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Fall 2022

Usability and Technology Acceptance of an Electronic Child Abuse Screening Tool in a Pediatric Emergency Department

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Usability and Technology Acceptance of an Electronic Child Abuse Screening Tool in the

Emergency Department

A
Translational Project Paper

Presented to the Faculty of
The University of Texas
Health Science Center at Houston
School of Biomedical Informatics
in Partial Fulfilment of the Requirements for the Degree of
Doctorate in Health Informatics

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2022

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Dedication

This project is dedicated to all the children and families whose lives are improved by increased access to resources that support them in living to their fullest potential.

Child abuse and neglect screening must never be used to criminalize poverty but instead to lift families and improve their ability to care for one another. It is essential that this distinction is made and that great care is taken in assessment and response protocols to protect children while supporting families in need.

Acknowledgements

Abstract

Up to half of all child physical abuse victims with major abuse injuries seen in hospitals had sentinel injuries assessed by medical providers. Universal screening for child abuse and neglect in the emergency department can potentially increase detection at lower levels of injury. However, we must consider usability for the electronic health record embedded child abuse and neglect-screening tool to be most effective. The user most likely to interact with the screening tool is the bedside nurse. The interface of the initial screening tool and the process of inputting information must be perceived as useful, usable, and satisfying to the bedside nurse. The alert for a positive screen needs to achieve the right balance in visual hierarchy and workflow while avoiding alert fatigue and information overload in an already busy space. This project addresses the lack of robust universal child abuse and neglect screening in the Texas Children's Hospitals' emergency department. It also aims to address the gap in the literature on electronic health record-embedded child abuse and neglect screening tool usability. In addition, it seeks to address the gap in the literature on child abuse, neglect screening, and response protocols, as well as expand those protocols so they encompass support services for families affected by the sequela of poverty to avoid future states of neglect.

Keywords: technology acceptance, usability, EHR, child abuse screening, emergency department, pediatric

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Section 1: Introduction

Child abuse and neglect screening and response

Child abuse and neglect affect children from all walks of life across the United States

(US). There are over 4.3 million child abuse and neglect reports annually in the US

(Administration for Children and Families, 2020). These reports affect 7.8 million children, or

approximately 10.5% of US children (Administration for Children and Families, 2020). In the

most tragic circumstances, this abuse or neglect leads to death. These deaths happen nearly

1,800 times each year in the US. Experts consider the number of deaths of this kind to be

grossly understated by as much as half (Administration for Children and Families, 2020). This is

because of differing definitions by state and the different depths of examination and review by

county (Administration for Children and Families, 2020).

Up to half of all child physical abuse victims with major abuse injuries seen in hospitals

had ***sentinel injuries*** (Guenther et al., 2010; Lindberg et al., 2015a; Pierce et al., 2009; Puls et

al., 2018; Ravichandiran et al., 2010; Sheets et al., 2013a). However, these sentinel injuries often

go undetected or are underappreciated by clinicians because they are subtle and training in

abuse and neglect detection is limited and not mandated (Drinkwater et al., 2017; Lee et al.,

2012). This leads to many clinicians doubting their ability to recognize child physical abuse or

missing the abuse entirely (Drinkwater et al., 2017; Lee et al., 2012). Additionally, there can be

detection bias against minority and low-income patients (Lane et al., 2002; Lane & Dubowitz,

2007; Wood et al., 2010, 2012). Universal screening for child abuse and neglect in the

emergency department has the potential to decrease implicit bias and increase detection at

lower levels of injury (Riney et al., 2018; Schouten et al., 2017; Sittig et al., 2016; Wood et al., 2010).

The American Academy of Pediatrics (AAP) recommends that clinicians screen for child abuse and neglect to help prevent future injuries (AAP, n.d.). The Joint Commission (a national hospital accreditation body) also requires that "possible victims of abuse are identified." This has been interpreted to mean that every child at every visit to a hospital should be screened for abuse (*Joint Commission Standard PC 01.02.09 on Victims of Abuse*, 2009). Child Abuse Pediatrics was approved as a subspecialty of Pediatrics in 2006, with the first certification in 2009 (State Child Health Coordinator, 2020). As of July 2020, there were only 337 doctors board certified, with only about 300 practicing (State Child Health Coordinator, 2020). With the area in its infancy, there is little published literature on routine child abuse and neglect screening and response in the medical setting. Experts are still exploring the best way to accomplish this effectively and safely (Chen et al., 2022; McTavish et al., 2020a; Offidani et al., 2022; J. S. Sittig, Uiterwaal, Moons, Russel, Nievelstein, Nieuwenhuis, & Putte, 2016; Stilwell et al., 2022).

Lack of economic resources, individually and at a neighborhood level, is often correlated with higher detected rates of neglect (Black et al., 2001; Maguire-Jack & Font, 2017a, 2017b; Morris et al., 2019). Neighborhoods that are *socially impoverished* are also prone to higher rates of child physical abuse and neglect (Maguire-Jack & Font, 2017b). These socially impoverished neighborhoods can create "a set of environmental attributes that undermine family functioning and are conducive to suboptimal parenting" (Maguire-Jack & Font, 2017b). Some families who, on initial screening, appear to be neglectful may be in need of social and economic resources to enable them to better care for their children (J. S. Sittig, Uiterwaal,

Moons, Russel, Nievelstein, Nieuwenhuis, & Putte, 2016; Stilwell et al., 2022). Analyses of some

child abuse and neglect screenings have shown a higher detection rate of families needing

support (Sittig et al., 2016). This could be due in part to lower incidence rates of child abuse or

neglect (McTavish et al., 2020a; Sittig et al., 2016). Given the complexity of socioeconomic risk

factors for child abuse and neglect and the subtle nature of the potential findings, each positive

screen requires a balance between a thorough evaluation and a compassionate response.

One screening tool specifically aimed at child abuse and neglect has been tested more

than others; the Escape instrument, "a six-question checklist addressing risk factors for child

abuse" (Bailhache et al., 2013; Dinpanah & Akbarzadeh Pasha, 2017; Gilchrist et al., 2019; E. C.

F. M. Louwers et al., 2014; McTavish et al., 2020a). Some have viewed the validation processes

as incomplete because researchers have not been able to compare their results with protective

services' records due to privacy and security constraints (McTavish et al., 2020a; Stilwell et al.,

2022). Researchers have also been unable to create standardized Gold Standard outcomes for

comparable validation studies. There is only one study published on the electronic

implementation of the Escape tool (Rumball-Smith et al., 2018). Based on this author's

conversations at a national conference on electronic child abuse screening, only a few other

hospitals across the nation have begun electronic implementation. To date, no full review of

that work has been published. Studies on ideal implementation and response practices with this

electronic tool are also lacking in the literature. In order to achieve the greatest effectiveness,

implementation and response standards must be further explored.

Figure 1

The Child Safety Assessment previously in use at TCH

☐ Child Safety Assessment Complete

Child and adult/elder physical abuse injuries are injuries often inflicted by the caretaker or parent but can be inflicted by anyone that has contact with the child or adult/elder. Indicators for abuse may include, but are not limited to, the following:
a. History is incompatible with the pattern and/or degree of injury,

b. Explanation of how injury occurred is vague, or parent/guardian is reluctant to provide information,

c. Patient is brought in with minor, unrelated complaint and significant trauma is found,

d. Histories are contradictory among caregivers,

e. Mechanism of injury provided is not possible given age or developmental level of patient,

f. Bruising or other injury present in a non-mobile patient,

g. Patient's affect is inappropriate in relation to extent of injury,

h. Evidence of abusive or neglectful parent/child interaction,

i. Parent, guardian or custodian disappears after bringing patient in for trauma or patient with suspicious injury is brought in by an unrelated adult,

j. Multiple fractures of differing ages,

k. Delay in seeking care,

l. Disclosure from parent or caregiver that abuse has or may have occurred,

m. Patient makes an outcry of abuse or neglect

The current protocols at Texas Children's Hospitals' (TCH) emergency departments (The Texas Medical Center, Houston, Texas; West Campus, Houston, Texas; The Woodlands Campus, The Woodlands, Texas) could benefit from standardization of both the screening process and response to positive triggers. There is a verbose yet non-specific description of abuse that is not pediatric-focused ("child and adult/elder physical abuse…") within EPIC, the electronic health

record system in place (see Figure 1). This tool only has a positive or negative binary response, with no place for notes or specifics. A data query on this tool only shows whether it has been marked and does not indicate if the response was positive or negative. According to unstructured interviews with the staff, this step is often bypassed in practice, with some staff not even aware it was available. In instances where there was a concern for child abuse or neglect (whether the assessment tool was marked positive or not), an order for a consult with social work is entered into the system. Usually, within an hour, a social worker trained in child abuse identification arrives to interview the child and the family or caregivers who are present. They also discuss the situation with the clinicians interacting with the child and caregivers. When the social worker and clinicians agree there is a reasonable concern for abuse or neglect with the available information, a report is made to Child Protective Services (CPS). TCH prioritizes protecting children; therefore, they have sought to update their screening and response practices.

Alert Fatigue

Electronic health record usability is vital to the quality of care and patient safety (Ca & A, 2014; Howe et al., 2018a; Kaipio et al., 2020; Lau et al., 2019). Often, electronic health record vendors and developers have not recognized its value (Howe et al., 2018a). We must consider usability for the electronic health record embedded child abuse and neglect-screening tool to be most effective. "Usability refers to how useful, usable, and satisfying a system is for the intended users to accomplish [the intended] goals…" (Zhang & Walji, 2011). Included in this system (the electronic health record as emergency department clinicians interact with it) are

alerts for clinicians indicating everything from possible medication interactions, to sepsis, to

documentation reminders. These alerts and other parts of the system design can cause

cognitive overload (Genco et al., 2016). In reference to electronic health record usability,

cognitive overload has five elements; information overload, alert fatigue, visual hierarchy,

workflow, and response design (Zahabi et al., 2015a). The users most likely to interact with most

electronic health record (EHR)-based screening tools are the bedside nurses. The interface of

the initial screening tool and the process of inputting information must be perceived as useful,

usable, and satisfying to the bedside nurse. The alert of a positive screen needs to achieve the

right balance in visual hierarchy and workflow while avoiding alert fatigue and information

overload in an already busy EHR screen (Zahabi et al., 2015a).

Cognitive overload is a foundational problem with most electronic health record

usability designs, particularly in emergency departments (Zahabi et al., 2015a). One of the first

steps when designing alerts is to make them visually and verbally simple and easy to

comprehend (Powers et al., 2018; Zahabi et al., 2015a). The alert should only contain precisely

the information that is needed in the moment and offer a simple way to maneuver past it

(Ancker et al., 2017; Brady et al., 2015; Harrison et al., 2017; Powers et al., 2018; Zahabi et al.,

2015a; Zopf-Herling, 2011). In the case of an informational alert (e.g., something a child abuse

and neglect screening tool would trigger), the alert would be used to inform the nurse that they

should consult with the physician before assessing the patient to discuss concerns of possible

non-accidental trauma or neglect. This project employs a ***low-level universal screening tool***,

which commonly has only moderate specificity. The alert should reflect the need for further

investigation and be visually unobtrusive (i.e., not flashing across the entire screen) but still in

an appropriate space (Holmes et al., 2015; Zahabi et al., 2015a; McCoy et al., 2012). For

instance, a small red flag could be next to a patient's name on the front screen where patients

are listed.

Additionally, the alert should be near similar information (Zahabi et al., 2015a). Similar

could mean information needed simultaneously, the same priority level, and unique patient

information. It should be shaped and colored in a fashion that does not distract from being able

to obtain other information on the screen (Zahabi et al., 2015a). Emergency department EHRs

are not always designed ideally. The trigger for the alert should be carefully set in the best

possible order to work frequently (Fong & Ratwani, 2018; Kumar & Aldrich, 2010; Zahabi et al.,

2015a). While researchers and data collectors would always like to add more questions and data

collection points, that also adds more time for the clinician at the computer, more frustration,

and eventually less engagement leading to no or bad data collection. This kind of alert should

remain persistent in the patient chart until it is addressed. A positive response should have

documentation in the electronic health record, such as ordering a social work consult or

ordering a ***non-accidental trauma work-up***.

Objective

This project seeks to address the lack of robust universal child abuse and neglect

screening in the Texas Children's Hospitals' emergency departments by implanting a new

screening tool and response protocol. It also aims to address the gap in the literature on

electronic health record embedded child abuse and neglect screening tool technology

acceptance and usability. Thirdly, it seeks to address the gap in the literature on child abuse and

neglect screening and response protocols and to expand those protocol suggestions to

encompass support services for families affected by the *sequela* of poverty to avoid possible

future states of neglect.

S.M.A.R.T. and P.I.C.O

A SMART statement (Specific, Measurable, Achievable, Relevant, and Time-bound) and

PICO (Population, Intervention, Comparison, and Outcome-measure) were used to organize this

project and its boundaries. The SMART objective helps outline steps to achieve the project's

long-term goal (see Table 1). The PICO format helps to frame a thorough and well defines

research question in evidence-based clinical practice (see Table 2).

Table 1

S.M.A.R.T. statement

S	Specific	Stable infants under 12 months seeking care at TCH's EDs were screened for child abuse and neglect using a modified Escape screening tool in the EHR.
M	Measurable	Usability testing was conducted with the System Usability Scale prior to rollout. It was administered to clinical users testing the EPIC portion of the screening process. Workflow satisfaction was assessed by post-implementation structured interviews and evaluation of the need for system and user support. Post-implementation analysis of adoption rates was conducted. Positive screening rates were calculated.
A	Achievable	Data on response and appropriate use rates were gathered with a 50% adoption rate goal. There was time and ability to analyze these.
R	Relevant	Child abuse and neglect are tragic. Prevention and early intervention are a priority for TCH.
T	Time-bound	90-day pilot

Table 2

P.I.C.O.

P	Population	Stable infants under 12 months seeking care at any Texas Children's Hospital's emergency departments during a 90-day pilot
I	Intervention	Introduced the new screening tool for child abuse detection into EPIC; usability and technology acceptance testing on the tool and workflow
C	Comparison	Standard practice at TCH prior to introducing the new screening tool
O	Outcome measure	Primary: Usability and technology acceptance - SUS assessment (pre-deployment), use rate, qualitative interviews on workflow satisfaction (post-pilot), need for user support, and system support Secondary: Child abuse or neglect - number of positive screens

Section 2: Evidence-Based Practice Review

Child Abuse and Neglect

One way to prevent child abuse and neglect is early identification by screening an at-risk portion of the population. Up to half of all children who present at an ED with major abuse injuries were seen in a medical setting with sentinel injuries (Guenther et al., 2010; Lindberg et al., 2015a; Pierce et al., 2009; Puls et al., 2018; Ravichandiran et al., 2010; Sheets et al., 2013a). This means that children who present in an emergent care facility are an at-risk population who may benefit from screening (Guenther et al., 2010; Lindberg et al., 2015a; Pierce et al., 2009; Puls et al., 2018; Ravichandiran et al., 2010; Sheets et al., 2013a). Child abuse and neglect screening is unique in the medical setting because the clinician considers ***heuristic questions*** and answers them without directly consulting the patient. Other forms of screening are questions asked directly of the patient or laboratory and radiological findings of some kind.

Moreover, as child abuse and neglect screening is a new area of study, peer-reviewed literature on best practices in screening, provider education, implementation, and response is sparse (McTavish et al., 2020a; J. S. Sittig, Uiterwaal, Moons, Russel, Nievelstein, Nieuwenhuis, & Putte, 2016; Stilwell et al., 2022). It would be unethical to create a randomized study of abusing and not abusing children to test an identification method for abused and neglected children. The assumption in this project, supported by Institutional Review Board approval, is that no harm is done by screening for children at risk and providing supports to families. We assume that the cohort of children identified will benefit in some way, and their lives will be better. Further research is needed to support this assumption.

Very early research on child abuse screening processes and tools started in the late 1990s (McTavish et al., 2020). In 2007, Louwers and colleagues (2012) began developing the Escape screening tool in The Netherlands. Pilot studies were conducted in 2008 and 2009. The tool began as a checklist called "the Escape form." Included in the publication of their first pilot was the implementation process identifying that training and education of the ED staff are necessary for the screening process to be effective. Louwers and colleagues (2014) continued to refine and study the accuracy of the tool they developed, including the implementation process of staff education.

Other researchers picked up the tool and continued to test its validity in emergency departments worldwide (Berger & Lindberg, 2019b; Dinpanah & Akbarzadeh Pasha, 2017; Gilchrist et al., 2019). One of the lessons learned from these implementations is that the tool should be used to supplement, not supersede clinician concern (Gilchrist et al., 2019; E. C. F. M. Louwers et al., 2014). Caution should also be taken before implementation to consider whether an increased detection rate causes an increased workload for the child abuse specialists called in when there is a concern for abuse on the part of the emergency care clinician (Berger & Lindberg, 2019b; E. C. F. M. Louwers et al., 2014; Stilwell et al., 2022). Those specialists must have the capacity to respond appropriately to an increased workload. Implementation of the Escape screening tool in several hospitals revealed that emergency care clinicians tend to find the tool user-friendly and, overall, resistance to adoption is low (Rumball-Smith et al., 2018). High screening tool completion rates, with the highest completion rates among the least experienced clinicians, suggests the tool is successful at child abuse and neglect identification, user-friendly, and can be implemented successfully (Rumball-Smith et al., 2018).

There is only one study published on the electronic implementation of this tool (Rumball-Smith et al., 2018). Rumball-Smith et al. (2018) modified the paper-based screening tool to improve suitability for use in an EHR system and to accommodate ideal interpretability. Some questions were reworded so that any "yes" answer constituted a positive screening result. They also combined questions five and six because of the lack of sensitivity of question five ("Is the behavior of the child/the carers and their interaction appropriate?") found in Louwers' (2014) study. They found that the tool and provider education were relatively easily implemented across a 13-hospital system, all serving the general population, not pediatric-specific (Rumball-Smith et al., 2018). The hospitals vary in size, were both rural and urban, and some were teaching hospitals while others were not (Rumball-Smith et al., 2018). These differences did not affect adoption rates among providers.

The studies using the Escape screening tool showed high levels of accuracy in abuse identification (Berger & Lindberg, 2019b; Dinpanah & Akbarzadeh Pasha, 2017; Gilchrist et al., 2019; E. C. F. M. Louwers et al., 2012, 2014; Rumball-Smith et al., 2018). The tool also showed high levels of adoption by the staff, indicating they found it to be helpful and valuable (Berger & Lindberg, 2019b; Dinpanah & Akbarzadeh Pasha, 2017; Gilchrist et al., 2019; E. C. F. M. Louwers et al., 2012, 2014; Rumball-Smith et al., 2018). These attributes and the comparatively strong evidence in these studies versus other tools led this author to choose the modified Escape screening tool as the most appropriate tool for this project.

The research conducted by Sittig and colleagues in 2016 highlighted that using a screening tool in an emergency department to identify child abuse and neglect can also lead to successfully identifying families needing **social and economic support**. This highlights the need

for careful consideration in designing the response to a positive screen as not all children identified are in need of Child Protective Services intervention (McTavish et al., 2020a; Sittig et al., 2016). There is currently no gold standard in response protocols for supporting these families.

One of the most often cited causes of lack of child abuse recognition in a medical setting is provider ignorance or lack of provider self-efficacy in identification (Carson, 2018; Drinkwater et al., 2017; J. S. Sittig et al., 2014). Carson (2018) implemented and evaluated an education program for providers in the ED. The program showed success at increasing provider knowledge and self-efficacy in child physical abuse identification, but they did not measure the change in child neglect recognition (Carson, 2018).

Sittig and colleagues (2014) implemented and evaluated the AAP guidelines for evaluating suspected child abuse in the emergency department. They found that implementing an evaluation structure improved child abuse detection (J. S. Sittig et al., 2014; J. S. Sittig, Uiterwaal, Moons, Russel, Nievelstein, Nieuwenhuis, & Putte, 2016). Gonzalez and colleagues (2017) and Letson and colleagues (2016) all identified the need for screening tools in child abuse detection to reduce missed cases and increase detection accuracy with or without provider education.

Many articles endorsed the need for better provider education and regularly refreshing knowledge through continuing education (Berger & Lindberg, 2019c; Lindberg et al., 2015b; McGinn et al., 2021; Sheets et al., 2013b; Vaithianathan et al., 2020). However, I could not find articles discussing any specific best practices in provider education. No articles were found discussing the content of the provider education, the delivery methods (face-to-face, online, in

a child abuse clinic, etc.), or appropriate intervals for re-education. While laying a foundation in

medical school would be an excellent first step, it does not address the need to educate the

current workforce or other clinicians involved in children's medical care. Research needs to be

conducted on best practices for provider education covering child abuse and neglect

identification for the current workforce.

The reviewed evidence for screening showed reasonably high levels of specificity and

sensitivity in well-structured quasi-experimental and non-experimental studies (McTavish et al.,

2020a). In addition, an interrupted time series experimental control trial showed a fivefold

increase in abuse detection with the implementation of provider education and universal

screening (McTavish et al., 2020a). This is all backed by expert panels and committees

supporting provider education and intentional protocol for abuse identification and response.

These together show strong and consistent evidence of the need for this project.

EHR Alerts

"What is accepted in electronic health records would not be tolerated in other domains"

(Schumacher et al., 2010).

The literature reviewed below revealed that the most significant usability problem with

ED EHRs could be described with a single umbrella term, cognitive overload. Cognitive overload

is "a problem that occurs when ***perceptuo-cognitive capacity*** is exceeded by the quantity of

data presented via an interface to the extent that errors occur in user information processing"

(Zahabi et al., 2015a). When specifically working with alerts, cognitive overload can be broken

into five principles: information overload, alert fatigue, visual hierarchy, workflow, and view

personalization (Zahabi et al., 2015a).

Information overload is when there is too much information on the screen at once, too

many steps, or too complex to complete a process (Bouamrane & Mair, 2013; Harrison et al.,

2017; Schumacher et al., 2010; Zahabi et al., 2015a). For instance, imagine a spreadsheet full of

words and numbers covering your screen. That is a form of information overload. There could

be much valuable information, but it cannot easily be accessed because too much data is

displayed, the proverbial needle in a haystack. In one interview with an emergency department

physician, Bouamrane et al. reported, "…that screen's really kind of clogged up with stuff, and

you can't see easily. And it's also quite hard to read because of the way the results are

presented on the screen; it's actually quite hard too to read" (Bouamrane & Mair, 2013).

Alternately, information overload is also used to describe a situation with too many steps or

that is too complex to access the needed information. In this case, you might imagine Indiana

Jones trying to break into one of the many caves to find ancient treasure where he must only

step on specific stones, turn knobs in only one direction, and duck to miss a flying object.

Schumacher et al. describe this well, "it is hard to believe that an executive at a bank would be

satisfied with software that required tellers to use 25 clicks to locate and document a single

transaction" (Schumacher et al., 2010). These systems, both the spreadsheet and the Indiana

Jones styles, do not make ideal situations for emergency department clinicians trying to care for

patients expeditiously.

One of the most commonly mentioned issues, both with electronic health record

usability in general and in many other domains, is alert fatigue (Abramson et al., 2012; Ancker

et al., 2017; Brady et al., 2015; Genco et al., 2016; Harrison et al., 2017; Holmes et al., 2015;

McCoy et al., 2012; Paterno et al., 2009; Powers et al., 2018; D. F. Sittig & Singh, 2012; Todd et

al., 2021; Zahabi et al., 2015a). Alert fatigue is when too many alerts fire, and the user begins to

block them out, ignore them, or dismiss them without reading them. This is similar to the

experience of those who struggle to wake up in the morning. They set several consecutive

alarms in an attempt to wake up, but all it does is prime their brain to ignore the sound because

it will just come back again later. Similarly, in the emergency department, not only are clinicians

faced with many different alerts, they are also faced with numerous "false alarms" mixed in.

Alerts triggered by non-specific criteria (false positives) can cause the clinician to ignore all

alerts.

Visual hierarchy, while not often studied in electronic health records, is critical. It ranks

how and when the user finds the information on the screen (Zahabi et al., 2015a). This can be

compared to children's object search games, where specific objects are disguised into everyday

scenes. When assessing new technology design, this concept can be measured using eye-

tracking technology as a user explores the interface. Three parts affect visual hierarchy;

location, visualization, and view personalization. People tend to view screens in a similar visual

pattern. Therefore, the information placement location on the screen is essential for the timing

of identification (Meksuła et al., 2018; Romano Bergstrom et al., 2013; Țichindelean et al.,

2021). The visualization of the information is also vital. Whether a font or a symbol is used, line

boldness, colors, and size all play a role in how quickly information is detected on the screen.

For view personalization, each user has a preferred way to interact with the information they

need. Personalization of the information on the screen using both location and visualization can make or break the usability of an interface (Zahabi et al., 2015b).

One piece of usability that is rarely overlooked by process experts but can be missed by EHR usability experts is workflow. Is the system providing task-critical information in the order it is needed (Abramson et al., 2012; Fong & Ratwani, 2018; Kumar & Aldrich, 2010; Zahabi et al., 2015a)? If a clinician is alerted of a patient allergy after they input the administration of a drug, the patient's safety is already in jeopardy. If a clinician is alerted that a patient needs their seasonal flu vaccine while in critical condition, that information may be important but is not helpful at the moment. The information needs to be available and accessible in a timely manner (Abramson et al., 2012; Kumar & Aldrich, 2010).

Lastly, response design can change how clinicians interact with and view an alert. Response design is mentioned as much in the literature as alert fatigue. It is the method with which the user responds to the alert (Ancker et al., 2017; Bouamrane & Mair, 2013; Brady et al., 2015; Genco et al., 2016; Harrison et al., 2017; Hill et al., 2013; Holmes et al., 2015; McCoy et al., 2012; Paterno et al., 2009; Powers et al., 2018; Zahabi et al., 2015a; Zopf-Herling, 2011). Responses may include clicking a button, entering freeform text, or selecting from a drop-down menu. The more actions (clicks and typing) required the more time it takes. Time is a precious commodity in emergency departments; this part of the design can determine the quality of the data received.

Usability testing is becoming more prominent in many areas as technology becomes ubiquitous. However, this all-important part of the design process is still often overlooked in EHRs (Press et al., 2016; Walji et al., 2014). Much more research is needed on electronic health

record usability, particularly in the emergency department, where every second counts in saving lives. Zhang et al. set forth a unified framework for EHR usability called TURF (Zhang & Walji, 2011). While it is an excellent start, it is only that, a start. The area of study would benefit from universal usability guidelines and standards.

Usability

A vital component of patient safety and quality of care is EHR usability (Graber et al., 2019; Howe et al., 2018b; Kutney-Lee et al., 2021; Zahabi et al., 2015b). We know that the use of health information technology (health IT) can reduce the number of cases of *iatrogenesis*, and the use of a well-designed EHR and computerized physician order entry (CPOE) can reduce those errors further, as well as *e-iatrogenesis* (Bates & Gawande, 2003; Classen et al., 2020; *Computerized Provider Order Entry*, 2019; Graber et al., 2019; Middleton et al., 2013; Ratwani et al., 2018). In addition to the importance of patient safety and quality care, EHRs must be certified to meet Meaningful Use standards (*Usability and Provider Burden | HealthIT.Gov*, 2019). In order for an EHR to be certified by the Office of the National Coordinator for Health Information Technology (ONC) and Centers for Medicare and Medicaid Services (CMS), they must adopt a user-centered design (*2017 Modified Stage 2 Program Requirements for Eligible Hospitals, CAHs and Dual-Eligible Hospitals Attesting to CMS | CMS*, 2018; *Usability and Provider Burden | HealthIT.Gov*, 2019; Zhang & Walji, 2014). This design must include conducting usability testing as outlined in Meaningful Use Stage 2 (*Usability and Provider Burden | HealthIT.Gov*, 2019).

Definition

The term usability has varying definitions in different sectors. Within health IT, the definition provided by the International Organization for Standardization (ISO) and referenced by the United States government in the Health IT Playbook can be summarized as a reliable standard

The International Organization for Standardization (ISO) defines usability as: 'The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.' (*Health IT Playbook*, 2020; *ISO/TS 20282-2:2013(En), Usability of Consumer Products and Products for Public Use — Part 2: Summative Test Method*, 2019)

Zhang and Walji rephrased this definition so that it applies specifically to EHRs. Usability is "how useful, usable, and satisfying a system is" (Zhang & Walji, 2011). In this interpretation, useful is "how well the system supports the work domain where the users accomplish the goals for their work, independent of how the system is implemented," as opposed to effective, which is "the accuracy and completeness with which users achieve specified goals" (Zhang & Walji, 2011). Additionally, usable "is easy to learn, efficient to use, and error-tolerant" versus the ISO efficient, "the resources expended in relation to the accuracy and completeness with which users achieve goals" (Zhang & Walji, 2011). Satisfaction carries a similar definition for both approaches; "the subjective impression of how useful, usable, and likable the system is to a user" (Zhang & Walji, 2011).

Usability Models

The literature offers many models that represent the breakdown, structure, and study of usability. One proposed by Alonso-Ríos and colleagues is a taxonomy that breaks down usability into knowability, operability, efficiency, robustness, safety, and subjective satisfaction (Alonso-Ríos et al., 2009). They further break down each piece into dozens more details (Alonso-Ríos et al., 2009). Another framework is MOLD-US (mHealth for Older Users), which is aimed at mobile health technology for older adults (Wildenbos et al., 2018). This framework focuses on barriers specific to an aging population, such as cognition, motivation, physical abilities, and perception (Wildenbos et al., 2018). These all align in different ways with the typical definitions of usability, including errors, efficiency, learnability, memorability, and satisfaction (Wildenbos et al., 2018). The Health-ITUEM (Health Information Technology Usability Evaluation Model) evaluates mobile health technology (Brown et al., 2013). This model includes efficiency, effectiveness, satisfaction, perceived ease of use, and perceived usefulness (Brown et al., 2013). All these and others can be used to structure an understanding of the usability of information technology.

One of the most important frameworks for EHR usability is TURF (Tasks, Representations, Users, and Functions) (Zhang & Walji, 2011). TURF is an EHR usability framework designed for "(1) describing, explaining, and predicting usability differences in terms of the representation effect; (2) for defining, evaluating, and measuring usability objectively; (3) for designing built-in good usability; and (4) for developing EHR usability guidelines and standards" (Zhang & Walji, 2011). The heart of usability can be summed up as the representation effect. The representation effect is when the same process can have dramatically different outcomes based on its representation. The representation can cause or prevent errors,

reveal or hide structures or activities, and make information available or unavailable. This can be seen in the difference between a spreadsheet full of numbers and a simple graph representing their interpretation.

Under TURF, the usability of an EHR is broken into intrinsic complexity and extrinsic difficulty (see Figure 2 below). The complexity of the work domain is an indicator of intrinsic complexity, which points to the system's usefulness. It can also include the amount of work and complexity of the work being done. The extrinsic difficulty is specific to the representation or user interface for a specific task which is determined by the workflow of tasks and the formats of representations. It is a direct reflection of how usable a system is. These two things and the user's satisfaction make up the system's usability.

Figure 2

TURF Framework for EHR Usability

(Zhang & Walji, 2011)
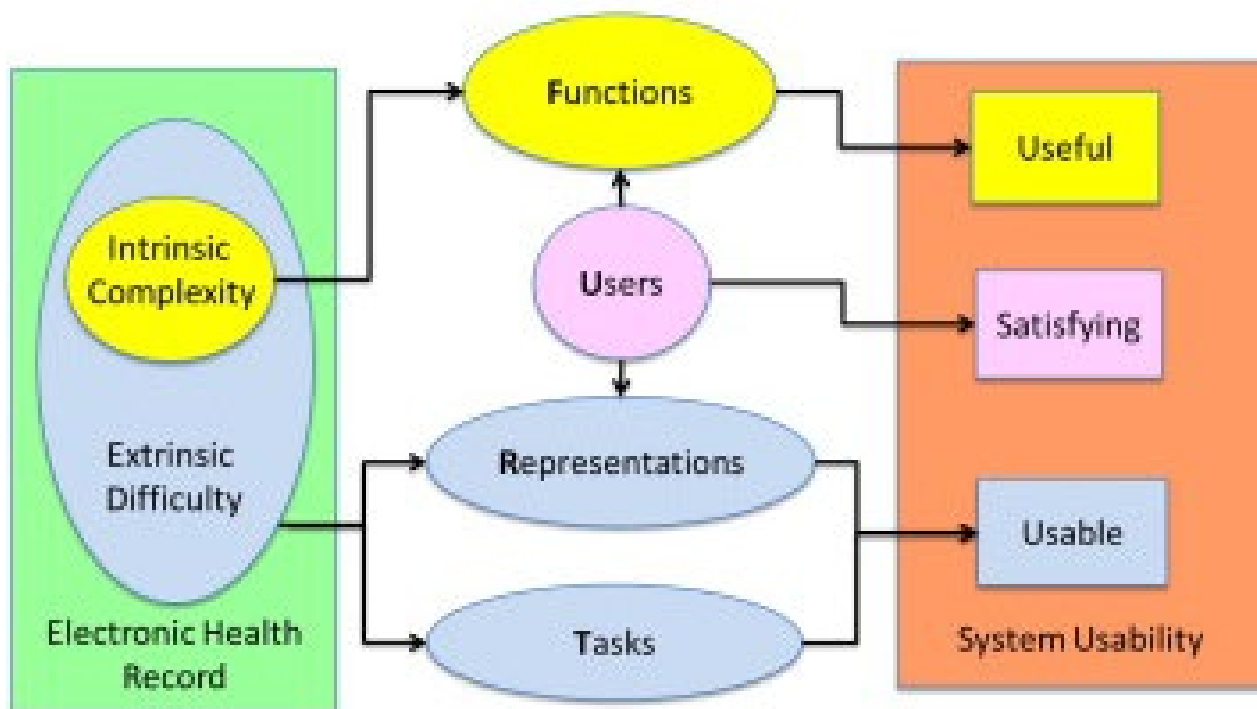
Usability Measures

There are many ways to assess usability in health IT. Some of the tools used for assessment include the CUE-tool (The Credible and Usable Evaluation of patient education tools for websites), which consists of 68 items with **Likert scale** responses aimed at determining the usability and quality of the content of patient health education websites (Klompstra et al., 2021). Richardson and colleagues conducted "think aloud" and "near live" usability testing (Richardson et al., 2017). They reported that the "near live" testing helped with usableness and usefulness. However, their "think aloud" testing reported on ease of use which falls more under

technology acceptance (Richardson et al., 2017; Zhang & Walji, 2011; Zhu & Zhang, 2021).

Another assessment tool for usability is the Visual Aesthetics of Website Inventory (VisAWI)

(Lazard & King, 2020; Moshagen & Thielsch, 2010). This assessment focuses on the visual

aesthetics of the screen, which aligns with usableness in usability.

One of the older and more established measures of assessment for usability is the

System Usability Scale (SUS) (Assistant Secretary for Public Affairs, 2013). This scale was created

in 1986 and has been used in over 1,300 articles and publications. It is easy to administer,

reliable with small sample sizes, and effectively differentiate between usable and unusable

systems. The SUS is an easy ten-question assessment with five-point Likert scale answers (see

Figure 2). To use the scores, they must be converted from a scale of 0 – 40 to a scale of 0 – 100.

Then the new total score is converted to percentiles, where a score above 68 is considered

above average (see Figure 3) (Sauro, 2011).

Figure 3

System Usability Scale

(Assistant Secretary for Public Affairs, 2013)

When a SUS is used, participants are asked to score the following 10 items with one of five responses that range from Strongly Agree to Strongly disagree:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Figure 4

System Usability Scale scoring and interpretation

(Pal & Vanijja, 2020; Sauro, 2011)

Range of SUS Score	Grading	Percentile Range
84.1–100	A+	96–100
80.8–84.0	A	90–95
78.9–80.7	A–	85–89
77.2–78.8	B+	80–84
74.1–77.1	B	70–79
72.6–74.0	B–	65–69
71.1–72.5	C+	60–64
65.0–71.0	C	41–59
62.7–64.9	C–	35–40
51.7–62.6	D	15–34
0.0–51.6	F	0–14

Technology Acceptance

Some consider technology acceptance as a precursor to usability. However, without proper design, function, and representation, a user's attitude toward the technology is a poor predictor of actual use. Usability and technology acceptance research must work hand-in-hand to achieve the most effective results.

Definition

According to Teo in *Technology Acceptance Research in Education,* "technology acceptance can be defined as a user's willingness to employ technology for the tasks it is designed to support" (Teo, 2011). Technology acceptance is often broken down into two key areas; perceived ease of use (PEoU) and perceived usefulness (PU) (Zhu & Zhang, 2021). PEoU can be thought of as how difficult it is to learn and remember a new technology and how complex or straightforward the process is (Davis, 1989; Legris et al., 2003). PU is how well the technology fits the task (Legris et al., 2003).
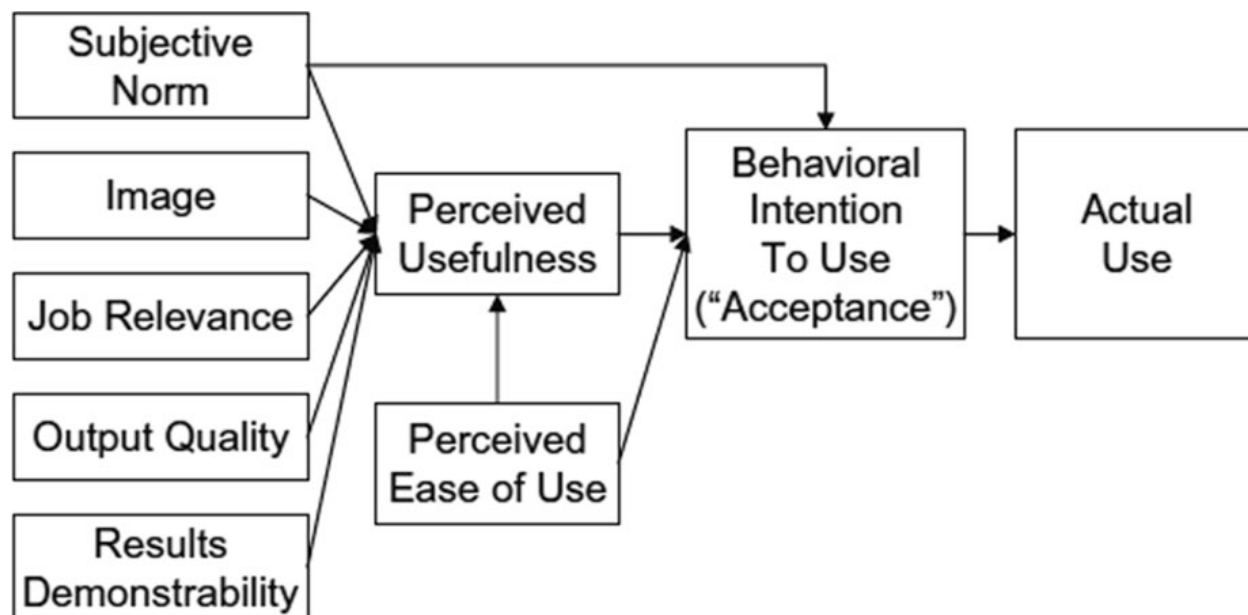
Technology Acceptance Models

Three of the most common models used in technology acceptance are the Technology Acceptance Model (TAM), Technology Acceptance Model 2 (TAM2), and the Unified Theory of Acceptance and Use of Technology (UTAUT). These all have many similarities. TAM2 grew out of the need to understand PU in TAM better and what drives it (see Figure 5) (Davis, 1989; Venkatesh & Davis, 2000; Zhu & Zhang, 2021). Additionally, UTAUT is sometimes referred to as an extended TAM.

Figure 5

Technology Acceptance Model 2

(Zhu & Zhang, 2021)

Technology Acceptance Measures

Technology acceptance can be harder to measure than usability because it tends to be more subjective and specific to the technology (C.-C. Chang et al., 2012; Pickering et al., 2020; Velsen et al., 2018). Often qualitative interviews are conducted based on questions unique to the technology being assessed (Zhu & Zhang, 2021). Others have used more structured questions with Likert scale responses (Scherer et al., 2019).

Relationship between Usability and Technology Acceptance

Usability and technology acceptance are crucial to making health IT more user-friendly, helpful, and safer. They build on one another and work at different levels to provide insight into the end user's perspective. These things are the bedrock of excellent health IT.

The usability frameworks provide a broader and more zoomed-out view. They consider the entire technology system; in TURF, it is the entire EHR system, including its use in the workflow. Usability also helps ensure that the right tool for the job has been selected (or created) and that it does not do too much or too little.

Technology acceptance frameworks provide a perspective on users' attitudes about the technology and their intended behavior. Measurement can take place before deployment to test the users' attitudes and after deployment to learn more about a piece of technology and its implementation, whether it was (or was not) accepted. Technology acceptance gives a closer look at the individuals and their feelings toward the technology they engage with.

Usability and technology acceptance are two sides of the same coin. One is not complete and cannot exist without the other. For instance, if the users' attitudes are positive (high technology acceptance) but the technology is built or implemented poorly (usability), then the users' attitudes will quickly change. In the same sense, the users could still dismiss well-built technology that functions appropriately for non-technology-related reasons (e.g., social climate). While these two frameworks provide very different views, they still rely on one another to complete the picture.

How These Apply to This Project

In my project, I implemented a screening tool and structured workflow. I conducted a sociotechnical assessment to investigate the usableness (TURF) of the system and to explore individual variation as seen in components of TAM. These pieces were measured under both frameworks, usability and technology acceptance. The interface and interactive design of the nurse's screening tool (representation) and the workflow (tasks) structure fall under usability. Specifically, these parts were assessed for usableness (the grey bubbles at the bottom of the TURF visual in Figure 2). For the alerts to be usable, they needed to be visually suitable and function properly (e.g., signaling at the correct time and dismissing when the command is given). The usableness was evaluated by having end-users test the process (both the computer interface and the workflow) in a lab environment and then complete the SUS. After completing the SUS, the nurses were asked to complete a short survey built from measures found in the literature to determine their attitudes about the technology they interacted with. This survey was a measure of PEoU under technology acceptance. I gained insight into the subjective norms, job relevance, perceived output quality, and how they felt about the implementation of the new screening tool.

Section 3: Methodology (Setting and Project Design)

Model/Framework

Using the best evidence available to guide clinical practice and changes to clinical

practice is essential. The Consolidated Framework for Implementation Research (CFIR) (see

Figure 6) is an amalgamation of evidence-based constructs from 20 different sources covering

13 scientific disciplines (Safaeinili et al., 2020). It offers a menu of 39 constructs across five

domains associated with effective implementation (illustrated in Figure 6). This creates a

practical guide for "systematically assessing potential barriers and facilitators in preparation for

implementing an innovation, to providing theory-based constructs for developing context-

specific logic models or generalizable middle-range theories." (CFIR Research Team-Center for

Clinical Management Research, 2021). Evidence-based practice in a healthcare environment is

vital to providing the best possible care for patients and achieving the best health outcomes

(Dang et al., 2018). The CFIR was the best fit to guide this project. It provided guidance

throughout the planning, researching, designing, assessing barriers, preparing, implementing,

and assessing this project. Nine constructs are most applicable to this project. Table 3 outlines

the constructs, their meanings, and their application in this project.

Figure 6

*The Consolidated Framework for Implementation Research five domain*s

(CFIR Research Team-Center for Clinical Management Research, 2021)
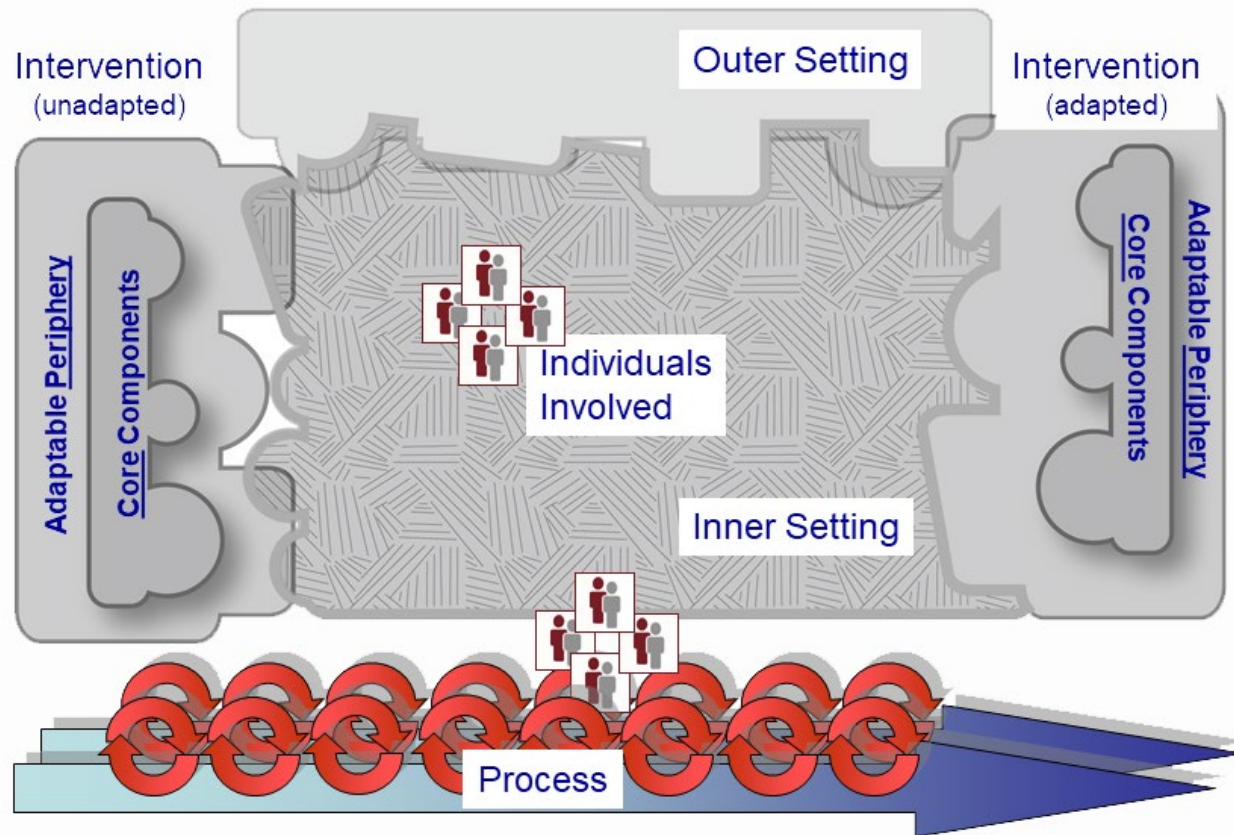
Table 3

Consolidated Framework for Implementation Research Constructs for this project

Domain	Construct	Short Description	Application to this project
II. OUTER SETTING			
A	Patient Needs and Resources	The organization accurately identifies and prioritizes the extent to which patient needs, as well as barriers and facilitators to meet those needs.	Younger children (under 12 months) are at the highest risk of abuse and neglect in part because of their inability to care for themselves and their lack of external contacts (like teachers). This population is particularly at risk, and the emergency department is one of the few points of contact they may have for intervention.
C	Peer Pressure	Mimetic or competitive pressure to implement an intervention; typically, because most or other key peer or competing organizations have already	There is no gold standard for child abuse and neglect screening and response protocols. TCH would like to be out in front with a new approach for usability and response that prioritizes internal workflow needs and supports families in new ways.

Domain	Construct	Short Description	Application to this project
		implemented or are in a bid for a competitive edge.	
D	External Policy and Incentives	This broad construct includes external strategies to spread interventions, including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting.	The hospital accrediting entity The Joint Commission requires that all hospitals screen patients for violence. The American Academy of Pediatrics also recommends that all healthcare providers screen for child abuse.
III. INNER SETTING			

Domain	Construct	Short Description	Application to this project
C	Culture	Norms, values, and basic assumptions of a given organization comprise the culture.	TCH prioritizes caring for at-risk populations. Conversely, emergency department MDs tend to focus on patients per hour and room utilization, so there could be push back on a workflow that takes up a room while the family receives support and connections to services.
E	Readiness for Implementation		
1	Leadership Engagement	The commitment, involvement, and accountability of leaders and managers with the implementation is engagement.	Leadership at many levels is involved, supportive, and committed to the project.
2	Available Resources	The resources dedicated for implementation and ongoing operations include money, training, education, physical space, and time.	There are appropriate resources committed from TCH for implementing and maintaining this project.

| Domain	Construct	Short Description	Application to this project
3	Access to Knowledge and Information	Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks.	TCH has a stellar child abuse pediatrics team experienced in teaching medical students and non-clinicians about abuse and neglect identification. They will be supporting the creation of enduring education modules.
V. PROCESS			
C	Executing	They are carrying out or accomplishing the implementation according to plan.	There is support internally at TCH and externally at UTH for this project to be implemented wholly and well.
D	Reflecting and Evaluating	This is quantitative and qualitative feedback about the progress and implementation quality, accompanied by regular personal and team debriefing about progress and experience.	Quantitative and qualitative feedback will be collected and analyzed throughout this project.

Setting

Child abuse is a tragic problem that affects people from all walks of life across the US and the world (Administration for Children and Families, 2020). To better identify children in need of help, clinicians in EDs can screen for abuse and neglect (Riney, Frey, Fain, Duma, Bennett, & Kurowski, 2018; Schouten et al., 2017; J. S. Sittig, Uiterwaal, Moons, Russel, Nievelstein, Nieuwenhuis, & Putte, 2016; Wood et al., 2010). TCH serves children in and around Houston, Texas, and focuses on helping children who have been abused and neglected and preventing future abuse and neglect. Therefore, they welcomed a screening project to improve the identification of abused and neglected children who may seek care at their EDs.

TCH is the largest children's hospital network in the nation and has three EDs in the Houston area; one in the Texas Medical Center (TMC) in the heart of Houston, one on the west side of Houston near Katy, and one on the north side of Houston in The Woodlands. These EDs accommodate over 157,000 patient visits annually, serving more than 60% of the Houston market (TCH By the Numbers report, 2020). Approximately 18% of the ED visits are infants under 12 months old (B. Patel, personal communication, August 13, 2021).

Figure 7

Map of TCH campuses around Houston
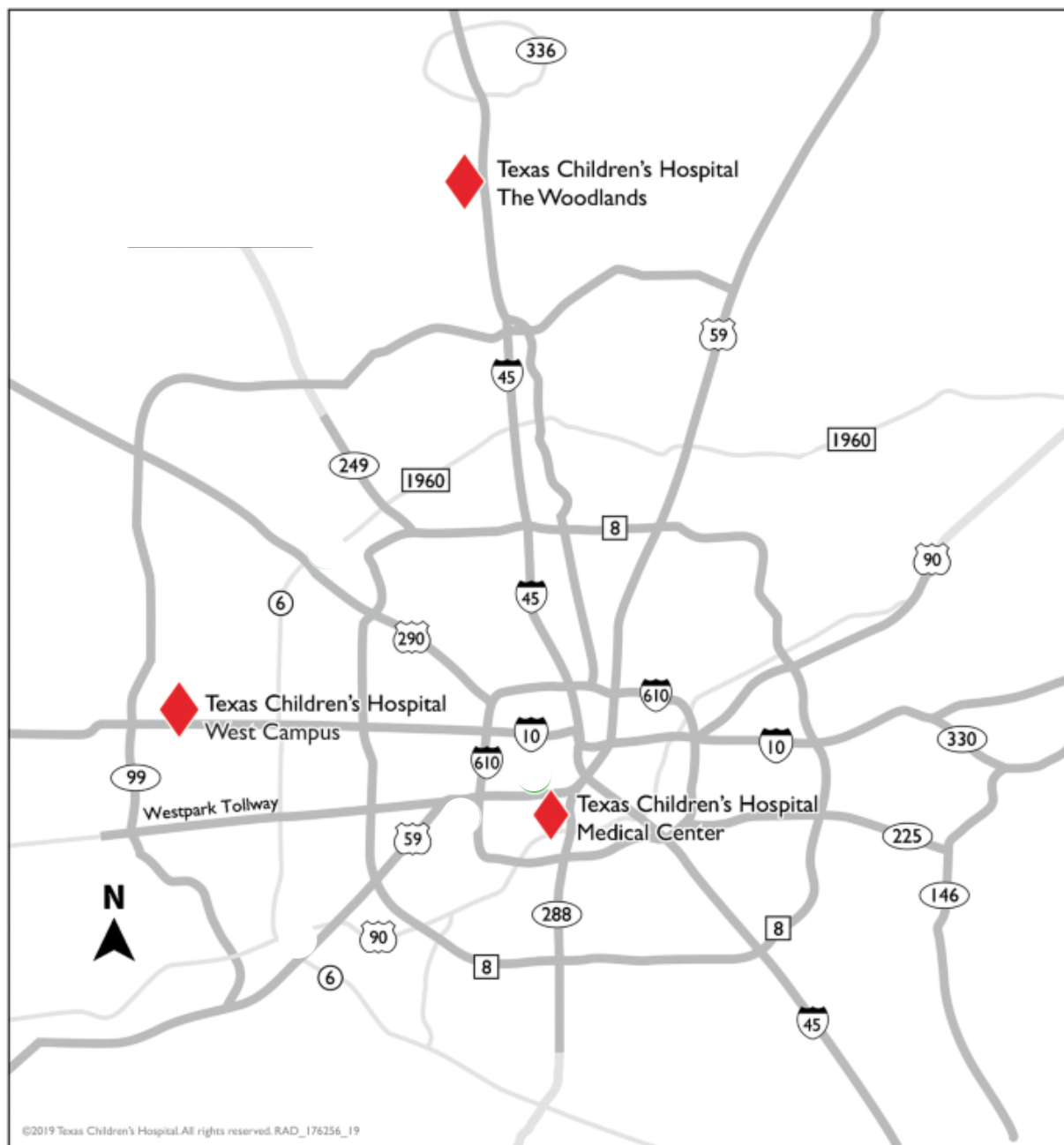
In addition to the EDs, TCH also provides many areas of specialty care, primary care and

has the only combined public health and child abuse pediatrics team in the nation. This

combination gives them the unique ability to respond to instances of child abuse and implement prevention strategies. The Division of Public Health Pediatrics focuses much of its research on social determinants of health and programs that can be instituted upstream to prevent adverse health outcomes, including the prevention of child abuse and neglect. The team includes Baylor College of Medicine academic faculty, public health researchers, community health workers, social workers, and program managers. In addition, the largest child abuse pediatrics team in the nation is comprised of six child abuse pediatricians, six supporting clinical staff such as nurses and social workers who specialize in child abuse and neglect, and eight other staff. They provide care for children who are victims of abuse and neglect and consult on the diagnosis of possible abuse in EDs. Seven social workers are also designated to respond to the ED's patients' social needs, including suspected child abuse and neglect (M. Lawson & J. Huynh, personal communication, August 13, 2021).

A current state analysis was conducted on-site at all three EDs. A convenience sample of nurses and physicians were informally interviewed about their current practices and workflow. In all three locations, the real-time process for child safety screening showed opportunities for improvement in staff education and increased buy-in. Therefore, it was determined that the previously used child abuse screening tool would be replaced with the Modified Escape screening tool. Following the current protocol, bedside nurses will continue to conduct the screening after a patient is triaged and roomed.

TCH is committed to caring for children in the greater Houston area in emergency care, urgent care, primary care, and prevention programs to improve positive health outcomes. As a part of that focus, they participated in the implementation of a new child abuse and neglect-

screening program in their EDs across Houston. Child abuse and neglect continue to harm

individual children and society as a whole, but this is one step toward improving the lives of

children in need.

Description of Project Teams

The project team consisted of several leaders and experts who advised on different

implementation parts. The team included the Chief Quality Officer over the EDs, the Division

Chief of Public Health Pediatrics, the head physicians for the EDs, the head of the ED nursing

staff, the head of Social Work, the head of nurse education in the ED, several child abuse

pediatricians, other lead staff from each of those sections, the EPIC ASAP module programming

expert, and myself. This team worked together to determine the appropriateness of the project

for the hospital, the appropriate screening tool to use, the protocol for response to a positive

screen, and the educational requirements for clinicians.

Modification of Screening Tool

Louwers et al. published a six-question paper-based child abuse screening tool called the

Escape tool (see Figure 8) (E. C. Louwers et al., 2012; E. C. F. M. Louwers et al., 2011, 2012,

2014). This was adopted and well-used in Iran and the US (Dinpanah & Akbarzadeh Pasha, 2017;

Rumball-Smith et al., 2018). When Rumball-Smith et al. began using the screening tool, they

modified it to implement it into the EHR, where each "yes" answer constituted a positive screen

for increased risk of abuse (see Figure 8) (Rumball-Smith et al., 2018). Rumball-Smith also found

question four of the Escape tool less sensitive, so they incorporated it into question five,

creating The UPMC CAS tool (University of Pittsburgh Medical Center Child Abuse Screen).

Based on expert interviews, input from TCH risk management, and project team collaboration, I

modified The UPMC CAS to better suit the needs of Texas Children's Hospital's population (see

Figure 10). Most notably, the answer choices were updated from "yes" and "no" to "yes or

possibly" and "no." Additionally, question five was significantly rephrased to "Is there any other

pertinent information regarding the well-being of the child, the child's family, and/or their

environment which might help in guiding their care? Please include any explanations for all "Yes

or Possibly" answers. Because of these changes, the screening tool has been named The BCM

Social Needs Assessment.

Figure 8

Paper-based Escape screening tool as designed by Louwers et al.

(E. C. F. M. Louwers et al., 2014)

1. Is the history consistent?	Yes	No
2. Was seeking medical help unnecessarily delayed?	Yes	No
3. Does the onset of the injury fit with the developmental level of the child?	Yes/N. A.	No
4. Is the behavior of the child, his or her carers and their interaction appropriate?	Yes	No
5. Are findings of the head-to-toe examination in accordance with the history?	Yes	No
6. Are there other signals that make you doubt the safety of the child or other family members? *If Yes describe the signals in the box 'Other comments' below.	Yes*	No
Other comments		

Figure 9

The UPMC CAS (modified from Escape) screening tool

(Rumball-Smith et al., 2018)

Figure 10

The BCM Social Needs Assessment

1. For children presenting for evaluation of a possible injury/illness, was there a delay in seeking medical attention given the severity of the injury/illness?

   ☐ Yes or Possibly   ☐ No

2. Are you concerned that the reported history for this visit may not be consistent with this injury or illness?

   ☐ Yes or Possibly   ☐ No

3. Are any of the following findings present on physical examination?

   ☐ Yes or Possibly   ☐ No

   a. In a child under 4 months – ANY bruise, burn, subconjunctival hemorrhage, or frenulum injury
   b. Older than 4 months
      i. Bruises, burns, or other markings in the shape of an object
      ii. Bruises on non-bony prominences/protected regions (e.g., torso, genitalia/buttocks, upper arms, ear, neck)
      iii. More bruises than you would expect to see even in an active child

Undress all infants under 12 months

4. Are there findings that might reflect poor supervision, care, nourishment, or hygiene?

   ☐ Yes or Possibly   ☐ No

5. Is there any other pertinent information regarding the well-being of the child, the child's family, and/or their environment which might help in guiding their care? Please include any explanations for "Yes or Possibly" answers.

   ☐ Yes   ☐ No

Free Text Area

Implementation Protocols

Child abuse screening is a relatively new area of study, and the evidence base for implementation practices is lacking. In the absence of scientific literature for evidence, this researcher consulted expert opinion and conducted medical record reviews to provide evidence for practice change. National conferences on child abuse screening in hospitals were attended, where panels of experts worked to create best practice recommendations. Additionally, medical records from TCH were pulled to assess current documentation practices. These steps offered a foundation of evidence to build the implementation protocol.

Ethical Approvals

TCH determined that this pilot project did not include protected health information. It received institutional review board exemption from Baylor College of Medicine (BCM) and the University of Texas Health Science Center at Houston. TCH and BCM's legal departments cleared the project from a risk management perspective.

Technical and Workflow Implementation

The Modified Escape screening tool (Figure 8) was placed on the nurses' charting view of EPIC and was only triggered to be visible for patients under 12 months. The bedside nurse assessed the patient once they were triaged, determined to be stable, determined to be treated for reasons other than suspicion of abuse, and were roomed. After the nurse assessed the patient, the tool notification would turn red in the charting area to remind the nurse that the

screening tool results had not been recorded. The record of this tool, no matter the status

(positive or negative), has privacy settings so that it is not visible to patients or caregivers

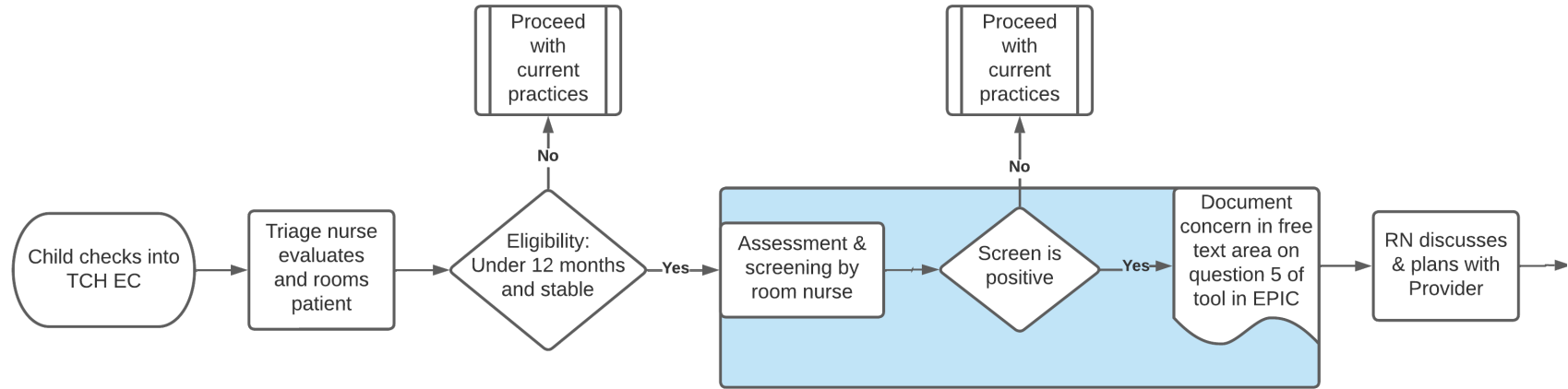accessing the child's medical records (except when appropriately ordered by a court).

If the nurse marked the screening tool as positive for suspicion of abuse or neglect, the

nurse sought out the physician to discuss their findings orally. Based on research and initial user

feedback, there was not a physician-facing alert in EPIC.

Once the nurse and physician assessed the patient, they determined the next steps. If

they concluded that the child was safe (no suspicion of abuse or neglect) and the family did not

need additional social support, then standard treatment protocol was followed. If they

concluded the child and family needed further assessment and support, they placed an order

for a social work consult, and the nurse marked this action in the EHR. The social worker

assessed the child and the caregivers present. In conjunction with the physician and the nurse,

they determined the needs of the child and family to the best of their ability. If they suspected

child abuse or neglect, they followed the standard protocol of ordering a child injury panel (also

referred to as a Non-Accidental Trauma workup), reporting to CPS, and if the child was in

imminent danger, they would also contact law enforcement. If they determined there was no

suspicion of abuse or neglect but that the family would be better able to care for their child

with more social support, then the social worker provided counseling and connected them with

resources that may help (e.g., Women, Infants, and Children, Temporary Assistance for Needy

Families, transportation support, food insecurity supports, housing insecurity supports, etc.). As

a standard protocol, the social worker then recorded the disposition and details in an internal
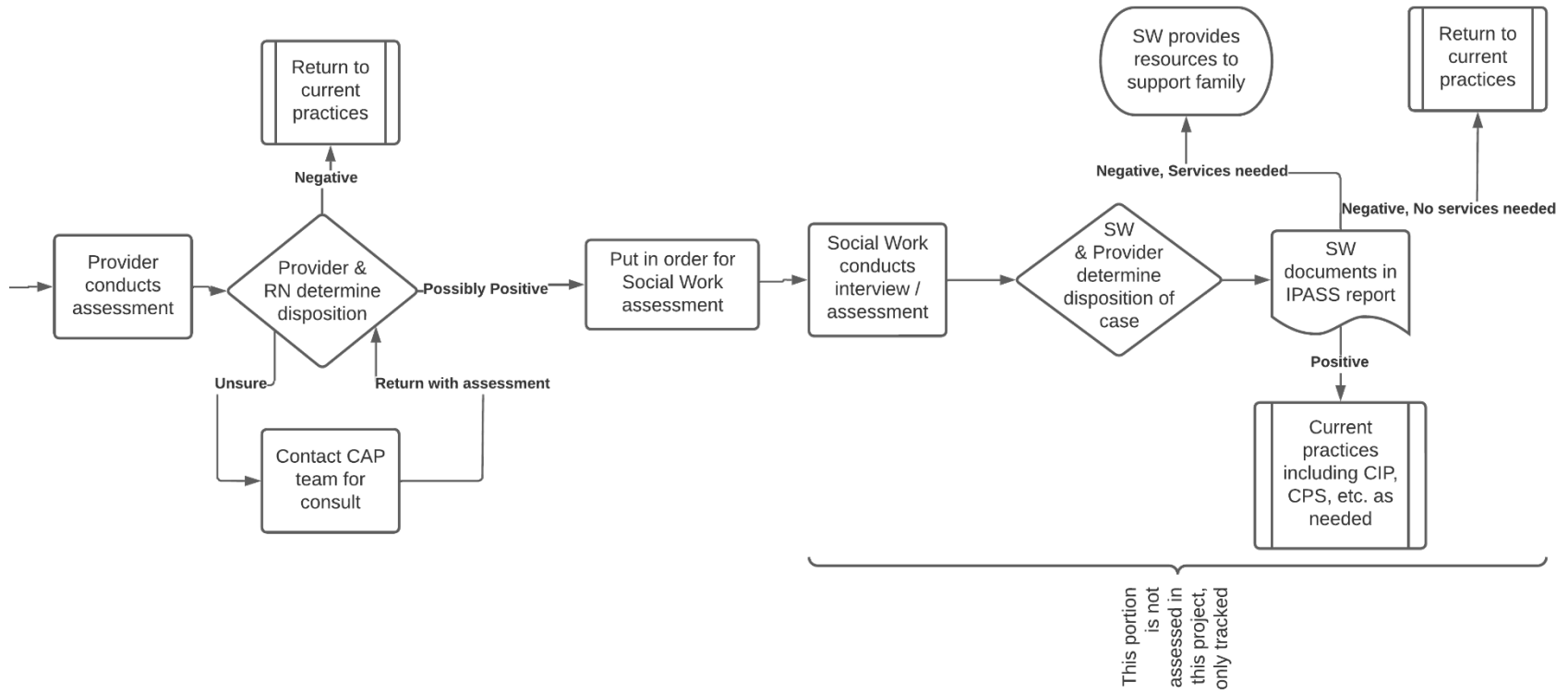
report.

Figure 11

Workflow

Provider conducts assessment

Provider & RN determine disposition

Negative → Return to current practices

Unsure → Contact CAP team for consult → **Return with assessment**

Possibly Positive → Put in order for Social Work assessment → Social Work conducts interview / assessment → SW & Provider determine disposition of case

Negative, Services needed → SW provides resources to support family

Negative, No services needed → Return to current practices

SW documents in IPASS report

Positive → Current practices including CIP, CPS, etc. as needed

This portion is not assessed in this project, only tracked

Education Protocol

Educators from the Child Abuse Pediatrics team created two enduring education modules (one geared toward physicians and one toward nurses) on identifying child abuse in a clinical setting. Once these were created, they were distributed to the clinicians via email.

Evaluation of Usability and Technology Acceptance

The EPIC ASAP module expert at TCH built the screening tool into EPIC. It was tested in the integrated testing environment to ensure that none of the changes made caused glitches or unintended changes in other linked modules in EPIC. The tool was placed into a sandbox environment for user testing. Twelve ED nurses, four from each ED (convenience sample), were brought in for a demonstration and hands-on testing of the tool. A System Usability Scale (SUS) assessment was administered to each nurse. Following the SUS, structured interviews were conducted using an interview guide built from the modified questions in The Consolidated Framework for Implementation Research to determine expected satisfaction and gather suggestions for design improvement (CFIR Research Team-Center for Clinical Management Research, 2021). The nurses' feedback was assessed and incorporated into the screening tool and implementation.

Following the pilot, structured interviews were conducted with nurses and physicians to determine their satisfaction with the screening tool, the workflow, and the response protocols. Technology acceptance was assessed by pulling data from the EPIC EHR system on nurse response rates (did they complete the screening tool each time and how it was completed), the

amount of user support needed to go live, and the amount of system support needed after launch.

Pilot

The screening tool and alerts went live in EPIC at midnight on Monday, April 18th, 2022. System support from IS was available by phone. There was also a person well-versed in the system available to the EDs throughout the pilot for user support. After 90 days, the data was pulled for analysis.

Limitations of Protocol

The limitations of this project protocol include the technical functionalities of EPIC. On the nurses' view of EPIC, the "row info" box must be selected for the details of the screening tool to be visible, though it only has to be selected once and is persistent after. Additionally, due to the fast-paced nature of EDs, the time allotted for surveys was limited.

Section 4: Results

Pre-implementation

Before implementing the new screening tool, four nurses were recruited from each of the three ED campus locations. The twelve nurses were given a brief introduction to the project and the purpose of the screening tool. Then they tested the screening tool in an EPIC sandbox environment. After testing the screening tool, they completed the System Usability Scale (SUS) and a qualitative assessment based on validated CFIR questions (Brooke, 1996; Means et al., 2020). The SUS gave an average score in the 91st percentile (see Table 4). There was some variability among the campuses, but the scores were very close (see Figure 12). This score was consistent with end-user experiences. Because the SUS is a validated tool, none of the questions were adjusted, but the users were instructed that the term "the system" referred to the screening tool they had just tested out (see Table 4). The questions with the poorest scores were two and eight, indicating the system was unnecessarily complex and cumbersome. Three people marked that the system was complex, and two marked it cumbersome. Based on the qualitative assessments, these users would prefer shorter and fewer questions. The best scoring questions were four, nine, and ten, where users said they felt confident using the tool and did not think they would need technical support or much education to learn the tool.

After completing the System Usability Scale, the nurses were asked to complete a qualitative assessment. Some of the notably positive feedback included "it makes you more aware and gets you to stop and think about these things" and "it's quick and comprehensive" (see Figure 13). They also noted that the answer choice of "yes or possibly" made it easier to

use because they felt freer to mark that answer in situations where more investigation was

needed (see Table 5 for all responses). Two users were more hesitant about the screening tool,

noting that the questions were wordy and that the screening tool may add time to their

charting process. The nurses also offered feedback that led to changes in our implementation.

They pointed out that some of the details of the questions were not visible if the box called

"row info" was not marked. This only has to be marked once, and the system remembers the

user's preference. This step was added to the training document. Additionally, they requested

that we add a follow-up section with space for them to mark once they have consulted with the

provider and when a social work consult is ordered.

Table 4

System Usability Scale assessment prior to implementation

|	Questions	Adjusted total
1	I think that I would like to use this system frequently.	45
2	I found the system unnecessarily complex.	36
3	I thought the system was easy to use.	43
4	I think that I would need the support of a technical person to be able to use this system.	47
5	I found the various functions in this system were well integrated.	46
6	I thought there was too much inconsistency in the system.	46
7	I would imagine that most people would learn to use the system very quickly.	45
8	I found the system very cumbersome to use.	39
9	I felt very confident using the system.	47
10	I needed to learn a lot of things before I could get going with this system.	47
Average		36.75
Percentile		91.875

Figure 12

SUS score percentile by campus
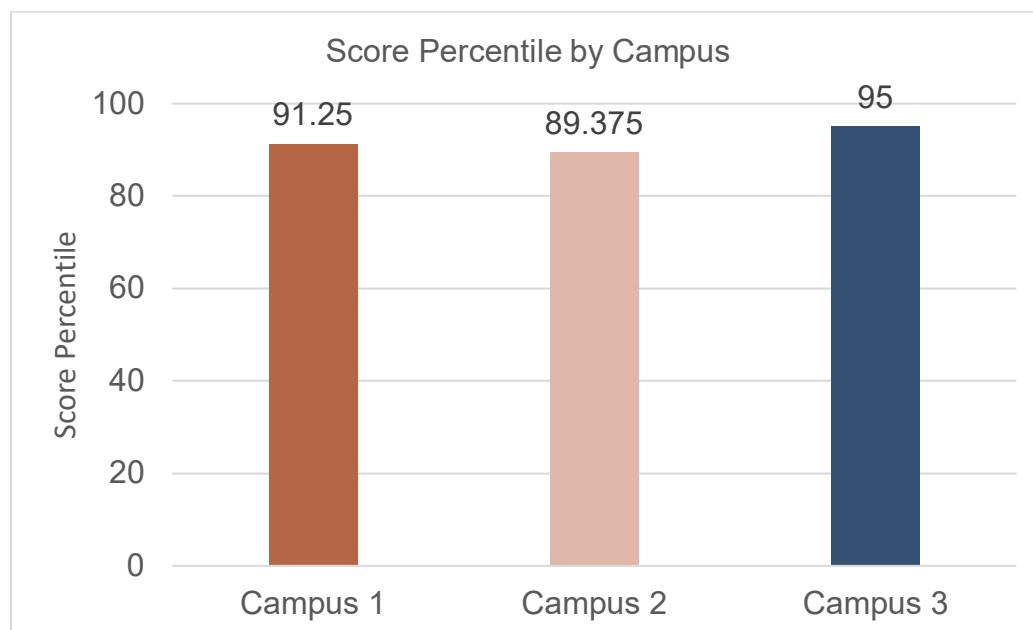
Figure 13

Pre-implementation feedback
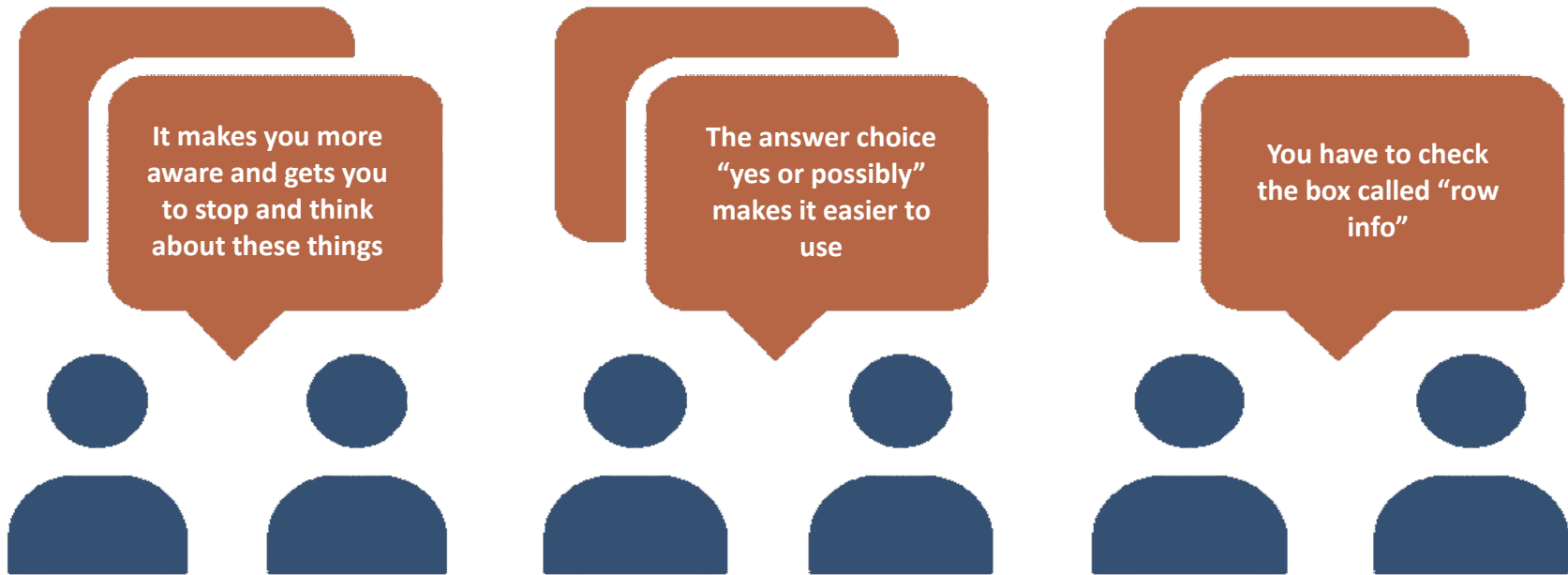
Table 5

Qualitative assessment prior to implementation

	User A	User B	User C	User D	User E	User F
Slow down workflow	No, it's quick and user friendly	No	No	No	Makes you more aware and gets you to think about things	No
Impede efficient assessment	No	No	No	No	No, it's already a thought process, and now we can relay this	No
Questions clear	Yes	Yes	Yes	Yes	Quite comprehensive for children	Yes
Suggestions on possible missing questions	Perfect number of questions	No	None	No	an appropriate amount of data	No
Phrasing effective	No	N/A	Free text for every question	No	It works well	No
Other	"Possibly" was a great idea			Add Doc Notified		

	User G	User H	User I	User J	User K	User L
Slow down workflow	No, this should help with assessment and thorough evaluation	No	No	No	It's pretty wordy and it may take a while to learn to incorporate it into the workflow	Yes, it will slow down workflow, but it's useful and needed
Impede efficient assessment	No, this tool should help	No	No	No	No	No
Questions clear	Yes, they are clear and fit well with what we are doing for patients	Yes	Yes	Yes	Yes	Yes, it will slow down workflow, but it's useful and needed
Suggestions on possible missing questions	None	No	Just enough	Will this be put in a sensitive note?	It is all pertinent information, but it is pretty long	Good questions - Maybe combine 1 and 4
Phrasing effective	None	Yes, "row info" must be checked in the system		No	No	Add comment boxes to each question
Other						

Implementation

The screening tool went live on all three campuses on April 18th, 2022, and ran for 90 days until July 17th, 2022. The technical portion of the implementation went smoothly. There were no calls for technical support or at-the-elbow support. As determined by TCH leadership, the previously used tool was left active during the pilot.

Post-implementation

Usage rates

Over the 90-day pilot, from mid-April to mid-July, care was provided to infants via nearly 6,000 visits to the ED. In those visits, the new screening tool was completed approximately 3,000 times (see Table 6). The percentage of patients screened with the new screening tool, the dashed line in Figure 15, increased over time from 46% in April to 53% in July across all campuses. Use of the prior screening tool, the solid lines on Figure 15, pre-COVID in 2018 and 2019, and 2022 varied slightly but stayed in the mid to low 60% range for completion.

Data were unavailable to determine if and who completed both screening tools during the pilot. The previously used screening tool only records whether the tool was responded to and not whether the response was positive or negative. Of the approximately 3,000 completed screening tools on all campuses, 2,900 were eligible (meaning that the patient was stable, the chief complaint was not sexual assault, and they were not a high trauma level patient). Sixty-seven of those were marked positive (see Table 7). The average positivity rate for all campuses was 2.31% (see Table 6). The average positivity rate for all campuses decreased over time (see Figure 16).

Table 7 provides a breakdown of which questions were marked positive, and Table 8 breaks down which questions were marked positive in concordance with the other questions. Tables 6 and 7 also show which tools had follow-up questions marked in the chart, including "EC Provider Notified" and "Order for Social Work Placed."

There was significant variation between campuses on when and how the tool was completed. Campuses 1 and 2 had consistent completion rates of both the prior and new tools across the years at 72% to 82% (see figures 17 and 19 and tables 9 and 10). The third campus completed the prior tool 44% to 53% of the time in 2018 and 2019 and 38% to 41% in 2022 (see Figure 21 and Table 11). They completed the new tool an average of 15% of the time.

There were also drastic differences among campuses in their positivity rates and trends over time. Campus 1 had the most consistent positivity rates, varying only from 1.56% to 2.37% while completing 1,357 screens (see Figure 18). Campus 2 had a significant decrease over time. They completed 1,282 screens, and their positivity rates ranged from 4.88% to 0.35% (see Figure 20). Campus 3 also saw variation, though their average positivity rate was higher overall. They completed 369 screens, and their positivity rate ranged from 4.27% to 7.32% (see Figure 22). Campus 3's positivity rate was 3 to 21 times higher than the other two campuses.

Complaints and Diagnoses

The most common complaint or diagnosis in the 67 positive cases was a head injury in 46.3% (see Table 9). Head injuries occurred four times more frequently than the subsequent complaint or diagnosis. In my analysis, I grouped all head injury diagnoses within each case. For instance, fracture of the parietal bone, subdural hematoma, and epidural hemorrhage were all

grouped under head injury; if more than one appeared in a single case, it was only counted

once. The second most common complaint or diagnosis was a fever at 11.9%. There were 20

different complaint and diagnosis categories in the 67 positive cases. It is important to

remember that this tool is used to assess risk. A positive screening result did not necessarily

lead to the escalation of intervention.

Qualitative Assessment

At the end of the pilot, twelve more nurses were recruited to complete a survey on their

use of the new screening tool (see Table 12). At Campus 3, the nurses expressed little familiarity

with the screening tool. Their responses were consistent: they expressed that it did not impede

their workflow. The nurses at the other two campuses were more familiar with the education

module on abuse detection and the screening tool. They had a generally positive attitude

toward the new screening tool and found it helpful, and it did not negatively impact their

workflow (see Figure 23). Some notable comments include, "it doesn't take much time and is

essential for a good assessment" and "the tool is effective at alerting the nurses to pay more

attention to potential risks." Three nurses expressed an interest in further education and more

support from management in engaging the staff in this area.

Table 6

Usage rates, positivity rates, and completion of all campuses combined

All Campuses		April	May	June	July	Total
Infants Checked In		668	1890	2098	1298	5954
Completed New Screening Tool		310	912	1101	685	3008
Percentage Completed New Screening Tool		46.41%	48.25%	52.48%	52.77%	50.52%
	Not Eligible	18	52	24	14	108
	Eligible	292	860	1077	671	2900
	Positive	11	25	21	10	67
	Percentage Positive	3.77%	2.91%	1.95%	1.49%	2.31%
	"Provider Notified" marked	6	16	17	5	44
	"SW Order Placed" marked	3	6	9	5	23
	Nothing Marked	5	7	8	3	23

2018	April	May	June	July
Percentage Completed Prior Screening Tool - 2018	63.51%	64.13%	61.80%	62.29%

2019	April	May	June	July
Percentage Completed Prior Screening Tool - 2019	64.77%	60.45%	64.87%	66.03%

2022	January	February	March
Percentage Completed Prior Screening Tool - 2022	63.51%	64.13%	61.80%

Table 7

Questions marked positive on screening tool question

	Questions (abbreviated)	Positive Questions N=67	Percentage
Q1	Was there a delay in seeking medical care?	26	38.8%
Q2	Is the history consistent with the injury?	25	37.3%
Q3	Are there concerning bruises or injuries?	25	37.3%
Q4	Are there possible signs of neglect?	35	52.2%
Q5	Is there anything else? Explain all other yes answers. (free text box)	38	56.7%
Total Positives		67	100%
Questions with the Follow-Up Section Completed		41	61.2%
Total Tools Completed		3008	

Note: Total number of positives is not equal to the sum of questions marked positive because

one screening tool could have multiple questions marked positive in any variation.

Table 8

Questions combinations marked positive on the screening tool

Positives	Q1	Q2	Q3	Q4	Q5
Q1	3	3	0	2	0
Q2		4	1	1	2
Q3			4	6	1
Q4				8	5
Q5					10
Q1 and 2			3	4	0
Q1 and 3				2	0
Q2 and 4					1
Q1 and 2 and 3				1	0
Q1 and 2 and 3 and 4					6

Note: There were no results with question combinations of 1 and 4 and 5; 2 and 3 and 4; 2 and 3 and 5; 3 and 4 and 5; and 2 and 3 and 4 and 5

Table 9

Types of complaints and diagnoses in positive cases

Number of Cases	Complaint or Diagnosis	Percent of Positive Cases
31	Head	46.27%
8	Fever	11.94%
7	Extremity Fracture	10.45%
7	Vomiting	10.45%
6	Bruising	8.96%
6	Respiratory Issues	8.96%
4	Rib Fracture	5.97%
3	Drug Exposure	4.48%
2	Burns	2.99%
2	Diarrhea	2.99%
2	Ear Infection	2.99%
2	Failure to Thrive	2.99%
2	Neglect	2.99%
2	Urinary Tract Infection	2.99%
1	Choking	1.49%
1	Eye Hemorrhage	1.49%
1	Heat Exhaustion	1.49%
1	Herpes Simplex Virus Infection	1.49%
1	Rash	1.49%
1	Swallowed Foreign Body	1.49%

Note: The total number in this table is greater than the total number of positive cases because some cases had multiple complaints and diagnoses.

Figure 14

Average positivity rates of the new tool across all campuses during the pilot

Average Positivity Rates Across All Campuses

Figure 15

Use rates of all campuses
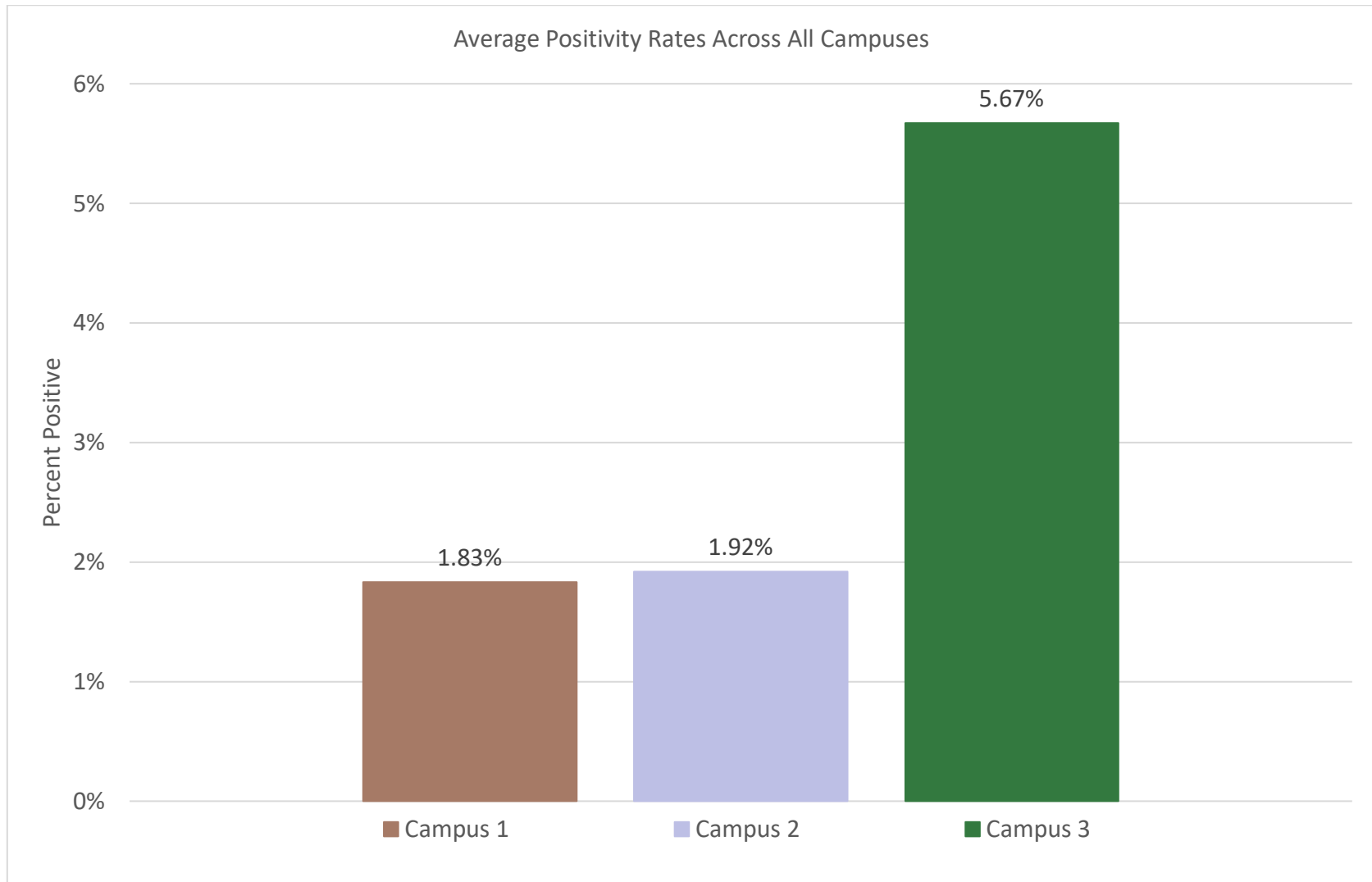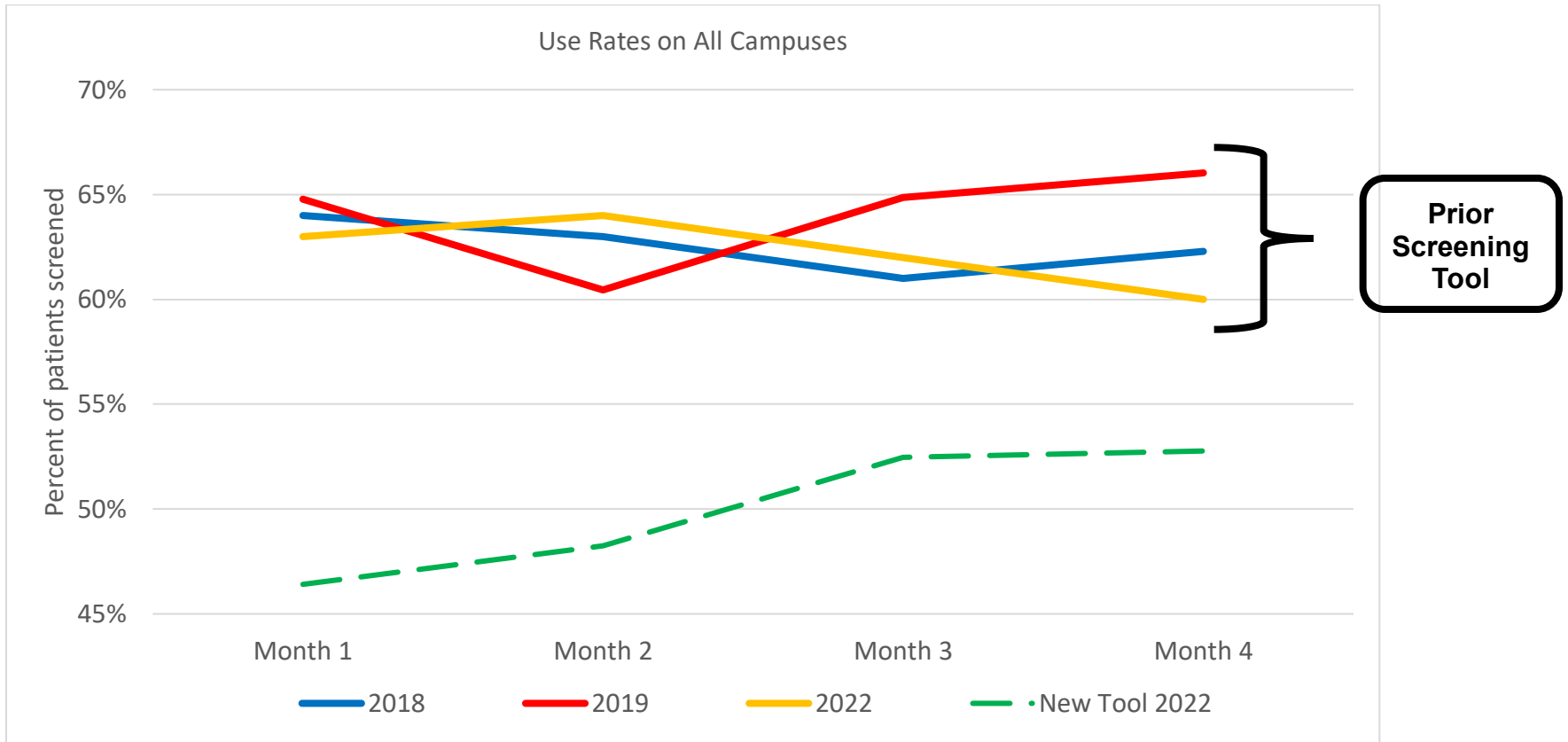

Use Rates on All Campuses

Figure 16

Positivity rates of the new tool on all campuses

Positivity Rates of the New Tool Over Time on All Campuses
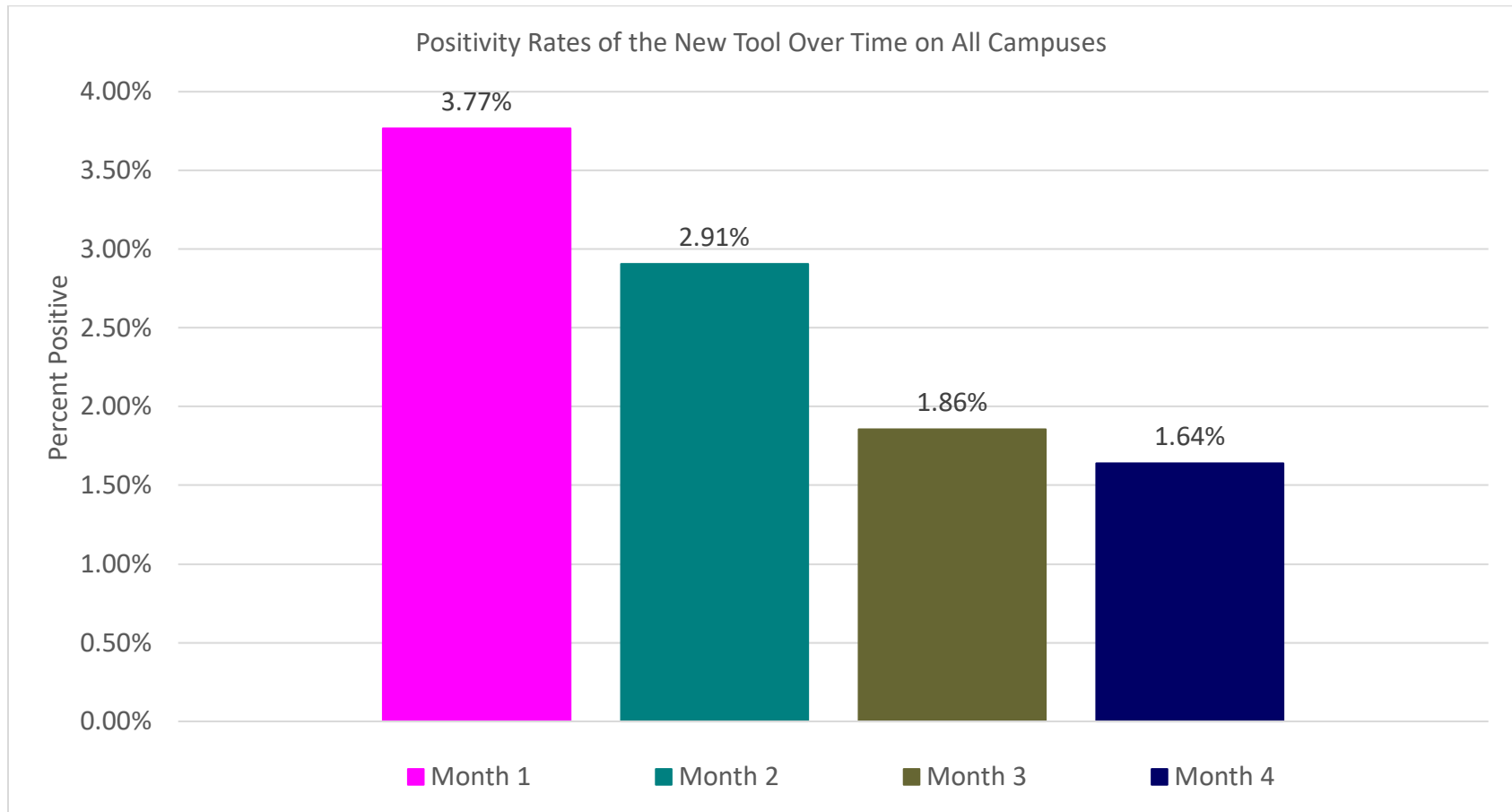
Figure 17

Use rates on campus 1

Use Rates on Campus 1
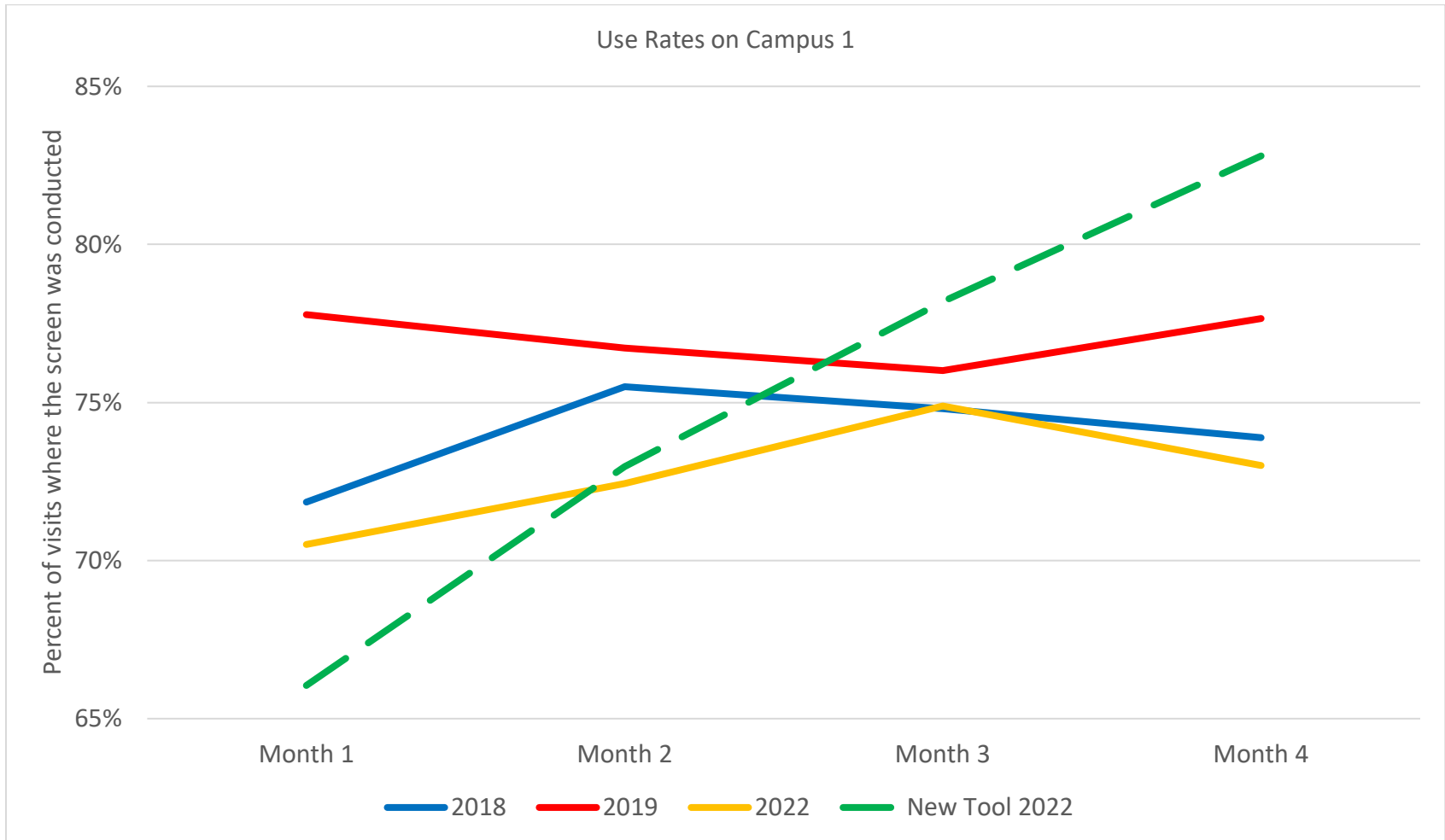
Figure 18

Positivity rates on campus 1
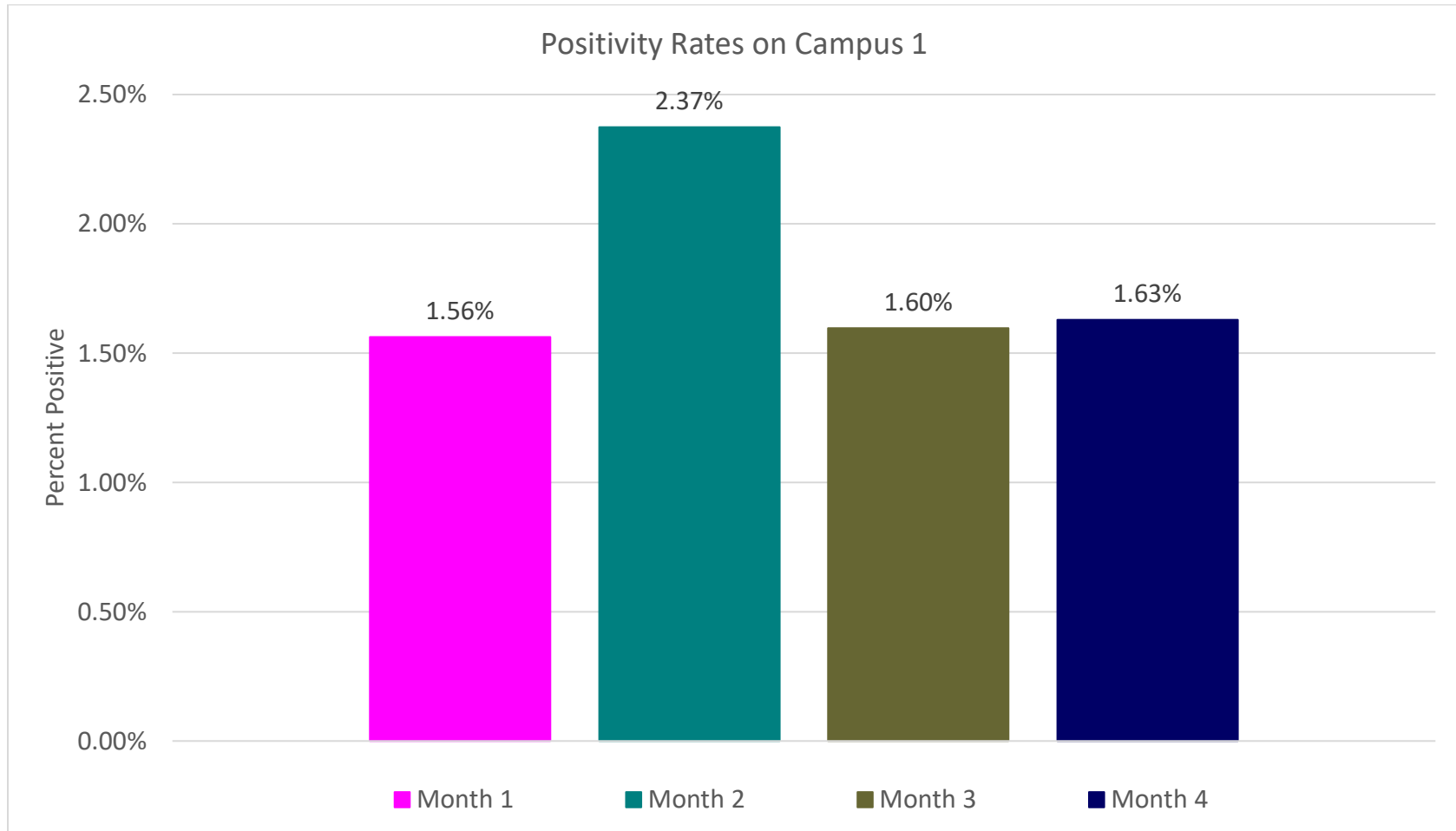
Table 10

Usage rates, positivity rates, and completion of Campus 1

Campus 1	April	May	June	July	Total
Infants Checked In	215	555	642	372	1784
Completed New Screening Tool	142	405	502	308	1357
Percentage Completed New Screening Tool	66.05%	72.97%	78.19%	82.80%	76.07%
Marked Not Eligible	14	26	1	1	42
Marked Eligible	128	379	501	307	1315
Marked Positive	2	9	9	5	25
Percentage Positive	1.56%	2.37%	1.80%	1.63%	1.90%
"Provider Notified" marked	2	8	6	2	18
"SW Order Placed" marked	1	3	4	2	10
Nothing Marked	0	1	3	2	6

2018	April	May	June	July
Percentage Completed Prior Screening Tool - 2018	71.85%	75.50%	74.80%	73.89%

2019	April	May	June	July
Percentage Completed Prior Screening Tool - 2019	77.78%	76.72%	76.01%	77.65%

| 2022	January	February	March
Percentage Completed Prior Screening Tool - 2022	70.51%	72.43%	74.89%

Figure 19

Use rates on campus 2

Figure 20

Positivity rates on campus 2

Table 11

Usage rates, positivity rates, and completion of Campus 2

Campus 2	April	May	June	July	Total
Infants Checked In	197	546	644	390	1777
Completed New Screening Tool	126	396	471	289	1282
Percentage Completed New Screening Tool	63.96%	72.53%	73.14%	74.10%	72.14%
Not Eligible	3	10	12	7	32
Eligible	123	386	459	282	1250
Positive	5	10	7	1	23
Percentage Positive	4.07%	2.59%	1.53%	0.35%	1.84%
"Provider Notified" marked	1	3	1	0	5
"SW Order Placed" marked	1	1	1	1	4
Nothing Marked	4	7	6	0	17

2018	April	May	June	July
Percentage Completed Prior Screening Tool - 2018	69.57%	71.24%	70.95%	74.54%

2019	April	May	June	July
Percentage Completed Prior Screening Tool - 2019	73.97%	72.69%	79.89%	78.56%

2022	January	February	March
Percentage Completed Prior Screening Tool - 2022	82.35%	85.09%	78.56%

Figure 21

Use rates on campus 3
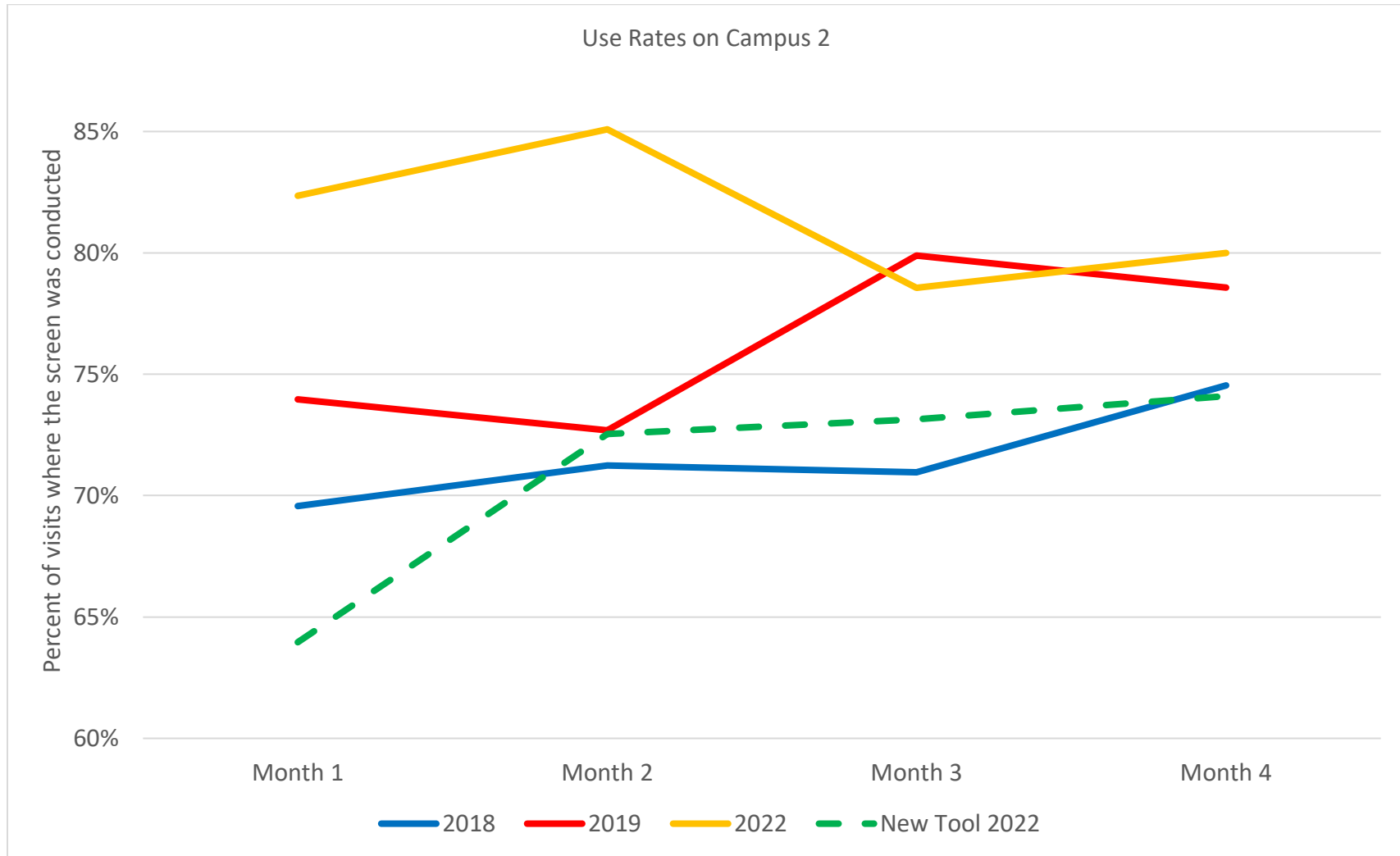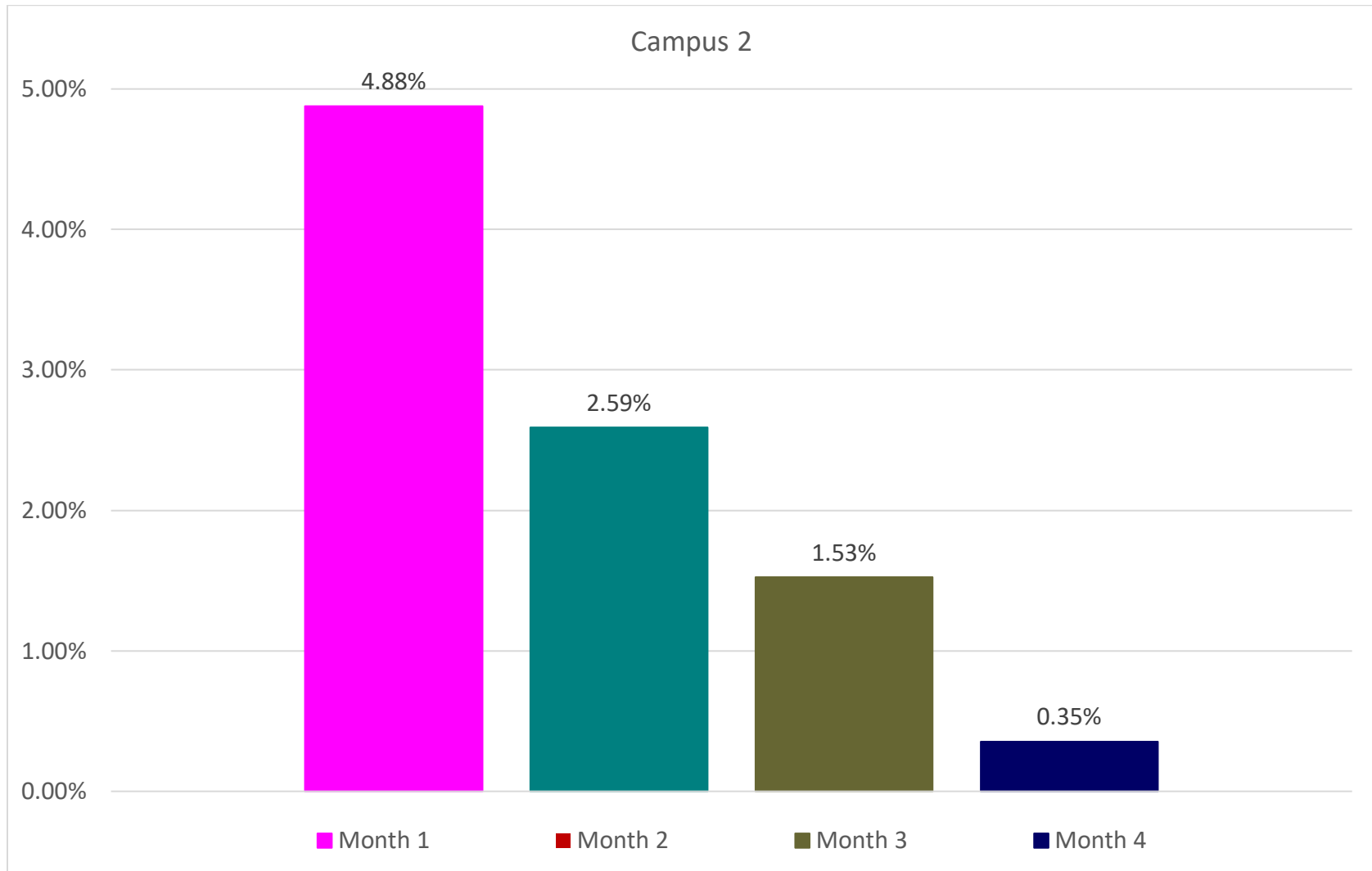

Campus 3

Figure 22

Positivity rates on campus 3
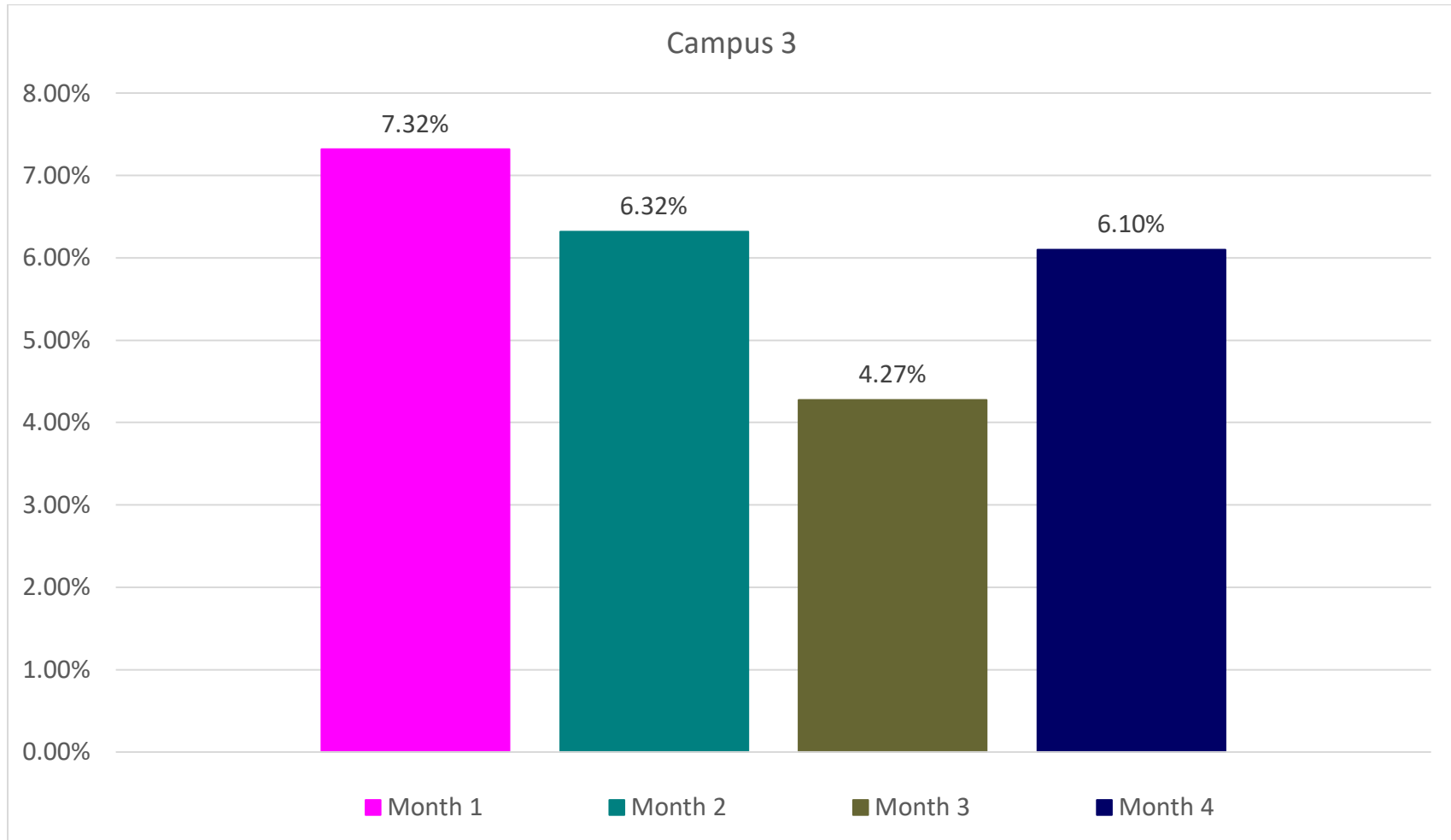
Table 12

Usage rates, positivity rates, and completion of Campus 3

Campus 3	April	May	June	July	Total
Infants Checked In	256	788	807	536	2387
Completed New Screening Tool	42	111	128	88	369
Percentage Completed New Screening Tool	16.41%	14.09%	15.86%	16.42%	15.46%
Not Eligible	1	16	11	6	34
Eligible	41	95	117	82	335
Positive	3	6	5	4	18
Percentage Positive	7.32%	6.32%	4.27%	4.88%	5.37%
"Provider Notified" marked	3	6	3	3	15
"SW Order Placed" marked	2	2	4	2	10
Nothing Marked	0	0	1	1	2

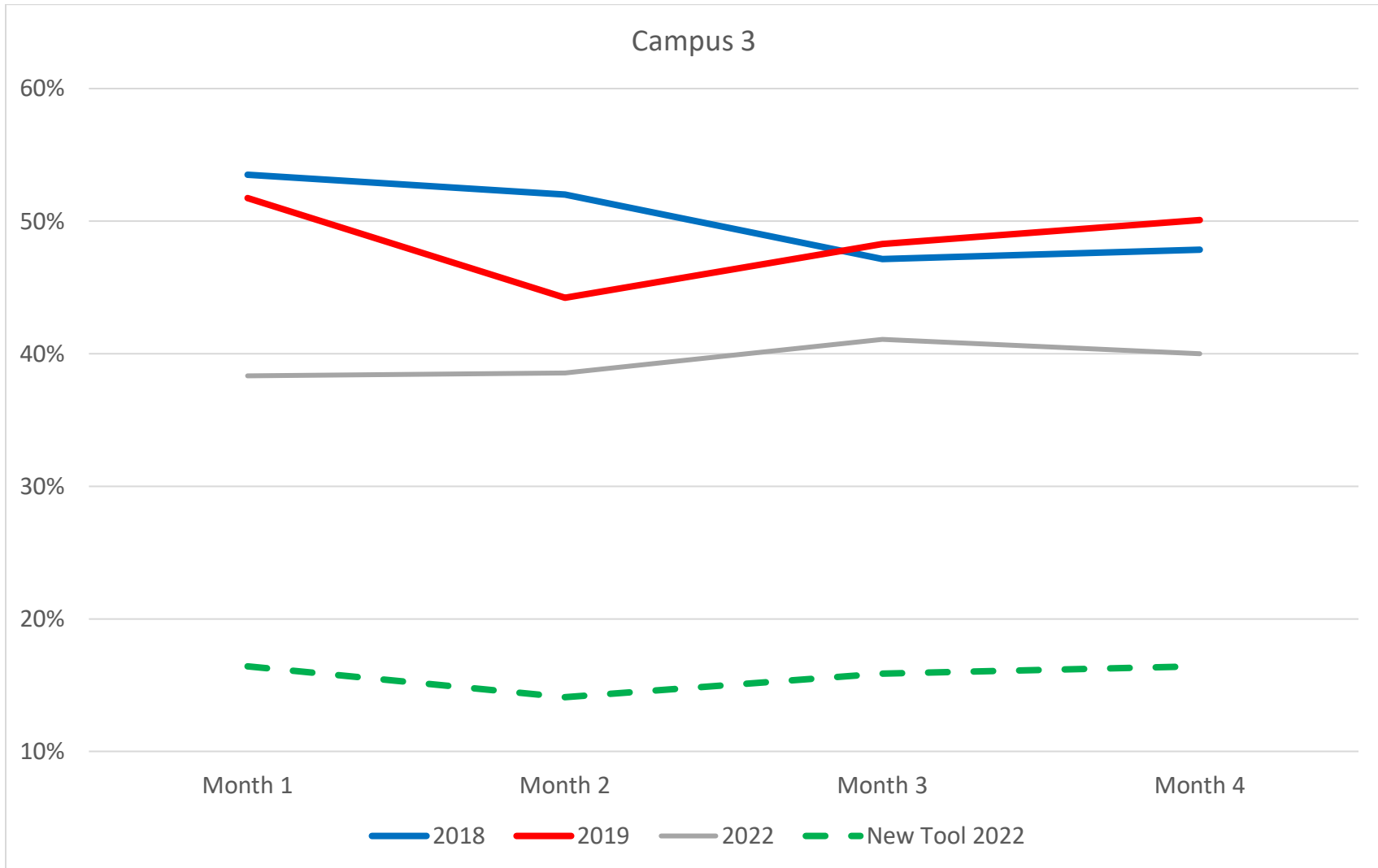| 2018	April	May	June	July
Percentage Completed Prior Screening Tool - 2018	53.50%	52.00%	47.14%	47.85%

2019	April	May	June	July
Percentage Completed Prior Screening Tool - 2019	51.74%	44.22%	48.28%	50.07%

2022	January	February	March
Percentage Completed Prior Screening Tool - 2022	38.33%	38.54%	41.08%

Figure 23

Qualitative assessment post-implementation highlights
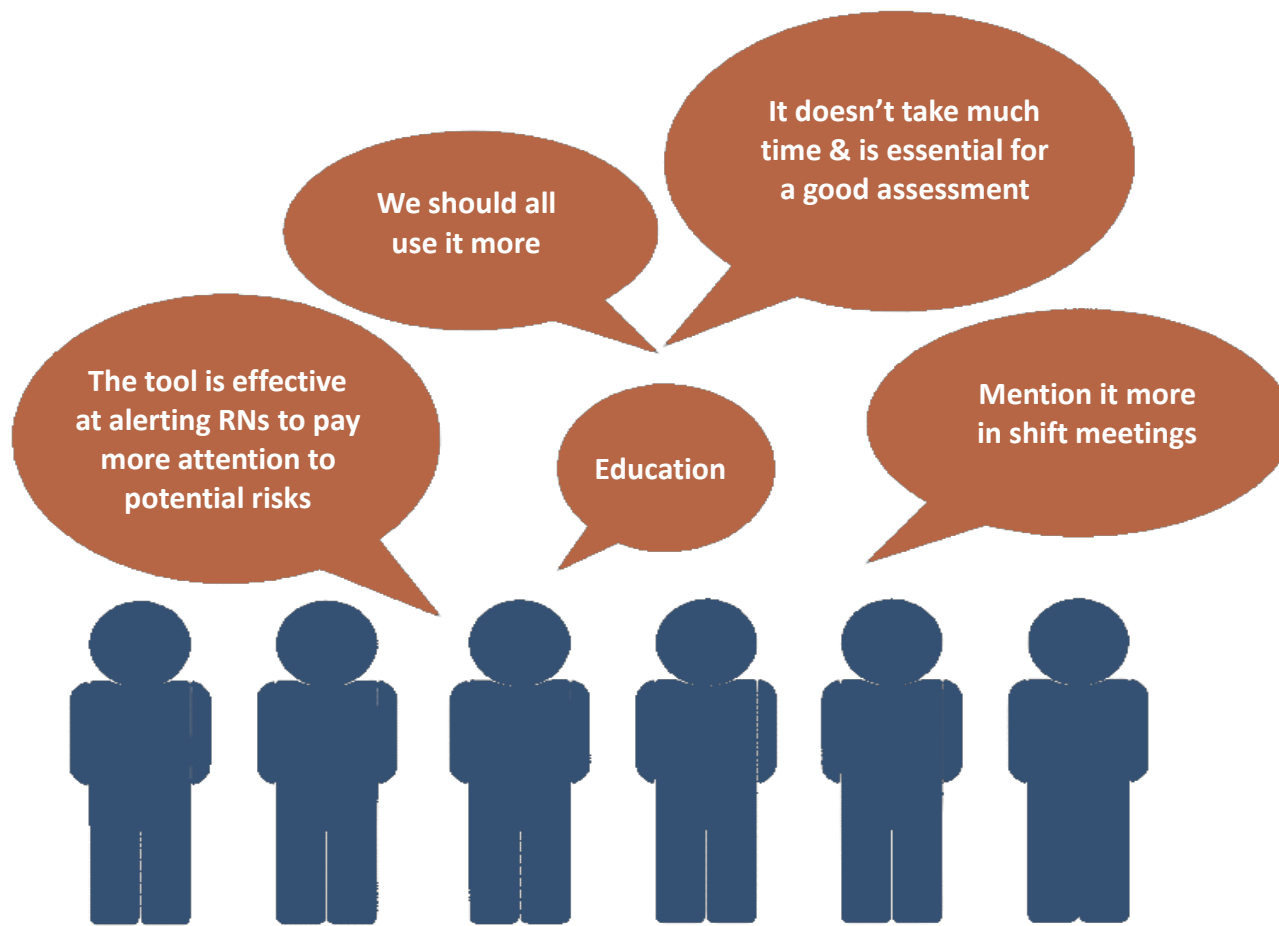
Table 13

Qualitative assessment post-implementation

	User M	User N	User O	User P	User Q	User R
Did it affect your workflow?	No effect; it was easy	Does not affect	No negative affect	Doesn't affect it	Doesn't take much time and is essential for good assessment	No major changes, only a more thorough assessment
Suggested changes?	None	Works as is	None	No	Staff should be trained on this more. It's important.	No
Did you see the email?	No	No	Yes	Yes	Yes - and mentioned shift announcements	Yes
Did you view the training?	No	No	No	No	No	Maybe

	User S	User T	User U	User V	User W	User X
Did it affect your workflow?	The tool is effective at alerting the nurses to pay more attention to potential risks	The questions are kind of long and hard to remember	It's a good feature in EPIC, quick and easy	Helpful and easy to use	Operates well in the workflow	No affect
Suggested changes?	No, simple to use	Make it shorter	No	None	Education in the shift huddle to increase awareness	More education for the nurses
Did you see the email?	No	Yes	No	No	No	No
Did you view the training?	No	No	No	No	No	No

Qualitative ROI

Texas Children's Hospital prioritizes serving at-risk populations and working in prevention, as evidenced partly by the large public health and child abuse pediatrics team supported by the hospital. They also prioritize research and innovation (see also the new low-cost Covid vaccine designed for quick global scaling for production and distribution) (*Coronavirus Vaccines*, n.d.). In the spirit of this culture, they are interested in making their child abuse and neglect detection protocols more robust in the emergency departments. They are also excited to pioneer the social support model designed for this project, where families who are identified as needing support to avoid future neglect are offered assistance in connecting with community resources. This is the first response protocol of this kind. TCH would like to be an industry leader in modeling family support and pediatric practice that goes beyond just treating the immediate medical need.

One of the benefits of improving child abuse and neglect detection is preventing future abuse and neglect, thereby improving the life of the child and possibly their siblings. In addition to preventing future maltreatment, the response protocol of supporting families in need to prevent possible future neglect has even farther-reaching long-term benefits in the life of the child and the family. It is difficult to capture the value added to these lives with prevention and early detection.

However, the cost of improved family support and looking beyond the immediate medical need is, in part, increased service times. In some cases, it may take longer to clear a room because a social worker is connecting the family to resources, a process that is not

currently in place. This may also have a domino effect of occasionally increasing wait times during peak service hours.

This project has a small potential risk of misidentifying a child as a victim who is not. That would cause the family the added stress of dealing with CPS until their case is ruled out. However, as a mandatory reporter would make the report in good faith, it would not put TCH at legal risk or liability. Every precaution is being taken to ensure this is avoided by including robust abuse identification education and multifaceted case intervention.

Quantitative ROI

Identifying child abuse, neglect, and social needs early on produces an incalculable benefit for society. It directly improves the present lives of the victims and, later in life, enables them to become involved and supportive members of their community. These benefits are essential and, in some cases, lifesaving.

Fang and colleagues estimated the cost of child abuse, both direct costs and indirect costs (Fang et al., 2012). Their calculations were conducted in 2010 dollars. Assuming the universal inflation rate of all parts calculated, the numbers here will be provided in 2021 dollars. A known limitation of this assumption is that medical care costs have increased significantly faster than general inflation, and the average wages have not increased as quickly as inflation, along with other variances. Limitations within Fang's estimations include no differentiation in the cost based on the severity of the maltreatment or what age the maltreatment is discovered. They also excluded the direct cost of law enforcement, which Wang and colleagues included in 2007, and they excluded the cost of foster care, adult criminality, and the impacts of mental

health costs across a lifetime (in productivity and mental healthcare), all of which Caldwell

included in 1992 (Caldwell, 1992; Fang et al., 2012; Wang, 2007).

Using Fang's estimations, the lifetime cost of non-fatal child maltreatment for a single

child is $261,673 in 2021 dollars. This includes short-term and long-term health care costs,

productivity losses, child welfare costs, criminal justice costs, and special education costs. A fatal

case of child maltreatment costs $1,586,023 in 2021 dollars. This includes direct medical costs

and future productivity losses. Using the estimated number of substantiated child maltreatment

cases in a year, non-fatal maltreatment costs the U.S. $178 billion annually. Fatal child

maltreatment costs $3 billion per year.

The immediate cost breakdown of this project is below. BCM uses an estimated

overhead rate of 60% for grant funding (when allowed by the grants). Therefore, 60% of the

total cost has been used to calculate the overhead in this project.

Table 14

Estimated cost breakdown

Backfill/Build Team	No. of Required Build Hrs	Rate per hr	Total
EPIC ASAP (ER module) Expert Builder	20	$63.80	$1,276.00
Education Module Team	25	$70.00	$1,750.00
Sub Total	**45**		**$3,026.00**
Go-live Support	**No. of Support Hrs**	**Rate per hr**	**Total**
EPIC Experts * 3	0	$63.80	$0.00
Super Users * 3	0	$50.00	$0.00
Sub Total	**0**		**$0.00**
Training team	**No. of Training Hrs**	**Rate per hr**	**Total**
Education Module Team	2	$70.00	$140.00
Education of providers	300	$75.00	$22,500.00
Sub Total	**302**		**$22,640.00**
Sub Total of Project Costs			**$25,666.00**
Overhead		**60% of the cost**	**$15,399.60**
Total Cost			**$41,065.60**

This implementation cost to the hospital is not reimbursed in any way. The hospital has no monetary incentive to screen for social needs or child abuse. The social costs mentioned above are not directly attributable to the hospital. However, Texas Children's Hospital is devoted to children's health and safety and invests in detection and prevention efforts around child abuse and neglect.

Section 5: Discussion

Theme One: CFIR Constructs

Patient Needs

Within highlighted constructs of the Consolidated Framework for Implementation

Research used in this project, two key points stood out in the implementation process. The first

is the prioritization of patient needs and resources by the clinicians. The construct Patient

Needs and Resources is summarized as the extent to which patient needs and barriers and

facilitators to meet those needs are accurately known and prioritized by the organization. This is

often evaluated via qualitative assessments. In this project's qualitative assessments, we found

strong support for addressing patient needs and providing resources. Some of the supporting

comments include "this is helping the children," "it's better at helping than the current

standard," "it will take time to adjust, but it's a better screening tool," and "it's a helpful

comprehensive screening tool." There is no published literature addressing the nurses'

perceived ease of use in child abuse screening to compare these results. However, TCH nurses

tend to be passionate about pediatric patient care, which is reflected here.

Leadership Engagement

The second key point is the importance of leadership engagement for the success of an

implementation. Leadership Engagement is summarized as the commitment, involvement, and

accountability of leaders and managers with the implementation. Throughout the planning and

implementation, leadership's focus was divided among pressing, several high-level changes that

had to be made and this project. In addition, this pilot was run during the COVID pandemic,

adding complexity to data collection and analysis and increasing the complexity of leadership's work. In a broad sense, these tend to be expected barriers, though they can still be challenging to navigate as the specifics are unpredictable. The project also saw some delays in the process of Risk Management approval. The concern from Risk Management was that clinicians are mandatory reporters, and they worried that a positive screen would immediately require a report to CPS, leading to over-reporting. Once a discussion about the function of the screening tool as a risk assessment process and not a diagnostic tool, their fears were assuaged, and the implementation continued.

Additionally, my institutional position also affected my ability to access some of the resources that may have bolstered this implementation, including increased access to staff to build a sense of urgency and to foster a champion for the implementation, both critical points in highly successful implementations. The Consolidated Framework for Implementation Research includes structure from Everett Rogers' Diffusion of Innovations Theory which highlights the need for an institutional position that allows the project manager to engage the staff involved at the highest level (Rogers, 2003). In the future, with more focused leadership buy-in, the expansion of this project may see even greater success. The Leadership Engagement at TCH was crucial to the success of this project. The leaders had to balance the needs of the hospital from many directions. There was also some concern at the highest levels about the public's understanding of child abuse detection and the effect it could have on the hospital. These concerns were assuaged through a more thorough understanding of the project and the needs of the community being served.

Table 15

CFIR implementation constructs, as seen in this project

Domain	Construct	Short Description	How it was seen in this project
II. OUTER SETTING			
A	Patient Needs and Resources	The organization accurately identifies and prioritizes patient needs and barriers and facilitates meeting those needs.	Comments found in Qualitative assessments o this helps the kids o better at helping than the current standard o will take time to adjust, but a better screening tool o comprehensive screening tool
C	Peer Pressure	Mimetic or competitive pressure to implement an intervention; typically, because most or other critical peer or competing organizations have already	Literature continues to evolve as more hospitals implement child abuse screening tools as a standard. However, there is still no gold standard for child abuse and neglect screening and response protocols.

Domain	Construct	Short Description	How it was seen in this project
		implemented or are in a bid for a competitive edge.	
D	External Policy and Incentives	A broad construct that includes external strategies to spread interventions, including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting.	The hospital accrediting entity The Joint Commission requires that all hospitals screen patients for violence. The American Academy of Pediatrics also recommends that all healthcare providers screen for child abuse. No policies or incentives have been edited or implemented throughout this project.

Domain	Construct	Short Description	How it was seen in this project
III. INNER SETTING			
C	Culture	Norms, values, and basic assumptions of a given organization.	TCH prioritizes caring for at-risk populations. There were questions from providers about any increased room usage time in the EC. Overall, the project garnered broad support in its efforts to support families in need.
E	Readiness for Implementation		
1	Leadership Engagement	Commitment, involvement, and accountability of leaders and managers with the implementation.	Over the course of planning and implementation, leadership's focus was pulled away intermittently by pressing, high-level changes that had to be made. This caused some delay in implementation.

Domain	Construct	Short Description	How it was seen in this project
			There was also some concern at the highest levels about the public's understanding of child abuse detection and the effect it could have on the hospital. These concerns were assuaged through a more thorough understanding of the project and the needs of the community being served.
2	Available Resources	The resources dedicated to an implementation and ongoing operations include money, training, education, physical space, and time.	There were appropriate resources committed from TCH for implementing and maintaining this project. However, in the building and implementation process, some resources were stretched by other commitments, which caused some delays in implementation.

Domain	Construct	Short Description	How it was seen in this project
3	Access to Knowledge and Information	Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks.	TCH has a stellar child abuse pediatrics team experienced in teaching medical students and non-clinicians about abuse and neglect identification. They championed the creation of the enduring education modules. The distribution of the education to all clinicians left some opportunities for follow-up and more robust involvement of those being educated.
V. PROCESS			
C	Executing	Carrying out or accomplishing the implementation according to plan.	There was support internally at TCH and externally at UTH for this project to be implemented wholly and well. However, the realities of competing needs within a large organization led to unexpected

Domain	Construct	Short Description	How it was seen in this project
			and unavoidable execution delays. Nonetheless, the execution was well carried out.
D	Reflecting and Evaluating	Quantitative and qualitative feedback about the progress and implementation quality, accompanied by regular personal and team debriefing about progress and experience.	Quantitative and qualitative feedback showed acceptance and positive attitudes about the implementation. The nurses found value in using the new screening tool.

Figure 24

CFIR qualitative assessment support

Theme Two: Usability and Technology Acceptance

SUS

The System Usability Scale scores were high, with an average 91st percentile (considered an A on an A+ through F grading scale; see Figure 4). This may be an inflated score. It may have been affected by the constraints on the assessment administration. The nurses involved were on shift while participating in the screening tool assessment and may have felt rushed to complete the survey and return to their regular duties. This lack of time may have played into the nurses' level of investment in the project, as the introduction to its value and purpose was necessarily brief. The nurse participants in the pre- and post-assessment were selected via convenience sample. They were working weekday day shifts, and the administration selected the participants.

A benefit of collecting data across three different campuses was the variation by site. The qualitative assessments revealed site-specific perceptions and attitudes about the implementation of a new tool in EPIC. Some of the nurses showed more enthusiasm about the project than others. These variations were also borne out in the quantitative data, including the usage rates.

Technology Acceptance: Qualitative Assessments and Use Rates

Qualitative Assessments

The qualitative assessments revealed site-specific perceptions and attitudes about the implementation of a new tool in EPIC. For instance, some nurses showed more enthusiasm about the project than others. On Campus 3, some nurses were unaware of the new screening

tool entirely. These attitudes may also reflect local-level leadership's perception of the new screening tool. Nurses at both Campus 1 and 2 mentioned that the tool was encouraged during staff meetings, while nurses at Campus 3 mentioned that it would have been helpful if it had been promoted during staff meetings. This matches the established implementation science with the need for buy-in at all levels to achieve the greatest success.

Use Rates

Campuses 1 and 2 had higher use rates of both the prior tool and the new tool. This may be affected by staffing types and the levels and types of cases. There was also a steady increase in use rates across the pilot period on two campuses starting at 64% and moving up to 83%. This matched or surpassed the use rates of the prior screening tool in previous years. The first two campuses each served just under 1,800 infants in the pilot. Campus 3 had use rates below 20% for the new tool and 40% for the prior tool. They served almost 2,400 infants in that period. They also see more cases with higher trauma levels. This increased volume may impact the nurses' available charting time.

TCH's standard nurse-to-patient ratio is 1 to 3 across all campuses. Use rates should not be affected by the population served because all campuses should have the same staffing ratio. The quality of care is not affected by an increased volume of patients if the staffing levels are proportionately increased. However, charting time could be affected by increased trauma levels at the third campus.

Screening is a standard practice in many forms across all types of healthcare. New screening tools are introduced and adopted well in many places, just like the first two

campuses. In this project, we saw a difference in management's implementation methods at the third campus. On the first two campuses, leadership focused on using the new screening tool, including mentioning it in shift meetings and encouraging nurses to watch the education module sent out. The low use rates at the third campus are likely attributable to the adoption process.

Additionally, uptake of the screening tool increased over time, and we expect to see a continued increase on all campuses. Change in any form can be slow for people to adopt. Education on the screening tool and abuse identification is vital to the success of this process. Nevertheless, the crux of implementation success lies in the hands of leadership and peer-to-peer champions for the new process.

Theme Three: How the Tool was Applied

Screening Tool Positivity by Campus

Positivity rates can help us understand how the tool is applied, indicating whether it is usable. One notable difference is the variability among campuses. Campuses one and two had an average rate of around 1.9%. This matches the literature on expected findings in a pediatric ED (McTavish et al., 2020a). The third campus had an average positivity rate of more than twice that at 5.67%. This is well above the expected range from the literature. One reason may be that the nurses on the third campus were more likely to use the tool only when they suspected a patient was at risk. They may have used it to help determine their assessment of the patient or to document the assessment already made.

Screening Tool Positivity by Question

Beyond how often the tools are marked positive, we can gain insight into the usableness

of the tool by looking at which questions and combinations of questions were used when it was

positive. This can tell us where further education might be needed. Within the 67 positive

screening tools, questions 4 and 5 were the most likely to be marked positive at 52% and 57%,

respectively. Question 4 asks about poor supervision, care, nourishment, or hygiene. In some

cases, this could indicate a lack of resources rather than possible neglect. Greater use of EDs for

primary healthcare by those without means reflects the lack of access to general healthcare.

This may be an indictment of the US's fee-for-service, multi-payer approach to the population's

health. Question 5 asks about any other concerns, the child's family, environment, and a free

text area for notes on why any question was positive. If the instructions were followed

thoroughly, question 5 would be filled out for every positive case. Based on the literature, we

expected questions 4 and 5 to be the most marked.

Questions 2 and 3 were the least likely to be marked positive at 37% each. Question 2

asks about the consistency of the history with the presenting injury or illness. This can be

difficult to assess and may not be as common as other issues. Question 3 asks about specific

bruising and injuries in areas of the body that are less likely to be accidentally injured. This may

be less common or detected less often as infants must be fully undressed to assess all the areas

of concern. Nurses may not always have the capacity to undress every infant fully.

Consistent with Berger's implementation in Pittsburgh, the most common positive case

had only question 5 marked, the free text box. Nine of these were about insufficient supervision

and rashes, which could be interpreted as neglect or hygiene issues, and the last one was a

possible head injury which was ruled out. This means nine of the ten cases marked with only question 5 would have been more accurately marked as questions 4 and 5 together. The next most common question combinations were numbers 4 and 5 together or all five questions together. The positive cases with questions 4 and 5 were about drugs, failure to thrive, access to medication, injury from a fall, and swelling and diaper rash. The cases with all five questions marked positive consisted of three complaints or diagnoses: five head injuries, one femur fracture, and one history of illness that needed care (i.e., possible medical neglect). In notable cases of abuse, it is not surprising to see all the issues in the screening tool present.

Complaints and Diagnoses

Analyzing the most common chief complaints and diagnoses can tell us whether the tool effectively identifies high-risk cases that might otherwise be missed. Based on the literature, it is not surprising that head injuries are the most prevalent. Infants under 12 months have large heads proportionately to their bodies and fragile necks. Extremity fractures are surprising in infants and often indicate non-accidental trauma because infants' bones are relatively soft and malleable. Rib fractures presented with chief complaints such as fever and vomiting and indicated non-accidental trauma. Fractures of the parietal bone were the most common non-accidental injury in these cases. Some others, like fever, vomiting, and respiratory issues, were the sequelae of more severe injuries like fractured ribs and head injuries.

ROI

      This screening tool and implementation process have great potential for generalizability because of the low-cost barrier. Accessible adoption can encourage accreditation policy changes pushing more hospitals to adopt detection and prevention practices. However, depending on the hospital, cost and savings may vary as initial resources may vary. Rural or lower-resourced hospitals may not have child abuse pediatricians on staff to consult. They may need to establish relationships with larger organizations for consultations.

Section 6: Project Limitations

The pilot program was implemented in three EDs in one hospital system and one major metro area with a diverse population. It should be noted that hospitals in significantly different settings may not have the resources necessary to duplicate this process safely.

Limiting factors also include external forces that could not be accounted for. The need for interagency work with Child Protective Services (CPS) limits the ability to compare the outcomes of families referred to CPS versus those offered other support services. In addition, this pilot was conducted during the global Covid pandemic with waves of infection. These may affect the number of positive cases and the volume of patients seen, affecting the nurses' willingness or ability to conduct the screen. We do not know if this will be the new normal or if things will return to circumstances similar to those before the pandemic.

There were also some limitations on the implementation itself. The pilot had unfortunate conflicting timing with some Joint Commission required changes in process and protocol in the EDs which caused a delay and may have influenced the nurses' perception of the changes. Risk Management's project review process caused an additional delay. These delays may have caused a decreased sense of urgency in some of the leadership.

This project was led from a position lacking institutional (positional or political) power to accomplish some points of established implementation science that could have improved the project implementation process. Some of these limitations include limited access to staff. That limited access reduced my ability to build interest, establish a sense of urgency, and rally champions. One point of restriction that may have decreased staff confidence in screening for

abuse or neglect is the competing institutional priorities that limit staff education. The modules

created for this project and training on the screening tool were sent to the staff via email.

The SUS assessment is a validated set; therefore, it could not be adjusted to

accommodate specific questions that might have been helpful.

Section 7: Conclusions

Any level of prevalence of child abuse and neglect is too high. In hopes of detecting current and preventing future cases, screening for child abuse and neglect can be implemented in the ED. This implementation process was an enormous undertaking involving stakeholders across all levels of the hospital. This project implementation reflected established implementation science showing the need for buy-in at all levels, the need for a sense of urgency, and for having champions at the staff level to urge the uptake of the new process. The level of institutional (positional and political) power strongly influences the process and outcome of the implementation of a project. While this implementation was successful, there were opportunities for it to be smoother and quicker with the right level of buy-in from more leaders. There were also external influences on the implementation, some were anticipated, and some were not. The pilot was conducted during the COVID pandemic, and just before the planned implementation, there were changes from the Joint Commission. As all well-planned implementations should be, this project was agile enough to respond to these unexpected changes.

The adoption rates across the campuses varied widely. Campus 3 has opportunities to improve the promotion of the new screening tool and increase the use rates. Documentation of reasoning in the free text area on question 5 could be improved on all three campuses. Additionally, all campuses could benefit from increased attention to the use of the tool and broader distribution of the education module on abuse identification. Uptake is expected to continue to increase over time.

The positivity rates on Campuses 1 and 2 meet the literature expectations. The appropriate follow-up should include case reviews and end-user interviews to ensure the screening tool is applied appropriately and across all demographics equally. The high positivity rates on Campus 3 are an opportunity to share with the nurses how well the screening tool can work and encourage further adoption. Increased training across all campuses has the potential to hone nurses' ability to use the tool more effectively.

Future work may include reviewing the success of the screening tool in the identification and the response protocol's effect on patients' needs. The next steps should also include a deep dive into the data exploring the cases that were positive and why they were positive by type and category. This work should also include a case review of what responses were given, including social work consults, connections to other social needs resources, or a connection with CPS. Further work should be done to find possible missed cases. This may include case reviews of patients whose injuries sometimes indicate abuse or neglect. Lastly, we are working toward broader implementation within TCH and reaching out to other hospitals in the area.

Finally, child abuse and neglect screening must never be used to criminalize poverty but instead to lift families and improve their ability to care for one another. It is essential that this distinction is made and that great care is taken in assessment and response protocols to protect children while supporting families in need.

References

2017 Modified Stage 2 Program Requirements for Eligible Hospitals, CAHs and Dual-Eligible Hospitals Attesting to CMS | CMS. (2018, April 25). https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Stage2Modified_RequireEH

AAP. (n.d.). *Child Abuse Prevention*. American Academy of Pediatrics. Retrieved August 8, 2020, from http://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Pages/Child-Abuse-Prevention.aspx

Abramson, E. L., Patel, V., Malhotra, S., Pfoh, E. R., Nena Osorio, S., Cheriff, A., Cole, C. L., Bunce, A., Ash, J., & Kaushal, R. (2012). Physician experiences transitioning between an older versus newer electronic health record for electronic prescribing. *International Journal of Medical Informatics*, *81*(8), 539–548. https://doi.org/10.1016/j.ijmedinf.2012.02.010

Administration for Children and Families. (2020, January 15). *Child abuse, neglect data released; 29th edition of the Child Maltreatment Report* [29th edition of the Child Maltreatment Report]. Administration for Children and Families. https://www.acf.hhs.gov/media/press/2020/child-abuse-neglect-data-released

Alonso-Ríos, D., Vázquez-García, A., Mosqueira-Rey, E., & Moret-Bonillo, V. (2009). Usability: A Critical Analysis and a Taxonomy. *International Journal of Human–Computer Interaction*, *26*(1), 53–74. https://doi.org/10.1080/10447310903025552

Alter, S. (2006). *The Work System Method: Connecting People, Processes, and IT for Business Results*. Work System Press. https://books.google.com/books?id=wO3hsfudatgC

Ancker, J. S., Edwards, A., Nosal, S., Hauser, D., Mauer, E., Kaushal, R., & with the HITEC

Investigators. (2017). Effects of workload, work complexity, and repeated alerts on alert

fatigue in a clinical decision support system. *BMC Medical Informatics and Decision

Making*, *17*(1), 36. https://doi.org/10.1186/s12911-017-0430-8

Assistant Secretary for Public Affairs. (2013, September 6). *System Usability Scale (SUS)*.

Department of Health and Human Services. https://www.usability.gov/how-to-and-

tools/methods/system-usability-scale.html

Bailhache, M., Leroy, V., Pillet, P., & Salmi, L.-R. (2013). Is early detection of abused children

possible?: A systematic review of the diagnostic accuracy of the identification of abused

children. *BMC Pediatrics*, *13*, 202. https://doi.org/10.1186/1471-2431-13-202

Bates, D. W., & Gawande, A. A. (2003). Improving Safety with Information Technology. *New

England Journal of Medicine*, *348*(25), 2526–2534.

https://doi.org/10.1056/NEJMsa020847

Benger, J. R., & Pearce, A. V. (2002). Simple intervention to improve detection of child abuse in

emergency departments. *BMJ : British Medical Journal*, *324*(7340), 780–782.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122710/

Berger, R. P., & Lindberg, D. M. (2019a). Early Recognition of Physical Abuse: Bridging the Gap

between Knowledge and Practice. *The Journal of Pediatrics*, *204*(Journal Article), 16–23.

Berger, R. P., & Lindberg, D. M. (2019b). Early Recognition of Physical Abuse: Bridging the Gap

between Knowledge and Practice. *The Journal of Pediatrics*, *204*, 16–23.

https://doi.org/10.1016/j.jpeds.2018.07.081

Berger, R. P., & Lindberg, D. M. (2019c). Early Recognition of Physical Abuse: Bridging the Gap

between Knowledge and Practice. *The Journal of Pediatrics*, *204*, 16–23.

https://doi.org/10.1016/j.jpeds.2018.07.081

Black, D. A., Heyman, R. E., & Smith Slep, A. M. (2001). Risk factors for child physical abuse.

Aggression and Violent Behavior, *6*(2), 121–188. https://doi.org/10.1016/S1359-

1789(00)00021-5

Bouamrane, M.-M., & Mair, F. S. (2013). A study of general practitioners' perspectives on

electronic medical records systems in NHSScotland. *BMC Medical Informatics and

Decision Making*, *13*(1), 58. https://doi.org/10.1186/1472-6947-13-58

Brady, T. M., Neu, A. M., Miller, E. R., Appel, L. J., Siberry, G. K., & Solomon, B. S. (2015). Real-

Time Electronic Medical Record Alerts Increase High Blood Pressure Recognition in

Children. *Clinical Pediatrics*, *54*(7), 667–675.

https://doi.org/10.1177/0009922814559379

Brooke, john. (1996). SUS: A "Quick and Dirty" Usability Scale. In *Usability Evaluation In

Industry*. CRC Press.

Brown, W., Yen, P.-Y., Rojas, M., & Schnall, R. (2013). Assessment of the Health IT Usability

Evaluation Model (Health-ITUEM) for evaluating mobile health (mHealth) technology.

Journal of Biomedical Informatics, *46*(6), 1080–1087.

https://doi.org/10.1016/j.jbi.2013.08.001

Ca, P., & A, S. (2014). A nursing focus on EMR usability enhancing documentation of patient

outcomes. *The Nursing Clinics of North America*, *49*(1), 81–90.

https://doi.org/10.1016/j.cnur.2013.11.010

Caldwell, R. A. (1992). *The Costs Of Child Abuse vs. Child Abuse Prevention: Michigan's Experience*. 26.

Carson, S. M. (2018). Implementation of a Comprehensive Program to Improve Child Physical Abuse Screening and Detection in the Emergency Department. *Journal of Emergency Nursing*, *44*(6), 576–581. https://doi.org/10.1016/j.jen.2018.04.003

CFIR Research Team-Center for Clinical Management Research. (2021). *The Consolidated Framework for Implementation Research – Technical Assistance for users of the CFIR framework*. Consolidated Framework for Implementation Research. https://cfirguide.org/

Chang, C.-C., Yan, C.-F., & Tseng, J.-S. (2012). Perceived convenience in an extended technology acceptance model: Mobile technology and English learning for college students. *Australasian Journal of Educational Technology*, *28*(5), Article 5. https://doi.org/10.14742/ajet.818

Chang, D. C., Knight, V. M., Ziegfeld, S., Haider, A., & Paidas, C. (2005). The multi-institutional validation of the new screening index for physical child abuse. *Journal of Pediatric Surgery*, *40*(1), 114–119. https://doi.org/10.1016/j.jpedsurg.2004.09.019

Chen, C.-J., Chen, Y.-W., Chang, H.-Y., & Feng, J.-Y. (2022). Screening Tools for Child Abuse Used by Healthcare Providers: A Systematic Review. *Journal of Nursing Research*, *30*(1), e193. https://doi.org/10.1097/JNR.0000000000000475

Classen, D. C., Holmgren, A. J., Co, Z., Newmark, L. P., Seger, D., Danforth, M., & Bates, D. W. (2020). National Trends in the Safety Performance of Electronic Health Record Systems

From 2009 to 2018. *JAMA Network Open*, *3*(5), e205547.

https://doi.org/10.1001/jamanetworkopen.2020.5547

Computerized Provider Order Entry. (2019). https://psnet.ahrq.gov/primer/computerized-

provider-order-entry

Coronavirus Vaccines. (n.d.). Baylor College of Medicine. Retrieved August 6, 2022, from

https://www.bcm.edu/departments/pediatrics/divisions-and-centers/tropical-

medicine/research/vaccine-development/coronavirus-vaccines

Dang, D., Dearholt, S., Sigma Theta Tau International., & Johns Hopkins University. School of

Nursing. (2018). *Johns Hopkins nursing evidence-based practice: Model & guidelines*

(Third edition., Vol. 1–1 online resource (xxii, 329 pages)). Sigma Theta Tau International.

https://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk

&AN=1625431

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of

Information Technology. *MIS Quarterly*, *13*(3), 319–340. https://doi.org/10.2307/249008

Definition of SEQUELA. (n.d.). Retrieved August 6, 2022, from https://www.merriam-

webster.com/dictionary/sequela

Dinpanah, H., & Akbarzadeh Pasha, A. (2017). Potential Child Abuse Screening in Emergency

Department; a Diagnostic Accuracy Study. *Emergency*, *5*(1).

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5325929/

Drinkwater, J., Stanley, N., Szilassy, E., Larkins, C., Hester, M., & Feder, G. (2017). Juggling

confidentiality and safety: A qualitative study of how general practice clinicians

document domestic violence in families with children. *Br J Gen Pract*, *67*(659), e437–

e444.

Emiliano, I. (2015). *Heuristic Reasoning: Studies in Applied Philosophy, Epistemology and

Rational Ethics*. Springer International Publishing.

Fang, X., Brown, D. S., Florence, C. S., & Mercy, J. A. (2012). The economic burden of child

maltreatment in the United States and implications for prevention. *Child Abuse &

Neglect*, *36*(2), 156–165. https://doi.org/10.1016/j.chiabu.2011.10.006

Fong, A., & Ratwani, R. M. (2018). Understanding Emergency Medicine Physicians Multitasking

Behaviors Around Interruptions. *Academic Emergency Medicine*, *25*(10), 1164–1168.

https://doi.org/10.1111/acem.13496

Genco, E. K., Forster, J. E., Flaten, H., Goss, F., Heard, K. J., Hoppe, J., & Monte, A. A. (2016).

Clinically Inconsequential Alerts: The Characteristics of Opioid Drug Alerts and Their

Utility in Preventing Adverse Drug Events in the Emergency Department. *Annals of

Emergency Medicine*, *67*(2), 240-248.e3.

https://doi.org/10.1016/j.annemergmed.2015.09.020

Gilchrist, J., Hutchinson, E., & Ramlakhan, S. (2019). Impact of implementing the escape

safeguarding screening tool in a paediatric ED. *Archives of Disease in Childhood*,

104(Suppl 2), A135–A135. https://doi.org/10.1136/archdischild-2019-rcpch.320

Gonzalez, D. O., & Deans, K. J. (2017a). Hospital-based screening tools in the identification of

non-accidental trauma. *Seminars in Pediatric Surgery*, *26*(1), 43–46.

Gonzalez, D. O., & Deans, K. J. (2017b). Hospital-based screening tools in the identification of

    non-accidental trauma. *Seminars in Pediatric Surgery*, *26*(1), 43–46.

    https://doi.org/10.1053/j.sempedsurg.2017.01.002

Graber, M. L., Siegal, D., Riah, H., Johnston, D., & Kenyon, K. (2019). Electronic Health Record–

    Related Events in Medical Malpractice Claims. *Journal of Patient Safety*, *15*(2), 77–85.

    https://doi.org/10.1097/PTS.0000000000000240

Guenther, E., Powers, A., Srivastava, R., & Bonkowsky, J. L. (2010). Abusive head trauma in

    children presenting with an apparent life-threatening event. *The Journal of Pediatrics*,

    157(5), 821–825. https://doi.org/10.1016/j.jpeds.2010.04.072

Harrison, A. M., Thongprayoon, C., Aakre, C. A., Jeng, J. Y., Dziadzko, M. A., Gajic, O., Pickering,

    B. W., & Herasevich, V. (2017). Comparison of methods of alert acknowledgement by

    critical care clinicians in the ICU setting. *PeerJ*, *5*, e3083.

    https://doi.org/10.7717/peerj.3083

Health IT Playbook. (2020, March 11). https://www.healthit.gov/playbook/quality-and-patient-

    safety/

Hill, R. G., Sears, L. M., & Melanson, S. W. (2013). 4000 Clicks: A productivity analysis of

    electronic medical records in a community hospital ED. *The American Journal of*

    Emergency Medicine, *31*(11), 1591–1594. https://doi.org/10.1016/j.ajem.2013.06.028

Holmes, J. F., Freilich, J., Taylor, S. L., & Buettner, D. (2015). Electronic Alerts for Triage Protocol

    Compliance Among Emergency Department Triage Nurses: A Randomized Controlled

    Trial. *Nursing Research*, *64*(3), 226–230.

    https://doi.org/10.1097/NNR.0000000000000094

Howe, J. L., Adams, K. T., Hettinger, A. Z., & Ratwani, R. M. (2018a). Electronic Health Record

Usability Issues and Potential Contribution to Patient Harm. *JAMA*, *319*(12), 1276–1278.

https://doi.org/10.1001/jama.2018.1171

Howe, J. L., Adams, K. T., Hettinger, A. Z., & Ratwani, R. M. (2018b). Electronic Health Record

Usability Issues and Potential Contribution to Patient Harm. *JAMA*, *319*(12), 1276–1278.

https://doi.org/10.1001/jama.2018.1171

ISO/TS 20282-2:2013(en), Usability of consumer products and products for public use—Part 2:

Summative test method. (2019). https://www.iso.org/obp/ui/#iso:std:iso:ts:20282:-2:ed-

2:v1:en

Joint Commission Standard PC 01.02.09 on Victims of Abuse. (2009).

https://www.futureswithoutviolence.org/wp-content/uploads/THE-JOINT-

COMMISSION.pdf

Kaipio, J., Kuusisto, A., Hyppönen, H., Heponiemi, T., & Lääveri, T. (2020). Physicians' and nurses'

experiences on EHR usability: Comparison between the professional groups by

employment sector and system brand. *International Journal of Medical Informatics*, *134*,

104018. https://doi.org/10.1016/j.ijmedinf.2019.104018

Klompstra, L., Liljeroos, M., Lundgren, J., & Ingadottir, B. (2021). A Clinical Tool (CUE-tool) for

Health Care Professionals to Assess the Usability and Quality of the Content of Medical

Information Websites: Electronic Delphi Study. *Journal of Medical Internet Research*,

23(2), e22668. https://doi.org/10.2196/22668

Kumar, S., & Aldrich, K. (2010). Overcoming barriers to electronic medical record (EMR) implementation in the US healthcare system: A comparative study. *Health Informatics Journal*, *16*(4), 306–318. https://doi.org/10.1177/1460458210380523

Kutney-Lee, A., Brooks Carthon, M., Sloane, D. M., Bowles, K. H., McHugh, M. D., & Aiken, L. H. (2021). Electronic Health Record Usability: Associations With Nurse and Patient Outcomes in Hospitals. *Medical Care*, *Publish Ahead of Print*. https://doi.org/10.1097/MLR.0000000000001536

Lane, W. G., & Dubowitz, H. (2007). What factors affect the identification and reporting of child abuse-related fractures? *Clinical Orthopaedics and Related Research*, *461*, 219–225. https://doi.org/10.1097/BLO.0b013e31805c0849

Lane, W. G., Rubin, D. M., Monteith, R., & Christian, C. W. (2002). Racial differences in the evaluation of pediatric fractures for physical abuse. *JAMA*, *288*(13), 1603–1609. https://doi.org/10.1001/jama.288.13.1603

Lau, F., Bartle-Clar, J. A., & Bliss, G. (2019). *Improving Usability, Safety and Patient Outcomes with Health Information Technology: From Research to Practice*. IOS Press. https://books.google.com/books?id=6uOYDwAAQBAJ

Lawson, M., & Huynh, J. (2021, August 13). *Social work EC staff* [Personal communication].

Lazard, A. J., & King, A. J. (2020). Objective Design to Subjective Evaluations: Connecting Visual Complexity to Aesthetic and Usability Assessments of eHealth. *International Journal of Human–Computer Interaction*, *36*(1), 95–104. https://doi.org/10.1080/10447318.2019.1606976

Lee, P.-Y., Dunne, M. P., Chou, F.-H., & Fraser, J. A. (2012). Development of the child abuse and

neglect reporting self-efficacy questionnaire for nurses. *The Kaohsiung Journal of*

Medical Sciences, *28*(1), 44–53. https://doi.org/10.1016/j.kjms.2011.10.032

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A

critical review of the technology acceptance model. *Information & Management*, *40*(3),

191–204. https://doi.org/10.1016/S0378-7206(01)00143-4

Letson, M. M., Cooper, J. N., Deans, K. J., Scribano, P. V., Makoroff, K. L., Feldman, K. W., &

Berger, R. P. (2016). Prior opportunities to identify abuse in children with abusive head

trauma. *Child Abuse & Neglect*, *60*, 36–45. https://doi.org/10.1016/j.chiabu.2016.09.001

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, *22 140*,

55–55.

Lindberg, D. M., Beaty, B., Juarez-Colunga, E., Wood, J. N., & Runyan, D. K. (2015a). Testing for

Abuse in Children With Sentinel Injuries. *Pediatrics*, *136*(5), 831–838.

https://doi.org/10.1542/peds.2015-1487

Lindberg, D. M., Beaty, B., Juarez-Colunga, E., Wood, J. N., & Runyan, D. K. (2015b). Testing for

Abuse in Children With Sentinel Injuries. *Pediatrics*, *136*(5), 831–838.

https://doi.org/10.1542/peds.2015-1487

Lorenz, D. J., Pierce, M. C., Kaczor, K., Berger, R. P., Bertocci, G., Herman, B. E., Herr, S., Hymel, K.

P., Jenny, C., Leventhal, J. M., Sheehan, K., & Zuckerbraun, N. (2018). Classifying Injuries

in Young Children as Abusive or Accidental: Reliability and Accuracy of an Expert Panel

Approach. *The Journal of Pediatrics*, *198*, 144-150.e4.

https://doi.org/10.1016/j.jpeds.2018.01.033

Louwers, E. C. F. M., Korfage, I. J., Affourtit, M. J., Ruige, M., van den Elzen, A. P. M., de Koning,

    H. J., & Moll, H. A. (2014). Accuracy of a screening instrument to identify potential child

    abuse in emergency departments. *Child Abuse & Neglect*, *38*(7), 1275–1281.

    https://doi.org/10.1016/j.chiabu.2013.11.005

Louwers, E. C. F. M., Korfage, I. J., Affourtit, M. J., Scheewe, D. J. H., Merwe, M. H. van de, Vooijs-

    Moulaert, A.-F. S. R., Elzen, A. P. M. van den, Jongejan, M. H. T. M., Ruige, M., Manaï, B.

    H. A. N., Looman, C. W. N., Bosschaart, A. N., Teeuw, A. H., Moll, H. A., & Koning, H. J. de.

    (2012). Effects of Systematic Screening and Detection of Child Abuse in Emergency

    Departments. *Pediatrics*, *130*(3), 457–464. https://doi.org/10.1542/peds.2011-3527

Louwers, E. C. F. M., Korfage, I. J., Affourtit, M. J., Scheewe, D. J. H., Merwe, M. H. van de, Vooijs-

    Moulaert, F. A. F. S. R., Woltering, C. M. C., Jongejan, M. H. T. M., Ruige, M., Moll, H. A., &

    Koning, H. J. D. (2011). Detection of child abuse in emergency departments: A multi-

    centre study. *Archives of Disease in Childhood*, *96*(5), 422–425.

    https://doi.org/10.1136/adc.2010.202358

Louwers, E. C., Korfage, I. J., Affourtit, M. J., De Koning, H. J., & Moll, H. A. (2012). Facilitators

    and barriers to screening for child abuse in the emergency department. *BMC Pediatrics*,

    12, 167. https://doi.org/10.1186/1471-2431-12-167

Maguire-Jack, K., & Font, S. A. (2017a). Intersections of individual and neighborhood

    disadvantage: Implications for child maltreatment. *Children and Youth Services Review*,

    72, 44–51. https://doi.org/10.1016/j.childyouth.2016.10.015

Maguire-Jack, K., & Font, S. A. (2017b). Community and Individual Risk Factors for Physical Child Abuse and Child Neglect: Variations by Poverty Status. *Child Maltreatment*, *22*(3), 215–226. https://doi.org/10.1177/1077559517711806

McCoy, A. B., Waitman, L. R., Lewis, J. B., Wright, J. A., Choma, D. P., Miller, R. A., & Peterson, J. F. (2012). A framework for evaluating the appropriateness of clinical decision support alerts and responses. *Journal of the American Medical Informatics Association*, *19*(3), 346–352. https://doi.org/10.1136/amiajnl-2011-000185

McGinn, T., Feldstein, D. A., Barata, I., Heineman, E., Ross, J., Kaplan, D., Richardson, S., Knox, B., Palm, A., Bullaro, F., Kuehnel, N., Park, L., Khan, S., Eithun, B., & Berger, R. P. (2021). Dissemination of child abuse clinical decision support: Moving beyond a single electronic health record. *International Journal of Medical Informatics*, *147*, 104349. https://doi.org/10.1016/j.ijmedinf.2020.104349

McTavish, J. R., Gonzalez, A., Santesso, N., MacGregor, J. C. D., McKee, C., & MacMillan, H. L. (2020a). Identifying children exposed to maltreatment: A systematic review update. *BMC Pediatrics*, *20*(1), 113. https://doi.org/10.1186/s12887-020-2015-4

McTavish, J. R., Gonzalez, A., Santesso, N., MacGregor, J. C. D., McKee, C., & MacMillan, H. L. (2020b). Identifying children exposed to maltreatment: A systematic review update. *BMC Pediatrics*, *20*. https://doi.org/10.1186/s12887-020-2015-4

Means, A. R., Kemp, C. G., Gwayi-Chore, M.-C., Gimbel, S., Soi, C., Sherr, K., Wagenaar, B. H., Wasserheit, J. N., & Weiner, B. J. (2020). Evaluating and optimizing the consolidated framework for implementation research (CFIR) for use in low- and middle-income

countries: A systematic review. *Implementation Science: IS*, *15*(1), 17.

https://doi.org/10.1186/s13012-020-0977-0

Medical Definition of IATROGENESIS. (n.d.). Retrieved August 6, 2022, from

https://www.merriam-webster.com/medical/iatrogenesis

Meksuła, D., Mikołajczyk, K., Plechawska-Wójcik, M., & Borys, M. (2018). The use of eye-tracking

methods for evaluation of responsive web application. *Journal of Computer Sciences

Institute*, *6*, 20–27. https://doi.org/10.35784/jcsi.634

Middleton, B., Bloomrosen, M., Dente, M. A., Hashmat, B., Koppel, R., Overhage, J. M., Payne, T.

H., Rosenbloom, S. T., Weaver, C., & Zhang, J. (2013). Enhancing patient safety and

quality of care by improving the usability of electronic health record systems:

Recommendations from AMIA. *Journal of the American Medical Informatics Association*,

20(e1), e2–e8. https://doi.org/10.1136/amiajnl-2012-001458

Morris, M. C., Marco, M., Maguire-Jack, K., Kouros, C. D., Im, W., White, C., Bailey, B., Rao, U., &

Garber, J. (2019). County-level socioeconomic and crime risk factors for substantiated

child abuse and neglect. *Child Abuse & Neglect*, *90*, 127–138.

https://doi.org/10.1016/j.chiabu.2019.02.004

Moshagen, M., & Thielsch, M. T. (2010). Facets of visual aesthetics. *International Journal of

Human-Computer Studies*, *68*(10), 689–709. https://doi.org/10.1016/j.ijhcs.2010.05.006

Offidani, C., Villani, A., Reale, A., Marchili, M. R., Aufiero, L. R., Moras, P., Lodise, M., Raucci, U.,

Barbieri, M. A., & Raponi, M. (2022). Early recognition of child abuse through screening

indicators at the emergency department: Experience of a tertiary urban pediatric

hospital. *Italian Journal of Pediatrics*, *48*(1), 32. https://doi.org/10.1186/s13052-022-01214-9

Pal, D., & Vanijja, V. (2020). Perceived usability evaluation of Microsoft Teams as an online learning platform during COVID-19 using system usability scale and technology acceptance model in India. *Children and Youth Services Review*, *119*, 105535. https://doi.org/10.1016/j.childyouth.2020.105535

Patel, B. (2021, August 13). *Number of EC visits under 12 months old* [Personal communication].

Paterno, M. D., Maviglia, S. M., Gorman, P. N., Seger, D. L., Yoshida, E., Seger, A. C., Bates, D. W., & Gandhi, T. K. (2009). Tiering Drug–Drug Interaction Alerts by Severity Increases Compliance Rates. *Journal of the American Medical Informatics Association*, *16*(1), 40–46. https://doi.org/10.1197/jamia.M2808

Paul, A. R., & Adamo, M. A. (2014). Non-accidental trauma in pediatric patients: A review of epidemiology, pathophysiology, diagnosis and treatment. *Translational Pediatrics*, *3*(3), 195–207. https://doi.org/10.3978/j.issn.2224-4336.2014.06.01

Pickering, B., Bartholomew, R., Nouri Janian, M., López Moreno, B., & Surridge, M. (2020). Ask Me No Questions: Increasing Empirical Evidence for a Qualitative Approach to Technology Acceptance. In M. Kurosu (Ed.), *Human-Computer Interaction. Design and User Experience* (pp. 125–136). Springer International Publishing. https://doi.org/10.1007/978-3-030-49059-1_9

Pierce, M. C., Smith, S., & Kaczor, K. (2009). Bruising in infants: Those with a bruise may be abused. *Pediatric Emergency Care*, *25*(12), 845–847. https://doi.org/10.1097/PEC.0b013e3181c06217

Powers, E. M., Shiffman, R. N., Melnick, E. R., Hickner, A., & Sharifi, M. (2018). Efficacy and

unintended consequences of hard-stop alerts in electronic health record systems: A

systematic review. *Journal of the American Medical Informatics Association*, *25*(11),

1556–1566. https://doi.org/10.1093/jamia/ocy112

Press, A., DeStio, C., McCullagh, L., Kapoor, S., Morley, J., & Conigliaro, J. (2016). Usability Testing

of a National Substance Use Screening Tool Embedded in Electronic Health Records.

JMIR Human Factors, *3*(2). https://doi.org/10.2196/humanfactors.5820

Puls, H. T., Anderst, J. D., Bettenhausen, J. L., Masonbrink, A., Markham, J. L., Plencner, L.,

Krager, M., Johnson, M. B., Walker, J. M., Greeley, C. S., & Hall, M. (2018). Potential

Opportunities for Prevention or Earlier Diagnosis of Child Physical Abuse in the Inpatient

Setting. *Hospital Pediatrics*, *8*(2), 81–88. https://doi.org/10.1542/hpeds.2017-0109

Ratwani, R. M., Moscovitch, B., & Rising, J. P. (2018). Improving Pediatric Electronic Health

Record Usability and Safety Through Certification: Seize the Day. *JAMA Pediatrics*,

172(11), 1007–1008. https://doi.org/10.1001/jamapediatrics.2018.2784

Ravichandiran, N., Schuh, S., Bejuk, M., Al-Harthy, N., Shouldice, M., Au, H., & Boutis, K. (2010).

Delayed identification of pediatric abuse-related fractures. *Pediatrics*, *125*(1), 60–66.

https://doi.org/10.1542/peds.2008-3794

Richardson, S., Mishuris, R., O'Connell, A., Feldstein, D., Hess, R., Smith, P., McCullagh, L.,

McGinn, T., & Mann, D. (2017). "Think aloud" and "Near live" usability testing of two

complex clinical decision support tools. *International Journal of Medical Informatics*,

106, 1–8. https://doi.org/10.1016/j.ijmedinf.2017.06.003

Riney, L. C., Frey, T. M., Fain, E. T., Duma, E. M., Bennett, B. L., & Kurowski, E. M. (2018).

  Standardizing the Evaluation of Nonaccidental Trauma in a Large Pediatric Emergency

  Department. *Pediatrics*, *141*(1). https://doi.org/10.1542/peds.2017-1994

Riney, L. C., Frey, T. M., Fain, E. T., Duma, E. M., Bennett, B. L., & Murtagh Kurowski, E. (2018).

  Standardizing the Evaluation of Nonaccidental Trauma in a Large Pediatric Emergency

  Department. *Pediatrics*, *141*(1), 10.1542/peds.2017-1994. Epub 2017 Dec 6.

Rogers, E. (2003). *Diffusion of Innovations* (5th ed.). Free Press.

Romano Bergstrom, J. C., Olmsted-Hawala, E. L., & Jans, M. E. (2013). Age-Related Differences in

  Eye Tracking and Usability Performance: Website Usability for Older Adults. *International*

  Journal of Human–Computer Interaction, *29*(8), 541–548.

  https://doi.org/10.1080/10447318.2012.728493

Rosenthal, B., Skrbin, J., Fromkin, J., Heineman, E., McGinn, T., Richichi, R., & Berger, R. P. (2019).

  Integration of physical abuse clinical decision support at 2 general emergency

  departments. *Journal of the American Medical Informatics Association : JAMIA*, *Journal*

  Article.

Rumball-Smith, J., Fromkin, J., Rosenthal, B., Shane, D., Skrbin, J., Bimber, T., & Berger, R. P.

  (2018). Implementation of routine electronic health record-based child abuse screening

  in General Emergency Departments. *Child Abuse & Neglect*, *85*, 58–67.

  https://doi.org/10.1016/j.chiabu.2018.08.008

Safaeinili, N., Brown-Johnson, C., Shaw, J. G., Mahoney, M., & Winget, M. (2020). CFIR

  simplified: Pragmatic application of and adaptations to the Consolidated Framework for

  Implementation Research (CFIR) for evaluation of a patient-centered care transformation

within a learning health system. *Learning Health Systems*, *4*(1), e10201.

https://doi.org/10.1002/lrh2.10201

Sauro, J. (2011, February 3). *Measuring Usability with the System Usability Scale (SUS) –*

MeasuringU. https://measuringu.com/sus/

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-

analytic structural equation modeling approach to explaining teachers' adoption of

digital technology in education. *Computers & Education*, *128*, 13–35.

https://doi.org/10.1016/j.compedu.2018.09.009

Schouten, M. C., van Stel, H. F., Verheij, T. J., Houben, M. L., Russel, I. M., Nieuwenhuis, E. E., &

van de Putte, E. M. (2017). The Value of a Checklist for Child Abuse in Out-of-Hours

Primary Care: To Screen or Not to Screen. *PLoS ONE*, *12*(1).

https://doi.org/10.1371/journal.pone.0165641

Schumacher, R. M., Berkowitz, L., Abramson, P., & Liebovitz, D. (2010). Electronic Health

Records: Physician's Perspective on Usability. *Proceedings of the Human Factors and*

Ergonomics Society Annual Meeting, *54*(12), 816–820.

https://doi.org/10.1177/154193121005401202

Sheets, L. K., Leach, M. E., Koszewski, I. J., Lessmeier, A. M., Nugent, M., & Simpson, P. (2013a).

Sentinel Injuries in Infants Evaluated for Child Physical Abuse. *Pediatrics*, *131*(4), 701–

707. https://doi.org/10.1542/peds.2012-2780

Sheets, L. K., Leach, M. E., Koszewski, I. J., Lessmeier, A. M., Nugent, M., & Simpson, P. (2013b).

Sentinel Injuries in Infants Evaluated for Child Physical Abuse. *Pediatrics*, *131*(4), 701–

707. https://doi.org/10.1542/peds.2012-2780

Sittig, D. F., & Singh, H. (2012). Electronic Health Records and National Patient-Safety Goals. *New England Journal of Medicine*, *367*(19), 1854–1860. https://doi.org/10.1056/NEJMsb1205420

Sittig, J. S., Post, E. D. M., Russel, I. M. B., van Dijk, I. A. G., Nieuwenhuis, E. E. S., & van de Putte, E. M. (2014). Evaluation of suspected child abuse at the ED; implementation of American Academy of Pediatrics guidelines in the Netherlands. *The American Journal of Emergency Medicine*, *32*(1), 64–66. https://doi.org/10.1016/j.ajem.2013.08.038

Sittig, J. S., Uiterwaal, C. S. P. M., Moons, K. G. M., Russel, I. M. B., Nievelstein, R. A. J., Nieuwenhuis, E. E. S., & Putte, E. M. van de. (2016). Value of systematic detection of physical child abuse at emergency rooms: A cross-sectional diagnostic accuracy study. *BMJ Open*, *6*(3), e010788. https://doi.org/10.1136/bmjopen-2015-010788

Sittig, J. S., Uiterwaal, C. S. P. M., Moons, K. G. M., Russel, I. M. B., Nievelstein, R. a. J., Nieuwenhuis, E. E. S., & van de Putte, E. M. (2016a). Systematic detection of physical child abuse at emergency rooms. *Nederlands Tijdschrift Voor Geneeskunde*, *160*, D672.

Sittig, J. S., Uiterwaal, C. S. P. M., Moons, K. G. M., Russel, I. M. B., Nievelstein, R. A. J., Nieuwenhuis, E. E. S., & van de Putte, E. M. (2016b). Value of systematic detection of physical child abuse at emergency rooms: A cross-sectional diagnostic accuracy study. *BMJ Open*, *6*(3). https://doi.org/10.1136/bmjopen-2015-010788

State Child Health Coordinator. (2020). *Medical Child Abuse Resources and Education System Biennial Report 2019—2020* (p. 34). Texas Department of State Health Services.

Stilwell, L., Golonka, M., Ankoma-Sey, K., Yancy, M., Kaplan, S., Terrell, L., & Gifford, E. J. (2022). Electronic Health Record Tools to Identify Child Maltreatment: Scoping Literature Review

and Key Informant Interviews. *Academic Pediatrics*, *22*(5), 718–728.

https://doi.org/10.1016/j.acap.2022.01.017

Teo, T. (2011). Technology Acceptance Research in Education. In T. Teo (Ed.), *Technology*

Acceptance in Education (pp. 1–5). SensePublishers. https://doi.org/10.1007/978-94-

6091-487-4_1

Țichindelean, M., Țichindelean, M. T., Cetină, I., & Orzan, G. (2021). A Comparative Eye Tracking

Study of Usability—Towards Sustainable Web Design. *Sustainability*, *13*(18), Article 18.

https://doi.org/10.3390/su131810415

Todd, B., Shinthia, N., Nierenberg, L., Mansour, L., Miller, M., & Otero, R. (2021). Impact of

Electronic Medical Record Alerts on Emergency Physician Workflow and Medical

Management. *The Journal of Emergency Medicine*, *60*(3), 390–395.

https://doi.org/10.1016/j.jemermed.2020.10.017

Universal Screening Guidance: Mental Health, Social, Emotional, and Behavioral Health. (2021).

Rhode Island Department of Education.

Usability and Provider Burden | HealthIT.gov. (n.d.). Retrieved September 26, 2021, from

https://www.healthit.gov/topic/usability-and-provider-burden

Usability and Provider Burden | HealthIT.gov. (2019, May 30).

https://www.healthit.gov/topic/usability-and-provider-burden

Vaithianathan, R., Putnam-Hornstein, E., Chouldechova, A., Benavides-Prado, D., & Berger, R.

(2020). Hospital Injury Encounters of Children Identified by a Predictive Risk Model for

Screening Child Maltreatment Referrals: Evidence From the Allegheny Family Screening

Tool. *JAMA Pediatrics*, *174*(11), e202770.

https://doi.org/10.1001/jamapediatrics.2020.2770

Velsen, L. van, Evers, M., Bara, C.-D., Akker, H. O. den, Boerema, S., & Hermens, H. (2018).

Understanding the Acceptance of an eHealth Technology in the Early Stages of

Development: An End-User Walkthrough Approach and Two Case Studies. *JMIR*

Formative Research, *2*(1). http://dx.doi.org/10.2196/10474

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance

Model: Four Longitudinal Field Studies. *Management Science*, *46*(2), 186.

https://doi.org/10.1287/mnsc.46.2.186.11926

Walji, M. F., Kalenderian, E., Piotrowski, M., Tran, D., Kookal, K. K., Tokede, O., White, J. M.,

Vaderhobli, R., Ramoni, R., Stark, P. C., Kimmes, N. S., Lagerweij, M., & Patel, V. L. (2014).

Are three methods better than one? A comparative assessment of usability evaluation

methods in an EHR. *International Journal of Medical Informatics*, *83*(5), 361–367.

https://doi.org/10.1016/j.ijmedinf.2014.01.010

Wang, C.-T. (2007). *Total Estimated Cost of Child Abuse and Neglect in the United States*. 5.

Weiner, J. P., Kfuri, T., Chan, K., & Fowles, J. B. (2007). "e-Iatrogenesis": The Most Critical

Unintended Consequence of CPOE and other HIT. *Journal of the American Medical*

Informatics Association, *14*(3), 387–388. https://doi.org/10.1197/jamia.M2338

Wildenbos, G. A., Peute, L., & Jaspers, M. (2018). Aging barriers influencing mobile health

usability for older adults: A literature based framework (MOLD-US). *International Journal*

of Medical Informatics, *114*, 66–75. https://doi.org/10.1016/j.ijmedinf.2018.03.012

Wood, J. N., Feudtner, C., Medina, S. P., Luan, X., Localio, R., & Rubin, D. M. (2012). Variation in

occult injury screening for children with suspected abuse in selected US children's

hospitals. *Pediatrics*, *130*(5), 853–860. https://doi.org/10.1542/peds.2012-0244

Wood, J. N., Hall, M., Schilling, S., Keren, R., Mitra, N., & Rubin, D. M. (2010). Disparities in the

evaluation and diagnosis of abuse among infants with traumatic brain injury. *Pediatrics*,

126(3), 408–414. https://doi.org/10.1542/peds.2010-0031

Zahabi, M., Kaber, D. B., & Swangnetr, M. (2015a). Usability and Safety in Electronic Medical

Records Interface Design: A Review of Recent Literature and Guideline Formulation.

Human Factors, *57*(5), 805–834. https://doi.org/10.1177/0018720815576827

Zahabi, M., Kaber, D. B., & Swangnetr, M. (2015b). Usability and Safety in Electronic Medical

Records Interface Design: A Review of Recent Literature and Guideline Formulation.

Human Factors, *57*(5), 805–834. https://doi.org/10.1177/0018720815576827

Zhang, J., & Walji, M. (2011). TURF: Toward a unified framework of EHR usability. *Journal of

Biomedical Informatics*, *44*, 1056–1067.

Zhang, J., & Walji, M. (2014). *Better EHR: Usability, workflow and cognitive support in electronic

health records* (First). The National Center for Cognitive Informatics and Decision Making

in Healthcare.

Zhu, M., & Zhang, Y. (2021). Medical and public health instructors' perceptions of online

teaching: A qualitative study using the Technology Acceptance Model 2. *Education and

Information Technologies*. https://doi.org/10.1007/s10639-021-10681-2

Zopf-Herling, K. M. (2011). Enhancing Usability in EMR Screen Design. *CIN: Computers,*

Informatics, Nursing, *29*(12), 679–691.

https://doi.org/10.1097/NCN.0b013e31823ea54e

Appendix A: Glossary of Terms

Child injury panel / non-accidental trauma workup

A battery of tests to further assess the extent of the injuries the child may

have suffered (Paul & Adamo, 2014)

e-Iatrogenesis   Patient harm caused at least in part by the application of health

information technology (Weiner et al., 2007)

Heuristic questions   Using the strategies derived from previous experiences with similar

problems (Emiliano, 2015)

Iatrogenesis   Inadvertent and preventable induction of disease or complications by the

medical treatment or procedures of a physician or surgeon (*Medical*

Definition of IATROGENESIS, n.d.)

Likert scale   A psychometric scale commonly involved in research; respondents

specify their level of agreement or disagreement on a symmetric agree-

disagree scale for a series of statements (Likert, 1932)

Low-level universal screening tool

A short assessment administered to a broad population that is easy to

score (*Universal Screening Guidance*, 2021)

Perceptuo-cognitive capacity

The upper limit of how much perceptual data can be processed (Zahabi et al., 2015a)

Sentinel injuries   A previous injury reported in the medical history that was suspicious of abuse or the explanation was implausible (Sheets et al., 2013a)

Sequela   A condition that is the consequence of a previous disease or injury, an aftereffect of a disease, condition, or injury (*Definition of SEQUELA*, n.d.)

Social and economic supports

Help to sign up for Medicaid, WIC, or accessing other supports for food and housing security, transportation help for medical appointments, and education in parenting skills

Socially impoverished

A key aspect is an exchange between neighbors: social interactions and more tangible assistance exchanges. (Maguire-Jack & Font, 2017b)

Appendix B: Project Management Plan

Project Overview

Literature shows that 27% to 56% of victims with major abuse injuries seen in hospitals had sentinel injuries assessed by the medical community prior to that major injury (Guenther et al., 2010; Lindberg et al., 2015a; Pierce et al., 2009; Ravichandiran et al., 2010; Sheets et al., 2013a). However, these sentinel injuries go undetected or unreported by clinicians because, among other reasons, training in abuse and neglect detection is limited and not mandatory; therefore, clinicians often do not feel confident in their ability to recognize it, or they genuinely miss the diagnosis entirely (Drinkwater et al., 2017; Lee et al., 2012). The American Academy of Pediatrics (AAP) recommends screening for child abuse and neglect by clinicians to help prevent future injuries (AAP, n.d.). The Joint Commission also requires that "possible victims of abuse are identified," which has been interpreted to mean every child at every visit to a hospital should be screened for abuse (Joint Commission Standard PC 01.02.09 on Victims of Abuse, 2009).

To date, only one screening tool specifically aimed at child abuse has been extensively tested; the Escape instrument, "a six-question checklist addressing risk factors for child abuse" (Bailhache et al., 2013; Dinpanah & Akbarzadeh Pasha, 2017; Gilchrist et al., 2019; E. C. F. M. Louwers et al., 2014; McTavish et al., 2020b). There is only one study published on the electronic implementation of this tool (Rumball-Smith et al., 2018). Based on this author's conversations at a national conference on child abuse screening, a few other hospitals across the nation have begun electronic implementation, but no review of their work has been conducted or published. Work on ideal implementation practices with this tool electronically is

missing from the literature entirely. In order to achieve the greatest effectiveness, implementation standards must be determined.

There is currently no standard practice for child abuse identification at Texas Children's Hospital Emergency Departments. There is a "yes / no" option above a verbose yet vague description of abuse that is not child specific within EPIC, the electronic medical record (EMR) system in place. According to interviews with the staff, this is often ignored in practice. Some staff were not aware it was present. In the cases where child abuse is suspected, an order for social work is entered, and usually, within about 30 minutes to an hour, a social worker trained in child abuse identification comes to interview the child, and whichever caregivers are present as well as the clinicians who have interacted with them. If the team suspects child abuse, a report is made to child protective services (CPS). TCH has child abuse experts within the system and prioritizes protecting children. Therefore, they have sought to update their screening practices. This project seeks to address the lack of universal screening in the TCH ECs by implementing a modified Escape child abuse screening tool into EPIC and creating appropriate review and reporting protocols to put into practice.

Problem

Summary of Literature

The practice of screening for child abuse is still new to the field of medicine but is supported as an effective practice. The effectiveness of the practice is largely dependent on using well-planned protocols, which are missing from the literature. Electronic implementation of child abuse screening is a burgeoning approach.

Problem Statement

Many children who suffer from abuse touch the medical system at some point but are not identified and offered help because of a lack of provider education and universal screening. As EMRs replace paper charts in hospitals, the screening tools we use must be adapted to fit the technology appropriately. Best practices for provider education and implementation protocols are lacking.

Table 16 *Review of Evidence*

Author & Year	Summary
(Bailhache et al., 2013)	A systematic review of literature on screening for child abuse in hospitals. Showed sensitivity and specificity ranging from 50% to 98%.
(Benger & Pearce, 2002)	Retrospective chart review of 2,000 preschool children in a suburban teaching hospital's emergency department. They found that adding a reminder sticker with a flowchart to the attendance notes increased documentation of possible intentional injury and improved referral rates.
(Berger & Lindberg, 2019a)	A position paper by industry experts in child abuse detection and electronic implementation of screening supports universal screening in emergency departments because it leads to increased identification and reporting.

(D. C. Chang et al., 2005)	Used discharge data from 1,961 hospitals & 17 states to run a retrospective database review (n=58,558) on child abuse detection variables.
(Dinpanah & Akbarzadeh Pasha, 2017)	Escape screening tool, paper based, implemented in a hospital emergency department, screening all children 16 years and younger (n=6,120). Screening rates more than tripled in 3 months. Detection rate increased 5-fold.
(Gilchrist et al., 2019)	Found that clinicians looked favorably on using a universal child abuse screening tool and found it user friendly.
(Gonzalez & Deans, 2017a)	Implementation of hospital-based screening protocols for detection of intentional injuries should be multidimensional and include education programs for the healthcare providers that triage and manage at-risk patients, automated notes, checklists, and flow charts incorporated within the EMR to create warning notifications, and a multidisciplinary team of practitioners.
(Lee et al., 2012)	Pediatric nurses self-report increased perceived self-efficacy in child abuse detection after education and colleague support.
(Letson et al., 2016)	Retrospective chart review of 232 children that presented at tertiary care children's hospitals with severe abusive head trauma. One third of them had prior opportunities for identification and intervention.

(Lindberg et al., 2015a)	Retrospective database analysis of ICD-9 codes that identified abused children to find putative sentinel injuries. Different facilities had varying degrees of ability to identify occult injuries as abusive.
(Lorenz et al., 2018)	Expert panel review was determined to be a highly accurate way to classify possible abuse cases. Nearly perfect agreement with the corroborative classification.
(Louwers et al., 2011)	Detection of suspected child abuse 3 times higher in hospitals with screening guidelines in place than those without.
(Louwers et al., 2012a)	Within hospitals that screened for child abuse, detection was 5 times higher among patients that were screened than those that were not screened.
(Louwers et al., 2012b)	Position paper by expert multidisciplinary panel supporting national guidelines on universal child abuse screening and instrument.
(Louwers et al., 2014)	Supported the need for minimizing the time and effort it takes to conduct screening in emergency departments. Instruments should be as limited as possible without decreasing reliability.
(McTavish et al., 2020b)	Systematic review, update from 2013. Specificity is pretty high in most tools and wide degrees of sensitivity.
(Riney, Frey, Fain, Duma, Bennett, &	Quality improvement project that increased guideline-adherent evaluation for patients with provider concern for non-accidental

Murtagh Kurowski, 2018)	trauma. Education and support at the point of care were key drivers for implementation.
(Rosenthal et al., 2019)	A retrospective chart review using a clinical decision support system increased identification of possible suspicious cases 4-fold. Half of participating physicians said seeing the alert changed their perspective on the injury.
(Rumball-Smith et al., 2018)	Escape child abuse screening tool integrated into the EMR at 13 emergency departments. 3-fold increased detection of possible child abuse in children that were screened.
(Sheets et al., 2013a)	Retrospective chart review of infants 12months and younger who had presented to an emergency department. Sentinel injuries were common for cases where abuse was confirmed, occasionally present for cases with concern for abuse and absent in cases without abuse.
(J. S. Sittig et al., 2014)	Having a structured child abuse detection procedure in place could increase the detection rate just by improving awareness.

Proposed Solution

Table 17 *IT Solution*

Name of IT Solution:	**Modified Escape child abuse screening tool adapted to be implemented into EPIC**
Problem Statement	Many children who suffer from abuse touch the medical system at some point but are not identified and offered help because of a lack of provider education and lack of universal screening. As EMRs replace paper charts in hospitals the screening tools we use must be adapted to appropriately fit the technology. Best practices for provider education and implementation protocols are lacking.
Vendor Name	**EPIC vendor for EHR**
Description of IT Solution	The modified Escape tool will be implemented into the workflow in the emergency departments for stable infants under 12 months. Positive screens will trigger review with a physician and possibly a social work consult. Education modules on child abuse identification will be put together and rolled out before the implementation of the screening tool.

Project Integration

The organization (chart)

Figure 25

Organizational chart

Baylor College of Medicine / Texas Children's Hospital
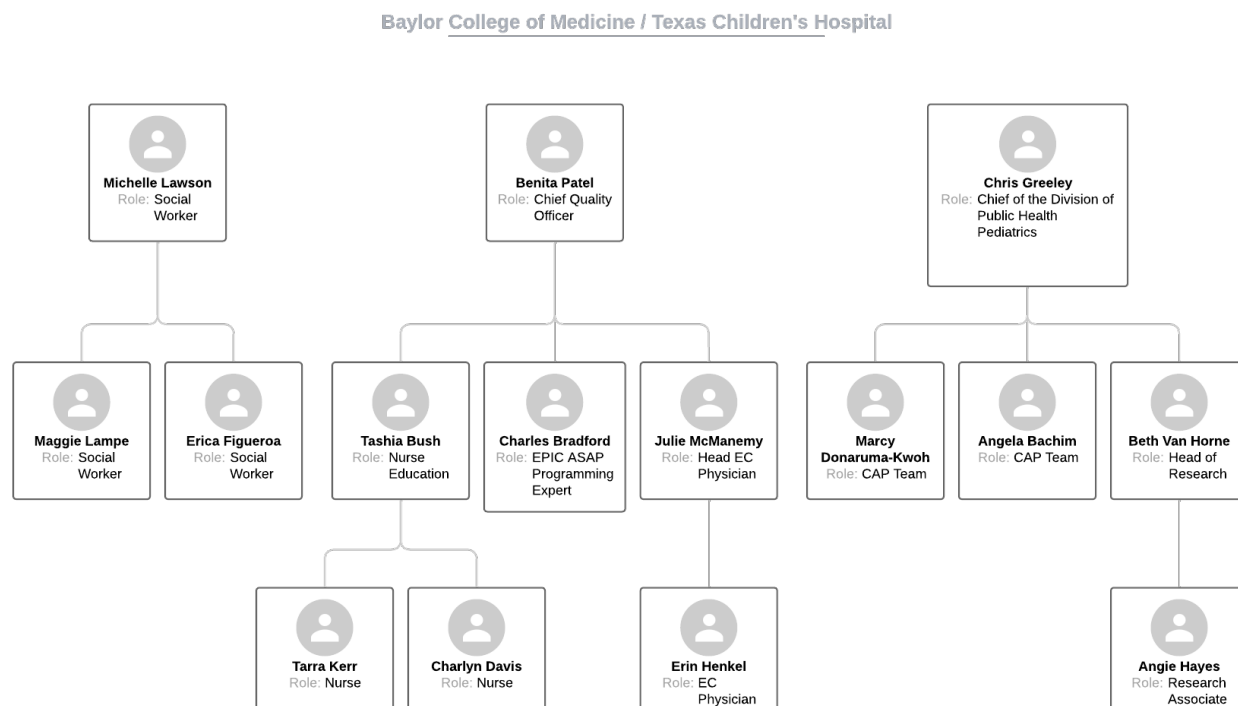
Dr. Alter System Snapshot (chart)

<u>*Work System Snapshot*</u>

Customers	Products & Services
End users involved in child abuse detection in the emergency departments include:	Products and services involved in child abuse detection in the emergency departments
• Room nurses • Fellows & Attending Physicians	• Screening instrument in EPIC • internal documentation tool

| Child abuse specialist social workers Child Protection Team (CPT) Patients/person(s) who brought the patient in | |

Major Activities or Processes

Processes that are part of child abuse screening in the emergency department:

1. Infant under 12 months checks into TCH EC

2. Triage nurse determines the patient is stable

3. The patient is placed in a room

4. The room nurse assesses the patient and completes the screening tool in the EMR

   a. Documents concerns if the screen is positive

5. Room nurse discusses and plans with the physician

6. Physician conducts the assessment of the patient

   a. Documents concerns if they also share the nurses concern

   b. Puts in an order for social work consult

   c. Orders a NAT if needed

7. Social work team conducts an assessment of the patient and caregiver

8. Social work, physician, and nurse discuss together

   a. If they agree, a report to CPS is made

9. Social work completes their internal report

Participants	Information	Technologies
- nurses - Fellows & attending physicians - Social work team - Child Protection Team	Observations of clinical staff and social workers	EPIC

(Alter, 2006)

Project Scope Management

Scope statement and project charter

Project:	Child Abuse Screening in an EMR
Title:	Project Charter
Document number:	1
Version	1.1
Document status:	Draft
Author:	Hayes, Angela K.
Responsible:	Hayes, Angela K.
Date created:	02/09/2021
Protection class:	"For internal use only"

Project Purpose and Justification. The emergency department child abuse screening implementation project has been proposed and justifies planning, redesign, and implementation of a revised workflow in the emergency departments for future child abuse screening protocols. The purpose of this project is to implement a universal child abuse screening tool for infants under 12 months in all Texas Children's Hospital emergency departments in order to detect possible child abuse more effectively to prevent future trauma for those children. The Joint Commission has charged all hospitals with the identification of violence against children. The American Academy of Pediatrics also encourages all pediatricians to be educated on and on the lookout for signs of possible abuse when treating any child. While more severe cases are recognized and reported there are many cases of sentinel injuries that could prevent future severe injury if identified early on. Universal screening increases accurate detection and decreases biases in detection. The success of this child abuse screening implementation is expected to increase accurate detection of possible child abuse and lead to the prevention of future more severe injuries.

Scope Description. The scope of the emergency department child abuse screening project is to plan, implement and evaluate the child abuse screening tool in the electronic medical record. Implementation will include education on child abuse detection and use of the screening tool for all clinicians involved in the process. The screening tool is a "first line of defense" and is not considered a diagnostic tool. It will be used by the room nurse to bring up questions about a situation they may not have thought of to help them detect possible cases of abuse. Following a positive screen, the nurse will then involve the physician and possibly social

work child abuse experts. Evaluation involves a regular multidisciplinary review of all positive

cases. The scope of this project includes all requirements in the information gathering, planning,

design, educating, development, and implementation of the emergency department child abuse

screening tool.

Boundaries. The screening tool usage is restricted to patients presenting at the

emergency department that are stable and under 12 months of age. The clinician education

component of this project is restricted to initial roll out of the education module, not follow up

education, education of new hires, or evaluation of the education tool directly. This section may

be expanded upon consultation with other departments in TCH.

Strategies. For the emergency department child abuse screening tool implementation,

the project team will test the visual display and the workflow of the new tool. The EPIC

management experts at TCH will assist in coding, testing, configuration, and troubleshooting of

the tool in EPIC for the project.

Assumptions. Several assumptions have been made in the conception of this project.

Stakeholders should be aware of such assumptions. The screening tool must be designed in a

way that future encounters with TCH staff are not colored by notes in the tool. Additionally,

parents/guardians should not be able to view the screening tool or results in the medical record

electronically or otherwise. Lastly, we are assuming that the order for social work consultation

will come with the ability for the physician to triage the order the social workers are needed when there are many cases in the emergency department at the same time.

     Constraints. Several constraints are on this project. Stakeholders should be aware of such constraints. The project must fit into the current workflow without hindering clinicians' ability to provide quality care to all patients. It must also fit into the time and budget constraints imposed.

Requirements / characteristics

Table 18 *System/solution features, capabilities, and functions*

	Desired Functionality	Existing Functionality	Change / New	Justification for the Desired Functionality	Stakeholders / Business impacted	Priority
1	Restricted access to the tool and screening results by parent/ guardian	None	New	This is sensitive information whether it is a false positive or a true positive and restricting follows the literature on best practices	EPIC build team	High
2	Restricted access to the tool and screening results by future clinicians at future visits	None	New	This is sensitive information whether it is a false positive or a true positive and restricting follows the literature on best practices	EPIC build team	High

3	Alerts visible only to attending or fellows in the EC and not to residents	None	New	Residents sometimes access the EMR before assessing the patient or for patients they are not assessing as a learning process and don't need this information	EPIC build team	High
4	Education modules need to be individualized to the type of user (RN, MD, SW)	None	New	General education best practices include specialization of education modules to the users' needs	Education project sub-team, clinicians	Medium
5	Screening tool should only appear in the EMR if the patient is under 12 months	None	New	It makes compliance easier for the RNs. They don't have to consider whether the patient is eligible.	End user RNs	Medium

Table 19 *User requirements based on the interview or literature*

	Desired Functionality	Existing Functionality	Change / New	Justification for the Desired Functionality	Stakeholders / Business impacted	Priority
1	Flexible (by campus) requirements in workflow around when the RN, MD, & SW should consult together	None	New	Flexibility is required to accommodate the workload and patient influx in the EC	End user RNs, MDs, & SWs	High
2	Ability to triage / prioritize calls for SW consult in the case there are multiple calls in one time period	Manual	Change	There is only 1 social work team on call and there may be instances where one patient is in need of consult before another	End user RNs, MDs, & SWs	High
3	Tool should be easy to use, require very little free text note taking	None	New	The amount of time the room nurse spends with the patient should not be extended	RNs	High

				inordinately for a screening tool that is not diagnostic.		
4	Implementation into workflow must not inhibit clinicians' ability to provide care to all patients	None	New	High adoption and retention rates depend on the functionality of the tool within the workflow	All ED	High
5	Screening tool should be implemented by the room RN and not the triage RN	None	New	This fits the workflow the best	RNs	High

Acceptance criteria

The acceptance criteria define the boundaries of the user requirements and will be used to confirm that the child abuse screening tool protocol is working as intended. The protocols will meet all of the following criteria:

- The screening tool only triggers when the patient is under 12 months

- The call for consult with SW and call for CIP/NAT trigger appropriately when selected

- Screening data are preserved on the back end for quality control but not accessible by parents/guardians or clinicians at future visits

- At 90 days there is a 60% adoption rate by users

Project deliverables

There are several deliverables which will be produced because of the successful implementation of the child abuse screening tool into the EMR. If all the following are not met, then the project will not be considered successful.

- Deliverable 1: A tested and operational screening tool system, free of errors

- Deliverable 2: A tested and operational response protocol for positive screens

- Deliverable 3: Virtual education modules that address both the use of the tool / protocols and child abuse detection with certification

- Deliverable 4: An assessment of the screening tool by reviewing the positive screens after the 90-day implementation pilot

SWOT analysis

Table 20

Business planning SWOT

INTERNAL FACTORS	
STRENGTHS (+)	WEAKNESSES (-)
- TCH has the largest public health and child abuse pediatrics team in the nation. - Division is led by a nationally renowned child abuse expert. - TCH is committed to protecting children and supports the goal of identifying child abuse at patient encounters.	- Work flow change is always hard. Getting buy in from end users could be difficult. - Creating sufficient education for providers to avoid over identification while not under identifying victims of abuse is a difficult and fine line to walk. - There are many projects going on.

• The EC teams are committed to protecting children and are open to the idea of this change in workflow to better identify children at risk.

EXTERNAL FACTORS

OPPORTUNITIES (+)	THREATS (-)
• Joint Commission requires screening all patients for violence and this fulfills that requirement. It is currently not done or not done well in many/most hospitals across the US. This could set precedence for	• Recent news reports ignorantly attacking child abuse pediatricians with unfounded claims. There potentially could be internal/external backlash that could thwart or delay the project.

how to do implement a new child abuse identification screening tool well. • Only a few other hospitals are currently doing work in this area and this gives TCH the opportunity to lead the way in safe child abuse identification • There is a small national and international movement to push for better identification and protection of vulnerable children. • There are some state legislators who support the protection of children and this opens the door to request funding/reimbursement for screening (CMS).	• Because of these reports, if the general public buys into the lies, they could stir up enough trouble to cause TCH to shy away. • If this causes an increase in reports, CPS could be stretched even thinner. • COVID has changed the demographics of the children brought into the ECs meaning many of the more minor cases that might have presented before are not presenting now.

PROJECT SCHEDULE MANAGEMENT (SCHEDULE)

Schedule development - Gantt chart

	20-Sep	20-Oct	20-Nov	20-Dec	21-Jan	21-Feb	21-Mar	21-Apr	21-May
BCM/TCH Kick off meeting	First meeting - Intro; Second meeting - screener selection								
Approval from legal	▓	▓	▓	▓	▓				
TCH/BCM Work Group		Protocol & New screener External Consultation	New screener & Work flow	Work flow	Protocol & response	▓	▓	▓	▓
Workflow analysis						▓	▓		
IRB approval									
Integration into EPIC									
Sandbox usability testing									
Provider education									
Go Live									
Follow up / assessment / analysis									

	21-Mar	21-Apr	21-May	21-Jun	21-Jul	21-Aug	21-Sep	21-Oct	21-Nov
BCM/TCH Kick off meeting									
Approval from legal									
TCH/BCM Work Group									
Workflow analysis									
IRB approval									
Integration into EPIC									
Sandbox usability testing									
Provider education									
Go Live									
Follow up / assessment / analysis									

	21-Dec	22-Jan	22-Feb	22-Mar	22-Apr	22-May	22-Jun	22-Jul	22-Aug
BCM/TCH Kick off meeting									
Approval from legal									
TCH/BCM Work Group		Provider education development	Provider education development	Provider education testing	Deploy Provider Education				
Workflow analysis									
IRB approval									
Integration into EPIC									
Sandbox usability testing									
Provider education									
Go Live									
Follow up / assessment / analysis									

Schedule control

ID	Name	Start	Finish	Resources	Completion	Days in total	Weekend days	Days completed	Days remaining	Days of delay
0	Child Abuse Screening Implementation Project	9/15/2020	4/30/2022			593	169	0	593	164
1	TCH/BCM Project Team Meetings	9/16/2020	11/1/2021		40%	412	118	164	248	
2	Approval from Legal	2/1/2021	4/30/2021		25%	89	24	22	67	3
3	IRB Approval	3/1/2021	4/30/2021		20%	61	16	12	49	
3.1	UTH	3/1/2021	3/31/2021			31	8	0	31	
3.2	BCM	4/1/2021	4/30/2021			30	8	0	30	
4	Workflow Analysis	2/20/2021	4/30/2021		56%	70	20	38	32	
4.1	TMC Campus	2/20/2021	4/30/2021		66%	70	20	46	24	
4.2	Woodlands Campus	2/20/2021	4/30/2021		66%	70	20	46	24	
4.3	West Campus	2/20/2021	4/30/2021		0%	70	20	0	70	6
5	Develop new protocols & workflow	1/1/2021	4/30/2021		90%	120	34	108	12	
6	EPIC Build	5/1/2021	10/31/2021			184	54	0	184	
6.1	First draft	5/1/2021	7/1/2021			62	18	0	62	
6.2	End user testing	7/1/2021	8/1/2021			32	10	0	32	
6.3	Make adjustments	8/1/2021	10/31/2021			92	27	0	92	
7	Provider Education	3/15/2021	12/31/2021			292	82	0	292	
7.1	Create modules	3/15/2021	4/30/2021			47	12	0	47	
7.1.1	RN modules	3/15/2021	4/30/2021			47	12	0	47	
7.1.2	MD modules	3/15/2021	4/30/2021			47	12	0	47	
7.1.3	SW modules	3/15/2021	4/30/2021			47	12	0	47	
7.2	End user testing	5/1/2021	5/31/2021			31	10	0	31	
7.3	Make adjustments	6/1/2021	6/30/2021			30	8	0	30	
7.4	Deploy provider education	9/1/2021	11/1/2021			62	18	0	62	
8	Project Go Live	11/1/2021	4/30/2022			181	51	0	181	
9	Follow up & Analysis	2/1/2022	4/30/2022			89	25	0	89	
9.1	Provider interviews	2/1/2022	3/31/2022			59	16	0	59	
9.1.1	RN	2/1/2022	3/31/2022			59	16	0	59	
9.1.2	MD	2/1/2022	3/31/2022			59	16	0	59	
9.1.3	SW	2/1/2022	3/31/2022			59	16	0	59	
9.2	Data analysis	2/1/2022	4/30/2022			89	25	0	89	

PROJECT COST MANAGEMENT

Cost estimation

Texas Children's Hospital / Baylor College of Medicine

Child Abuse Screening in Ecs

Proposed 5 Year Total Cost of Ownership (TCO)

2022-2027

Vendor Cost	One-time Fees	Year 1	Year 2	Year 3	Year 4	Year 5	Total
None							
Organizational Cost	One-time Fees	Year 1	Year 2	Year 3	Year 4	Year 5	Total
EPIC ASAP (ER module) Expert Builder	$ 5,100						$ 5,100
Education Modules	$ 10,000						$ 10,000
Go-Live Support	$ 5,500						$ 5,500
End User Education		$ 23,000		$ 23,000		$ 23,000	$ 69,000
Followup / Verification		$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 750,000
Vendor Total	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Organizational Total	$ 20,600	$ 173,000	$ 150,000	$ 173,000	$ 150,000	$ 173,000	$ 839,600
Taxes - all salary costs, included above							$ -
Grand Total	$ 20,600	$ 173,000	$ 150,000	$ 173,000	$ 150,000	$ 173,000	$ 839,600

Budget

Activity Cost Estimate	$ 850,000
Activity Contingency Reserve	$ 85,000
Work Package Cost Estimate	$ 935,000

Work Package Cost Estimate	$ 935,000
Contingency Reserve	$ 93,500
Control Accounts	$ 1,028,500

Cost Baseline	$ 1,028,500
Management Reserve	$ 102,850
Project Budget	**$ 1,131,350**

Cost Excel sheet

Estimated Cost Breakdown			
Backfill/Build Team	No. of Required Build Hrs	Rate per hr	Total
EPIC ASAP (ER module) Expert Builder	80	$ 63.80	$ 5,104.00
Education Module Team	130	$ 70.00	$ 9,100.00
Social Worker * 1.5 for Follow up/review	15000	$ 50.00	$ 750,000.00
Sub Total	15210	$ 183.80	$ 764,204.00
Go-live Support	No. of Support Hrs	Rate per hr	Total
EPIC Experts * 3	30	$ 63.80	$ 1,914.00
Super Users * 3	72	$ 50.00	$ 3,600.00
Sub Total	102	$ 113.80	$ 5,514.00
Training/Materials	No. of Materials	Rate per hr	Total
Education Module Team	130	$ 70.00	$ 9,100.00
CNE/CME/CE Certification	3	$ 300.00	$ 900.00
Bi-annual education of providers	900	$ 75.00	$ 67,500.00
Sub Total	133	$ 370.00	$ 77,500.00

PROJECT QUALITY MANAGEMENT

Prepared by:	Angela Hayes
Date (MM/DD/YYYY):	3/1/2021

Planning

1. Deliverables and Acceptance Criteria	
Deliverables	**Acceptance Criteria / Applicable Standards**
1. Child abuse screening and response protocol	A workflow process that reasonably fits into current workflow standards and needs while providing care to children who are suspected victims of abuse.
2. EHR enabled screening tool and alert system	Error free tool and alert system that makes the information available to the MD without alert fatigue.
3. Education modules for RNs, MDs, & social workers	Modules fitted to their specific audience that follow best practices in education and learner engagement covering how the system works and education on child abuse identification.

Quality assurance (QA)

2. Quality Assurance Activities
▪ **What steps will you take to ensure that Quality is built into the production processes?**
User interviews and testing will be done with the protocol and screening tool/alerts before deployment. The education modules will be built following best practices in education and tested by the learners before deployment.
▪ **Will the test team work from a Test Plan? Do they understand their responsibilities?**
The test team will be walked through a test plan in order to ensure that the right information in gathered. They have not been brought up to speed on the project yet.
▪ **How will you ensure that Requirements are correct, complete and accurately reflect the needs of the Customer?**
Extensive interviews with testers will be conducted before and after deployment in order to determine if the needs are being met.
▪ **How will you verify that Specifications are an accurate representation of the Requirements?**
Specifications will be reviewed with the project team before the build and tested after the build to ensure they meet the requirements.
▪ **What steps will you take to ensure that the project plan (e.g. Risk Management Plan, Change Management Plan, Procurement Plan) is followed?**
Monthly/weekly (depending on where in the project we are) reviews of the plans and the progress of the project to ensure alignment.
▪ **Describe how *Requirement – Specification – Test Plan* traceability is managed (or provide Link_To_ Requirements_Traceability_Matrix**):
Documentation of all steps will be made including interviews and modifications made.
▪ **What audits and reviews are required and when will they be held?**
Informal reviews/spot checks will be conducted monthly to ensure compliance. Formal audit will be conducted after implementation.

2. Quality Assurance Activities
▪ **What will you measure to determine if the project is out of Scope?**
The scope will be reviewed and compared to progress regularly. The technical aspects and education aspects will be measured to hold them to scope.
▪ **What will you measure to determine if the project is within budget?**
There is no formal budget for this project.
▪ **What will you measure to determine if the project is within schedule?**
The progress and steps taken to date at review will be compared to the schedule plan

Quality control (QC)

3. Project Monitoring and Control
Define the following:
▪ **How will you ensure that adequate testing is done? How do you define "adequate"?**
When a majority of the test team agrees that the requirements are met then adequate testing has been conducted.
▪ **How will you report and resolve variances from acceptance criteria?**
Documentation of changes will be kept and reviewed with the project team at each meeting and compared with acceptance criteria.
▪ **At what milestones will testing and reviews take place – who and how will they do them?**
Once the screening tool and alert are built into EPIC, but not deployed, user testing will begin with the testing team. Testing will also be conducted with the testing team once the education modules are built.
▪ **What action by the Sponsor constitutes acceptance of deliverables at each phase?**

3. Project Monitoring and Control
Project meetings with updates and deliverables will be conducted at each phase and the sponsor will approve them with documentation made.
▪ **What action by the Sponsor constitutes "full and final acceptance" of final deliverables?**
The sponsor will sign off on the documentation showing full and final acceptance.

4. Project Quality Plan / Signatures			
Project Name:	Child Abuse Screening Implementation in Pediatric ERs		
Project Manager:	Angela Hayes		
I have reviewed the information contained in this Project Quality Plan *and agree:*			
Name	**Role**	**Signature**	**Date**

The signatures above indicate an understanding of the purpose and content of this document by those signing it. By signing this document, they agree to this as the formal Project Quality Plan *document.*

PROJECT COMMUNICATION MANAGEMENT

Project Name:	Child abuse screening in the ED
Project Manager:	Angie Hayes
Date:	3/30/2021

Recipient	Message	Assumptions	Timeline	Channel	Recipients Response	Responsible
Chris Greeley	project updates & feedback	That he stays abreast of current research in the area of child abuse	Monthly	video chat	feedback, ideas, personnel connections	Angie Hayes
Project team	project updates & feedback	That at least one rep from each area will be present at each meeting	every other month	video chat	feedback, ideas, personnel connections	Angie Hayes
Bradford, Charles H.	EPIC modifications	That he is still the local expert on the ASAP EPIC module.	As needed	video/voice chat	technical abilities of program, functionality, time line for changes being made	Angie Hayes
Donaruma-Kwoh, Marcella Marie	Child abuse training/education	That she will have/make time to help me build the training modules	starting in July	voice/video chat - in person later for video recording	knowledge of child abuse identification education process	Angie Hayes
Bush, Natashia R. (Tashia)	Nurse training process and CNE/CME process	That she will have/make time to help me build the training modules	starting in September	voice/video chat - in person later for video recording	knowledge of the EC training process and certification process	Angie Hayes

Figueroa, Erica	Social worker training/education	That she will have/make time to help me build the training modules	starting in September	voice/video chat - in person later for video recording	knowledge of social worker child abuse identification education process	Angie Hayes

Project Risk Management

Risk identification

Risk	Possible impacts on the project
Changes made in one EPIC module introducing unintended changes in other integrated modules	Temporary removal of the screening tool with a time delay while the problem is sorted out. Mitigation: integrated testing in the test environment to ensure it's not going to break something unexpected
A different project or work flow change is implemented before this project moves forward	Temporary delay in start time and/or changes to the project plan and implementation to work around the new processes in the emergency department.
Legislation or the "court of public opinion" could change the leadership's ability to approve the project	Temporary delay or permanent cancelation of the project
Issues with education module development or roll out	Temporary delay in start time
Legal department recommends against implementation	Temporary delay or permanent cancelation of the project

Risk analysis

Risk	Probability	Impact	Overall Risk Rating
Changes made in one EPIC module introducing unintended changes in other integrated modules	Before mitigation: 75% After mitigation: 10%	Low (easily mitigated)	Low
A different project or work flow change is implemented before this project moves forward	25%	Low	Low
Legislation or the "court of public opinion" could change the leadership's ability to approve the project	25%	Moderate	Moderate
Issues with education module development or roll out	50%	Low	Moderate
Legal department recommends against implementation	10%	Moderate	Low

Project Procurement Management

Procurement will not be needed in this project because the skills, equipment, and tools are all already available within the organization. The IT department is providing an EPIC expert to program the system with the new screening tool. The Child Abuse Pediatrics team is providing expert educators to develop enduring education modules on the identification of child abuse and the training department is hosting the modules along with other clinical education tools. There are no additional roles or positions created by implementing the new screening protocols.

Project Stakeholder Management

Stakeholder matrix

Tier 1 Stakeholders		
Senior Leaders and Key Decision Makers		
Ensuring project feasibility	**Name of person/group**	**Why exactly is this person/group important?**
Who can help fund the initiative?	• No funding needed, AQI project / if needed Section of Public Health & Child Abuse Pediatrics will find funding • *Chief of Public Health & Child Abuse Pediatrics; Dr. Chris Greeley*	• Funding is not needed as this is considered an AQI project • If something needs to be funded, it will happen through my department (PH&CAP) with either department funding or grant funding because my department is in charge of this area (child abuse prevention/treatment) for the entire hospital system.
Who can provide additional resources?	• N/A	• N/A
Who can decide whether or not the project can proceed, be terminiated or put on hold?	• Dr. Chris Greeley • Dr. Benita Patel, CQO • Dr. Julie McManemy	• Has decision making authority over my job and all child abuse prevention work in the hospital • Is the CQO and determines if projects are allowed in the ED • Head physician for the ED and can decide if this is good/bad for the ED

Who can remove obstacles and barriers that are beyond the project team's control?	• Everyone that can control obstacles are on the project team	• N/A
Who needs to approve/sign-off on deliverables?	• Drs. Greeley & Patel	• Has authority to approve/sign-off on deliverables
Who can help build additional senior level political support?	• Dr. Marcy Donaruma-Kwoh • Dr. Angela Bachim	• Have strong leadership roles in the child abuse department

Tier 2 Stakeholders		
Project Contributors		
Ensuring the quality of deliverables and activity execution:	**Name of person/group**	**Why exactly is this person/group important?**
Where can we find the required project resources	• Drs. Greeley & Patel	• Has the authority to reassign certain employees into a project role
Where can we find required SMEs?	• Dr. Greeley – Child Abuse • Dr. Donaruma-Kwoh – Child abuse education • Dr. Bachim – Child abuse prevention research • Nurse Bush – nursing education • Nurse Kerr – EC nursing expert • Nurse Davis – nursing informatics • Ms. Lawson – child abuse social work expert	• Listed at left

	• Ms. Lampe – EC social work expert • Ms. Figueroa – social work education • Dr. Patel – pediatric emergency medicine • Dr. McManemy – pediatric emergency medicine • Mr. Bradford – EPIC ASAP module expert	
Who can provide support in the areas of training and competency development?	• Dr. Donaruma-Kwoh – Child abuse education • Nurse Bush – nursing education • Ms. Figueroa – social work education	• Listed at left
What groups can help us publicize/communicate this initiative	• Dr. Patel – pediatric emergency medicine • Dr. McManemy – pediatric emergency medicine • Nurse Bush – nursing education • Ms. Lawson – child abuse social work expert	• Listed at left
Who can help us support the initiative once it is deployed?	• Mr. Bradford – EPIC ASAP module expert • Dr. Donaruma-Kwoh – Child abuse education • Nurse Bush – nursing education • Ms. Figueroa – social work education	• Listed at left

Tier 3 Stakeholders		
Recipients		
Areas where people/groups may be impacted:	**Name of person/group**	**Why exactly is this person/group important?**
Who is the intended audience for the project outputs or the change?	• ED Nursing	• The initiative will require a change is policy and protocol directly affecting their interactions with patients

Will the change have any effect on secondary groups or individuals?	• ED MDs • ED Social Work team	• The MDs could be responding to an increased number of concerns for child abuse • The SWs could be responding to an increased number of concerns for child abuse

IMPLEMENTATION / DEPLOYMENT STRATEGY

System Development Process	General Problem-Solving Steps Answer the Questions/Statements

System initiation	• What is the problem?
	    o There is no best practices process for electronic child abuse detection
	 • Who are stakeholders (system users, system owners)?
	    o End Users:
	      ▪ RNs, MDs, SWs, CAP team
	    o Owners:
	      ▪ EPIC programmers
	      ▪ CQO of EDs
	 • What are the goals and objectives?
	    o Improve accurate child abuse detection using electronic screening tools

System analysis	• Discuss and analyze the problem.
	○ Literature supports universal child abuse screening in emergency departments as a means to increase accurate detection and decrease biases. Very little research has been done in electronic implementation of child abuse screening. The technical aspect of implementing a screening tool is in-house and fairly straight forward. There are other tools of a similar nature already in our EPIC system.
	• Discuss the solution requirements or expectations.
	• The solution requirements involve a simple build of the screening tool in EPIC, testing the screening tool with end users while it is the EPIC "sandbox", developing online educational training modules for end users (RNs & MDs), and implementing the training modules – the process of encouraging the users to complete the training is yet to be determined.
System design	• Identify the selected solution, why was it chosen?
	○ The electronic implementation of a child abuse screening tool was chosen because the preliminary research on this is very promising, even more so than paper screening. Adoption rates are higher, end user satisfaction is higher, and identification without false positives improves.
	• Discuss the design, the chosen solution.
	• A five-question screening tool will be added into EPIC, the design will include a persistent alert on the side of the screen and a pop-up alert that will require a reason for acceptance or dismissal. Acceptance will link automatically to a social work consultation. Before or after the social work consultation the MD will have 1 click access to order a child injury work up from the persistent alert on the side of the screen.

System implementation	• Implement the chosen solution
	Meetings
	Observations
	Policy/Procedures
	User testing/Pilot
	Training
	Go Live
	• Evaluate the results
	Qualitative evaluation via user interviews after deployment
	Seasonally comparable pre and post data comparison on identification rates
	Tool completion rates
	Observational assessment of process completion

1. Work flow analysis

    a. Visit all 3 locations at 3 different times/days

    b. Observe workflow

    c. Informally interview staff on processes

    d. Design swim lane diagram of current workflow

    e. Determine the best place in the work flow to implement the screening tool

2. Build the tool into EPIC

    a. Build out functionality for notes privacy for any positive screens

    b. Link point of service education training to screening tool questions

    c. Integrated environment testing

    d. End user testing of tool in sandbox area of EPIC and testing of

       processes/procedures

    e. Adjustments and improvements to tool & processes/procedures

    f. Integrated environment testing

3. Create virtual education modules on tool & processes/procedures and on child abuse

   detection using expert input on child abuse and on pedagogy

    a. One child abuse detection training for RNs, MDs, & SWs

    b. Tool use and procedures, three different training modules for RNs, MDs, & SWs

4. Roll out education modules on tool & processes/procedures and on child abuse

   detection for end user education

    a. Follow up on completion rates

    b. Push completion by all staff

5. Go live of new screening tool & processes/procedures in all three TCH ECs at the same time.

    a. Tech support on standby

    b. At the elbow support at each location

    c. Personally visit each location on go live day

    d. Visit again throughout the first week

Appendix C: Return on Investment (ROI) / Cost-Benefit Analysis

Quantitative ROI

Identifying child abuse, neglect, and social needs early on produces an incalculable benefit for society as a whole. It directly improves the present lives of the victims and later in life enables them to become involved supportive members of their community. These benefits are important and in some cases lifesaving.

Fang and colleagues estimated the cost of child abuse, both direct costs and indirect costs (Fang et al., 2012). Their calculations were conducted in 2010 dollars. Assuming universal inflation rate of all parts calculated, the numbers here will be provided in 2021 dollars. A known limitation of this assumption is that the cost of medical care has increased significantly faster than general inflation and the average wages have not increased as quickly as inflation, along with other variances. Limitations within Fang's estimations include no differentiation in the cost based on severity of the maltreatment or what age the maltreatment is discovered. They also excluded the direct cost of law enforcement, which Wang and colleagues included in 2007, and they excluded the cost of foster care, adult criminality, and the impacts of mental health costs across a lifetime (in productivity and in mental healthcare), all of which Caldwell included in 1992 (Caldwell, 1992; Fang et al., 2012; Wang, 2007).

Using Fang's estimations, the lifetime cost of non-fatal child maltreatment for a single child is $261,673 in 2021 dollars. This includes short-term and long-term health care costs, productivity losses, child welfare costs, criminal justice costs, and special education costs. A fatal case of child maltreatment costs $1,586,023 in 2021 dollars. This includes direct medical costs and future productivity losses. Using the estimated number of substantiated child

maltreatment cases in a year, non-fatal maltreatment costs the U.S. $178 billion per year. Fatal

child maltreatment costs $3 billion per year.

The immediate cost breakdown of this project is below. BCM uses an estimated

overhead rate of 60% for grant funding (when allowed by the grants). Therefore, 60% of total

cost has been used to calculate the overhead in this project.

Table 21

Estimated Cost Breakdown

Estimated Cost Breakdown			
Backfill/Build Team	**No. of Required Build Hrs**	**Rate per hr**	**Total**
EPIC ASAP (ER module) Expert Builder	20	$63.80	$1,276.00
Education Module Team	25	$70.00	$1,750.00
Sub Total	**45**		**$3,026.00**
Go-live Support	**No. of Support Hrs**	**Rate per hr**	**Total**
EPIC Experts * 3	0	$63.80	$0.00
Super Users * 3	0	$50.00	$0.00
Sub Total	**0**		**$0.00**
Training team	**No. of Training Hrs**	**Rate per hr**	**Total**
Education Module Team	2	$70.00	$140.00
Education of providers	300	$75.00	$22,500.00
Sub Total	**302**		**$22,640.00**
Sub Total of Project Costs			**$25,666.00**
Overhead		**60% of cost**	**$15,399.60**
Total Cost			**$41,065.60**

Qualitative ROI

Texas Children's Hospital prioritizes serving at risk populations and working in prevention, as evidenced in part by the large public health and child abuse pediatrics team supported by the hospital. They also prioritize research and innovation (see also the new low cost Covid vaccine designed for quick global scaling for production and distribution). In the spirit of this culture, they are interested in making their child abuse and neglect detection protocols more robust in the emergency departments. They are also excited to pioneer the social support model designed for this project where families who are identified as being in need of support to avoid future neglect are offered assistance in connecting with community resources. This is the first response protocol of this kind. TCH would like to be an industry leader in modeling family support and pediatric practice that goes beyond just treating the immediate medical need.

One of the benefits of improving child abuse and neglect detection is preventing future abuse and neglect and thereby improving the life of the child and possibly their siblings. In addition to the benefit of preventing future maltreatment, the response protocol of supporting families in need in order to prevent possible future neglect has even farther-reaching long-term benefits in the life of the child and the family. It is truly difficult to capture the value added to these lives with prevention and early detection.

However, the cost of improved family support and looking beyond the immediate medical need is, in part, increased service times. In some cases, it may take longer to clear a room because a social worker is connecting the family to resources, a process that is not

currently in place. This may also have a domino effect of occasionally increasing wait times during peak service hours.

This project has a small potential risk of misidentifying a child as a victim who is not. That would cause the family the added stress of dealing with CPS until their case is ruled out. However, as the report would be made in good faith by a mandatory reporter it would not put TCH in any legal risk or liability. Every precaution is being taken to ensure that this is avoided by including robust abuse identification education and multifaceted case intervention.

Vita

2006...BBA, Management, University of Texas at Arlington

2019...MS, Biomedical Informatics, University of Texas Health Science Center Houston

2016 to present...Research Associate, Department of Pediatrics, Baylor College of Medicine

Publications

Field of Study

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