Establishing a plan to improve pediatric patient comfort during PIV insertions and blood specimen collection: a quality improvement effort

Jamie Lorenc, Nicholas Flaucher, Emily Evans and Jennifer V Schurman

HIGHLIGHTS

- Patient comfort during peripheral intravenous (PIV) insertion and specimen collection was increased.
- The authors extended the contingency plan implemented for PICC insertion to include PIV insertion and specimen collection.
- The authors met their goals by using quality improvement methodology.
- Prioritizing patient comfort often requires institutional culture change.

ABSTRACT

Background: Needle procedures can cause pain and distress, especially in pediatric patients.[1] Retrospective data collected at a freestanding pediatric facility revealed that approximately 30% of pediatric patients were not demonstrating sufficient levels of comfort during peripheral intravenous (PIV) catheter insertion and specimen collection (lab draws) even after successful implementation of comfort measures by the vascular access team (VAT) in an adjacent procedure (eg peripherally inserted central catheter placement). The current quality improvement project was implemented to support adaptation and expansion of previous lessons learned to PIVs and lab draws specifically.

Design and Methods: The VAT used the Pediatric Sedation State Scale,[2] a standardized assessment tool integrated into the electronic medical record, to assess procedural comfort during PIVs and lab draws from February 2021 through April 2023. A total of 24 134 patients aged 0 to 18 years were included in the data collection. Interventions were delivered concurrently and included (1) reeducation/ongoing support for implementation of the Comfort Promise[3] measures, (2) the creation and implementation of advanced comfort options, and (3) culture change.

Aims and Objectives: The goal of the interventions was to improve the percentage of pediatric patients achieving adequate levels of comfort beginning at 68% in year 1 to 90% in year 2.

Results: From February 2021 to April 2023, the VAT team was able to improve procedural comfort scores from 68% to 90% of pediatric patients with adequate comfort for lab draws and/or PIV insertions.

Conclusions: While standard comfort measures are a good first step in pain management during needle procedures, they are not sufficient for every pediatric patient. Nitrous, sedation, and the use of anxiolytics and analgesics can play an important role in reducing pain and anxiety during needle procedures and should be considered for patients not achieving adequate levels of comfort with standard comfort measures.

Key words: Pediatric ■ Lab draws ■ PIV ■ Comfort Promise[3] ■ Needlestick ■ Comfort

Approximately 150 to 200 million peripheral intravenous (PIV) catheters are placed each year in the United States, and 80% of inpatients receive one during their hospital stay.[4] In addition, 14 billion laboratory tests are ordered in the United States annually.[5] Children have rated needle procedure– related pain as the worst pain experienced when in the hospital.[6] If these painful experiences are left unaddressed, patients are at risk for increased needle phobia, which can, in turn, increase pain and distress during future needlesticks and ultimately to greater rates of vaccine hesitancy and health care avoidance in adulthood.[7,8]

Given the negative experiences associated with needle procedures, there has been increased attention to pain management and comfort techniques to help decrease pain and distress during needlestick procedures.[6,7,9–11] Generally, evidence-based pain management and comfort techniques can be categorized into pharmacologic and nonpharmacologic interventions.[10] The Comfort Promise[3] is a hospital initiative that combines both pharmacologic and nonpharmacologic pain management interventions as a bundle of 4 evidence-based pain management and comfort strategies to reduce or eliminate pain caused by needlesticks and to help prevent long-term negative psychological effects of trauma during these painful needle procedures. These 4 bundle elements include numbing the skin with pharmacologic agents,[3] distraction (including, but not limited to, the use of child-life[12]), comfort holds,[3] and sucrose or breastfeeding.[7] This pediatric hospital offers these strategies as a standard of care for all pediatric patients requiring

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routine needlestick procedures, including but not limited to PIV insertion, blood specimen collection, midline placement, peripherally inserted central catheter (PICC)/central line placement, intramuscular injections, and subcutaneous injections.

Evidence shows the Comfort Promise[3] bundle can eliminate most of the pain and anxiety during needle procedures.[7] Focusing on something other than pain (ie distraction) can keep patients from experiencing fear and anxiety.[13,14] A meta-analysis found that distraction interventions can also relieve the anxiety of parents and nurses (as observers). Furthermore, an upright position, rather than being physically restrained, has been shown to increase children's comfort and decrease pain, preferably with a parent holding up with soothing words.[14] Parents' reactions to children's stress greatly influence children's ability to deal with stress.[13,15] Even with incorporating all 4 elements of the comfort bundle, evidence shows that it does not cover all pain and anxiety; thus, a contingency plan will be needed in some cases.[16,17]

Despite the strong evidence-base literature, pain management strategies remain underused for needle procedures in pediatric health care settings.[11] In our own previous work with PICCs,[17] a clear practice gap was observed and addressed through a quality improvement (QI) framework. This involved standard implementation of the Comfort Promise[3] followed by the development of a contingency plan for management of those patients requiring a higher level of pain management to attain adequate levels of comfort.[17] The vascular access team (VAT) decided to tackle this issue with PIV insertion and lab draws for pediatric patients, as these procedures occur more frequently in comparison with central line placement and impact many patients daily. This QI project followed a similar implementation plan for PIV insertions and lab draws as was done with the PICC insertions by first implementing the routine use of the Comfort Promise[3] and then creating a contingency plan for patients needing enhanced comfort measures. While some carryover effect was noted from implementation of the Comfort Promise[3] with PICC insertion, a practice gap remained for PIVs and lab draws specifically. Based on data obtained at the start of the project, established between February through March 2021, initially only 65% of patients were meeting the goal for adequate comfort during PIVs and lab draws by VAT staff. The goal was to increase the percentage of patients within the acceptable comfort range by 1 standard deviation, from 65% to 73.6%, within the first year with a stretch goal of 90% within 2 years (February 2021–April 2023; based on previously attained rates of comfort on comfort during PICC placement).

The initial goal was based on the suggested rule of goal setting to be 0.5 to 1 standard deviation of the current state.

Design and methods

Study facility

This project was completed at a 367-bed, freestanding, pediatric academic medical center. Located in an urban area of Missouri, this hospital primarily serves patients from Missouri and Kansas. The VAT is an approximately 20-person procedural team who place PICCs and peripheral IVs, as well as perform generally difficult lab sticks, throughout the hospital and clinics.

Stakeholders

This evidence-based practice initiative came from a multidisciplinary team of stakeholders including pain management professionals, psychologists, child life representatives, and VAT who met monthly to discuss the progress of this initiative within our institution. Everyone involved in the discussion and project works directly with patients.

Project scope

Included were all patients who had a PIV insertion or lab draw completed by a member of the VAT during the project period.

Measures

This is a QI study with a rapid cycle improvement approach in which the team used multiple Plan-Do-Study-Act (PDSA) cycles to test interventions on a small scale, allow for experimentation, and discard unsuccessful tests. A total of 24 134 pediatric patients between the ages of 0 and 18 years received lab draws or PIVs by VAT between February 2021 and April 2023 and were included in the data collection. This was 738 patients, on average, per week.

The primary outcome measure was patient comfort and safety during PIV insertions and lab draws, as measured by the Pediatric Sedation State Scale (PSSS).[2] The PSSS[2] is a 6-point scale that allows for a wide assessment of verbal and nonverbal signs of discomfort, including displays of pain/anxiety. Patients were monitored throughout the procedures, and only the highest numerical rating (ie least sedation/most distress) assigned at any time during the procedure was recorded.

Adequate comfort levels were defined as a 0 to 3 on the PSSS.[2] A 0 PSSS[2] rating is a patient who is deeply asleep with ABNORMAL physiological parameters (oxygen desaturation/hypotension/tachycardia or bradycardia [more than 30% off from baseline]). A 1 PSSS[3] rating is defined as deeply asleep with normal vital signs—REQUIRES some airway intervention to maintain breathing (chin lift, nasal/oral airway, mask vent, etc). Physiological parameters are NORMAL. A 2 PSSS[2] is defined as patients who are not crying, not moving, not frowning, and no verbalization of discomfort. A 3 on the PSSS[2] is defined as patients who may have an expression of discomfort on the face or are crying/verbalizing discomfort but NOT moving or impeding the completion of the procedure, may require positioning, but NO restraint to stop movement, and may be awake or asleep. Inadequate comfort is defined as patients who are 4 to 5 on the PSSS[2]. A 4 PSSS[2] is defined as patients who are moving during the procedure and require gentle immobilization or positioning. They may appear uncomfortable, verbalize discomfort, or may be crying, but this not a requirement. A 5 PSSS[2] is a patient who is moving (purposefully or non-purposefully) in a manner that impedes the proceduralist and requires forceful immobilization. The patient may be sedated or awake. The patient may be crying or shouting (not required).

Interventions

Interventions were completed in an overlapping fashion due to the time required for implementation of some components. Critical interventions on the project timeline are outlined below.

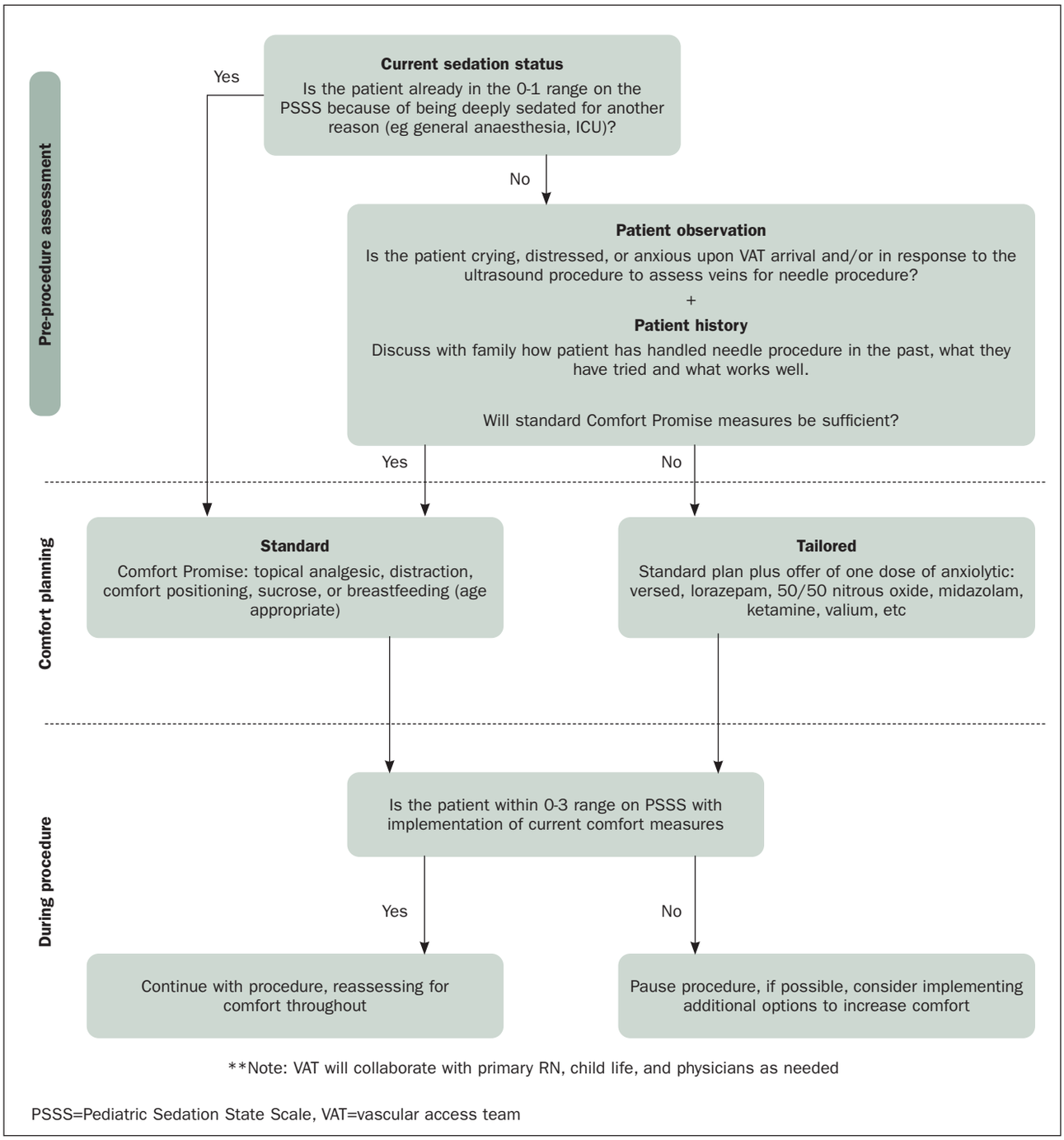


Figure 1. PIV & Lab Draw Comfort Algorithm

Comfort Promise[3] implementation

In the summer of 2017, our organization adopted the Comfort Promise[3] as the standard of care for all inpatient and outpatient areas for patients requiring routine needle procedures.[17] The VAT was reeducated on the Comfort Promise[6] and the use of the PSSS[2] as a tool to determine the comfort level during needlestick procedures for PICC line insertions in November 2019, then again for PIV insertions and lab draws in February 2021. The VAT then implemented the Comfort Promise[3] as standard of care for all PIVs and lab draws.

Development of a contingency plan

In May 2021, the VAT discussed options for a contingency plan related to PIV insertion and lab draws (see *Figure 1*). When VAT in conjunction with the family and/or nursing staff determined that a patient required more than the Comfort Promise[3] alone to achieve adequate comfort, the VAT then would collaborate with the physician to determine the best medication for the specific patient and situation. The addition of the contingency plan was deemed necessary to improve the percentage of patients achieving adequate comfort during lab draws and PIV insertion procedures.

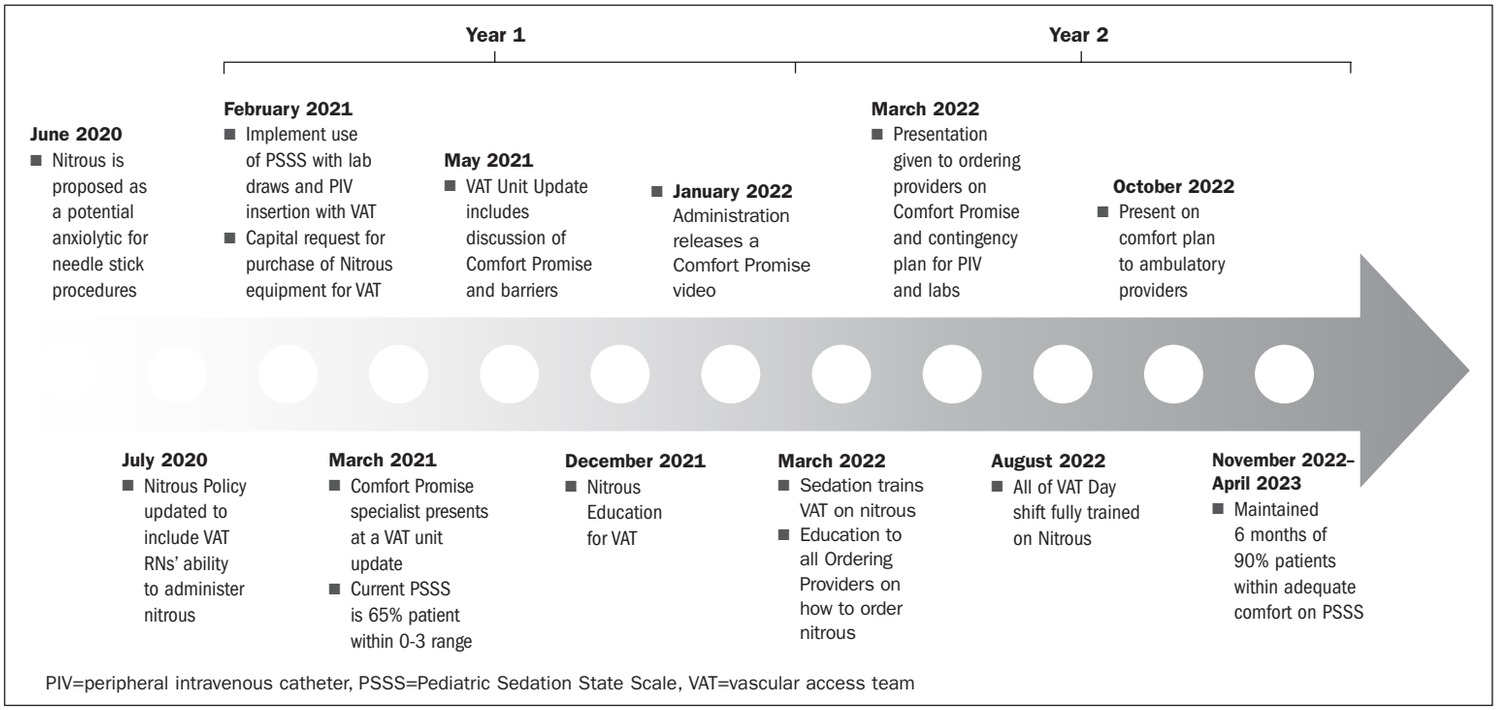


Figure 2. Timeline

During previous work on comfort for PICC line insertion, the team recognized several parts of the standard and contingency plan for comfort that would work well and other parts that would be either easier or more difficult with PIV insertion and lab draws.[17] The use of nitrous16 as an anxiolytic was trialed with PICC line insertions, but it was quickly discovered that the insertion process for PICC procedures takes longer than the effects of nitrous would safely allow. In June 2020, nitrous16 was identified as an excellent contingency plan for shorter procedures such as PIV insertion and lab draws. The use of nitrous[16] was identified as being essential to making a significant impact on the number of patients within the 0 to 3 range on the PSSS.[2]

To support implementation, the VAT leaders were first trained under the direction of the sedation team. Then, the nitrous policy was updated to include privileges for the VAT to administer nitrous. Equipment was purchased, and education was dispersed among the team through observation and supervised cases. Inpatient physicians and hospitalists were also educated via online modules on the initiative and how to order nitrous via email and with a PowerPoint presentation in March 2022.

This entire rollout process took approximately 25 months due to the operational, educational, and logistic changes that were required. From March to August 2022, the VAT trained on how to administer nitrous on day shift for inpatients only. In March 2023, weekend day shift began training to use nitrous.

Culture change

In March 2021, the Comfort Promise[3] expert and child life director presented an interactive refresher of the Comfort Promise[3] bundle, specifically discussing barriers related to comfort positioning, for the VAT. PSSS[2] scores were posted on the team's huddle board and discussed weekly from March 2021 through April 2023. In January 2022, hospital administration released a Comfort Promise[3] video supporting its use for needle procedures as a standard for this institution. Finally, in May 2022, a feature article was published on the hospital's main webpage highlighting this QI project (see *Figure 2*, the timeline of interventions for this project).

Study of the intervention

A monthly Business Objects report from the electronic medical record was created so that all monthly PIV insertions and lab draws could be tracked, and all VAT nurses were asked to begin to chart the PSSS[2] in the electronic medical record for these procedures at the start of the project. While this could be conceptualized as the first PDSA cycle, putting this standardized tracking into place was deemed necessary to create an accurate baseline metric against which future change could be measured in the absence of any reasonable retrospective proxy.

Results

Project aim

The aim of the project was to increase the percentage of patients within the acceptable comfort range by 1 standard deviation, from 65% to 68%, within the first year, with a stretch goal of 90% within 2 years. Over the course of this project, 19 952 patients were in the 0 to 3 range and 4,182 patients were within the 4 to 5 range on the PSSS.[2] However, significant shifts in the percentage of patients achieving adequate comfort were noted. In the fall of 2021, a centerline shift occurred from 65% to 84% of patients demonstrating adequate comfort according to the PSSS.[2] Another smaller shift occurred in the summer of 2022, from 84% to 90%. The control chart of the PSSS[2] ratings shows

that we had stability at the start and again achieved stability at an improved level by the end of the project (*Figure 3*). This improved level was deemed a success, and we moved into the maintenance/monitoring phase.

Discussion

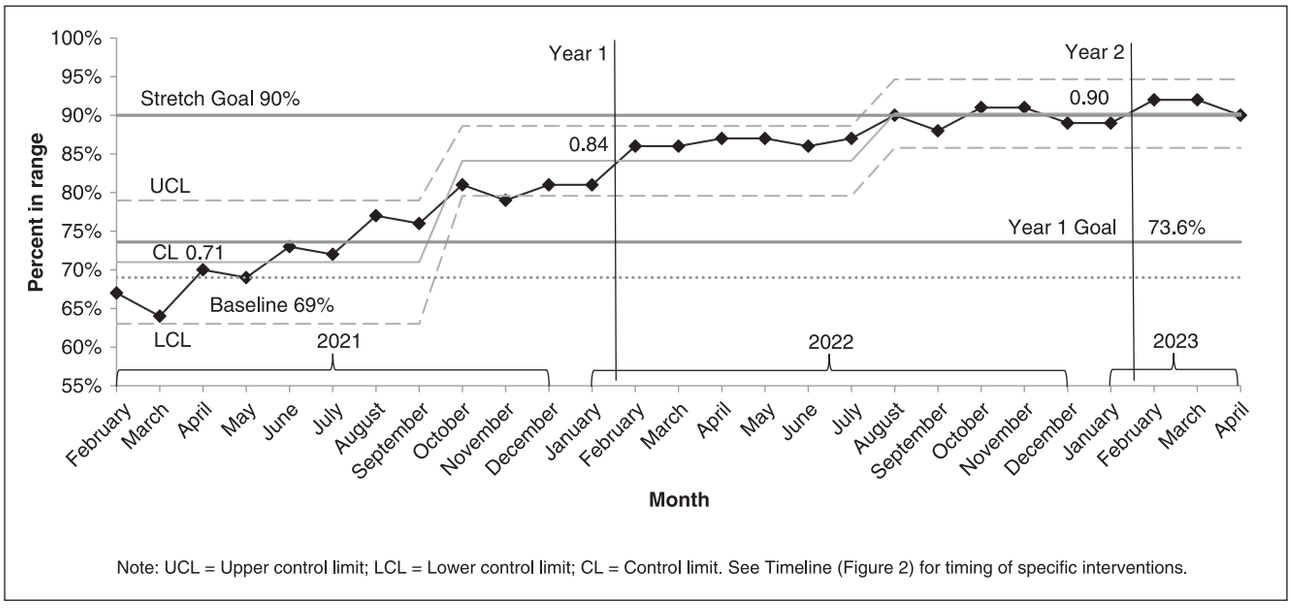
We were able to meet the original project goal for both year 1 and year 2 (stretch goal). Actions that may have contributed to the shift in the fall of 2021 include the multiple education opportunities given to the VAT between March 2021 through May 2021 as well as the initial rollout of the contingency plan alongside the standard Comfort Promise.[3] The shift that occurred in the summer 2022 may be related to education on, and implementation of nitrous (see *Figure 3*, the control chart for this project).

The desire to reduce pain and anxiety in pediatric patients is strong, but the resistance comes from the time it takes to implement the Comfort Promise[6] bundle and necessary contingency plan measures. Traditionally, PIV insertion and lab draws have been done with restraints, holds, and swaddling to decrease movement and time spent doing these needle procedures. The VAT team's theory behind using restraints instead of comfort techniques was there would be less trauma to the patient with less time spent doing the procedure. At the outset, the team did not completely believe that implementing the Comfort Promise[3] techniques would result in less trauma to the patient overall. Education on how restraints can increase anxiety and have negative long-term consequences, and how implementing the Comfort Promise[3] bundle and contingency plan has decreased pain and anxiety compared with traditional techniques, is important for continual progress in improving patient comfort (ie PSSS[2] scores), as well as the desire to change. A culture of acceptance on the part of both families and the professional staff is crucial.

The VAT chose to address the human factors issue by including the patient and families in the preprocedure planning process through education on the Comfort Promise,[3] providing a multitude of options, and creating an individualized plan for the patient. The team found that patients have improved comfort scores and a better experience when they have as much control over the situation as possible. VAT found that most patients prefer topical ointment, sucrose, and breastfeeding as age appropriate, and almost all patients like comfort positioning. VAT also found that not all kids like distraction. Some prefer low sensory input, and others prefer to know and watch everything that is happening in real time. In addition, there also is a fine balance of listening to the parent's preference versus the child's, especially as they grow and establish their own autonomy.

The contingency plan developed for PIV insertion and lab draws includes the use of oral and nasal analgesics and anxiolytics[17] such as midazolam, lorazepam, diazepam, ketamine, and 50/50 nitrous oxide gas.[16,17] The goal with the contingency plan is to reduce needle fear in the short term and allow the patient to accumulate more positive experiences with needle procedures. Over time, this can help to de-escalate fear, engage more directly in comfort planning, and reduce the need for interventions beyond the standard Comfort Promise.[3] While this is an achievable goal for most patients, there are some (particularly those with developmental differences or significant medical trauma, etc) for whom a contingency plan may be a longer-term solution.

Scaling up this QI initiative from only PICC placement to include all needle procedures completed by VAT was challenging because the scope increased from 10% of the VAT workload (for PICC line insertions) to 90% (lab draws and PIV insertions), included multidisciplinary teams, and involved patients in every area of the hospital, including inpatient and outpatient areas. Some concerns were that this would increase the time and resources needed to complete needlestick procedures, which would increase the workload and potentially result in delays in patient care. The implementation of the Comfort Promise[3]



Note: UCL = Upper control limit; LCL = Lower control limit; CL = Control limit. See Timeline (Figure 2) for timing of specific interventions.

Figure 3. Percent 'in range' for Comfort on PSSS (0-3) by month

techniques did not increase time nor resources needed to complete the needlestick procedures, but the use of nitrous did. The VAT leadership team was initially trained and used nitrous until they were able to create a workflow process that minimized procedure time the most. Using nitrous for needlestick procedures does require an additional VAT nurse and approximately 20 to 30 more minutes of nursing time for set up, use, and take down of nitrous equipment as well as longer stay in a treatment room. This additional time has created some delays in care and resistance to the use of nitrous. These are challenges that the VAT is still working through.

The VAT also identified that patients who are unable or unwilling to have a mask on their face are not good candidates for nitrous. The VAT have partnered with child life and psychology to work with this population of patients to help them get used to the mask prior to the procedure being done. There are no results to publish to date on this work because this is a very small population of patients, and the teams are very early in the process of implementing, learning from, and formalizing this process as part of contingency planning.

The largest barrier with this project was and continues to be human factors. A long-held theory within this organization is that the quicker needlestick procedures are completed, the less pain and anxiety the patient will experience. That theory may have some basis to it, as much of the anxiety comes from the anticipation of the needlestick itself.[7,8] It is true that the quicker the procedure, the less anticipation and therefore decreased anxiety. However, the lasting effects of the pain and anxiety that go along with the procedure can have psychologically damaging effects and increase the amount of time needed to complete the procedure in future instances.

This organization implemented the Comfort Promise[3] bundle with use in needle procedures in 2017, but the use of all bundle elements is still not consistent across all hospital areas and staff. Work remains to be done to scale up the successes of the VAT with needle procedures completed by other staff while tailoring solutions to the unique barriers inherent to those settings/ populations (eg phlebotomy, emergency room).

Conclusions

Results from the current QI project suggest that use of a Comfort Promise3 bundle is a good initial step in improving pain and anxiety related to needle procedures in pediatric patients. However, not all pain and anxiety are relieved by these 4 basic comfort measures. Development of a contingency plan that includes the patient/family's preferences is the next best step. However, nitrous, sedation, and the use of anxiolytics and analgesics can also play an important role in reducing pain and anxiety during needle procedures and should be considered for patients not achieving adequate levels of comfort.[16,18] More evidence is needed regarding these specific interventions and how best to use them within a comprehensive pain management approach.

Disclosure

The authors have no conflict of interest to disclose.

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