

Using a Bedside Interactive Technology to Solicit and Record Pediatric Pain Reassessments: Parent and Nursing Perspectives on a Novel Workflow

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Abstract

To measure the impact of a novel interactive inpatient pediatric pain management solution integrating our hospital's electronic health record system, the nurse communication phones, and the pharmacy dispensing system, we assessed parent and nurse perspectives on the tool's potential value, benefits, and challenges. A mixed-methods approach with survey instruments containing closed-ended and open-ended questions was administered to 30 parents and 59 nurses (66% and 23% response rate respectively). Overall, parents were more satisfied with the interactive technology experience (90%) compared to nurses (50%) with both indicating timely reassessments of pain being the most valuable feature. Qualitative analysis of nurses' responses yielded 6 themes for technology benefits and 12 for challenges. While patient-interactive technology solutions appear well-received particularly by parent end-users for pediatric hospital pain management, nurse training and interface improvements may result in higher efficacy, ultimately empowering patients/parents, promoting patient engagement and satisfaction.

Introduction

Healthcare delivery in the United States continues to shift to a patient-centered approach, with increased attention being paid in how to engage patients in the use of their medical data including access to their electronic health record (EHR).¹⁻⁴ Initially, larger efforts from a policy and EHR vendor perspective have focused on patient-facing health information technology (HIT) tools to provide patients with access to their clinical notes and results from laboratory and imaging tests as well as communicate with their providers and other members of their healthcare team.⁵ Recently, a number of patient-centered HIT tools allow for the capture of patient-generated health data⁶ and outcomes (e.g., home blood pressure or blood glucose levels).^{6,7} Ultimately, integrating patient-reported data into the EHR may drive better patient outcomes, assist providers in their clinical documentation practices, and support researchers by improving the quality of EHR data.^{8,9} Thus far, however, most of this integration has been limited to outpatient patient/provider systems.^{10,11}

In the inpatient setting, the use of interactive patient care (IPC) tools accessed at the patient's bedside including thru the television or other bedside devices is beginning to emerge.^{12,13} These IPC tools are often also used as an entertainment platform for patients, by delivering on-demand video and game content, with the added benefit of other virtual patient care interactions such as patient tailored-information delivery through the bedside television (e.g., disease specific educational videos, guided imagery) by the care team selectively assigning content.¹⁴ In most cases, however, IPC tools are stand-alone technology lacking EHR integration limiting the ability to support real-time and meaningful bi-directional interfaces to affect patient care.¹⁵⁻¹⁶

To improve our ability to provide timely information delivery particularly around pain control, we successfully integrated our inpatient television-based IPC with three other stand-alone HIT systems (the EHR system, the nurse communication phones, and the pharmacy dispensing system) at our children's hospital, and leveraged this integration to engage parents in their reporting of their child's pain through a time-triggered television pop-up pain reassessment which was communicated to the nurses' phone and documented within the EHR.

After implementing this solution, timely documentation of nursing pain reassessment increased 26% compared to the prior year.¹⁷ While this was a statistically significant increase in timely nursing documentation, the overall utilization of the IPC reassessment by patients was low (6.5%). In this study, as this type of patient-centered television-based workflow was previously unreported and the factors contributing to low utilization were unknown, we sought to gain insight from end-users by gathering the perspectives of nurses and parents using this novel interactive pain management tool. This study has the potential to aid in further modifications of the workflow and technology as well as provide broader learnings for improved user experience and utilization for similar IPC tools.

Methods

Hospital Setting and the Pain Management Solution

The University of Minnesota Masonic Children's Hospital is a 246-bed comprehensive quaternary children's and mother's hospital and is part of Fairview Health Systems. In 2014, the hospital piloted a novel pain management solution, which was developed internally to integrate four stand-alone technologies: a television-based IPC system¹⁸, the EHR system, a nursing call system, and the pharmacy inventory management system. The solution was implemented on four units within the hospital: the intensive care unit, bone marrow transplant unit, and two medical/surgical units that care for a variety of general pediatric and subspecialty patients. The motivations behind developing this system were: (1) to pursue transformative strategies to eliminate pain, (2) activate an additional tool to alert nurses when it was time for pain reassessment and documentation, (3) provide a tool for patients and their families to alert their nurse about the perception of pain and effectiveness of interventions, improve regulatory compliance and efficiency, and (4) reduce variation in access to pain management resources.

Clinical Workflow

Prior to the launch of the new interface, the pain management clinical workflow was mostly manual with no system triggers. The patient/parent reported the level of pain by calling for the nurse, or the nurse identified pain as a problem while interacting with the patient. The nurse was then required to document the pain rating score in the EHR, check pain medication orders, and select and administer the appropriate medication. To conduct patient pain reassessment, the nurse was required to anticipate the medication peak, (which varies for each medication), performs the reassessment, and document the pain rating in the EHR. If pain was still an issue indicated by the patient/parent, the nurse selected an additional intervention (another medication, and/or non-pharmacological support, and/or contact a physician).

After the new interface was implemented, the pain management clinical workflow starts proactively. Once the patient and family are in the admission room, the IPC shows a brief video to set expectations about pain, pain management options, and the partnership between family and the hospital care team in managing pain. When the patient is prescribed pain medications (Figure 1), the nurse first removes the medication from the medication dispensing machine. This initiates a time-based trigger (i.e. 30 minutes for oral pain medications and 15 minutes for intravenous pain medications) for a pop-up window to be displayed on the inpatient television screens showing a pain rating question. Once the patient or parent responds to the question using the television remote or a keyboard, the patient's pain rating score is communicated to the nurse through their phone and automatically documented in the EHR. Nurses access and interact with the system through their phones and the inpatient computer stations, while patients or parents use the remote bedside clickers or keyboards and their television screens to access and interact with the system.

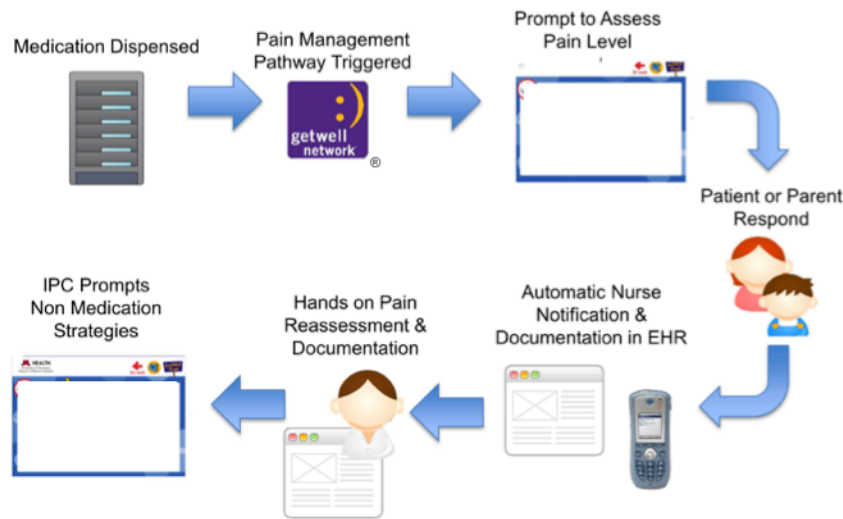


Figure 1: Overview of Interactive Pain Management Solution Clinical Workflow

Study Design

We used a mixed-method concurrent triangulation approach for this study. Since the experience with the pain management tool differs between nurses and parents, we developed two survey instruments with questions specific to each user's experience. We built the surveys in Qualtrics@UofM¹⁹ and used questions based on examples of other patient and provider technology user experience and satisfaction surveys.²⁰⁻²² After a pilot study was conducted, surveys were adjusted based on participants' comments and feedback.

The nurse survey instrument was developed to capture closed ended and open-ended responses. There were 14 closed-ended questions in multiple-choice format designed to collect demographic information, experience with computers, and the perceived usefulness of the tool on a 5-point Likert scale (1=not at all useful to 5=extremely useful). There were 2 open-ended questions designed to capture the experience, benefits and challenges of the tool as perceived by nurses. Nurses were eligible if they had experience with using the solution for at least a month. Invitation emails were sent through the hospital's nursing email distribution list in December 2015. Reminder e-mails were sent approximately 1, 2, and 3 weeks after the initial e-mail invitation. Upon completion of the survey, nurses were given a \$10 gift card.

The patient survey instrument included 32 close-ended questions in multiple-choice format designed to collect demographic information, experience with computers, satisfaction with nursing pain management communication, and the perceived usefulness of the tool on a similar 5-point Likert scale. Based on the feedback received from parents during the pilot study, open-ended questions were omitted from the survey instrument in an effort to minimize time burden of the parents of inpatient children. Parents were eligible if they were 18 years of age or older, used the interactive tool to report their child's pain for two times or more, and were fluent in English. Parents were surveyed using convenience sampling in which 2 informatics researchers (RA and GH) were notified of inpatient families who met inclusion criteria, and if available and the parents provided informed consent, the researchers administered the survey orally using hand held devices. Participating parents were able to choose from a variety of small gifts valued at under \$10 for themselves and their children.

The study was approved by the University of Minnesota Institutional Review Board and the University of Minnesota Masonic Children's Hospital Nursing Research Council. The study was conducted over a 6-month period starting from December 2015.

Data and Statistical Analysis

The responses to the Likert scale items were analyzed through the Qualtrics website to produce descriptive statistics. Additional analysis was performed in SAS version 9.3 (SAS Institute Inc., Cary N.C.). Non-parametric Spearman correlation, the non-parametric Wilcoxon rank sum test, and the Kruskal-Wallis test were used to assess differences between subgroups. Comparison groups were constructed based on participant demographics with findings being considered statistically significant at $P < 0.05$. Only correlated items at $R > 0.5$ are reported in study.

To understand nurses' responses to the open-ended questions, two reviewers (RA and MP) conducted a thematic content analysis. Reviewers looked for repetition and statements relevant to benefits and challenges with using the solution. Next, the reviewers met together and identified a single set of themes via consensus and created standardized codes for the themes along with a set of definitions. To increase validity and comprehensiveness of the themes, each reviewer independently reviewed the themes while examining the original data. Lastly, each reviewer coded the entire original data independently and then a meeting was convened to reach 100% agreement and consensus between inconsistencies. The final codes were then reviewed and sorted on the basis of the thematic content. The analysis lasted 4 weeks, with 2 group meetings during that period.

Results

Participants

Parents

A total of 30 parents, who met the inclusion criteria were approached to participate during the study period. Twenty parents (66%) agreed to participate. Table 1 summarizes parent demographics.

Table 1. Parent Participant Demographics

Characteristic	<i>n</i> (%)
Gender	
Female	16 (80)
Male	4 (20)
Parent Age (years)	
< 30	5 (25)
30-39	8 (40)
40-49	4 (20)
50-59	3 (15)
Ethnicity	
Caucasian	14 (70)
African American	2 (10)
Asian	2 (10)
Native American	2 (10)
Education Level	
Less than high school	2 (10)
High school graduate or GED	2 (10)
Some college	7 (35)
College graduate	5 (25)
Postgraduate degree	4 (20)
Income	
<35K	5 (25)
35-49.9K	2 (10)
50-74.9k	4 (20)
75-99.9K	1 (5)
100K +	6 (30)
General level of computer experience	
Less experienced (e.g., browse web, check email, or less)	1 (5)
Somewhat experienced (e.g., edit photos, use spreadsheet)	12 (60)
Very experienced (e.g., create web page, write computer programs, or more)	7 (35)
Patient (child) Age (years)	
<5	5 (25)
5-11	5 (25)
>11	10 (50)
Admission inpatient unit	
ICU	2 (10)
Medical/Surgical, Hem Onc, Transplant	6 (30)
Medical/Surgical, Cardiac, Other Specialties	12 (60)
First admission	
Yes	6 (30)
No	14 (70)
Length of Stay	
>3	4 (20)
3-4	5 (25)
5-6	3 (15)
7-8	2 (10)
> 8	6 (30)
Prior use of the pain management interactive tool	
Yes	12 (60)
No	8 (40)
Number of times the interactive tool was used during the current inpatient stay	
2-3	10 (50)
4-6	5 (25)
> 6	5 (25)
Knowledge of the non-medication patient education resources available through the system	
Yes	12 (60)
No	8 (40)

Note: Bold numbers indicate the highest value within a specific group

Nurses

Although the exact number of email addresses on the hospital's email distribution list was unknown, there were around 260 registered nurses (RN) and nurse technicians working in the 4 inpatient units included in this study. Fifty-nine nurses (23%) participated in the study. We accepted completed surveys from participants who self-identified as RNs. The survey took an average of 8 min to complete. The majority of nurses indicated they were somewhat experienced with computers (83%, $n = 49$) such as using spreadsheets, and (80%, $n = 47$) indicated having more than 6 months experience in using the pain management solution. Nurse participant demographics are provided in Table 2.

Table 2. Nurse Participant Demographics

Characteristic	<i>n</i> (%)
Gender	
Female	57 (97)
Male	2 (3)
Age (years)	
< 26	9 (16)
26-34	36 (62)
35-54	11 (19)
55-64	2 (4)
Inpatient hospital unit	
ICU	3 (5)
BMT	13 (22)
Medical/Surgical, Hem Onc, Transplant	9 (15)
Medical/Surgical, Cardiac, Other Specialties	34 (58)
Previous experience with adult patients	
Yes	14 (24)
No	45 (76)
General level of computer experience	
Less experienced (e.g., browse web, check email, or less)	8 (14)
Somewhat experienced (e.g., edit photos, use spreadsheet)	49 (83)
Very experienced (e.g., create web page, write computer programs, or more)	2 (3)
Experience working with the pain management interface tool (months)	
2	1 (2)
3	5 (9)
4	3 (5)
5	3 (5)
>6	47 (80)
Knowledge of the non-medication patient education resources available through the system	
Yes	37 (62)
No	22 (37)

Note: Bold numbers indicate the highest value within a specific group

Perceived Usefulness of the Tool

Parents

Most of the parent participants were satisfied with the general experience of using this interactive tool to manage their child's pain (90%), indicating that it helped their nurse manage their child's pain in a more timely manner (75%), and many (45%) felt the tool helped them better understand their child's pain. Additionally, half of the parents indicated the tool led to access to non-pharmacologic alternative resources for pain control including video/visualization resources embedded in the bedside TV entertainment system (Figure 2).

Several differences among parent sub-groups were identified in relation to the perceived usefulness and general satisfaction with the tool. Parent age was found to be negatively correlated with the usefulness of the tool in helping the nurse know the level of child's pain ($R = -0.52$, $p = 0.02$) with younger parents being more satisfied. Results also indicated a correlation between the overall level of satisfaction with the use of the tool and the overall satisfaction with the nursing pain management communication activities. This correlation was found in 5 out of 9 statements that asked parents about levels of satisfaction with specific nursing pain management communication activities: (1) time to discuss concerns in using the tool ($R = 0.61$, $p = 0.004$), (2) ability of the tool to communicate the level of pain to the nurse ($R = 0.66$, $p = 0.002$), (3) nurse listening regarding child's pain ($R = 0.58$, $p = 0.007$), (4) nurse assessment of

child's pain ($R=0.65$, $p=0.002$), and (5) nurse concern with child's emotional and physical wellbeing ($R=0.60$, $p=0.005$)

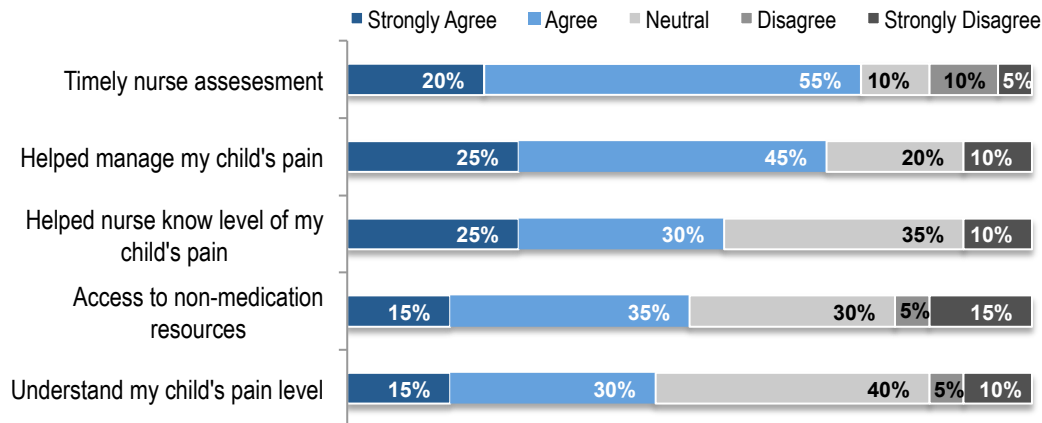


Figure 2: Perceived usefulness of the tool based on parent responses

Nurses

Results from the nursing survey indicated that 50% of the nurses were generally satisfied with the use of the pain management tool, 40% were indifferent, and 10% indicated dissatisfaction. When nurses were asked about the perceived usefulness of the tool, timely reassessment reminders and phone triggers were the top useful features (Figure 3).

We identified several differences among nurse sub-groups with respect to perceived usefulness and general satisfaction with the tool. Nurses with experience working with adults scored lower for reassessment of patient's pain ($p=0.028$) and for general satisfaction with the tool ($p=0.052$). General satisfaction with the tool varied among the hospital units ($p=0.034$), with the Medical/Surgical, Hematology Oncology, Transplant Unit scoring highest and the Bone Marrow Transplant Unit scoring the lowest.

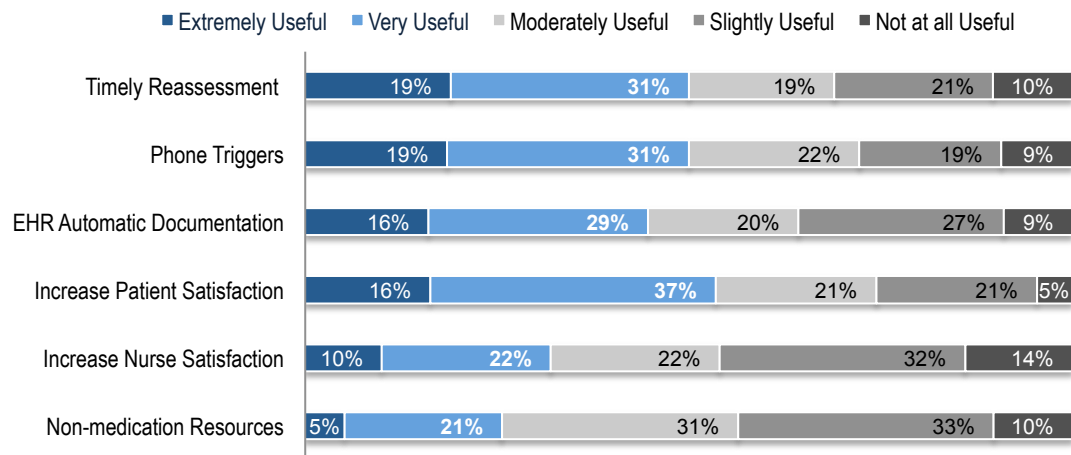


Figure 3: Perceived usefulness of the tool based on nurse responses

Nurse Perspectives on the Benefits and Challenges of the Solution

All nurses participating in the study provided a total of 118 responses to the open-ended questions related to the benefits and challenges of using the tool. A total of 45 unique nurse statements were derived and coded from responses to the benefits question, with thematic analysis yielding 2 main themes: (1) nurse benefits and (2) patient benefits (Table 3).

Having phone reminders to reassess patient pain was the most frequently mentioned benefit (n=16) with one nurse stating: *It reminds me to check back with my patients in the appropriate window of time following a pain med (oral or IV)*” and another stating, *“Sometimes it can be a reminder to check in on patients after giving an oral pain medication; especially if it is within a busy shift.”* Several nurses (n=8) cited that the system supported patient empowerment and satisfaction. For example, *“...[it] gives the patient/family more control over pain management,”* *“...there is definitely value in participating in voicing their pain level through this avenue.”*

Nurses also described several challenges with using the tool, with 112 unique nurse statements derived and coded from responses to this question. These challenges were mapped to 4 main themes: (1) nurse related, (2) system related, (3) patient related, and (4) organization related.

The most frequent challenge described by nurses (n=16) was uncertainty of patient-rating score. Nurses described concern that patients/parents are using the tool mainly to make the pop-up pain-rating question disappear so that patients continue using the entertainment feature of the system rather than accurately reporting the level of pain. For example one nurse stated, *“If patients don't use it, or just click buttons to get message to go away. Wonder about accuracy in describing pain.”* and another stating, *“I feel as though most pts just push a button on the GWN to continue watching their program and dont honestly answer at their true pain level”.*

The second highest challenge was system related, indicating low utilization of the system among both nurses and patients/parents-undefined reason (n=15). Some examples of nurse statements include, *“...it is very rare that a patient will actually use the Get well network® [IPC vendor name] to reassess their pain.”*, and *“I don't see a lot of families clicking the multi-modal pain management strategies button.”*

Patient related challenges included low utilization due to patient factors (i.e, age, language, technology comfort) (n=14). Examples of nurse statements include, *“Sometimes it is irrelevant because alot of my patients are too young to read.”*, and another *“It is rarely used properly on the PICU [Pediatric Intensive Care Unit] because our patients are so sick they are unable to utilize the tool.”*

Table 3. Benefits and challenges to the use of the pain management tool

No.	Category	Example	Count
Benefits			
1. Nurse benefits			28
1.1	Phone reminder to reassess patient pain	<i>“Super helpful in reminding me to reassess and document...”</i>	16
1.2	Auto documentation within the EHR	<i>“I like that when the pt responses to their pain after an intervention that it charts it in Epic...”</i>	6
1.3	Decision support to prioritize patients’ needs	<i>“... If I get a message that pain is increased, I know to prioritize and get back into the room sooner to intervene...”</i>	6
2. Patient benefits			17
2.1	Empowerment and satisfaction	<i>“...I think there is definitely value in participating in voicing their pain level through this avenue...”</i>	8
2.2	Sense of connection	<i>“... its nice that it lets you know where your patients pain is at after a medication.”</i>	5
2.3	Non medication resources	<i>“...The best resources in the non-medication section of the GWN are videos ...”</i>	4
Challenges			
1. Nurse related			33
1.1	Uncertain of patient rating scores	<i>“some patients will click the first button they see to get rid of the pop up and it will ding to us that their pain is worse...”</i>	16
1.2	Less experienced with system /need more training	<i>“Getting all info i need to use it to it's full capability”</i>	11
1.3	Distraction from other tasks	<i>“... And as a nurse I also find the alerts that come to my phone as annoying. Its just another "beep" on my phone that distracts me from patient care.</i>	4
1.4	Discourage best practice - (pain assessment/reassessment documentation)	<i>“...it can never replace the need for a nurse with training a permission to use non-medication pain management ...”</i>	2

2. System related			39
2.1	Low utilization (unspecified reason)	<i>“some patients/families do not report the reassessment of pain.”</i>	15
2.2	Low utilization due to environmental factors	<i>“the biggest challenge is the TV being broken-then I can't use the interface.”</i>	13
2.3	System design limitations	<i>“Organization of the non-pharmacological pain interventions. Would be easier to have a quick link or to assign these modules...”</i>	8
2.4	Discrepancy pain scales between patient rating and nurse assessment	<i>“...Hence it would be great if the tool used in the GWN could follow the same suit as the one used in Epic.”</i>	3
3. Patient related			20
3.1	Low utilization due to patient factors (i.e-age, language, technology comfort)	<i>“some dont know how to navigate or use it cause they are too young, i see some adults but mostly little kids.”</i>	14
3.2	Patient annoyed/dissatisfied/uninterested with the tool	<i>“Some patients have expressed annoyance with the question always popping up on their televisions.”</i>	6
4. Organization related			20
4.1	Extra work and does not improve overall workflow	<i>“...it doesn't save us any time or steps.”</i>	11
4.2	Duplicate charting requirement	<i>“...I wish that there was a way to verify it or co-sign it so that we didn't have to double chart their response.”</i>	9

The last main theme was coded as being related to the organization and included challenges related to workload and overall clinical workflow (n=11). Nurses described this challenge in statements such as *“making sure phones are logged in correctly each shift (one more thing the charge RN has to do)...”* and *“Honestly, it is one more sign-in to have to do...”*.

Discussion

The importance of capturing the perceptions of parents, as consumers, is as important as capturing the perceptions of nurses. Or and Karsh²¹ specifically addressed the main factors that influence consumer acceptance, while other studies examined the effects of introducing health information technology tools on providers.^{23,24} Our objective was to study the perspectives of both parents and nurses towards using an interactive patient care tool in the management of pain at our children’s hospital.

Our main findings indicate cohesive agreement among parents and nurses on the perceived usefulness of the pain management tool. Both indicated that the most usefulness feature of the tool was its ability to support timely reassessment of patients’ pain. Similarly, this feature was the top mentioned benefit that emerged from our qualitative analysis. These findings can be viewed as a factor of successful implementation, as it is aligned with one of the main reasons for implementing this solution. While both parents and nurses indicated that the non-medication pain management resources accessed through the IPC tool was the least useful feature, in comparison to the other system’s features. It is worth noting that this may be a result of a lack of familiarity with this tool. . Inexperience with using the full set of features of the solution and the need for more training has emerged as one of the challenges that nurses face with the tool. This is similar to the finding of other research studies examining the challenges to interactive technology adoption.^{11,25}

Although demographic group differences in parents’ perceived usefulness of the tool were not found to be clinically significant, results indicated a correlation between parents’ satisfaction with nursing pain management communication activities and the general satisfaction with the use of the tool. These findings are similar to other findings examining the relationship between that satisfaction with HIT tools and provider communication.⁵

Interestingly, nurses recognized the value of this solution in engaging and empowering patients and their families, increasing patient satisfaction, and creating a communication platform for patients and families to voice their perceptions of pain. This was aligned with the parents’ perspectives, which showed the majority of the surveyed parents satisfied with the experience of using the tool and indicated that it provided a good method to communicate their child’s pain to their nurse.

Many of the challenges that nurses stated suggested a desire for system improvements that would better support nursing pain management care and documentation, rather than resistance to the use of the tool. Nurses indicated uncertainty of the patient pain response scores as the number one challenge. In response to this concern, system

changes were done to the pain rating pop-up question in order to change the default display value “hurts less” to “hurts more”. This change has increased the variability of the patient responses documented in the EHR, which in turn may address this challenge. Educating the patient/parent on the benefits of using the tool and the contribution they make in the pain management process is another vital method that can potentially address this concern.

Low utilization of the tool among patients/parents emerged as a second challenge. This was also found in our previous system’s evaluation study.¹⁷ Similar to other study findings^{11,25}, more education and training is needed to remind nurses about the existing features of the system and how to navigate and educate patients and families about the benefits of using the tool. Other nurses stated challenges related to the duplicate charting requirement and extra work during their shift. Although one of the reasons for developing this solution was to engage patients in their pain management care and support the nursing pain reassessment process, nurses were expecting the tool to replace pain reassessment documentation in the EHR. The overall sense of apprehension among nurses can be partially explained by lack of understanding of the main driver behind implementing this solution. Published literature has highlighted the importance of education for end-users in HIT system implementation, noting that inadequate familiarity and knowledge may potentially lead to user frustration.²³

Limitations of this study include the relatively small sample size of the participants and our inability to calculate the nurses’ response rate. Although we intended to be as systematic as possible in reaching as many nurses as we could, the exact number of nurse emails were unknown and the perspectives were limited to those nurses who were able to open their work emails on the days and times when messages to participate in the study were sent. Also, the study was limited to one institutional setting; pediatrics. Therefore, future research should explore these findings in an adult setting, where patient factors related to patient age might not be a challenge.

Future studies using time-motion or work sampling techniques may examine the amount of time nurses spend using the solution in their clinical practice and the impact of the tool on time efficiency in documentation practices and patient education. We also plan to conduct a patient/parent usability study to determine what areas can be improved to make the interface easier to use.

Conclusion

To our knowledge, this is the first study to assess parent and nurse perspectives on the implementation of an interactive tool developed to support the pain management clinical workflow within an inpatient pediatric setting. Our results could inform other health care organizations about the feasibility of and potential areas to focus on when implementing an interactive tool integrated with other HIT systems. We found that parents were satisfied with the use of the tool, highlighting its importance as a communication tool with nurses and its effect on timely reassessments of their child’s pain. Nurses recognized the tool’s importance in increasing patient engagement and satisfaction but also expressed some concerns about its validity in reporting patient pain scores. Inpatient interactive tools have the potential to increase patient engagement and communication with clinicians; however, if education and training are not given to end-users, the full benefits of these tools may not be realized. In addition, our findings indicate that nurses are in favor of the solution’s ability to automatically store patient pain reassessments in the EHR, suggesting that future interface changes to the pain rating question may be helpful in supporting pain reassessment documentation practices.

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