Delayed Cord Clamping in the Premature Neonate: Development of an Interdisciplinary Guideline

Karen M Frank1, Dawn Mueller-Burke2,3, Janine Bullard4, Jan Wilson2,5 and JoAnne Silbert-Flagg*1

1Johns Hopkins University, School of Nursing, Baltimore, USA
2University of Maryland, School of Nursing, Baltimore, Maryland, USA
3University of Maryland Medical Center, Baltimore, USA
4Johns Hopkins University, School of Medicine, Department of Pediatrics, Baltimore, USA
5Mercy Medical Center, Baltimore, USA

Abstract
Evidence supporting delayed cord clamping (DCC) in the premature newborn is increasing, yet in a level IV neonatal intensive care unit (NICU); DCC was not being consistently performed, and when it was there were noted variations in the absence of a standardized guideline.

The objective of this quality improvement (QI) project was to develop and secure institutional approval of a DCC guideline for the premature newborn and increase knowledge of DCC among healthcare providers (HCPs).

The design was a QI project using Rogers’ Diffusion of Innovations (DOI) Theory to guide the development of a DCC guideline. Educational in-services were conducted to increase knowledge of DCC and the components of the DCC guideline.

A panel of nine experts including interdisciplinary HCPs from the NICU and the obstetrics department (OB) defined and approved the DCC guideline content. A convenience sample of 90 HCPs participated in the DCC educational in-services.

The use of the DCC Guideline Development tool created from best evidence guided an interdisciplinary committee towards consensus and final approval of the DCC guideline. Eleven standardized DCC in-services were conducted with pretest-posttest knowledge surveys.

Essential components of the guideline include a delay of 45 seconds before cord clamping, inclusion and exclusion criteria, thermoregulation interventions, and responsibilities of the NICU and OB team. In-service education of DCC and guideline was effective based on survey results.

The DCC guideline and education of the HCPs seeks to translate best evidence into practice and standardize DCC implementation. Future plans include measuring retained knowledge, guideline adherence by the HCPs, and evaluation of clinical outcomes.

Keywords: Delayed cord clamping; Premature newborn; Guideline; Rogers theory

Background
The transition from fetal to newborn life involves many physiologic changes that come with the movement from intra to extra uterine life. Clamping the umbilical cord after birth is a necessary intervention and assists the newborn in this transition to extra uterine life; however, the timing of when it should occur after birth has varied throughout the centuries. “Primitive cultures” waited to clamp the umbilical cord after delivery sometimes as long as several hours. It is unclear when this practice changed, but some evidence indicates clamping the umbilical cord immediately after birth was being practiced by some providers dating back as early as the 17th century [1]. In the last century, as technology has advanced in the care of smaller, sicker newborns, immediate cord clamping (ICC), which involves clamping the umbilical cord within the first 20 seconds after birth, has become a common practice potentially depriving the newborn of additional blood volume which can help in the transition process [2]. However, a brief delay in clamping the cord (30-120 seconds) has been found to result in a placental transfusion that supplies the newborn with iron-rich red blood cells and additional blood volume [3].

In a Cochrane review of full-term newborns comparing delayed cord clamping (DCC) to ICC, there were no statistically significant differences found in mortality rate, Apgar score, or admission to a neonatal intensive care unit (NICU) [4]. Additionally, the authors reported many advantages to DCC including higher birth weight, increased hemoglobin (Hgb) values, and increased iron stores lasting up to six months after birth. DCC facilitates a gentle transition that benefits all newborns, but may be critical to the vulnerable preterm newborn. DCC at birth can support the preterm newborn during the transition to extra-uterine life through an autologous transfusion of blood from the placenta to the newborn which has been found to result in fewer transfusions for anemia, decreased intraventricular hemorrhage (IVH), and decreased necrotizing enterocolitis (NEC) [5]. Furthermore, DCC is the recommendation for premature newborns not requiring immediate resuscitation (no respiratory effort or significant bradycardia at birth).

*Corresponding author: JoAnne Silbert-Flagg, Johns Hopkins University, School of Nursing, University in Baltimore, Maryland, USA, Tel: +1 410-955-4766; E-mail: jsilber1@jh.edu
Received: November 10, 2015; Accepted: November 15, 2015; Published: November 22, 2015
Citation: Frank KM, Mueller-Burke D, Bullard J, Wilson J, Silbert-Flagg J, et al. (2015) Delayed Cord Clamping in the Premature Neonate: Development of an Interdisciplinary Guideline. J Preg Child Health 3: 261. doi:10.4172/2376-127X.1000261
Copyright: © 2015 Frank KM, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
The purpose of this quality improvement (QI) project was to develop a clinical practice guideline and educational intervention for health care providers (HCPs) in a large tertiary medical center on DCC for premature newborns <37 weeks GA.

The primary outcome of the project included an expert consensus generated standardized DCC guideline that was approved by the Departments of Neonatology and Obstetrics (OB) for implementation into practice at this institution. The secondary outcome included an increase in knowledge of DCC and the guideline by the HCPs who attend deliveries of premature newborns.

Theoretical Framework

The successful development of the guideline and educational intervention for DCC was based on translating the known DCC research into practice. Rogers’ Diffusion of Innovations (DOI) Theory offered a framework to guide the translation of evidence into practice and was used during the implementation of the project’s methods [11]. Diffusion is the process of how an innovation is connected through networks among individuals of a social system.

Innovation decisions are personal for each member of the social system and follow a five-step process that includes: knowledge, persuasion, decision, implementation, and confirmation [11]. The first stage, knowledge, is when first exposure to the innovation occurs. The individual is not yet inspired by the innovation, therefore, does not want more information. Project components that were used to increase knowledge included identifying and meeting with key stakeholders to discuss the evidence. The second stage, persuasion, is when interest in the innovation occurs, and individuals begin to form a positive view and actively seek detailed information. Champions were identified to support DCC during this phase. The third stage, decision, is when the individual or institution examines the plan and process of DCC by the teams. These inconsistent findings supported the need for a standardized guideline. The purpose of this framework was to guide the translation of evidence into practice.

Clinical Benefits and Perceived Risks

DCC has been shown to result in a significant placental transfusion in premature newborns and has an impact on morbidity including anemia, hemodynamic instability, IVH, and NEC. Anemia hinders growth, interferes with recovery, and places the neonate at risk of requiring blood transfusions. A systematic review and meta-analysis by Rabe, Reynolds and Diaz-Rosello looked at a 30-120 second delay in clamping the cord at delivery [12]. This review included seven RCT studies with a large sample size (N=454). The DCC group had higher hematocrit (HCT) values at birth (5 studies, p=0.0007), fewer newborns required transfusions (3 studies, p=0.005), and when a newborn did require transfusions, they required fewer number of transfusions (4 studies, p=0.0004). Other investigators found similar results including higher HCT values with a 30-120 second delay in cord clamping [13-16].

The premature neonate is also at risk for hypotension which can be compounded by not receiving the autologous transfusion from the placenta to the newborn. The hypotension is thought to be a result of hemodynamic instability which occurs in up to 52% of premature neonates. The literature indicates there is a link between hemodynamic instability and IVH [17,18].

The preterm neonate has a structure called the germinal matrix, the anatomic site of the development of neural cells. This highly vascular and metabolically active structure can be easily damaged resulting in IVH. The premature neonate also has a pressure passive cerebral circulation with an impaired ability to auto-regulate cerebral brain blood flow. As a result, there appears to be a relationship between fluctuations in systemic blood pressure and the occurrence of IVH [5].

A literature review was completed to evaluate the evidence related to the clinical benefits, and perceived risks of DCC for the premature neonate delivered at less than 37 weeks gestational age, the components critical to the development of the DCC guideline, including the length of time between birth and clamping the cord, as well as exclusion criteria.

Literature Review

A literature review was completed to evaluate the evidence related to the clinical benefits, and perceived risks of DCC for the premature neonate delivered at less than 37 weeks gestational age, the components critical to the development of the DCC guideline, including the length of time between birth and clamping the cord, as well as exclusion criteria.

Clinical Benefits and Perceived Risks

DCC has been shown to result in a significant placental transfusion in premature newborns and has an impact on morbidity including anemia, hemodynamic instability, IVH, and NEC. Anemia hinders growth, interferes with recovery, and places the neonate at risk of requiring blood transfusions. A systematic review and meta-analysis by Rabe, Reynolds and Diaz-Rosello looked at a 30-120 second delay in clamping the cord at delivery [12]. This review included seven RCT studies with a large sample size (N=454). The DCC group had higher hematocrit (HCT) values at birth (5 studies, p=0.0007), fewer newborns required transfusions (3 studies, p=0.005), and when a newborn did require transfusions, they required fewer number of transfusions (4 studies, p=0.0004). Other investigators found similar results including higher HCT values with a 30-120 second delay in cord clamping [13-16].

The premature neonate is also at risk for hypotension which can be compounded by not receiving the autologous transfusion from the placenta to the newborn. The hypotension is thought to be a result of hemodynamic instability which occurs in up to 52% of premature neonates. The literature indicates there is a link between hemodynamic instability and IVH [17,18].

The preterm neonate has a structure called the germinal matrix, the anatomic site of the development of neural cells. This highly vascular and metabolically active structure can be easily damaged resulting in IVH. The premature neonate also has a pressure passive cerebral circulation with an impaired ability to auto-regulate cerebral brain blood flow. As a result, there appears to be a relationship between fluctuations in systemic blood pressure and the occurrence of IVH [5].

Rabe et al. found a decrease in the incidence of IVH (7 studies, p=0.002) in premature neonates who received DCC compared to the neonates who did not receive DCC [19]. Elminian et al. found similar results in a RCT of neonates delivered between 24-34 weeks’ gestation [14]. This study included a large sample size (N=200), equal numbers within the groups, similar GAs within the groups, and the GAs used for the study were similar to the GAs that were proposed for the project’s methods. The study showed the premature newborns who received DCC had higher initial Hgb (17.4+/-2.5 versus 16.3+/-2.3 g/dL, p=0.001) and HCT values (51.3+/-7.3 versus 47.4+/-7.3, p=0.001) compared to the premature newborns who did not receive DCC.

Blood transfusions have been associated with NEC, the most common gastrointestinal emergency, seen in the premature neonate [20,21]. A Cochrane review found premature newborns who received DCC (30-180 seconds) had a decrease in the incidence of NEC (5 trials, 241 infants, RR 0.62, 95% CI 0.43 to 0.90) compared to premature newborns who did not receive DCC [5]. Using a consistent DCC time of 45 seconds, Azizz et al. reported a decrease in the incidence of NEC in premature newborns who received DCC compared to premature newborns who did not receive DCC (1.3% vs. 5.4%, p=0.026, N=480) [16]. This study was important as it used the same length of time for all newborns that received DCC and was the length of time that was used when developing the project guideline.
There were significant variations across the studies regarding the length of time used for DCC which may affect the generalizability and reliability of the outcomes. The studies included in a Cochrane review utilized 30-180 seconds when implementing DCC. Most of the studies used 30-60 seconds for DCC and documented statistically significant decreases in the incidence of IVH, fewer transfusions for anemia, and a lower risk of NEC [22]. Aziz et al. found similar results using 45 seconds for DCC [16]. These results demonstrated a decrease in the incidence of NEC and significantly higher Hgb values but no significant difference was found in the incidence of IVH.

Concerns have been raised about performing DCC on the premature newborn since it may cause a delay in resuscitation and an increased need for treatment for hyperbilirubinemia. Aziz et al. studied newborns delivered at <33 weeks GA and reported no significant differences in mortality, Apgar score, and delivery room ventilation in premature newborns who received DCC compared to ICC [16]. This supports DCC does not have a negative impact on resuscitation of the premature newborn and the benefits of DCC outweigh the potential risks.

Thermoregulation may be negatively impacted when DCC is performed as a result of the increased length of time it takes to get the newborn to the warmer to provide radiant heat. Rabe, Reynolds and Diaz-Rosello found no differences in admission temperatures in the premature newborns who received DCC compared to ICC despite variations in the length of time (30-120 seconds) DCC was performed [23]. Aziz et al. performed DCC for 45 seconds and reported no differences in admission temperatures between premature newborns who received DCC and ICC [16]. DCC may also result in an increase in the newborn’s body temperature as seen in a study by Jelin et al. [24,25]. Waiting 30-60 seconds from birth to clamping the umbilical cord resulted in an increase in body temperature in the newborns who received DCC from 36.3°C (pre-DCC) to 36.5°C (post-DCC) (<0.001) although it was mentioned that efforts to improve hypothermia occurred at the same time [24,25].

Hyperbilirubinemia is another concern related to the transfusion of blood by the placenta during DCC. A Cochrane review found higher peak bilirubin concentrations in newborns who received a longer placental transfusion compared to a shorter transfusion time (seven trials, 320 infants, 95% CI 5.62 to 24.40). Treatment with phototherapy was reported by three studies (180 infants, RR 1.21, 95% CI 0.94 to 1.55), and although it did not reach statistical significance there was an increased trend towards phototherapy [5]. This review was important because the large sample size added to the strength of this study and it identified one possible negative effect of DCC for the premature neonate.

**Exclusion Criteria**

There are situations where DCC may be contraindicated secondary to a maternal condition or the need for immediate resuscitation of the newborn. Some studies excluded multiple gestation deliveries while other studies such as Kugelman et al. included multiple gestations in their studies. No complications were reported by Kugelman. Several of the studies supported exclusion of neonates with congenital malformations, severe intrauterine growth retardation (IUGR), cord prolapse, discordant twins, and maternal conditions such as bleeding and maternal substance abuse. These studies helped to identify the premature neonates that were excluded in the project guideline.

**Method**

Rogers’ DOI Theory was used to guide the QI project through the guideline development and education of the HCPs. The project was implemented in a large metropolitan tertiary care facility that has a Level IV NICU and comprehensive birthing center in the Mid-Atlantic region. A panel of experts including interdisciplinary representation from the NICU and the OB department were used to define the guideline. A convenience sample of HCPs that attended the educational in-service was used to evaluate the knowledge of DCC and the guideline. The QI project began with the development of the DCC project guideline for premature newborns <37 weeks GA. The components of the guideline were based upon consensus of the committee. Preliminary discussions occurred with the project coordinator and key stakeholders in the NICU and OB department. This assisted in identifying HCPs that attend preterm deliveries, were knowledgeable of DCC, and interested in being a member of the committee. Three meetings were prescheduled through the use of Doodle® to ensure optimal number of attendees at each meeting. The first one-hour meeting included: a) introductions and a discussion of how each member would contribute to the process, b) a review of the DCC evidence which was sent out in advance so members would come to the meeting prepared to discuss the evidence, and c) discussion of the components that would need to be included in the guideline. The second, two hour meeting, consisted of reviewing the specifics of the guideline to formulate the first draft. A “Delayed Cord Clamping Guideline Development Tool” (DCC-GD tool) developed by the project coordinator was used to identify potential choices available regarding components of the guideline with supportive evidence. The tool was reviewed step by step to ensure that all important components of the guideline were addressed and the committee made decisions based on the evidence. The steps of the tool included: preparation of the labor and delivery rooms (LDR) and OR, the briefing process before the procedure, discussion and implementation, the coordinator was in charge of the OB team responsibilities, the neonatal team responsibilities, the length of time between birth and clamping the umbilical cord, documentation, exclusion criteria, and the use of maternal oxytocics. A maternal-fetal medicine physician, neonatologist, and clinical nurse specialist (CNS) who successfully implemented a DCC guideline at the center’s “sister” hospital discussed their experiences with the project coordinator. This valuable information was shared with the committee. An initial draft was finalized after the second meeting and sent out through email for review. A third, one hour meeting was held to answer questions related to the guideline that were not clear after the initial draft and to make the final edits to the guideline. Once the committee arrived at a consensus, the project coordinator submitted the final draft guideline to the medical directors of the OB department and Neonatology for review and approval. The directors approved the guideline with a July 1 implementation date which coincided with the new resident and
fellowship programs at the institution. The steps of the guideline can be found in Appendix.

Once the guideline was approved, it was communicated to the relevant HCPs through several educational in-services that were held approximately one month before implementation. Ten live instructor-led educational in-services using a PowerPoint presentation and/or hand-outs were conducted. The topic of DCC was presented at three journal club meetings with the DCC guideline and educational in-service being presented during this time. Additional in-services were presented at mandatory nursing staff meetings and medical provider division meetings to ensure an optimal number of attendees would receive the education. There were informal educational sessions given on the labor and delivery (L&D) unit that closely matched the standardized education. This informal method of teaching was chosen related to high unit census and acuity and included a very small group of participants. Committee members, with the project coordinator present, presented the educational in-service to their peers to improve receptiveness and buy-in from the HCPs. The in-service was presented as a 30 minute presentation (20 minute presentation and 10 minutes for questions) using a standardized PowerPoint format that was developed by the project coordinator and agreed upon by the committee. The attendees were given a copy of the guideline and algorithm with the steps at the in-service. HCPs who could not attend the in-service were sent the information via email after all of the in-services were delivered.

A pretest-posttest survey was used to evaluate knowledge of DCC as well as the guideline. A convenience sample of HCPs from OB (physicians, midwives, and nurses) and the NICU (physicians, nurse practitioners, nurses, and respiratory therapists) were recruited from a group of HCPs that attended the in-service. Before the in-service, a 10-item pen and paper survey using a 5 point Likert type scale ranging from strongly disagree (1) to strongly agree (5) was administered to ascertain the HCPs knowledge of DCC. The survey consisted of general demographic data and closed ended questions that were developed from a literature review. Prior to distribution, the general purpose of the survey was described. The closed ended items were reviewed by two doctoral prepared HCPs who are knowledgeable about DCC, and the items were found to have face validity. Survey content validity was ascertained by five HCPs who are knowledgeable of DCC. Two items on the initial survey were noted to be irrelevant at measuring knowledge of DCC, therefore were replaced. The content validity index (CVI) calculation for the final instrument was confirmed at 80%.

Knowledge of DCC was measured again after completion of the in-service, using an 11-item pen and paper survey using the same seven knowledge items used in the pre-test survey and four additional fill-in-the-blank items directly related to the guideline. The percentage of participants who scored the four guideline items correctly was reviewed. If less than 85% of participants answered the guideline items incorrectly additional education specific to the guideline would be held.

Data from the surveys were entered into Excel® for analysis. Descriptive statistics and frequencies were used to report the results. The Likert type item responses were collapsed and categorized as a “0” (strongly disagree, disagree, and undecided) indicating no knowledge or a “1” (strongly agree and agree) indicating knowledge of the item. The percentage of participants with knowledge of DCC was calculated before and after the in-service. Results were analyzed to identify additional ongoing educational needs as a whole.

In order to protect all subjects who completed the survey, the demographic data items contained no individual identifiers. The participation of the attendees at the in-services and completion of the survey was voluntary and there were no consequences for not participating. The participants placed the survey in a collection box at the front of the room after the in-service to maintain anonymity. A query to the Institutional Review Board (IRB) was made, and determination was granted that the QI project was non-human subjects research.

Results

Rogers’ DOI Theory guided this QI project from inception to successful completion. A committee of interdisciplinary HCPs within the NICU and the OB department led by the project coordinator developed a DCC guideline for premature newborns delivered at <37 weeks GA. This guideline development process took several months. The guideline received approval from the administration of the NICU and the department of OB and was implemented into practice July 1 2014. The meetings were successfully held as a result of being scheduled at optimal times that were conducive to the majority of the committee. The DCC-Guideline Development (GD) tool provided guidance and kept the committee focused during development of the guideline by listing every important step that needed to be discussed and the potential options. The members utilized the DCC-GD tool to discuss each component of the guideline with the evidence that supports it. Having the supporting evidence and institutional practice available for review by the committee allowed them to make sound decisions based on their current practice and the evidence. The committee was able to come to a consensus for each component of the guideline in an organized and effective manner.

The guideline includes:

- Inclusion and exclusion criteria
- Preparation of the LDR/OB operating room before delivery
- Briefing process
- Length of time between birth of the newborn and clamping the cord
- Thermoregulation interventions (newborn delivered >30 weeks GA and newborn delivered at <30 weeks GA)
- Responsibilities of the OB team (position of newborn at the level of the placenta and drying and stimulation of newborn)
- Responsibilities of the NICU team (timining procedure and monitoring newborn during procedure)
- Who determines whether the newborn should receive DCC based on the status of fetus or newborn and or mother

After the guideline was approved the educational intervention was implemented.

Ninety participants completed the pre-survey and 86 participants completed the post-survey. More participants participated in the survey from the NICU (64.0%). Fifty-seven percent of the participants have been working in their respective profession for more than five years and more than half of the participants (64.4%) have participated in a delivery of a premature newborn where DCC was performed (Table 1). The OB department scored higher on all items in the pre-test survey with the exception of the item specific to neonatal outcomes [OB (75.00%) compared to NICU (79.31%)]. The greatest difference in scores was on the item related to the effects on maternal post-partum hemorrhage [OB (81.25%), NICU (36.21%)] (Table 2). There was an increase in knowledge of DCC post-intervention on all survey items with the
Comparison of pre-test scores for disciplines for individual survey items.

| Variable                                      | n (%) | % |
|-----------------------------------------------|-------|---|
| Location of work                              |       |   |
| Obstetrical Department                        | 32    | 36|
| Neonatal Intensive Care Unit                  | 58    | 64|
| Other                                         | 0     | 0 |
| Years in profession                           |       |   |
| Less than 5 years                             | 32    | 35.5|
| More than 5 years                             | 52    | 57.8|
| Participated in delivery of                   |       |   |
| Yes                                           | 58    | 64.4|
| No                                            | 17    | 19|
| Less than 37 wk gest.                         |       |   |
| Where DCC has been performed                  |       |   |
| Not sure                                      | 11    | 12.2|

Table 1: Baseline characteristics of educational participant.

| Survey Item                                                                 | OB (n) | %  | NICU (n) | %  |
|------------------------------------------------------------------------------|--------|----|-----------|----|
| Delayed cord clamping is defined as waiting to clamp the umbilical cord for  |        |    |           |    |
| at least 30 seconds from delivery of the newborn to allow for transfusion of | Agree  | 30 | 93.75     | 54 |
| the blood from the placenta to the newborn.                                  | Disagree | 2 | 6.25     | 6.9 |
| Delayed cord clamping is safe to perform on premature newborns delivered at |        |    |           |    |
| 24-37 weeks gestation that does not require resuscitation as supported by   | Agree  | 27 | 84.38     | 42 |
| no differences in mortality rates or Apgar scores when comparing newborns   | Disagree | 5 | 15.62     | 18 |
| who received delayed cord clamping and immediate cord clamping.             |        |    |           |    |
| Delayed cord clamping improves Neonatal outcomes including higher hematocrit |        |    |           |    |
| values, decreased need for transfusions for anemia, improved cerebral       | Agree  | 24 | 75        | 46 |
| oxygenation and decreased risk for IVH in the premature newborn delivered at | Disagree | 8 | 25        | 12 |
| 24-37 weeks gestation.                                                       |        |    |           |    |
| Performing delayed cord clamping does not make the premature newborn         |        |    |           |    |
| delivered at 24-37 weeks gestation hypothermic upon admission to the         | Agree  | 18 | 56.25     | 21 |
| Neonatal Intensive Care Unit.                                                | Disagree | 14| 43.75     | 37 |
| During delayed cord clamping the obstetrician holds the newborn at the      |        |    |           |    |
| mother’s perineum at the level of the placenta or lower than the placenta.   | Agree  | 27 | 84.38     | 46 |
| Disagree                                                                     | 5      | 15.62 | 12  | 20.69 |
| Delayed cord clamping does not increase Maternal post-partum hemorrhage.    |        |    |           |    |
| Agree                                                                       | 26     | 81.25 | 21  | 36.21 |
| Disagree                                                                     | 6      | 18.75 | 37  | 63.79 |
| Delayed cord clamping is supported for the premature newborn by the AAP,    |        |    |           |    |
| the ILCOR and ACOG.                                                         | Agree  | 29 | 90.63     | 39 |
| Disagree                                                                     | 3      | 9.37  | 19  | 32.76 |

Table 2: Comparison of pre-test scores for disciplines for individual survey items.

Discussion

Identification of the appropriate committee members which included the key players within the two departments had a major impact on the success of the project. It was important to include members that had the knowledge, ability, and power to implement change within the institution. As the project progressed, it became clear that one of the team members was unable to assist in the dissemination of information and education. This challenge required the addition of a CNS and nurse educator from the OB department to assist with the project education and dissemination after the guideline was approved. The inclusion of the perinatal peri-operative supervisor on the committee was very beneficial and important as her role was to assure that the new thermoregulation supplies were available for use and the old supplies were removed from the LDR and OR suites. The process of getting approval from the different administrators varied between the two departments. For this reason, it was important to have a key player who represented both nursing and medicine from each department who was aware of the administrative process for both disciplines.

Using Rogers’ DOI theory assisted in the development of the project structure and a step by step plan to guide the project to success. Identifying one member as the project coordinator was important in keeping the committee focused and productive. Successful coordination of the project resulted in productive meetings. Scheduling meetings in advance through Doodle allowed the committee members to choose multiple dates and times that fit within their schedule. This process enabled the project coordinator to identify the best day and time to hold the meetings to facilitate the optimal number of attendees at each meeting. In addition, having the members of the committee review the literature ahead of time was beneficial as it allowed the meeting to be used productively instead of using valuable meeting time to educate the committee on the current evidence. The summary of the evidence was useful in helping the committee understand the depth and quality of DCC research in the premature newborn. The committee was in agreement regarding the evidence supporting DCC for the premature newborn which facilitated a smooth process in developing the guideline. Using the DCC-GD tool to direct the development of the guideline was paramount in the success of the project. The DCC-GD tool kept the committee focused on the specifics of the guideline during the meetings. The committee reached consensus without disagreement on each step of the guideline with the exception of the use of umbilical cord milking when DCC is contraindicated. Since it was not possible to have all medical providers at the meetings to discuss this step in detail it was difficult to come to an agreement. The initial decision was to include cord milking in the guideline for stable newborns. After a more in-depth review of the limited evidence regarding cord milking in the compromised premature newborn, the final decision was made to not include cord milking. This decision is supported by the new Neonatal 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care [31].

Delayed cord clamping is supported for the premature newborn by the AAP, the ILCOR and ACOG.

Delayed cord clamping does not increase Maternal post-partum hemorrhage.

During delayed cord clamping the obstetrician holds the newborn at the mother’s perineum at the level of the placenta or lower than the placenta.

Delayed cord clamping improves Neonatal outcomes including higher hematocrit values, decreased need for transfusions for anemia, improved cerebral oxygenation and decreased risk for IVH in the premature newborn delivered at 24-37 weeks gestation.

Performing delayed cord clamping does not make the premature newborn delivered at 24-37 weeks gestation hypothermic upon admission to the Newborn Intensive Care Unit.

Identification of the appropriate committee members which included the key players within the two departments had a major impact on the success of the project. It was important to include members that had the knowledge, ability, and power to implement change within the institution. As the project progressed, it became clear that one of the team members was unable to assist in the dissemination of information and education. This challenge required the addition of a CNS and nurse educator from the OB department to assist with the project education and dissemination after the guideline was approved. The inclusion of the perinatal peri-operative supervisor on the committee was very beneficial and important as her role was to assure that the new thermoregulation supplies were available for use and the old supplies were removed from the LDR and OR suites. The process of getting approval from the different administrators varied between the two departments. For this reason, it was important to have a key player who represented both nursing and medicine from each department who was aware of the administrative process for both disciplines.

Using Rogers’ DOI theory assisted in the development of the project structure and a step by step plan to guide the project to success. Identifying one member as the project coordinator was important in keeping the committee focused and productive. Successful coordination of the project resulted in productive meetings. Scheduling meetings in advance through Doodle allowed the committee members to choose multiple dates and times that fit within their schedule. This process enabled the project coordinator to identify the best day and time to hold the meetings to facilitate the optimal number of attendees at each meeting. In addition, having the members of the committee review the literature ahead of time was beneficial as it allowed the meeting to be used productively instead of using valuable meeting time to educate the committee on the current evidence. The summary of the evidence was useful in helping the committee understand the depth and quality of DCC research in the premature newborn. The committee was in agreement regarding the evidence supporting DCC for the premature newborn which facilitated a smooth process in developing the guideline. Using the DCC-GD tool to direct the development of the guideline was paramount in the success of the project. The DCC-GD tool kept the committee focused on the specifics of the guideline during the meetings. The committee reached consensus without disagreement on each step of the guideline with the exception of the use of umbilical cord milking when DCC is contraindicated. Since it was not possible to have all medical providers at the meetings to discuss this step in detail it was difficult to come to an agreement. The initial decision was to include cord milking in the guideline for stable newborns. After a more in-depth review of the limited evidence regarding cord milking in the compromised premature newborn, the final decision was made to not include cord milking. This decision is supported by the new Neonatal 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care [31].
Comparison of pre-test and post-test scores for individual survey items.

| Survey Item                                                                 | Pre (n=90) | Post (n=1) | %   |
|-----------------------------------------------------------------------------|------------|------------|-----|
| Delayed cord clamping is defined as waiting to clamp the umbilical cord for at least 30 seconds from delivery of the newborn to allow for transfusion of blood from the placenta to the newborn. | Agree 84  93.33 | 84  97.67 |     |
|                                                                             | Disagree  6 6.66 | 2  2.33 |     |
| Delayed cord clamping is safe to perform on premature newborns delivered at 24-37 weeks gestation that does not require resuscitation as supported by no differences in mortality rates or Apgar scores when comparing newborns who received delayed cord clamping and immediate cord clamping. | Agree 70  77.8 | 85  98.84 |     |
|                                                                             | Disagree  20  22.2 | 1  1.16 |     |
| Delayed cord clamping improves Neonatal outcomes including higher hematocrit values, decreased need for transfusions for anemia, improved cerebral oxygenation and decreased risk for IVH in the premature newborn delivered at 24-37 weeks gestation. | Agree 70  77.8 | 86  100 |     |
|                                                                             | Disagree  20  22.2 | 0  0 |     |
| Performing delayed cord clamping does not make the premature newborn delivered at 24-37 weeks gestation hypothermic upon admission to the Newborn Intensive Care Unit. | Agree 39  43.33 | 72  83.72 |     |
|                                                                             | Disagree  51  56.67 | 14  16.28 |     |
| During delayed cord clamping the obstetrician holds the newborn at the mother’s perineum at the level of the placenta or lower than the placenta. | Agree 66  73.33 | 84  97.67 |     |
|                                                                             | Disagree  24  26.67 | 1  1 |     |
| Delayed cord clamping does not increase Maternal post-partum hemorrhage. | Agree 55  61.11 | 81  94.19 |     |
|                                                                             | Disagree  35  38.89 | 4  4.7 |     |
| Delayed cord clamping is supported for the premature newborn by the AAP, the ILCOR, and the ACOG. | Agree 67  74.45 | 85  98.8 |     |
|                                                                             | Disagree  23  25.55 | 0  0 |     |

*Total N=86 with missing data

The Likert type item responses were collapsed and categorized as a “0” (strongly disagree, disagree, and undecided) indicating no knowledge or a “1” (strongly agree and agree) indicating knowledge of the item.

Table 3: Comparison of pre-test and post-test scores for individual survey items.

| Survey Item                                                                 | Answered Correctly | (na) | %   |
|-----------------------------------------------------------------------------|--------------------|------|-----|
| Delayed cord clamping will be performed for __ seconds for the premature neonate. | Yes 75  87.21     |      |     |
|                                                                             | No 8  9.3         |      |     |
| What can be done to assist in maintaining thermoregulation during DCC for the premature newborn? | Yes 67  100        |      |     |
|                                                                             | No 0  0           |      |     |
| Who determines if DCC should be performed at the time of delivery?           | Yes 65  75.58     |      |     |
|                                                                             | No 17  19.77      |      |     |
| Which newborns should be excluded from DCC?                                 | Yes 81  100       |      |     |
|                                                                             | No 0  0           |      |     |

*Total N=86 with missing data

*Answered correctly if 45 seconds was given as the answer.

*Answered correctly if one thermoregulation intervention was listed

*Answered correctly if both the obstetrical medical provider and the neonatal medical provider were listed

*Answered correctly if one exclusion was listed

Table 4: Post-test scores for survey items specific to guideline.

Education was a key component in implementation of the guideline into practice as it was written. Other factors that contributed to a successful education plan included timing, the use of multiple venues to present the information, and the use of different modalities in presenting the education. Implementation of the DCC guideline coincided with the new delivery room/transport (DR/TR) nurse role that was implemented in the NICU. This new required DR/TR nurse education facilitated an increase in participation and education of the NICU nurses. In addition, the project was implemented on July 1, which coincided with the starting rotation of the new residents and fellows at this teaching facility. There were multiple venues and modalities used to present the education. Presenting DCC at a respiratory and nursing journal club meeting, which is well attended sparked an interest in DCC and allowed an opportunity to perform the education and review the guideline. Snacks and lunch are provided at these journal club meetings which may have resulted in greater attendance. The use of a more informal method of teaching related to unit census and acuity as opposed to the standardized PowerPoint presentation allowed the OB members on the committee to reach more staff. Also having members of the committee present the education to their peers increased buy-in of the guideline. The midwife on the committee presented to the medical providers in the practice where she works that has practicing privileges at the tertiary care center. Making copies of the guideline and surveys for the members that presented the guideline to their peers guaranteed the presentation was standardized regardless of who presented the information.

Education on the guideline is important for successful implementation into practice. It will be important to continue to educate new HCPs as they begin working at the institution. The guideline will be added as a component of education received by the medical providers during orientation to the unit. It will also be included in the NICU Handbook, a resource that is given to all medical providers in the NICU. The NICU nurses will receive education specific to the guideline when they attend the education specific to the role of the delivery room nurse. The guideline will also be added to the OB organizational policy manual to allow all members of the team to be able to locate the guideline when unsure of the specific details of the guideline.

The pre-post survey helped to identify that the educational intervention was effective as a whole. However the structure of the survey items and the inability to link the pre-post surveys interfered with the ability to determine if the NICU or the OB department needed additional education on a specific item. The structure of the survey items made it difficult to identify knowledge gaps between the NICU and the OB department. The instructions that explained how to complete the posttest fill-in-the-blank items specific to the guideline were not clear. Some participants listed one of several answers making it difficult to determine if they had a good understanding of all of the
Communication was very important during development and implementation of the QI project. Although the meetings were prescheduled it was still difficult for all members of the committee to be present at every meeting. This affected the ability to make a decision to include or exclude cord milking in the guideline as an option if DCC was not possible. Since it was not possible to have all medical providers in the room at the same time to discuss this component, the final decision to exclude cord milking was made jointly by the most senior physicians on the committee in both departments. Emails were sent out by the project coordinator on a frequent basis to keep the committee up to date on the progress of the guideline and education. When the implementation date arrived, an email was sent out to members of the healthcare team in the NICU and the OB department as a reminder. Once the education was completed, the guideline was sent via email to all staff.

**Plans for Translation**

The guideline was posted at each warmer in L&D so the team could review the guideline before a delivery. There are several interventions that will facilitate translation into practice. A DCC screening tool to be initiated by the OB nurse while the mother is laboring could assist in the identification of newborns that should or should not receive DCC (e.g., history of a sibling with severe hyperbilirubinemia). Additional data to be added to the electronic documentation to allow for tracking outcomes and documentation of the intervention in the medical record include the delivery room set temperature, actual room temperature, status of the newborn at delivery (crying, tone, movements), position of the newborn during DCC (at the level of the placenta, below the placenta, infant coverage (Steri-Drape® or sterile towel), duration of DCC, and reasons for not performing DCC or stopping DCC early. This will assist in the documentation of the intervention and the collection of data to measure clinical outcomes. Another QI project to evaluate the clinical outcomes of the neonates is in the beginning stages. Some important clinical outcomes that should be included: Temperature on admission to the NICU, HCT values at birth and 12 hours of age, the use of vasopressor support or fluid boluses for hypotension immediately after birth, NEC, IVH, peak total bilirubin values, and the need for phototherapy. Finally, random and anonymous observations of deliveries of premature newborns will be performed by the project coordinator to monitor HCP adherence to the DCC guideline as written.

**Conclusion**

The development of the guideline and educational in-service on DCC for the premature newborn <37 weeks gestation will standardize the practice at this institution. The development of the guideline involved a long process that included many steps. Obtaining consensus from a committee consisting of a group of inter-professional, interdisciplinary HCPs was accomplished over a period of several months. Obtaining consensus required many key components. Assuring the most appropriate members were on the committee was very important to reach consensus. Effective communication including individual meetings by the project coordinator, several committee meetings, and written communications through email played a large role in obtaining consensus. The pre-scheduled meetings with a structured plan for each meeting optimized the productivity of the committee. The DCC-GD tool was critical in ensuring that each component of the guideline was addressed by the committee without missing a component/element. Even though initial agreement wasn’t reached regarding the exclusion of cord milking, the guideline helped the committee to review the evidence and base the final decision on the research that is currently available. The guideline also kept the committee on task by giving focused direction on each step that needed to be discussed.

The use of a standardized educational plan was a key component in guaranteeing the HCPs were receiving the same information. Also having the HCPs present to their peers was successful in increasing the knowledge and buy-in at this institution. The project coordinator played a significant role in guiding the inter-professional, interdisciplinary committee from inception to completion of this QI project resulting in a DCC guideline that was developed, approved, and implemented with success. Random and anonymous observations (communication between the OB and NICU team regarding which newborns should be included and excluded, performing DCC for the correct length of time, the use of thermoregulation interventions, drying and stimulating the newborn at the mothers’ perineum, and correctly timing the procedure) by the project facilitator suggest that the implementation of the DCC guideline and education was successful.

Future recommendations include measuring retained knowledge of the interdisciplinary team members to determine when re-education should occur. The institution is a teaching facility with new resident physicians every July so we want to make sure the guideline is being taught correctly. There is also a concern that the knowledge of DCC has decreased over time. Guideline adherence will be monitored through the use of random audits focusing on adherence to inclusion and exclusion criteria and the actual length of time DCC was performed and the reasons it was stopped before the completion of 45 seconds. Clinical outcomes will be evaluated including temperature on admission to the NICU, incidence of NEC and IVH, Hemoglobin values at birth and 12 hours of age, and the use of phototherapy.

**References**

1. Inch S (1984) Management of the third stage of labour-another cascade of intervention? Midwifery 114-122.
2. Ghavam S, Batra D, Mercer J, Kugelman A, Hosono S, et al. (2013) Effects of placental transfusion in extremely low birth weight infants: meta-analysis of long- and short-term outcomes. Transfusion 54: 1192-1198.
3. Hutton EK, Hassan ES (2007) Late vs. early clamping of the umbilical cord in full-term neonates: systematic review and meta-analysis of controlled trials. JAMA 297: 1241-1252.
4. McDonald SJ, Middleton P, Dowssett T, Morris PS (2013) Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes. Cochrane Database of Systematic Reviews 2013 7: 1-195.
5. Rabe H, Diaz-Rosello J, Duley L, Dowssett T (2012) Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes. Cochrane Database of Systematic Reviews 8: 84.
6. Committee on Obstetric Practice, American College of Obstetricians and Gynecologists (2012) Committee Opinion No.543: Timing of umbilical cord clamping after birth. Obstet Gynecol 120: 1522-1526.
7. International Liaison Committee on Resuscitation (2006) The international liaison committee on resuscitation (ILCOR) consensus on science with treatment recommendations for pediatric and neonatal patients Neonatal resuscitation.
8. Perlman J, Wyllie J, Kattwinkel J, Atkins D, Chameides L, et al. (2010) International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Circulation 122: s516-s538.
9. Raju T (2013) Do not rush to cut the cord: new recommendations call for delayed cord clamping in preterm infants. AAP News 34: 17.

Citation: Frank KM, Mueller-Burke D, Bullard J, Wilson J, Silbert-Flagg J, et al. (2015) Delayed Cord Clamping in the Premature Neonate: Development of an Interdisciplinary Guideline. J Preg Child Health 3: 261. doi:10.4172/2376-127X.1000261
10. WHO Guideline (2014) Delayed umbilical cord clamping for improved maternal and infant health and nutrition outcomes. Geneva: World Health Organization.

11. Rogers EM (2003) Diffusion of innovations, 5th Edition, New York: Free Press.

12. Rabe H, Reynolds G, Diaz-Rosello J (2008) A systematic review and meta-analysis of a brief delay in clamping the umbilical cord of preterm infants. Neonatology 93: 138-144.

13. Baenzerger O, Stolkin F, Keel M, VonSiebenthal K, Frachere J, et al. (2007) The influence of the timing of cord clamping on postnatal cerebral oxygenation in preterm neonates: a randomized controlled trial. Pediatrics 119: 455-459.

14. Elimian A, Goodman J, Escobedo M, Nightlingale L, Knutdson E, et al. (2013) A randomized controlled trial of immediate versus delayed cord clamping in the preterm neonate. American Journal of Obstetrics and Gynecology 208: S22-S22.

15. Oh W, Fanaroff A, Carol W, Donovan E, McDonald S (2011) Eunice Kennedy Shriver National Institute of Child Health and Human Development National Research Network. Effects of delayed cord clamping in the very-low-birth-weight infants. Journal of Perinatology S68-S71.

16. Aziz K, Chinnery H, Lacaze-Masmontel T (2012) A single-center experience of implementing delayed cord clamping in babies born at less than 33 weeks' gestational age. Adv Neonatal Care 12: 371-376.

17. Noori S, Stavroudis TA, Seri I (2009) Systemic and cerebral hemodynamics during the transitional period after premature birth. Clin Perinatol 36: 723-736.

18. Sommers R, Stonestreet BS, Oh W, Laptotk A, Yanowitz TD, et al. (2012) Hemodynamic effects of delayed cord clamping in premature infants. Pediatrics 129: e667-e672.

19. Rabe H, Reynolds G, Diaz-Rosello J (2008) A systematic review and meta-analysis of a brief delay in clamping the umbilical cord of preterm infants. Neonatology 93: 138-144.

20. Mohamed A, Shah PS (2012) Transfusion associated necrotizing enterocolitcs: a meta-analysis of observational data. Pediatrics 129: 529-540.

21. Oh W, Fanaroff AA, Carlo WA, Donovan EF, McDonald SA, et al. (2011) Effects of delayed cord clamping in very-low-birth-weight infants. J Perinatol 31 Suppl 1: S68-71.

22. Rabe H, Diaz-Rosello JL, Duley L, Dowswell T (2012) Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes. Cochrane Database Syst Rev 8: CD003248.

23. Rabe H, Reynolds G, Diaz-Rosello J (2010) Early versus delayed umbilical cord clamping in preterm infants. The Cochrane Collaboration 1-32.

24. Jelin A, Zlatnik M, Kuppermann M, Gregorich S, Nakagawa S, et al. (2015) Clamp late and maintain perfusion (CLAMP) policy: delayed cord clamping in preterm infants. The Journal of Maternal- Fetal and Neonatal Medicine 17: 1-5.

25. Jelin A, Zlatnik M, Kuppermann M, Nakagawa S, Gregorich S, et al. (2014) Does a delayed cord clamping policy improve neonatal outcomes? American Journal of Obstetrics and Gynecology 210L: S406.

26. Kaempf JW, Tomlinson MW, Kaempf AJ, Wu Y, Wang L, et al. (2012) Delayed umbilical cord clamping in premature neonates. Obstet Gynecol 120: 325-330.

27. Kugelman A, Borenstein-Levin L, Riskin A, Chistyakov I, Ohel G (2007) Immediate versus delayed umbilical cord clamping in premature neonates born <35 weeks: a prospective, randomized, controlled trial. American Journal of Perinatology 2: 307-316.

28. Mercer J, Vohr B, Erickson-Owens D, Padbury J, Oh W (2010) Seven-month developmental outcomes of very low birth weight infants enrolled in a randomized controlled trial of delayed versus immediate cord clamping. Journal of Perinatology 30: 11-16.

29. Meyer M, Milderhall L (2012) Delayed cord clamping and blood flow in the superior vena cava in preterm infants: An observational study. Archives of Disease in Childhood. Fetal and Neonatal Edition 97: F484-F486.

30. Baenzerger O, Stolkin F, Keel M, von Siebenthal K, Fauchere JC, et al. (2007) The influence of the timing of cord clamping on postnatal cerebral oxygenation in preterm neonates: a randomized, controlled trial. Pediatrics 119: 455-459.

31. Wyckoff M, Aziz K, Escobedo M, Kapadia V, Kattwinkel J. (2015) Neonatal Resuscitation American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency in Cardiovascular Care. Pediatrics 136: S196-S218.

OMICS International: Publication Benefits & Features

Unique features:
- Increased global visibility of articles through world-wide distribution and indexing
- Showcasing recent research output in a timely and updated manner
- Special issues on the current trends of scientific research

Special features:
- 700 Open Access Journals
- 20,000 editorial team
- Rapid review process
- Quality and quick editorial, review and publication processing
- Indexing at PubMed (parsial), Scopus, EBSCO, Index Copernicus and Google Scholar etc.
- Sharing Options: Social Networking Enabled
- Authors, Reviewers and Editors rewarded with online Scientific Credits
- Better discount for your subsequent articles

Submit your manuscripts as E-mail: www.omicsonline.org/submission/