

# Retrospective Review of Failed Labor Epidural Analgesia: A Quality Improvement Project

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## Background/Purpose

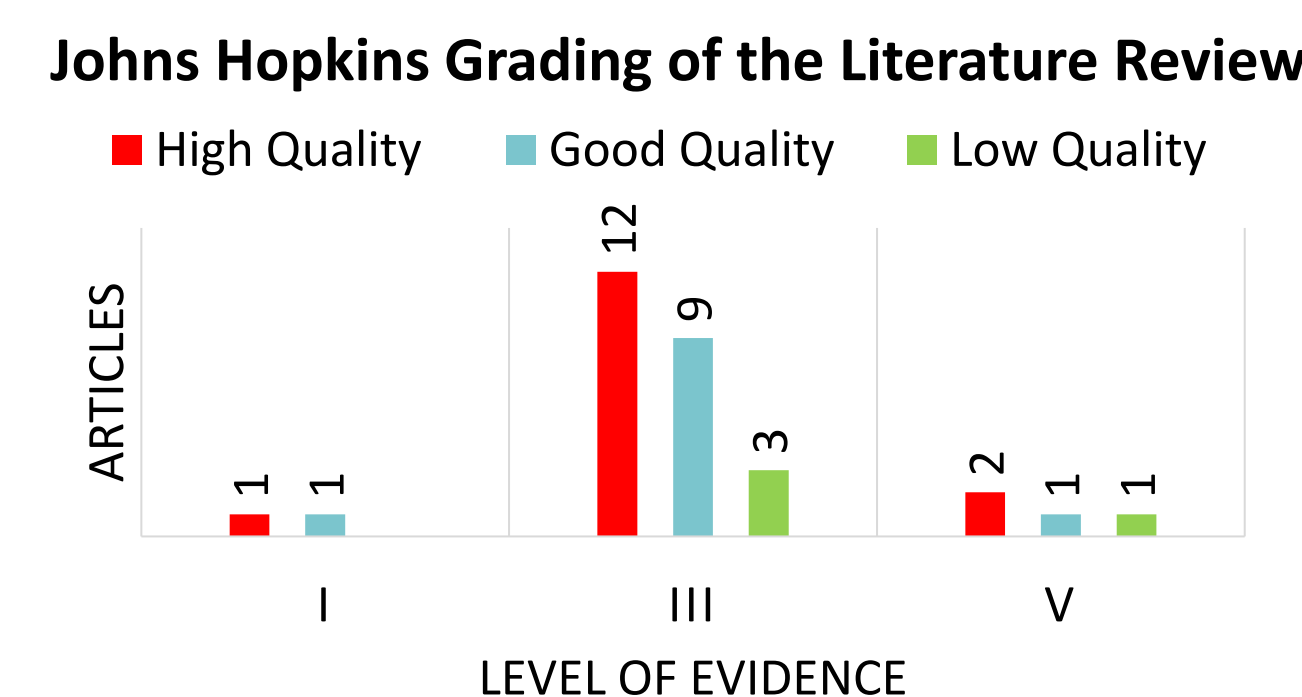
Lumbar epidural analgesia is the gold standard for pain control in the laboring patient (Jian et al., 2022). Successful epidural analgesia (SEA) offers numerous benefits, including significant reductions in various risks such as atrial fibrillation, supraventricular tachycardia, deep vein thrombosis, decreased respiratory drive, atelectasis, pulmonary infections, and ileus (Pöpping et al., 2014). SEA can be used in emergent cesarean sections to avoid general anesthesia (GA), which increases maternal morbidity and mortality due to hemodynamic instability, aspiration, and difficult airway placement (Parikh & Seetharamaiah, 2018). SEA is associated with decreased severe maternal morbidity, critical care admissions, vaginal-assisted deliveries, and 3rd and 4th degree tears (Callahan et al., 2023; Kearns et al., 2024; MacDougall et al., 2011). Additionally, SEA enhances mother-infant bonding compared to mothers who did not receive an epidural (Binyamin et al., 2022). Epidural analgesia does not increase cesarean section rates or have long-term effects on children (Anim-Somuah et al., 2018; Kearns et al., 2021). Infants born to mothers with epidurals typically have better acid-base status and comparable Apgar scores.

When failed epidural analgesia (FEA) occurs, the advantages of an SEA are forfeited, leaving parturient patients at risk. Labor pain can lead to poor maternal satisfaction, postpartum depression, and decompensation in conditions where epidurals are indicated to control the physiologic response to pain (Guasch et al., 2017; Halliday et al., 2022; Parise et al., 2021). Improving SEA rates is crucial for enhancing patient safety, increasing patient satisfaction, improving care efficiency, and achieving cost savings (Centers for Medicare and Medicaid Services, 2021).

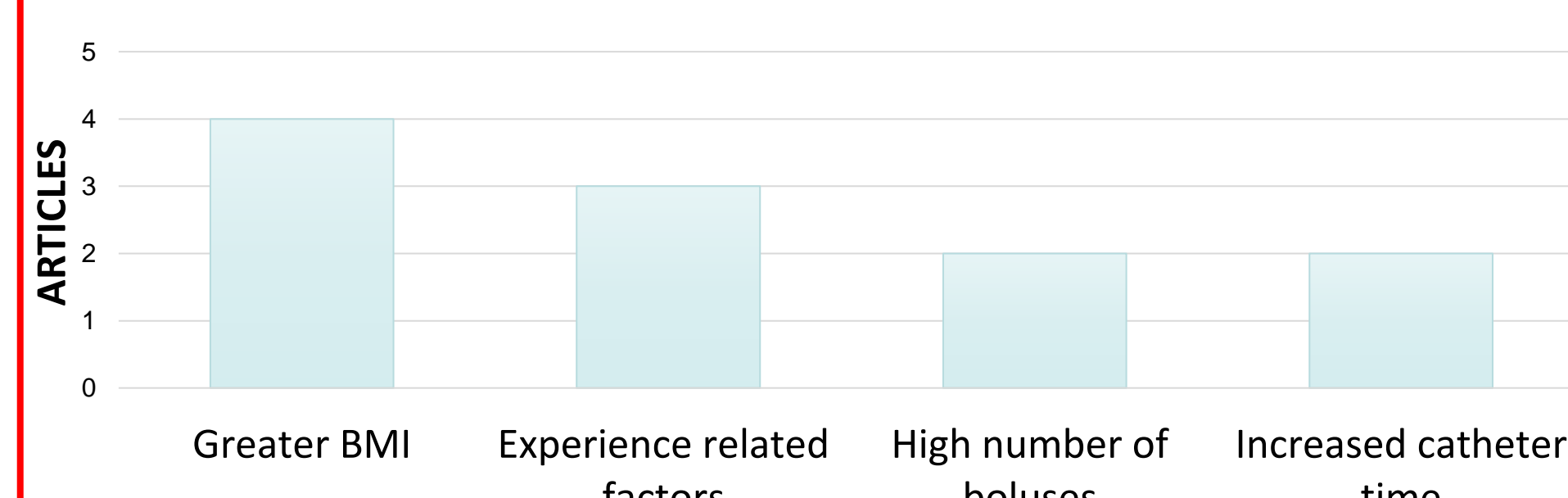
Problem Statement: Parturient patients on labor and delivery units who experience failed epidurals are at a greater risk for harm due to the subsequent use of alternative anesthetics or analgesic management. A quality improvement project was performed to identify factors contributing towards epidural failures among parturients.

## Available Knowledge

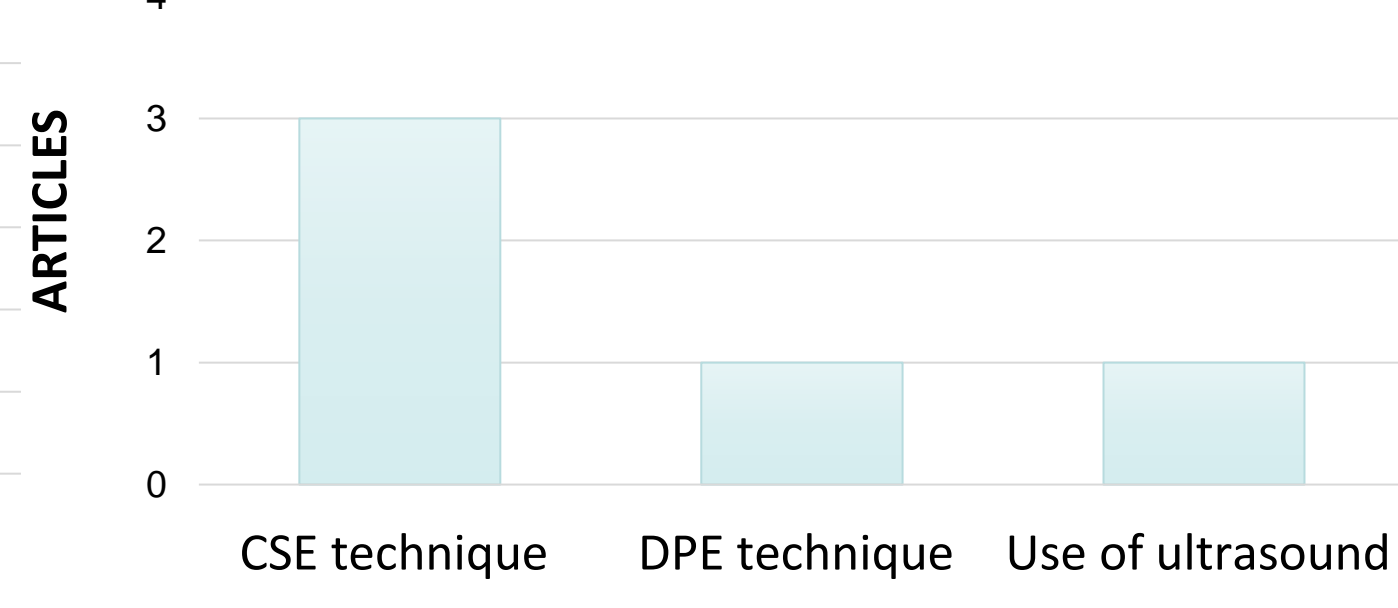
The University of Cincinnati Medical Center (UCMC) has an estimated failed epidural analgesia (FEA) rate of 15%. A literature review was conducted using PubMed, CINAHL, Embase, and Google Scholar databases to generate articles. Eleven high and four good-quality articles were identified, including one level I, 12 level III, and two-level V studies. The reported average FEA rates in the literature ranged from 8-23% (Thangamathu et al., 2013).



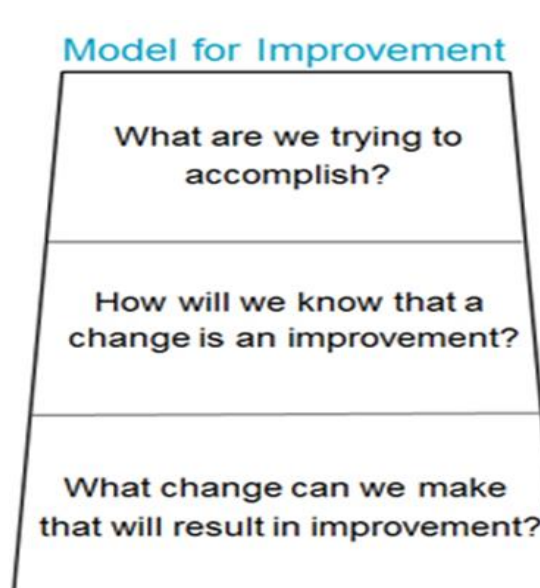
Factors that Increased the Incidence of Epidural Failure in the Literature



Factors that Decreased the Incidence of Epidural Failure in the Literature



## Model / Framework



Institute for Healthcare Improvement (IHI) Model for Improvement (IHI, n.d.)

- Aim:** Identification of factors contributing toward epidural failures
- Measure:** Data collection tool
- Idea:** Retrospective chart review

Plan-Do-Study-Act (PDSA)

- Plan:** Literature review
- Do:** Chart review
- Study:** Data analysis
- Act:** Dissemination of results

Note: Adapted from IHI, by IHI, n.d. (<http://www.ihi.org/resources/Pages/HowtoImprove/ScienceofImprovementHowtoImprove.aspx>). In the public domain.

## Methods

A retrospective chart review compared 100 patients who experienced FEA and 100 patients who experienced successful epidural analgesia (SEA) from January 1, 2023, to September 30, 2023. 105 data points were identified to track the association with epidural failures. The inclusion criteria required epidural placement for labor analgesia, while the exclusion criteria excluded neuraxial procedures performed within 45 minutes prior to a cesarean delivery.

University IRB determination was non-human subjects research. Data was collected through REDCap and analyzed through descriptive statistics, Chi-square tests, and Fisher's exact tests by JMP software.

Patient Characteristics	Provider Characteristics	Anesthetic Interventions	Delivery Events
Age, Height, BMI, Ethnicity, Gravidity & Parity, Interpreter status, ASA Classification, Mallampati, Patient Comorbidities, Back Related Factors, Substance Use Disorder, History of FEA	Provider Type (Anesthesiologist, CRNA, Resident, SRNA)	Epidural Placement Technique, Length of Catheter at Skin, Ultrasound Used for Placement, Epidural Replaced, Local Anesthetics (LAs) Used for Infusion and Boluses, Epidural LA Loading Dose and Volume, Adjunct Medications Used in Epidural, VAS Before and After Insertion, etc.	Labor Course (induced vs. spontaneous), Chorioamnionitis, Epidural Placement Time, Cervical Dilatation at Time of Placement

Data Collection Tool:



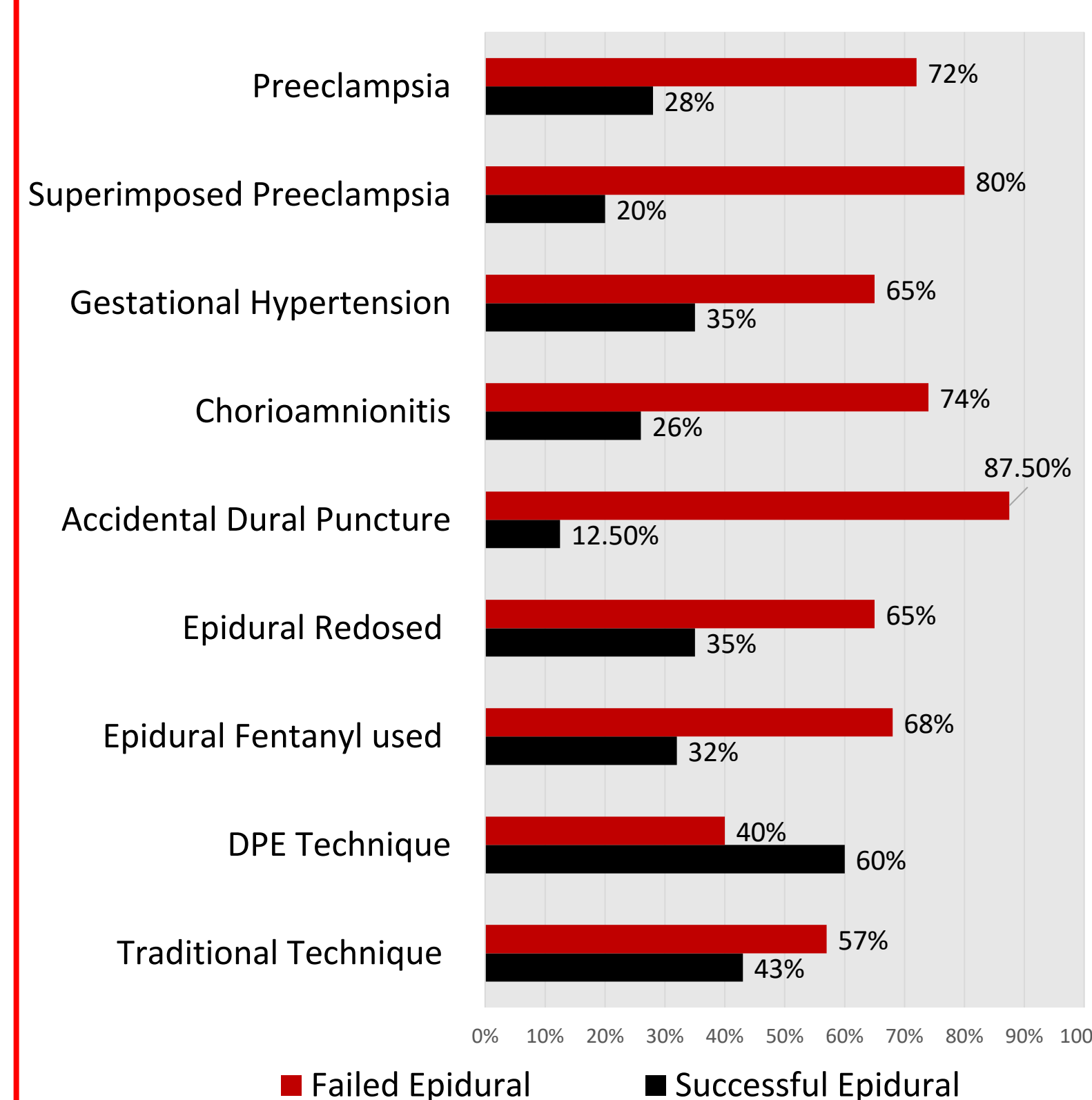
## Results / Outcomes

A total of 235 charts were reviewed and 35 charts were excluded. The factors associated with an increased incidence of epidural failure were:

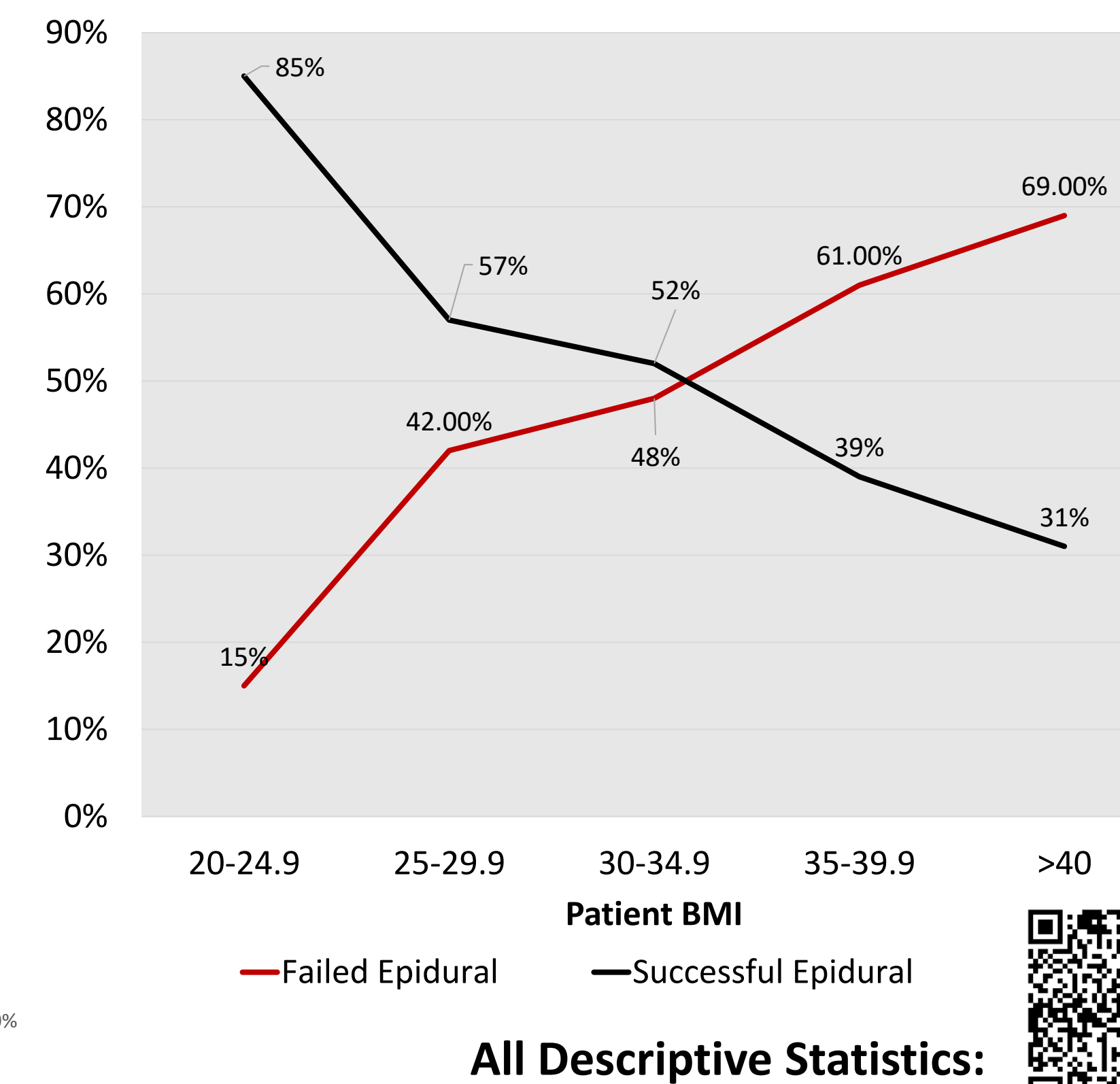
- Greater BMI >35kg/m<sup>2</sup> (p = 0.0019)
- Chronic hypertension with superimposed preeclampsia (p = 0.0143)
- Medication re-dosing of a labor epidural (p < 0.0001)
- Use of non-infusion epidural fentanyl boluses (p < 0.0001)
- Accidental dural puncture (p = 0.0324)
- Gestational hypertension (p = 0.0446)
- Preeclampsia (p = 0.0407)
- Chorioamnionitis (p = 0.0012)
- 74% of patients with chorioamnionitis had FEA

Of the 100 FEA that were reviewed, 63% of them were performed with the traditional epidural technique as opposed to 34% with the dural puncture epidural (DPE) technique (p = 0.0217).

Significant Factors Identified From Chart Review



Percentage of Epidural Replacement by BMI



All Descriptive Statistics:



## Discussion

- Many significant factors identified in the chart review were consistent with risk factors found in the literature. Distinguishing characteristics such as a BMI > 35kg/m<sup>2</sup>, gestational hypertension, preeclampsia, chronic hypertension with superimposed preeclampsia, chorioamnionitis, and accidental dural puncture during epidural replacement were identified as high risk for FEA.
- An increased BMI causes difficulty palpating the spine and locating the anatomical landmarks for epidural placement, whereas it also is associated with a false loss of resistance due to softer ligaments compared to individuals with a normal or overweight BMI (González-Tascón et al., 2021).
- Chorioamnionitis decreases the blood pH, causing more ionization of the local anesthetics used in the epidural, inhibiting the local anesthetic from entering the cell to block neuronal conduction (Katakura et al., 2021). Additionally, chorioamnionitis contributes to pain by the release of inflammatory mediators such as TNF-α, and can increase the washout or metabolism of local anesthetics due to increased blood flow caused by the hyperthermic state of the patient.
- Accidental dural puncture with a Tuohy needle contributes to a significant loss of cerebrospinal fluid (CSF), causing intracranial hypotension and sagging of the meninges and other pain-sensitive structures (Plewa & McAllister, 2023). This causes extreme headaches, neck pain, nausea, dizziness, etc. for the patient.
- Neuraxial ultrasound can be used to assist in identifying the intended interspace and determining the depth to the epidural space (Toledano & Leffert, 2021). Despite not showing significant results in this chart review, the literature has shown neuraxial ultrasound can improve the success rate of neuraxial procedures. Only 11 of the 200 patients had an epidural placed with ultrasound, so further evaluation will be conducted.
- The association between gestational hypertension, preeclampsia and chronic hypertension with superimposed preeclampsia and FEA requires further investigation.
- The use of epidural fentanyl and increased amount of re-dosing the epidural are signs of an impending failed epidural, or already failed epidural (Grap et al., 2022).
- The DPE technique, which ensures midline placement of the epidural by confirmation of CSF through the spinal needle, a faster onset of analgesia due to the translocation of the local anesthetic into the intrathecal space, and higher quality block was associated with a decreased FEA (Sharawi et al., 2023).

A limitation of this project includes the lack of a standardized definition of an FEA, which creates inconsistencies among reported FEA rates across institutions. The team identified an FEA as an epidural replacement, whereas other institutions may include an accidental dural puncture, abandonment of epidural placement, etc. (Thangamathu et al., 2013). Another limitation is the project consisted of patients from only one hospital, which does not reflect the larger population. Lastly, variability in provider documentation into the electronic medical record (EMR) may lead to incongruities in data collection. Despite these constraints, this project will be useful in future quality improvement at the hospital of implementation.

Due to the findings of this project, it is recommended to use the DPE technique in all high-risk groups. The project team delineated high risk patients to include patients with a BMI >35kg/m<sup>2</sup>, gestational hypertension, preeclampsia and chorioamnionitis. A trial of neuraxial ultrasound use in patients with a BMI >35kg/m<sup>2</sup> is also suggested to investigate if this improves epidural efficacy in the higher BMI population.

## Conclusions

This project distinguished the significant risk factors of FEA for patients in the Obstetrical Labor and Delivery Speciality Care Unit at UCMC in Cincinnati, Ohio. This supplies anesthesia providers with the knowledge to better individualize care and educate patients to decrease the rate of FEA and allow patients to make an informed decision regarding an epidural placement. Recommendations will be made to the anesthesia team at UCMC to incorporate the DPE technique and neuraxial ultrasound in all high-risk groups. A future chart review will then be conducted after 6 months to evaluate the effects of DPE technique and neuraxial ultrasound on rates of FEA.

## References / Appendices

