Childbirth is one of the most common reasons for hospital care with over 4 million births annually in the U.S. While a relatively safe reason for a hospitalization, complications arise in approximately 10% of births. Many of these complications can have serious consequences such as unintended maternal or neonatal intensive care unit admission, maternal blood transfusion, infection or venous thromboembolic disease, or birth asphyxia. Thus, improving the delivery of obstetric care could have significant public health implications. The “laborist” model of care, introduced nearly a decade ago, is a growing, but unproven alternative model of care. While variations in the implementation of the model may exist, a laborist model refers to the presence of labor and delivery provider for a period of time, whose sole focus is on the labor and delivery unit without other competing clinical duties. The premise is that continuous presence of labor and delivery staff with this model, in contrast to a traditional “as needed” model, will enhance safety and outcomes. This model was implemented based on the hospitalist model in medicine. Hospitalists, or physicians who spend more than 25% of their time caring for inpatients, are a model of inpatient care that has grown in importance over the past decade. The laborist model represents a significant and recent change in the way obstetrics has been experienced and practiced from both a patient and provider perspective. Although the idea for the laborist was initiated largely due to the theoretical improvement in patient outcomes with the hospitalist model in general medicine, there are several differences between the laborist and hospitalist models and evaluating the impact on this model on maternal and neonatal outcomes is critical.

While there are no studies specifically evaluating the impact of implementing a laborist model on maternal and neonatal outcomes, there are other studies that suggest that improvements in outcomes with this model are plausible. Intrapartum deaths are thought to result from suboptimal management of labor and delivery where timely recognition and management may have prevented the death from occurring. Additionally, it has been demonstrated that the early recognition of many peripartum events including infection, hemorrhage, and obstructed labor can result in the reduction in maternal and infant mortality during labor, delivery and neonatal periods.
Although the potential benefits of a laborist model on obstetric care are plausible, there is no literature to date evaluating the impact of the laborist model of obstetric care on maternal or neonatal outcome measures.

This study is the first analytic assessment of a model of care that is being adopted by hospitals across the nation despite the lack of evidence. The results from this proposal have allowed us to understand the current state of the model and rigorously evaluate the impact of an obstetric care delivery model on maternal and child health by strengthening the knowledge base around models of obstetric care delivery.

We first evaluated the state of the laborist model. In collaboration with the National Perinatal Information Center/Quality Analytic Services (NPIC/QAS), we assessed the utilization of this model of care delivery and hospital-level characteristics associated with its use. We performed a cross-sectional electronic survey of all NPIC/QAS member hospitals (26 states) in February 2010. Questions assessed staffing and clinical capabilities and utilization of laborists. The association between laborists and hospital-level characteristics were calculated using chi-square analyses or Fisher’s exact tests for categorical variables and t tests for continuous variables. Results. Ninety-three percent of hospitals (69/74) responded and only those that provide OB services were analyzed (N = 68). Nearly 40% (25/68) of hospitals responded that they are utilizing laborists. Delivery volume is significantly associated with implementation of laborists whereas OB level, presence of residents and fellows, and geography were not. This was the first assessment of the use of laborists in a large sample of US hospitals (This paper was published-first product listed under section VI.)

Utilizing these self-identified NPIC/QAS hospitals as laborists and non-laborists, we evaluated the effectiveness of the laborist model of care compared to the traditional model of obstetric care using specific maternal and neonatal process and outcome measures.

The overall hypothesis of the project was that the laborist model of care will lead to improved maternal and neonatal outcomes and quality of care. This study used an epidemiologic approach to compare maternal and neonatal outcomes between hospitals with laborists to those without. After consent and enrollment of 24 hospitals, we performed a difference in differences study to truly evaluate the impact of laborists on maternal and neonatal outcomes.

III. Study Design and Methods

National Perinatal Information Center
The NPIC/QAS is a non-profit membership organization which began in 1985 with a charter membership of major perinatal centers across the United States. It is a voluntary benchmarking organization. In 2010, 74 member hospitals were located in 25 states and represented all American Hospital Association geographic census divisions. The average annual delivery volume was 4,619 per hospital with a range of 589 to 16,544 annual deliveries per hospital. The characteristics of women at member hospitals
represent the general US population with 70% between the ages of 21 and 35 years old and approximately 40% unmarried. Additionally, patients were approximately 40% public assistance, 54% private and 6% other or unknown.

We performed a cohort study to compare pregnancy outcomes of unexposed (non-laborist) hospitals to exposed (laborist) hospitals. We used a matched sampling methodology to select the two groups of hospitals from the NPIC membership who responded to the cross-sectional survey (item indicating if hospitalists/laborists were performing deliveries). At the time the survey was performed, NPIC had 74 member hospitals from 26 states. Hospitals were matched 2:1 non-laborist to laborist using the following hospital based characteristic variables in order to minimize other differences between laborists and non-laborist hospitals that may be associated with differences in maternal and neonatal outcomes.

1) Annual volume of deliveries categorized as <=1000 or >1000
2) Geography based on US census bureau designated areas: Northeast, Midwest, South, West
3) Teaching hospital status (presence of OB residents)
4) Level of Neonatal Intensive Unit Care

These criteria were used to minimize other differences between laborists and non-laborist hospitals that may be associated with differences in maternal and neonatal outcomes. For example, hospital systems may differ based on volume of deliveries. Practice patterns may differ based on geography. The likelihood to move to a laborist system may vary based on whether a hospital has OB residents. Additionally, the level of NICU care may affect treatment available and neonatal outcomes.

Eight NPIC/QAS laborist and 16 non-laborist hospitals had adequate pre- and post-implementation data and agreed to participate. After hospitals were consented, maternal and neonatal discharge data from all 24 participating hospitals was obtained. NPIC/QAS provided a de-identified dataset to the investigators at the University of Pennsylvania - no patient level or hospital level identifiers were used in this study. Each hospital had an identified pre and post time period based on the time (year) of implementation of the laborist hospital within the group. The three hospitals in each triad (one laborist and 2 non laborists) each had at least three years of data in the “pre” period and up to 2 years of data in the “post” period. The pre and post period for each triad were assigned based on the year of laborist hospital implementation (implementation is year 0) of the laborist within that triad. Available NPIC/QAS data includes individual data submitted on all discharges at member hospitals for each quarter. The file is patient specific and comprised of discharge abstract/UB 04 data (also referred to as an “administrative data set”). Per NPIC/QAS protocol, maternal hospitalizations were linked using either medical record or billing number to the corresponding infant hospitalization based on a maternal medical record number field on the newborn record. The primary investigator and analysis team (Srinivas, Macheras, Small, Lorch) were blinded to hospital identity. Only exposure status and time of laborist implementation were known to the investigators. The data spanned from 1998-2011.
Outcomes measures were chosen based on either their public health relevance, such as neonatal mortality; inclusion in previous patient safety indices, such as birth injury, need for blood transfusion, or occurrence of infection; or measures of the relative health of the mother, such as the need for admission to the intensive care unit and prolonged length of stay, complications from induction of labor, as well as Agency for Health Care Research and Quality patient safety indicators such as significant perineal lacerations. Preterm birth, both spontaneous and medically indicated, was also evaluated. All outcomes were identified by ICD 9 codes. The maternal outcomes evaluated include: postpartum hemorrhage (estimated blood loss >500 for a vaginal delivery; >1000 for a cesarean delivery), transfusion, ICU admission, third or fourth degree lacerations, cesarean delivery, chorioamnionitis, induction of labor, preterm birth and prolonged length of stay. Neonatal outcomes evaluated include: Apgar at 5 minutes of less than 7, bacterial sepsis, birth asphyxia, birth injury, birth trauma, fracture, neonatal death, neonatal intensive care unit admission, and length of stay. All outcomes were initially evaluated for secular trends present in the 2 years prior to laborist implementation. If pre-existing trends were noted, either positive or negative, then that outcome was not included in the final analyses. The final maternal and neonatal outcomes evaluated include: cesarean delivery, chorioamnionitis, induction of labor, preterm birth, prolonged length of stay, Apgar at 5 minutes of less than 7, birth asphyxia, injury, trauma and neonatal death.

We used a before-and-after study with an untreated comparison group to examine whether the implementation of the laborist model at a hospital was associated with a change in the underlying trend in patient outcomes in the hospital. To analyze the study, we used the method of difference-in-differences. The method compares each hospital with itself, before and after the time at which the laborist was implemented at one of the hospitals in the hospital’s matched set, contrasting the changes in the hospital that implemented the laborist model to the hospitals that did not implement the laborist model, making adjustments for observed differences in patient risk factors.

IV. Detailed findings

8 laborist hospitals were matched to 16 non laborist hospitals. Nearly 550,000 patients were evaluated from 24 hospitals. Hospital level characteristics were balanced post match. When evaluating the patient level characteristics in the before time period, there were no clinically significant differences with respect to diabetes or chronic hypertension or multiple gestation in laborists compared to non laborist hospitals. Patient characteristics appeared clinically similar between laborist and non laborist hospitals in the "after" time period.

Both laborist and non laborist hospitals had an increase in cesarean delivery when comparing pre to post. However, the differences after the laborist hospital changed was smaller. Specifically, the rate of rise in rate of cesarean delivery was not as great in the laborist hospitals after implementation of laborists. For induction of labor, the pre difference was also much greater than the post difference. Non-laborist hospitals had an absolute 4% point increase increase whereas laborists had a 0.68% increase.
After adjusting for observed confounders, laborists were associated with a significant improvement in induction of labor and preterm birth. Laborists were associated with a 15% decrease in the odds of inductions of labor (odds ratio= 0.85, 95% CI: 0.71,1.0) and a 17% decrease in the odds of preterm births (odds ratio=0.83, 95% CI: 0.72, 0.96). There was no significant difference in cesarean delivery, chorioamnionitis, or prolonged length of stay after adjustment. There was no significant difference in neonatal outcomes between laborist and non laborist hospitals.

V. Discussion and interpretation of findings

The implementation of the laborist model creates a large shift in the way providers and patients experience obstetrics. Since its inception, there have been positive and negative attributes cited about this model with increased safety and potentially decreased liability being one significant reason for its increased utilization. This is the first study to date rigorously assess the impact of laborists on maternal and neonatal outcomes.

Our findings that laborists reduce inductions of labor and preterm birth are plausible. The reduction in inductions is likely due to changes in practice behavior secondary to continuous coverage and less pressure to “schedule for convenience” due to lack of interference with office hours or personal conflicts. Additional reduction in medically indicated preterm births may reflect a greater comfort with continued observation rather than automatic delivery, particularly in patients with controversial clinical presentations.

The reduction in spontaneous preterm birth is not fully explained through the data. The delivery of an infant prematurely is an important public health issue. However, there is little data to support the argument that physicians around the time of delivery can have a significant impact at reducing the rate of extreme premature delivery, although tocolytic drugs may delay delivery to allow for the administration of antenatal corticosteroids. There is growing evidence, though, that physician practice may influence the delivery of infants “near term” between 34 and 37 weeks gestation. These infants have recently been identified as having a higher risk of respiratory distress, poor feeding, and prolonged hospitalization. Laborists may have a more complete knowledge of this literature and change their patterns of delivery to reduce this risk and the reduction in spontaneous preterm births may be related specifically to this late preterm group. Finally, cesarean delivery was not reduced and in fact slightly increased (AOR 1.02).

Reduction in both induction of labor and preterm birth have major public health benefits. While labor induction is sometimes medically indicated, it historically has been done for non-medical indications with an increase in labor inductions in the United States from 9.5% in 1990 to 22.1% in 2004. Preterm birth is currently the most important maternal and child health problem in the United States. It is the leading cause of neonatal mortality and a significant contributor to neonatal morbidity. More recent interventions
have focused on decreasing the rate of spontaneous preterm birth through cervical length screening and progesterone. However, medically indicated preterm birth is an equally important contributor and is more dependent on medical decision-making. Many have suggested that the rise in preterm births more recently may be related to an increase in medically indicated preterm births. Therefore, any health services intervention to reduce preterm birth is of great value and is likely to have a huge public health and societal economic benefit.

Our study does have some limitations. It is based on administrative data. Administrative data have several advantages and disadvantages for this type of study. Although administrative data use ICD-9-CM codes to describe a patient which lacks the detail of chart abstraction, it allows for a larger sample size to be evaluated since it can be easily accessed and there is minimum cost involved in processing. It also offers standard data nationally and allows for a more robust inclusion of patients. Additionally, a rigorous study design to assess differences in outcomes after implementation of a model of care change (i.e. laborist) requires a large number of hospitals and would require extensive chart abstraction. This would be much less efficient and difficult to accomplish without using administrative data.

Studies from selected centers are potentially biased by patient and physician factors that influence the choice of a delivery hospital. Our algorithm to match hospitals on four hospital level factors aims to reduce this bias. While the NPIC/QAS members are a select group of hospitals, they represent 26 states and a wide range of geographies and annual delivery volumes. The only alternative design would include a single hospital pre/post laborist design. This would be far less generalizeable than our proposed multi-center design.

We acknowledge that based on the delivery volume and needs of individual hospitals, it is plausible that not all exposed hospitals will implement the laborist model of care in the same way. We were unable to evaluate outcomes by the method of laborist implementation at exposed hospitals.

Policy Implications
Our findings have significant policy implications. Obstetric care is rapidly evolving with increasing utilization of laborists. Our study demonstrates that the laborist model is a promising obstetric care delivery model that can significantly decrease the adverse outcomes and cost of OB care through a reduction in inductions and preterm birth. With additional research as outlined below, a large policy implication would be the development of a national standard and guidelines for models of inpatient labor and delivery care to optimize maternal and neonatal outcomes.

Future Research
1. Further evaluating the mechanism of reduction of preterm birth and induction of labor found in our study. Perhaps through a survey study of providers that are
both laborists and non-laborists related to their management practice of certain conditions.

2. Evaluate the role of midwives in laborists models

3. Assess the different types of laborist models and compare them in order to determine the most effective strategy to provide inpatient labor and delivery care in order to maximize maternal and neonatal outcomes.

4. Additional research related to patient satisfaction given the concern that this type of model eliminates the continuity of care aspect and erodes the doctor patient relationship. We evaluated this in one hospital (listed under publications below) but a broader patient survey would be interesting and insightful.

References

32. Pare E, Quinones JN, Macones GA. Vaginal birth after caesarean section versus elective repeat caesarean section: assessment of maternal downstream health outcomes. BJOG 2006;113(1):75-85.

VI. List of products
   a. Presentations
      iii. 60 minute webinar with large number of participant (>50) October, 2013-for NPIC/QAS-“ Does the laborist model of care improve outcomes?

   b. Publications:

v. Qualitative analysis –interviews of hospitals enrolled that implemented laborists-description of impetus for delivery model change, barriers to change and implementation. Resubmission planned; journal undecided