Use of High-Fidelity Simulation to Drive Quality Improvement: Implementation of Bubble CPAP (BCPAP) in the Neonatal Resuscitation Room

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BACKGROUND:

- Bronchopulmonary dysplasia (BPD), also known as chronic lung disease (CLD) of prematurity, is associated with increased risk of neurodevelopmental delays and mortality.
- Invasive mechanical ventilation significantly increases risk of BPD.
- Utilization of bubble CPAP (BCPAP) with an occlusive interface is shown to be beneficial in reducing BPD.
- Quality improvement (QI) methodology along with high-fidelity simulation can be utilized to produce an efficient process of BCPAP implementation in the resuscitation room.
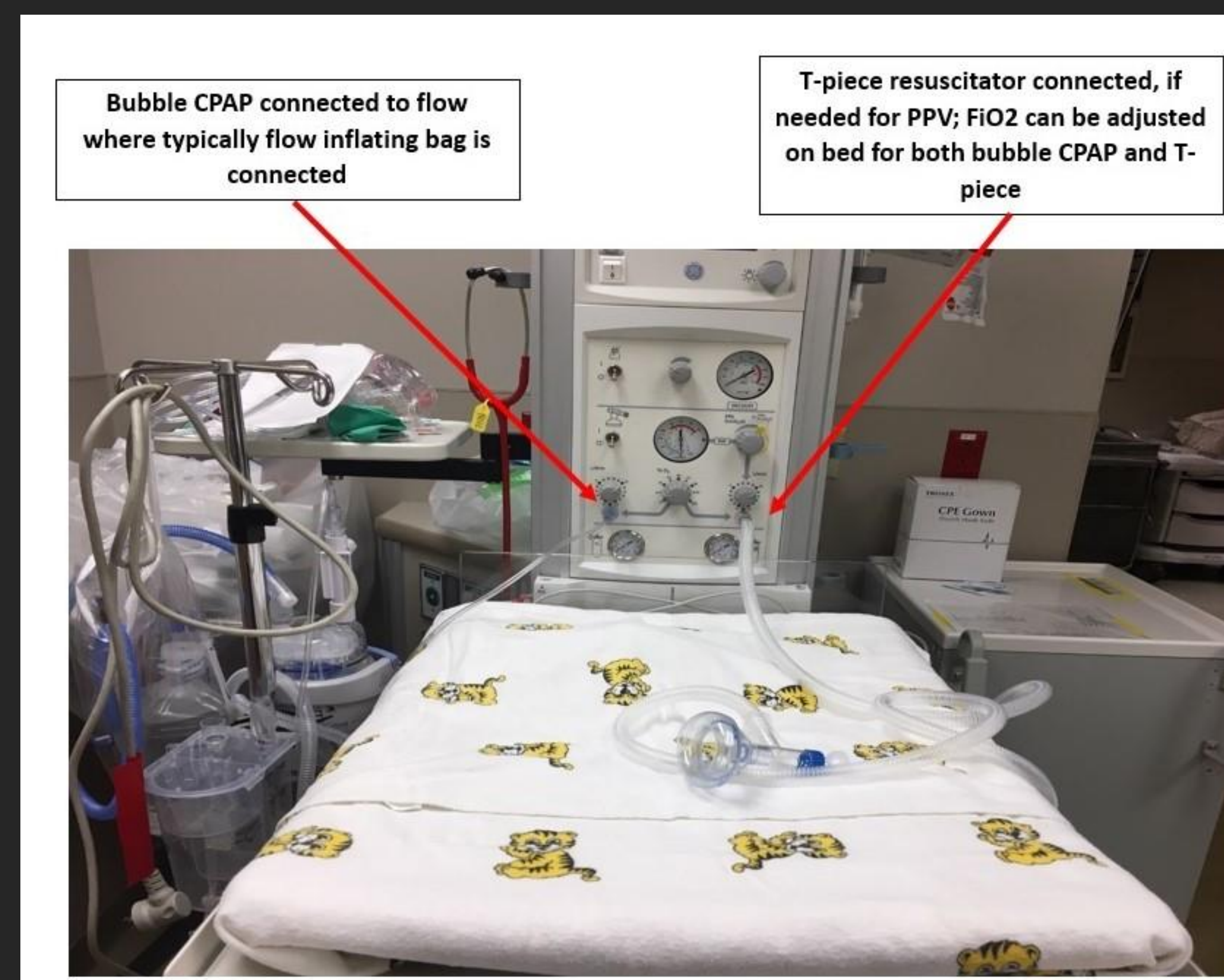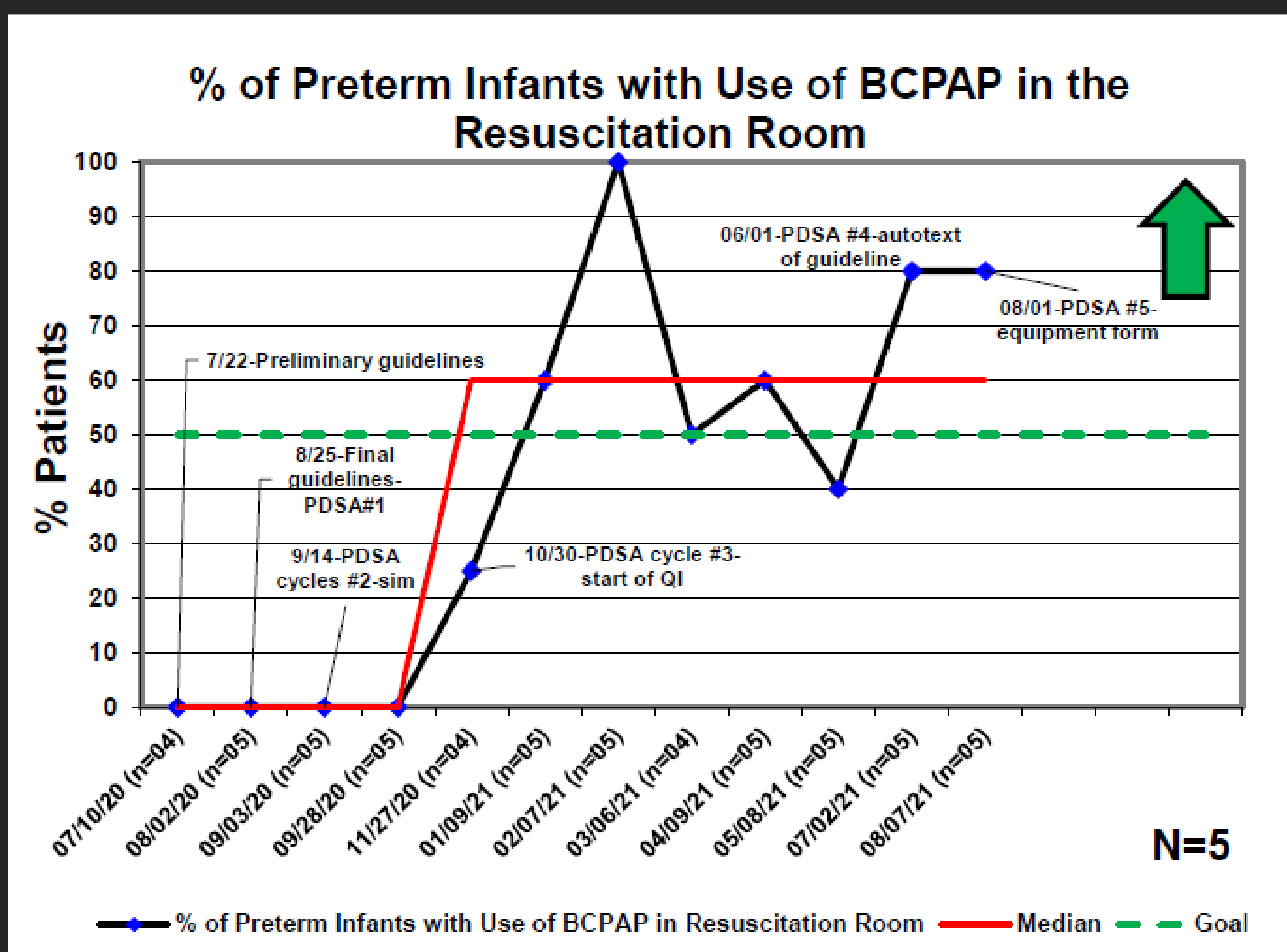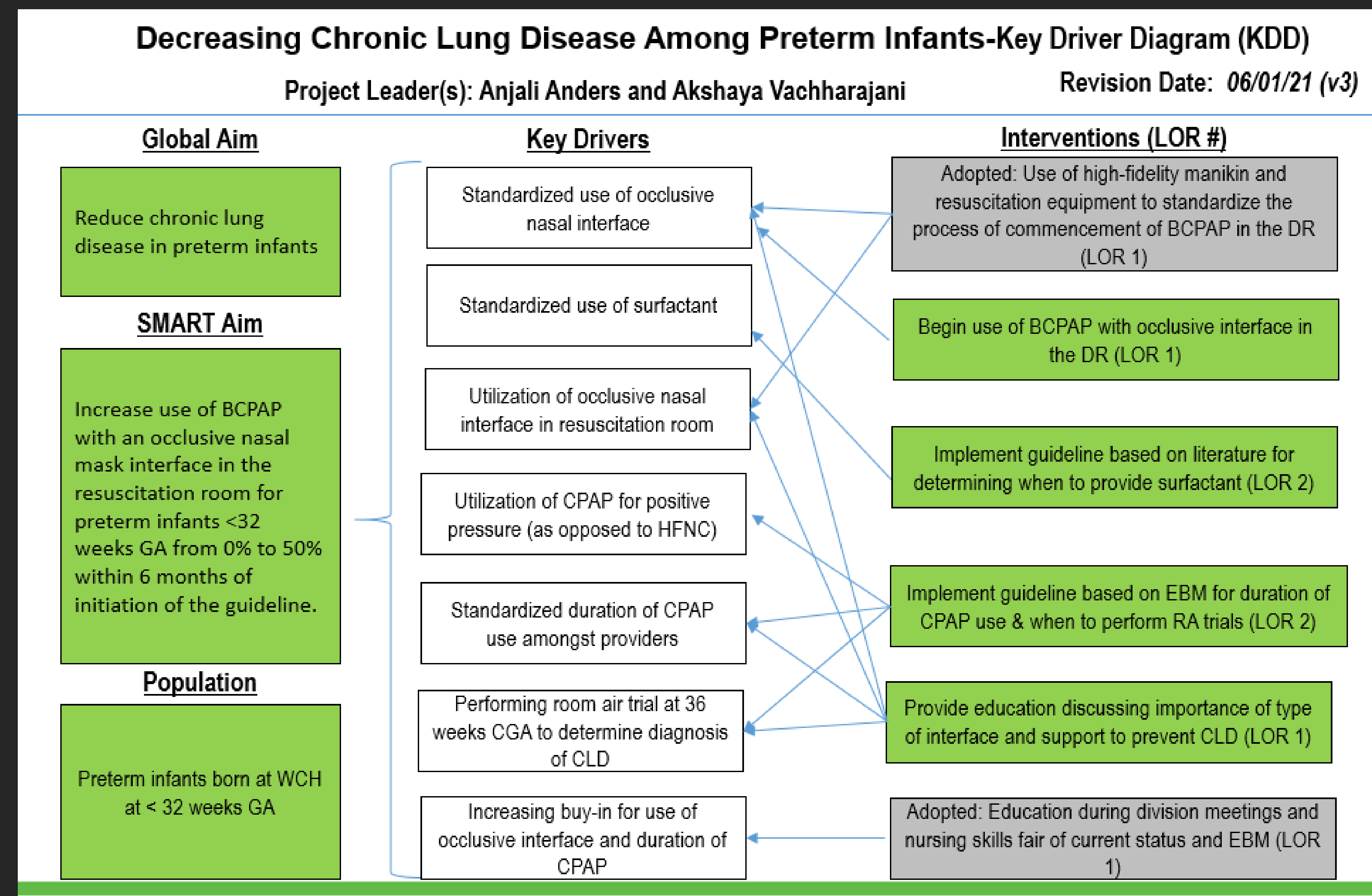
METHODS

- Baseline data was collected and reviewed from neonates <32 weeks gestational age (GA) at birth (inborn) admitted to the NICU
- SMART AIM was developed as shown in the key driver diagram (KDD)
- Initial PDSA cycles used high-fidelity simulation to determine the optimal equipment set up for the resuscitation of a preterm neonate that would incorporate BCPAP into neonatal resuscitation (see separate section on PDSA cycles)
- Use of BCPAP with an occlusive nasal (mask) interface on premature neonates began after an educational video utilizing high-fidelity simulation was developed along with unit guidelines regarding the duration of CPAP use and the earliest time period for discontinuation

RESULTS

- BCPAP with nasal occlusive interface increased from 0% to 60% after initiation of QI project (initial goal achieved, but continue to monitor for further improvement)
- Continuing to monitor for shift in FiO2 requirement at 28 days of age and respiratory support at 36 weeks corrected GA (required to determine if an infant has diagnosis of BPD)

High-fidelity simulation with QI methodology allowed for optimization of BCPAP use with the appropriate interface in the resuscitation room with increased safety of use on patients.

Decreasing Chronic Lung Disease Among Preterm Infants-Key Driver Diagram (KDD)
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Revision Date: 06/01/21 (v3)

% of Preterm Infants with Use of BCPAP in the Resuscitation Room

Bubble CPAP connected to flow where typically flow inflating bag is connected

T-piece resuscitator connected, if needed for PPV; FiO2 can be adjusted on bed for both bubble CPAP and T-piece

Plan Do Study Act (PDSA cycles):

- **1st PDSA cycle**-Evidenced based practices were reviewed, unit guideline was developed for non-invasive respiratory management of preterm infants <32 weeks GA at birth
  - Review of literature was provided to NICU physicians, NNPs, respiratory therapists, NICU nurses and Pediatric Pulmonologists; QI multidisciplinary team included NICU physicians, NNPs, NICU nurses, NNPs, and respiratory therapists (Pediatric Pulmonology and Cardiologist were also involved for infants diagnosed with CLD +/- pulmonary hypertension)

- **2nd PDSA cycle**-sequential in situ simulations using a high-fidelity manikin with resuscitation equipment to standardize the process of BCPAP commencement in the DR
  - Manikin simulated grunting and apnea; vital signs on monitors were used to reinforce effective versus ineffective CPAP. Initially used a flow-inflating bag from the radiant warmer and BCPAP on a transport pole to provide PPV or BCPAP, respectively. The process was recorded and educational video provided to staff on the application of BCPAP and transition to PPV if necessary. On repetition of the simulation, we discovered there were limited oxygen/air wall supply outlets in some of the delivery rooms and suction apparatus was not functional with this set up.
  - Performed sequential in situ simulation with use of T-piece resuscitator and BCPAP; determined when both are attached to the radiant warmer, this allows both forms of necessary respiratory support to be available along with suction

- **3rd PDSA cycle**- began use of BCPAP in the resuscitation room with preterm infants
  - Educational video was provided to all NICU staff for review prior to initiation of use on preterm infant

- **Next steps**-PDSA cycle with use of an equipment form to allow for consistency in available equipment for resuscitations (inconsistent stocking has led to some difficulties in available equipment during resuscitation)

% Placed on Invasive Ventilation

% of Preterm Infants on 21% FiO2 at 28 days of life
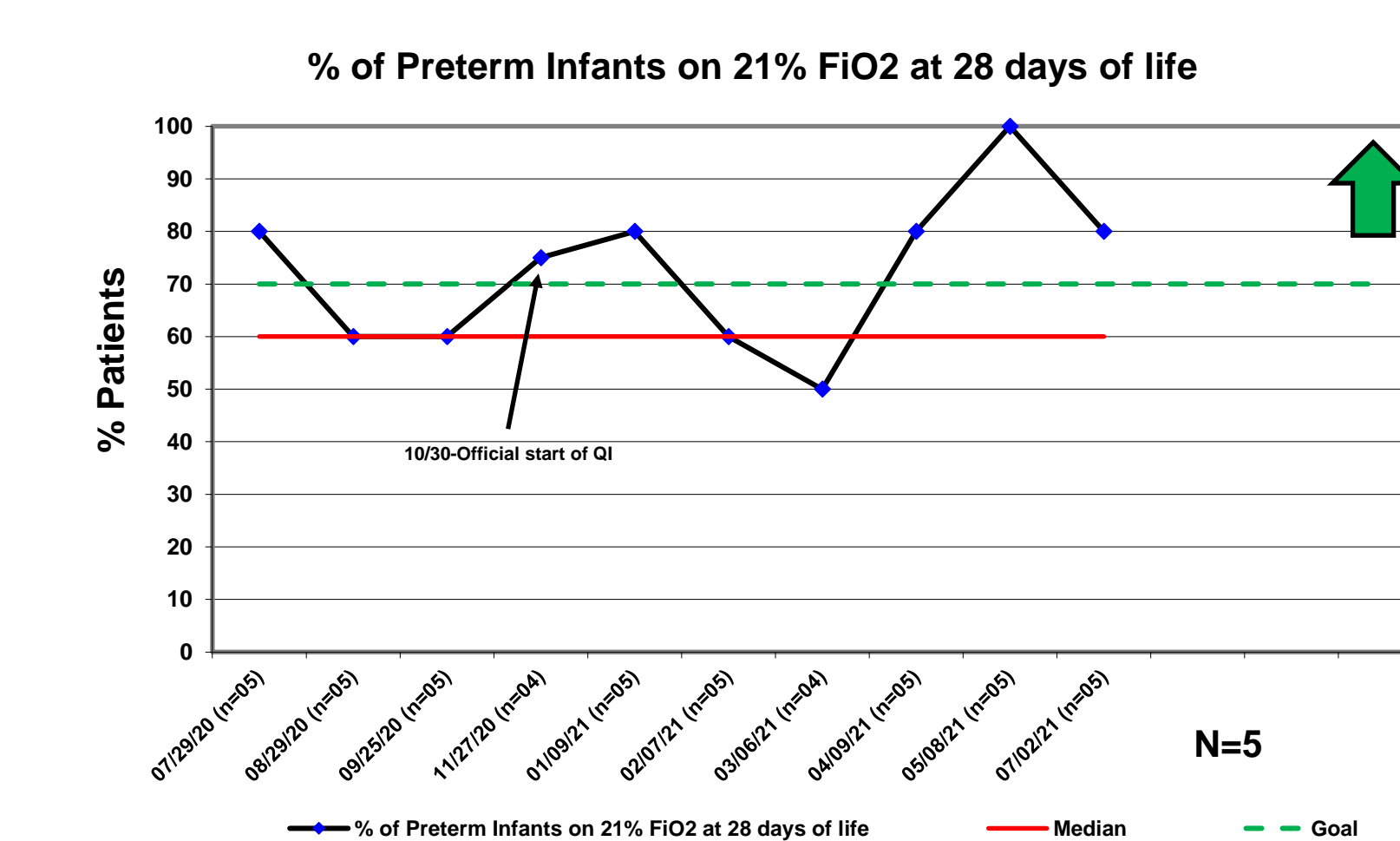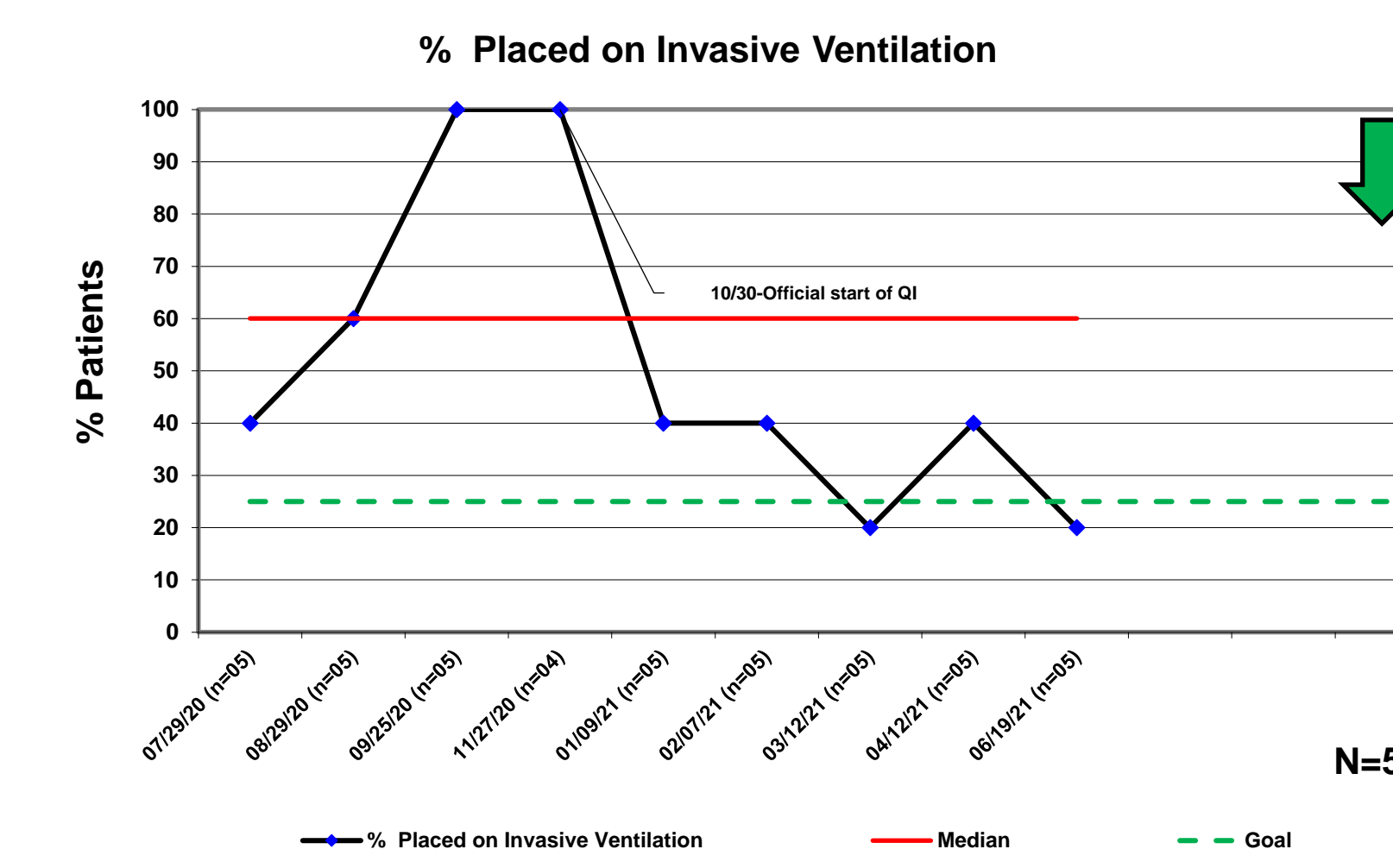
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