

Project Title: Perception and Use of a Patient Care Window to Improve Care and Family Engagement

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2. STRUCTURED ABSTRACT (250 word maximum). Include five headings: Purpose, Scope, Methods, Results, and Key Words

Purpose and Scope: Despite the rapidly spreading adoption of health information technology (HIT), it is unclear whether the potential of these technologies have been realized. One explanation is the “Field of Dreams” fallacy, which questions the belief that simply implementing a technology guarantees its use. Regardless of the purported quality of the technology or the fact that a given HIT was installed, ultimately, it is the perceptions of those intended to use the technology that determine both its use and whether potential benefits are realized. In addition, studies show that HIT has the potential to improve patient/family-centered care and engagement, a recent “hot topic” in healthcare research. However, it is unclear if there is evidence to support designing technologies to engage this population. Thus, more developmental research is needed on new types of technology that could potentially improve patient/family engagement. To address this gap in the literature, we studied provider and family perceptions and use of a specific technology: Large Customizable Interactive Monitor ().

Methods: We used a mixed method approach to collect both quantitative and qualitative data from three different groups, including providers, nurses and parents. In total 36 providers out 39 in the unit participated to the study. We also had 55 nurses participated to focus groups and 167 nurses completed the survey. Finally, we had 33 parents participated to the focus groups.

Results: Study results showed the perception of each stakeholders regarding the studies novel HIT. We also identified and measured the factors which influence their use of the . Finally, we identified how this technology contribute to family empowerment and improve the family-provider communication in the ICU room.

Keywords: Health information technology, pediatric intensive care units, workflow, family engagement, technology acceptance model

3. PURPOSE (Objectives of the study)

Specific Aim 1: Determine the specific needs of PICU patients/families that could inform changes to the design and use of the to enhance use and family/patient engagement. To accomplish this aim we will:

- a) Measure Perceived Usefulness (PU) and Perceived Ease Of Use (PEOU) among patients' families in a pediatric ICU (PICU) via a validated Technology Acceptance Model survey instrument.
- b) Contextualize the survey findings from aim 1a and identify additional unmet needs of patients' families beyond PU and PEOU via focus groups.

Specific Aim 2: Determine the specific needs of PICU physicians and nurses that could inform redesign of the to enhance use. To accomplish this aim we will:

- a) Measure PU and PEOU among providers in a PICU via a validated TAM survey instrument.
- b) Contextualize the survey findings from aim 2a and identify additional unmet needs of providers beyond PU and PEOU via semi-structured interviews and focus groups.

4. SCOPE (Background, Context, Settings, Participants, Incidence, Prevalence)

Despite the rapidly spreading adoption of health information technology (HIT), it is unclear whether the potential of these technologies has been realized. One possible explanation is the "Field of Dreams Fallacy," which questions the belief that simply implementing a technology

guarantees its use. Instead, the validated Technology Acceptance Model (TAM) aids understanding of the use of HIT. While TAM includes multiple predictors, two of the most important predictors of actual use of a technology are the perceived ease of use (PEOU) and perceived usefulness (PU). This model is one of the most common and influential frameworks for predicting how users come to accept and use a technology. Thus, regardless of the purported quality of the technology or the fact that a given HIT was installed, ultimately, it is the perceptions of those intended to use the technology that determine both its use and whether possible benefits are realized.

Children's Hospital of Wisconsin (CHW) implemented a commercially available electronic health record (EHR) in November of 2012. One novel application within the EHR was a Large Customizable Interactive Monitor (LCIM), a 42" (diagonal) flat panel touch screen monitor that displays validated patient information including vital signs, laboratory results, medications and interventions. In contrast to traditional HIT intended for providers that requires a secure log-in in order to access patient information, the LCIM is available in each patient's room for viewing and use by providers as well as patients/families without any login required. Instead, the LCIM is activated upon admission of a patient. Additionally, the content of the LCIM is customizable by the organization. This innovative technology has the potential to facilitate information transfer, reshape the workflow, and contribute to patient/family engagement, and thus may lead to breakthroughs in traditional hospital care. However, informal observation reveals wide variation in actual use of the LCIM between both providers and patient families. It is unclear why provider/patient/family members do or do not use a tool that could greatly facilitate information transfer, awareness, and engagement. One possibility is that the HIT, as currently implemented, fails to meet the needs of intended users.

The needs of physicians and nurses are likely related to easy and quick "just-in-time" access to information needed for clinical care. This is particularly true in the Intensive Care Unit (ICU) setting. However, patients and families may have distinct needs that can be met by the LCIM to promote family-centered care. This self-contained research study will measure both user perceptions and opportunities for improving this novel technology. Because TAM and other models are contextualized to use, it is essential to consider each user group independently.

5. METHODS (Study Design, Data Sources/Collection, Interventions, Measures, Limitations)

A prospective, observational study design was used to address both Specific Aims. The setting was the pediatric intensive care unit (PICU) at CHW. We used an observational design since the technology in question (LCIM) has already been implemented. Rather than an experimental design, we sought to understand reasons for use or non-use of the LCIM to inform future interventional studies. As this technology has been previously implemented in patient rooms and is already used by some providers and families, it would be unethical to deactivate a subset of the LCIM to create an experimental model. The use of observational design has been applied extensively in HIT research, including by members of this team on previously funded studies. We believe this design allowed us to ethically address the aims of this study.

Qualitative methods were used to systematically and comprehensively elicit previously unexplored phenomena from a grounded perspective without the possibly incorrect or outdated assumptions of the researcher. Like their quantitative counterparts, qualitative approaches are capable of generating data that are valid, reliable and generalizable. However, qualitative approaches maintain different goals overall (description and contextualization, rather than numerical representation), as well as differing orientations toward sampling (theoretically-based and concerned with documenting a range of responses rather than derived randomly and focused on central tendencies; aiming at data saturation rather than achieving sufficient power) and analysis (nonlinear and recursive rather than sequential).

Three data collection and analysis activities were reported to be conducted, including semi-structured interviews with PICU physicians and nurse practitioners (NPs), focus groups with PICU nurses, and focus groups with parents of patients admitted to the PICU; surveys were administered to all three user groups.

The focus of measurement was the current state use patterns (baseline) and perceptions of the LCIM by three distinct groups: PICU physicians (including nurse practitioners), PICU nurses, and PICU patients' families. There is no interest in the identity of study participants. To that end, no

identifying information that could link responses to any participants was collected. Qualitative data was collected via two methods. First, we conducted one-on-one semi-structured interviews for one subgroup of users, physicians and nurse practitioners. Second, we conducted focus groups with two subgroups, parents and adult family members of PICU patients, and PICU nurses. For nurses and providers, a standardized survey instrument was developed and validated during the first weeks of the study.

For each stakeholder/user group, we seek to understand: 1) how and why they currently use (or don't use) the LCIM (perceived usefulness), 2) perceptions regarding ease of use, and 3) how the LCIM could be made more useful or easier to use. We also explored the unmet needs of providers and families which can enhance their use of LCIM and family/patient engagement. Drs. Asan and Flynn conducted the interviews and focus groups. This approach ensured consistency in the data collection process. Undertaking thorough and valid description and examination of the PU and PEOU would be a time-consuming activity that necessarily limits the number of participants. Maintaining an overall modest study sample size, yet one that maximizes the full range of stakeholders will allow us to reach the point of "theoretical saturation," what qualitative researchers define as the point at which no new information is elicited.

Surveys: The study's theoretical framework was adapted from Technology Acceptance Model (TAM), a paradigmatic behavioral theory of IT acceptance and the leading theory applied in health IT acceptance research. TAM posits IT perceptions lead to its acceptance and acceptance results in actual use. TAM research variably defines acceptance as satisfaction with an IT system or the intention to use it.

The two IT perceptions canonically associated with acceptance are IT ease of use and usefulness, but perceptions of social influence to use IT, facilitating conditions, and motivation have also been included as predictors of acceptance in the literature.

The survey instrument was developed by using TAM to measure PU and PEOU for all providers (doctors and nurses) and was also used to measure non-specific categorical data about respondent, e.g., ranges of respondent age, years in current role, years in PICU for providers/duration of PICU stay for parents, as well as data regarding their current use of the monitor. The survey was

administered to physicians (n=36) and nurses (n=167). For PICU nurses, we followed a convenience sampling strategy and disseminate the survey to all nurses in the unit.

Semi-Structured Interviews: We conducted interviews with critical care physicians. While both the interviews and focus groups was guided by a uniform set of topics, separate question guides was tailored for each of the sub-groups. These guides allowed interviewees to respond to a set of core questions while allowing exploration of other key issues that emerge. Probes was used to explore each participant's responses in more depth. All guides were adapted from previous studies conducted by members of the study team that assessed similar topics, and was reviewed by the full study team to elicit their feedback about the cultural relevance, feasibility, and acceptability of the interview content, question structure and wording.

Focus Groups: We conducted focus groups with two sub-groups: PICU W3 nurses and parents of PICU patients to gain a broader and deeper understanding of PU and PEOU of the LCIM. A focus group question guide was used to facilitate the discussions, allowing participants to respond to a set of core questions while providing opportunities to pursue other key issues that emerge from the discussion related to the LCIM and engagement with providers. The focus group method allows participants to build off of each other's comments resulting in a potentially richer conversation than individual interviews can provide.

6. RESULTS (Principal Findings, Outcomes, Discussion, Conclusions, Significance, Implications)

A) Provider data

The providers in this study consisted of 36 participants: 19 (53%) attending physicians, 26 (44%) pediatric nurse practitioners, and one (3%) acute care specialist. Most participants were white, non-Hispanic (97%). Four (11%) were between 18-29 years old, 13 (36%) between 30-39, 11 (31%) between 40-49, 7 (19%) between 50-59, and one (3%) was older than 60 years.

Participants' average tenure in their current role was 9 years (mean). Additionally, participants

had an average 8 years experience with EHR/CPOE systems, and approximately 3 years (mean) using the hospital's Epic EHR system.

We completed the interviews and surveys with 36 providers out of 39 providers working in ICU. The initial analysis highlights contextual data on providers' use routines of the LCIM. Findings from thirty six interviews were classified into three groups: 1) providers' familiarity with the LCIM; 2) providers' use routines (i.e. when and how they use it); and 3) reasons why they use or do not use it.

Providers' familiarity with the LCIM varied widely and appeared to be affected by a perceived lack of training. Most providers stated there was no formal training on how to use the LCIM or its features, functions, reason for implementation, and purpose. Some providers reported being very familiar with the LCIM and its features. These providers reported becoming familiarized on their own or learning from other users, as demonstrated by this comment. All providers stated they were aware of the LCIM, but it was clear providers did not know all the existing content and features. We categorized providers into three groups based on familiarity obtained from their responses: high (20%), moderate (60%), and low/no (20%). High-familiarity providers reported knowing most, though clearly not all, the available functions and features.

We found three main uses: 1) Using the LCIM as a snapshot of the current data that is, gazing at it to view overall data; 2) Touching and interacting with the screen to get more detailed data, perhaps zooming in on a specific section; and 3) Using it as a teaching tool for families or other providers.

A few providers reported that they use LCIM when they assess a concern for the patients' health. It was also reported that they use LCIM as a reference point rather than computer desktop when they respond specific questions from families. Further, several providers reported using LCIM more often if the patient has severe illness and the parents are more computer savvy. In addition, providers who are on-call for the night expressed a benefit of using the LCIM to get very quick overview once they are called to a room.

When asked why providers used the LCIM, common categories of answers were: a) It is there (simply the existence of LCIM in the room is listed as a reason to use it); b) It is readily available as a quick reference point; and c) they do not need to log into the computer to access data, they can just walk in and glance at it.

Providers who were moderate or high users also reported the most and least commonly used features. Most respondents reported the two most commonly used features are viewing lab results, and I's and O's (Ins and outs). More than half of the providers also stated they use vital trends. The rest of the features/contents used at some degrees are ventilator settings, medication list, problem list, weight for dosage, and respirator for children. On the other hand, three providers reported using only the lab values features. Several providers reported specific contents they did not use including respiratory components, drops, medication list and vital trends.

The detail results can be accessed from the manuscript published in Applied Clinical Informatics (1). We also identified providers' positive and negative perceptions of LCIM as reported in Table 1 and 2.

Table 1. Themes and Subthemes of Providers' Positive Perceptions of LCIM

<i>Impact on family engagement and communication</i>
Helps improve provider-family communication if families use it
Can be used to educate/teach parents about their child's health
Might lead to conversations with families if they are interested in learning more
Helpful for overnight providers when they respond to the questions of families
Helps providers to explain context and rationale of data, especially lab and vital trends
Visual info on LCIM facilitates parents' understanding of the displayed data/info
Families look at data and start formulating questions if they see abnormal values
Families might feel more empowered to ask questions when they use it
Helps with medication reconciliation process with families especially for chronic kids
Chronic childrens' families like it more, due to the continuous access
Might help parents to develop some medical expertise and interpret the data
Helps providers to be transparent with families showing them the data they want to see
Might make families more involved in the rounds and feel comfortable to ask questions
Families can see the progress of their kids and access new info without asking the providers
Parents accessing all data providers see/access might influence trust in a positive way

<i>Impact on their work, including workflow, productivity and data access</i>
Quick access to data, no password, and snapshot of patient status might save time
Might give a better sense of information to improve the decision making process
When provider walks in the room, they can glance and see how patients' night looked like
It is most helpful when providers' cross cover for their colleague's patients
Helpful in explaining providers' thought process to the families
Can eliminate the time looking at desktop so more time to talk to parents at bedside
Helpful during the rounds, several people can look at it at the same time
No need to worry about printing lab reports while having a dialogue with parents
The information provider is looking for is generally there with an easy access point
Helpful when all computers in the room are occupied
<i>Data display and functions</i>
Provides a nice visual representation of data
Providers like seeing vitals in two different ways (graphs and tables)
It is clear, and user friendly
It is easy to use and understand
Having bigger, smaller bars, numbers in different colors facilitates understanding data (families)
Providers can eyeball information quickly from LCIM and see if any abnormality
Information on LCIM serves as memory aid for providers such as patients' name or basic info
Might be a nice teaching tool for providers to teach nurses in the room
Helpful for providers to teach trainees how to use vital signs to make decisions
<i>Physical properties/overall belief</i>
Provides transparent data
Appears family and patient oriented
Might improve family-centered care
Size is large and nice, it is easy to show values
Fun and interactive
Only accessing one patient's data at a time is critical (avoid privacy issues to access other data)

Table 2. Themes and Subthemes: Providers' Negative Perceptions of LCIM

<i>Concerns on interaction with families</i>
Information overload/too much information for some families
Red values might create additional/ unnecessary anxiety for families
Potential misinterpretation of data if not supervised by a provider/ not properly interpreted
Families might be too involved with LCIM without understanding the meaning of displayed data
It might be hard to understand some data for families with low health literacy level
Data on the LCIM might prompt unnecessary questions from the families
May created additional burden/disturbance for providers due to the family questions prompted
Informed family members can be concerned about medical team not accurately responding to problems
Highly involved families with LCIM give clinical suggestions, places more burden on the providers
Providers make decisions that are not always based on the data seen on LCIM which can be questioned by families
<i>Display /Data related</i>
Time frame for "Ins and Outs" (12am-12am) is different than the main system (7am-7am)
Weights and age did not update appropriately in the past (now it is fixed and updates accurately)
Garbage in /Garbage out (If nurses make error in data entry, which can lead to medication errors)
Lab results are not updating frequently
LCIM does not show dates of when labs were taken (is it from 3 hours ago or 3 days ago?)
The data on LCIM are based on validation of nurses, so if providers need more data they go to desktop
Providers cannot view orders in LCIM
<i>Technical features</i>
LCIM freezes or crashes sometimes
LCIM is not fast enough
Providers do not know how to reload or restart LCIM (when it is frozen, crashed or off)
The screen light on the LCIM is too bright, might disturb family during the night
You need to scroll back and forth too much to see needed info, especially med and lab section
Providers need to hit refresh button to get the data up to date

<i>Comparison with other technologies in the room</i>
LCIM does not accommodate the features of flowsheet used in the past
Vital sign information is less accurate in the LCIM than Bedmaster for second intervals
Duplication of information on LCIM with other current technologies in the room (e.g.ventilator)
For some providers, viewing the labs in desktop is easier
LCIM provides good snapshot of trends, but you cannot see longer trends, as you do in the desktop
For some providers, their workflow is more efficient with using desktop rather than LCIM
Some providers do not see any difference using the desktop/computer rather than LCIM
<i>Barriers to use</i>
Locations of LCIM in some rooms are inconvenient
Rooms in isolation is a barrier (not worth wearing gown and gloves to go in and use LCIM)
Rooms in PICU are not standard, so LCIMs are not implemented in a standard way
There are curtains hiding some of the LCIMs which prevent them being seen from the doorway
<i>Others</i>
Some providers are concerned with the cost of it
Some families are concerned with the name of the patient shown on it
Lack of training, how to use it, and benefits of using LCIM over desktop
Providers do not know who is in charge of turning it on and off
LCIM does not meet some providers' needs
Too much/ unnecessary information on the screen for the providers
Some providers need evidence that LCIM is useful and have advantages over desktop so they can use it

Implications

This study contributes to an understanding of providers' use characteristics of a novel, next generation HIT systems in pediatric critical care. Our findings demonstrate that providers' style of use as well as use characteristics of this novel HIT may vary for several reasons. A main message is to understand the importance of training on and orientation for this type of novel technology regarding its goal, purpose of implementation, functions and potential contribution to patient care. These findings can also be used to improve understanding of physicians' information needs in the context of novel HIT-enabled healthcare delivery.

B) Nurses' data

We conducted 7 focus groups including 55 nurses in total. We also administered Technology Acceptance model survey to all nurses in the unit to understand perceived usefulness and ease of use of this technology from their point of view. 167 nurses completed the survey in total. All analysis were completed for both focus groups and surveys.

From focus group data, six major themes emerged from the analysis: 1) familiarity and use routines, 2) positive experiences, 3) negative experiences, 4) privacy, 5) training, and 6) suggestions for improvement. The results were extensively reported in a recently published manuscript in International Journal of Human Computer Interaction (2)

From the survey data, Nurses reported low-moderate ratings of the novel IT's ease of use and low to very low ratings of usefulness, social influence, and training. Perceived ease of use, usefulness for patient/family involvement, and usefulness for care delivery were associated with system satisfaction ($R^2 = 70\%$). Perceived usefulness for care delivery and patient/family social influence were associated with intention to use the system ($R^2 = 65\%$). Satisfaction and intention were associated with actual system use ($R^2 = 51\%$). The results were reported in a recently published manuscript in BMC Medical Informatics and Decision Making (3).

Table 3. (a) Respondent characteristics and descriptive statistics for (b) perceptions, (c) acceptance, and (d) use.

(a) Respondent characteristics (N=167)	Count (%)
Age	
18-29	73 (44.8)
30-39	52 (31.9)
40-49	19 (11.7)
50-59	15 (9.2)
60+	4 (2.5)
Gender	
Female	150 (91.5)
Race and ethnicity	
White/European American	157 (96.9)
Black/African American	2 (1.2)
Asian	1 (0.6)
American Indian/Alaska Native	1 (0.6)
No response	5 (3.0)
% Hispanic, of those responding	5 (3.1)
Years of experience with any EHR / current EHR	
0-1	9 (5.7) / 31 (18.8)
1-2	19 (12.0) / 30 (18.2)
2-3	77 (48.7) / 104 (63.0)
>3	53 (33.5) / 0 (0.0)
Years at hospital	
Mean (SD)	8.9 (9.2)
(b) Perceptions (N=167)	Mean (SD)
Perceived ease of use, expanded	3.88 (1.52)
Perceived usefulness, traditional	2.03 (1.71)
Perceived usefulness for patient/family involvement, contextualized	2.58 (1.81)
Perceived usefulness for care delivery, contextualized	2.05 (1.79)
Social influence, institutional	2.84 (1.70)
Social influence, patient/family	2.04 (1.91)
Training on system	1.06 (1.39)
(c) Acceptance (N=167)	Mean (SD)
Satisfaction with system	2.16 (1.66)
Intention to use system	2.32 (1.62)
(d) Use (N=167)	Mean (SD)
Complete use of system	1.89 (1.52)

EHR = electronic health record system; The response scale for perceptions, acceptance, and use was 0 (not at all), 1 (a little), 2 (some), 3 (a moderate amount), 4 (pretty much), 5 (quite a lot), 6 (a great deal)

Table 4. Stepwise linear regression results for the outcomes satisfaction and intention to use.*

	Satisfaction		Intention	
	Estimate (SE)	t-value, p-value	Estimate (SE)	t-value, p-value
Intercept	-0.79 (0.41)	t = -1.90, p = 0.061	0.77 (0.22)	t = 3.54, p < 0.001
Perceived ease of use, expanded	0.31 (0.10)	t = 3.20, p = 0.002		†
Perceived usefulness for patient/family involvement	0.31 (0.10)	t = 2.93, p = 0.004		†
Perceived usefulness for care delivery	0.45 (0.10)	t = 4.41, p < 0.001	0.66 (0.07)	t = 9.13, p < 0.001
Social influence: Patients/Family		†	0.13 (0.06)	t = 2.02, p = 0.046
	Adjusted R ² = 0.70		Adjusted R ² = 0.65	

*Perceived usefulness, traditional; social influence, institutional; and perceived training on system were not significant in either model, and are not included in this table.

†Not a statistically significant model covariate.

Implications

Overall, this study appropriately contextualized a strong theory to measure pediatric ICU nurses' perceptions, acceptance, and use of a novel voluntary health IT. It yielded important findings about the relationships between these constructs, lending insight into future design, implementation, and research on similar technologies. It also produced insights about measuring health IT perceptions, acceptance, and use. We encourage further theory-based examination of both in-room inpatient IT and other novel systems intended to improve care delivery and patient engagement.

C) Family Data

The analysis yielded several positive and negative parents' perception of LCIM as reported in the following tables. The paper from this finding was submitted to JAMIA and currently under review.

The parents in the study consisted of 33 participants: 21 female and 12 male. Most participants were white (23), compared to African American (4), Hispanic (3) and Asian (3). Parents'

education background varied: 4 (12%) 9-12 years education, 4 (12%) high school graduate or GED, 11 (34%) some college/no degree, 2 (6%) associate degree, 8 (24%) bachelors degree, 2 (6%) masters degree and 2 (6%) PhD. Two (6%) parents were between 18-25 years old, 19 (58%) between 26-35, 9 (27%) between 36-45, 2 (6%) between 46-55, and one (3%) was between 56-65 years old. It was their first stay in PICU for seventeen parents. Twenty three parents reported having interaction (touching) to LCIM, whereas 10 parents stated that they looked at it but never touched it.

Table 5. Parents’ positive perceptions of LCIM

<i>Impact on family-care team communication</i>
Gives opportunity parents to initiate conversation with RNs by asking about information seen on the LCIM
Providers showing families where to locate information facilitates a more productive conversation
Helps with overall communication about the child’s care
Families look at data and start formulating questions if they see abnormal values
LCIM makes parents more involved in the rounds and feel comfortable to ask questions
Having specific information on LCIM allow parents to have expectations/agenda of the conversation they should have with the providers
LCIM prompts conversation between parents (mom and dad)
LCIM allows parent to have a much more intelligent conversation with the provider
LCIM is perceived as an interactive tool which guides the conversation between parents and doctors
LCIM is useful for discussing information in a group setting and allows for better communication.
LCIM breaks down existing barriers in the hospital
LCIM helps prompt question that parent may not think about when the provider are saying everything really fast
<i>Impact on parents’ understanding of situation/information</i>
The LCIM helps parents understand their child’s health problems and current situation
LCIM is helpful for parents’ understanding when providers use it as a visual reference to explain the case
LCIM helps parents understand X-ray better while the doctor explains what they see
Visual info on LCIM facilitates parents’ understanding of the displayed data/information when they look at by themselves
LCIM helps parents to know what is needed at the moment
Parent felt engaged with the treatment plan when provider showed x-rays and information on the screen discuss child’s progress
Parent see the information on LCIM and ask for clarification if needed to better understand

<i>Family empowerment</i>
Accessing LCIM gives the parent a sense of ownership when they critically review their child's medical information
Parents feel more empowered to ask questions when they use LCIM
Enables quick access to information without having to ask providers for it
Parent thinks LCIM helps him get answer to his questions without asking a provider and getting biased opinion
Parents think that LCIM makes them more engaged and be part of care team
Parent feels empowered to show visitors medical information about her son using the LCIM which helps her explain what the current medical situation is without having to ask a provider.
Transparency empower parents to know and understand what is going on with their children
LCIM makes parent to ask more educated questions and make more educated decisions
Highly educated parents involve in decision making of their child's treatment based on information they access from LCIM
Parent is empowered to challenge providers about making medical decisions because she receives information from the LCIM and feels knowledgeable
Parents can question care team when parents sees changes at LCIM about the medication/drugs or treatments
LCIM is helpful when the parent notices something that the provider may have overlooked or did not address during the round. This provides reassurance to the parent
Parents asks for clarification when she needs to; doing so helped to correct an error in the record.
Parent catches errors on LCIM and let the care team know to correct the displayed information
<i>Keeping up to date</i>
Parent uses the LCIM to remain updated on her daughter's medical information and to ensure data accuracy
Parents think LCIM enables transparency regarding medical information
Parents uses LCIM to stay updated by seeing what labs drawn overnight, lab results and orders placed when he/she was not there
Parents uses LCIM for lab values to understand ranges and stay up to date right before the round.
Parent finds the LCIM as an easy viewpoint to see any changes that occurred and remain updated on progress
Parents can see the progress of their kids and access new info without asking the providers
<i>Technical Features/display functions</i>
LCIM is clear and user friendly
LCIM is easy to learn how to navigate
LCIM is easy to read with a big size font
LCIM is intuitive
LCIM is good at providing visual for people who need it
LCIM is self-explanatory, and that a person who can use an iPad would be able to use LCIM
Large size makes the content on LCIM less overwhelming compared to if it was cluttered to a smaller screen
Having bigger, smaller bars, numbers in different colors facilitates understanding data
Big LCIM screen helps see information in a more open manner
It is nice feature to be able to only zoom in/out to the desired information/content
LCIM has well-labeled categories for medical information
The lay out is organized and you can decide which section you want to focus on, so not overwhelming
The highlighting functionality for allergies and warnings are helpful
Detailed reports on the bottom of LCIM is helpful in showing differentials

Table 6. Parents' negative perceptions or concerns of LCIM

<i>Lack of Instruction</i>
There is no official instructions or manuals for LCIM
The use of LCIM has not been explained to parents or if they are allowed to use it.
Parents received conflicting information, one nurse told she can use, another nurse told she cannot use.
<i>Lack of Interpretation/Misinterpretation</i>
Parents need some medical background to better understand information on LCIM
No interpretation over medical data displayed on LCIM
Parent seeing medical changes on LCIM without prompt explanations can create stress to the parents, which in turn may create stress for medical team
Need to be healthcare professional to understand data and where to look at it.
LCIM helps parent to manage, but not understand child's problem.
Parent finds it overwhelming to have a lot of information on the LCIM without no explanation
Parent recognizes the parameters, but still needs interpretation to truly understand
LCIM does not have more interpretative tools to help parents understand out of range info
Parent does not find LCIM useful at all times, since her child's situation is unique and needs provider to assist with understanding the situation.
<i>Additional anxiety/worry</i>
Red numbers are scary to see and creates worry and anxiety even if ranges are slightly off
Numbers that are red scare visitors, they ask why are all these numbers are red.
Watching I and O's and not seeing sufficient output created anxiety for parent
<i>Privacy</i>
Would like the LCIM to be in patient room away from the entry area for additional privacy
Do not want people walking by to have access to information displayed on the LCIM
Parent has faith in medical team and is not bothered by name appearing on LCIM
Parent suggests making problem list smaller and/or the ability to use screen saver
<i>Technical features</i>
LCIM sometimes freezes
Parents want information updated faster on the current problem list
Vitals are not real time
No pictures on LCIM
Screen transitions are sometimes slow
<i>Other Concerns</i>
The location is not always accessible
Curtains are in front of the LIM which create barriers to using LCIM (in some rooms)
LCIM does not help parents understand daily goals
Parents does not understand half of the information on the LCIM, but ignores whatever does not understand
Parents look at other monitors when there is a delay on LCIM (it says last 12 hours)
Parent will not touch the LCIM since she is afraid of messing up the overall summary information displayed
Language on the LCIM is only English
The LCIM can be intimidating equipment, if it is not in your language

7. LIST OF PUBLICATIONS and PRODUCTS

- 1) Asan, O., Holden, R. J., Flynn, K. E., Yang, Y., Azam, L., & Scanlon, M. C. (2016). Provider Use of a Novel EHR display in the Pediatric Intensive Care Unit. *Applied Clinical Informatics*, 7(3), 682-692.
- 2) Asan, O., Flynn, K. E., Azam, L & Scanlon, M. C. (2017). Nurses' Perceptions of a Novel Health Information Technology: A Qualitative Study in the Pediatric Intensive Care Unit. *International Journal of Human-Computer Interaction*, 33(4), 258-264. <https://doi.org/10.1080/10447318.2017.1279828>
- 3) Holden, R. J., Asan, O., Wozniac, E., Flynn, K. E., & Scanlon, M. C. (2016). Nurses' perceptions, acceptance, and use of a novel in-room pediatric ICU technology: testing an expanded technology acceptance model. *BMC Medical Informatics and Decision Making*, 16(1), 145.
- 4) Asan, O., & Carayon, P. (2017). Human Factors of Health Information Technology—Challenges and Opportunities. *International Journal of Human-Computer Interaction*. (Editorial) (2017): 255-257. <https://doi.org/10.1080/10447318.2017.1282755>
- 5) Onur Asan, Patient facing technologies to improve patient/family engagement in inpatient and outpatient settings, Pervasive Health, Istanbul/Turkey, 05/20/2015 - 05/23/2015
- 6) Onur Asan, Rich Holden, Kathryn Flynn, Matthew Scanlon, Perception and Use of a Patient Interactive Care Window to Improve Care and Family Engagement in Pediatrics ICU, International Symposium on Human Factors and Ergonomics in Health Care, San Diego, - 04/2016
- 7) Laila Azam, Kathryn Flynn, Matthew Scanlon, Onur Asan, Bedside Nurses' Perceptions of a Novel Health Information Technology Application in a Pediatrics ICU, International Symposium on Human Factors and Ergonomics in Health Care, San Diego, - 04/2016
- 8) Rupa Valdez, Peter Hoonakker, Ann Schoofs Hundt, Onur Asan, Yushi Yang, Designing Health Information Technology from Human Factors Perspective, 48th Annual Conference of the Association of Canadian Ergonomists & 12th International Symposium on Human Factors in Organizational Design and Management, Banf, Canada, 07/31/2017 - 08/03/2017