ensure that the CDS would include broadly useful information to guide pain management even when recommending non-opioid options.

Most of the participant-identified barriers fall under knowledge, as well as memory, attention, and decision processes when applying our findings to the theoretical domain framework (Atkins et al., 2017). Using this same framework, we note that our implementation activities with respect to the CDS were largely focused on the environmental context and resources for the dental providers. This misalignment may help explain why CDS uptake was low and also provide direction for overcoming these barriers in future projects. Improving how information was conveyed in the initial training on the CDS and reminding providers that other relevant health information pulled in by the CDS could be beneficial to optimizing pain management in any booster trainings likely would have dispelled these types of misconceptions. Also, reminding providers that patient health can change rapidly and that there are benefits to using the CDS even for long-term patients when they have not been seen in several months might have increased its use rates.

We did not include direct provider feedback as one of the implementation strategies in our study. Using audits and feedback to let providers know how well they are doing in reaching their expected behavioral/procedural targets can be helpful. In fact, providers in our study mentioned how much they appreciated getting that kind of feedback from the state in terms of their opioid prescribing rates (Rindal et al., 2023a, 2023b). Perhaps including this type of direct feedback on CDS use could have been helpful with respect to CDS use, particularly if the messaging came from leadership in the organization or making the CDS part of meaningful use, as a show of organizational support behind the tool's implementation. It may

be that, although the CDS was implemented as an organizational initiative aimed at furthering the goal of reducing opioid prescribing in dentistry, its association with the NICDR-funded study conveyed the idea that it was experimental, optional, or temporary.

## Limitations

There are several potential limitations to these findings that bear mentioning. First, only a subset of dental providers who participated in the larger study were interviewed as part of the qualitative component, and the views expressed may not thoroughly represent the reasons underlying the low CDS use observed in the larger trial. Similarly, we did not use a grounded theory approach to data analysis, continue sampling until thematic saturation was reached, or use any specific implementation framework for grouping responses during analysis. Second, the study was conducted in a large non-profit healthcare organization in the Midwestern United States and may not generalize to smaller private dental practices. Finally, the COVID-19 pandemic shut down all but urgent dental services for several months shortly after the study launched, and its impact on building CDS use into clinic workflow may have been considerable.

## Conclusions

While observed CDS use rates were low in the larger study, the findings from this qualitative exploration point to several human, organization, and technical issues that give context to the reasons for low uptake, many of which could be addressed in future CDS implementation efforts. Additionally, the potential to expand CDS use beyond planned tooth extractions would ensure that the resources put into its development and the value of its content were more fully realized.

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### Authors' Contributions

BDR and SGM were the study co-principal investigators. JG was a co-investigator on the study. SGM conducted the interviews and led the analyses and writing of the manuscript. AT managed the project at HPI. SA and DW assisted with the interpretation of the findings. All authors critically reviewed and approved the final manuscript.

### Declaration of Conflicting Interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Unrelated to the present study, SGM was a co-principal investigator on a NIDA study that was provided medication in kind by Braeburn, and JG is part owner of the COG Analytics and has received donated study medication from Indivior and Alkermes as part of NIH-funded research.

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### Supplemental Material

Supplemental material for this article is available online.

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