

## **Can Health Information Technology Decrease Antibiotic Use in the Neonatal Intensive Care Unit**

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### **Abstract**

*Clinical signs of infection during the neonatal period are often nonspecific and non-localized. For this reason, it is extremely difficult to control antibiotic use during the neonatal period. Most times indication for antibiotics therapy in this population is based only on clinical presentation. A significant number of infants are prescribed antibiotics based on the symptom of tachypnea alone. Of these infants, a significant number of are later diagnosed with a benign condition called Transient Tachypnea of the Newborn. The purpose of the study is to evaluate whether a complete health history delivered through health Information technology can potentially decrease unnecessary antibiotic use in the neonatal intensive care unit at the Victoria Hospital in Saint Lucia. The research was conducted by interviews. Physicians mentioned that a major challenge they face in determining infant risk factors for the development of bacterial infection is the availability of critical information on the maternal history as well as the event surround the birth and delivery of the neonate. Other factors such as reliability, efficiency and availability of lab investigation as well as unit policies and guidelines were identified as influential in their decision of whether to administer treatment to the infant or not. The results of the study concluded that physician agreed that information delivered via information technology would potentially guide health care providers in the decision on antibiotics use in the neonatal unit.*

**Keywords:** *Tachypnea, Transient Tachypnea of the Newborn, Antibiotics, Resistance*

### **Introduction**

Antibiotic therapy although in most cases has been warranted; are sometimes unnecessary in the newborn. The indication for initial antibiotics therapy in the Neonatal Unit, are often based only on clinical presentation which is the common practice used. A significant number of infants are prescribed antibiotics based on the symptom of tachypnea and are not given a chance to transition from intrauterine to extra-uterine life. Later a significant number of these infants were diagnosed with Transient Tachypnea of the Newborn a benign condition in which the tachypnea is resolved within 12 - 24 hours of age. Because of the non-specific and non-localized nature of clinical signs of infection in the neonatal period, appropriate guidelines and resources should be in place to guide physician into the use of antibiotic therapy in neonates in the absence of positive septic screening. Research has shown that maternal health history significantly influences the health of a newborn. It is therefore important for this information should be readily available to those in direct care of the infant. The purpose of the study is to evaluate whether a complete health history delivered through health Information technology can potentially decrease unnecessary antibiotic use in the newborn.

### **Method**

Various online database and search engines were used to gather information on the topic. This included CINAHL: Cumulative Index to Nursing and Allied Health, MedlinePlus, PubMed, BMC Medicine, Open Access Library at Texila American University. Then 6 pediatricians working in direct contact with neonates in NICU located at the Victoria Hospital were interviewed.

## Results

The pediatric team at the Health Care Facility were interviewed on antibiotic usage in the NICU at the Victoria Hospital in Saint Lucia. When asked to identify the challenges they faced in determining infant risk factors for the development of bacterial infection or sepsis, physicians mentioned the availability of critical information on the maternal history and the events surrounding the birth and delivery of the neonate as important factors in influencing their decision. Other factors included reliability, efficiency and availability of lab investigation as well as unit policies and guidelines. They all voiced that having to search the mother's health record was cumbersome and most times incomplete and that they sometimes go on the decision to administer antibiotic just on the clinical presentation of the infant. They were of the view that they should take charge of the possibility of infection and treat the infant rather than to wait and place the infant at risk. They all agreed that an electronic copy of maternal health would be very useful and influential in guiding infant care and reduce antibiotic exposure in the neonatal period. They also pointed out that the availability of information technologies would also place critical information at their fingertips such as access to laboratory results, pharmacy, unit policies, key data elements, algorithms and recommendation from such health agencies as World Health Organization and improve patient care.

## Discussion

Well-designed observational studies have found that antibiotics are overused in hospitals. It was estimated that approximately one-third of all hospitalized patients received antibiotic and that of these patients an alarming 50% did not require this therapy (Fishman 2000). The Intensive care units produce a number of factors and circumstance to substantiate the use of antibiotics. Research has estimated that antibiotics use are as much as 10 folds higher in Intensive Care Units than the general population (Roder, Nielsen, Magnussen, Fridodt-Moller(1993); Gruneberg and Wilson (1994)).

The Neonatal Intensive Care environment is no different and antibiotics therapy was found to be the most commonly used therapy in the neonatal period. The growing rate of antibiotics in the Neonatal Intensive Care Unit has been attributed to the difficulty in physicians accurately identifying and distinguishing a bacterial infection from non-bacterial infection (Yang et al 2012).

Neonatal sepsis or bacterial infection is difficult to diagnose because clinical presentation is often subtle, nonspecific and non-localized (Chiesa, Pellegrini, Panero et al (2003); Tripathi, Cotton and Smith 2012) ranging from nasal flaring, tachypnea, convulsion, bulging fontanelles, fever, feeding intolerances, severe retractions and grunting (Weber, Carlin, Gatachalian, Lehman, Muhe and Mulholland, 2003).

Although more than 95% of infants admitted to neonatal intensive care units receive empirical antibiotic in the first postnatal days, only a mere 1- 5% have a positive blood culture result (Clark et. al 2006; Cotton, Taylor and Stoll et. al 2009 : Stoll, Hansen, Higgings, et al. 2005). To further compound the problem and difficult decision faced by pediatrician and neonatologist is how long to treat and which antibiotics to use (Clark, Bloom, and Spitzer, et. al 2006)

The decision to administer antibiotics is complicated by the fact that infants are uniquely susceptible to bacterial infection and neonatal sepsis has been found to be the main cause of morbidity and mortality in that group (Clark et al 2006, Baraff, Bass, and Fleisher et al 1993). Of the estimated 9.7 million children under the age of five deaths, neonatal mortality accounts for almost 40 percent (UNICEF 2012). Research has found that a child is about 500 times more likely to die on the first day of life than at one month of age. A common factor in these deaths is the health of the mother. Premature infants have the highest rates of infection due to their relatively immature systems and therefore, rapid administration of antibiotics by a physician for suspected neonatal sepsis is often accepted.

Empirical use, as well as the prolong use of antibiotics, have been shown to be associated with many health outcomes. The major health risk and widely documented is the development of bacterial antibiotic resistance. Antibiotic use in infancy have also been associated with (1) alter gut colonization (Gewolb, Schwalbe, Taciak et al 1999), (2) increase risk of candida colonization and candidiasis invasion (Cotton, mc Donald & Stoll et al 2006; Saiman, Ludington& Dawson et al 2001),(3) increase rate of late onset sepsis and increase risk of death(Clark et al 2006). Research has found that the choice of perinatal and early onset neonatal antimicrobial agents has facilitated the emergence of organisms which causes late onset sepsis and has altered the antibiotic resistance patterns of organisms that cause early onset sepsis. (Stroll et al 2002; de Man, Verhoeven, Verbrugh, Vos and van de Anker 2000; Cordero, Rau, Taylor& Ayers 2004).

### **Septic screening**

Ideally, the administration of antibiotics should be dependent on a positive blood cultural result obtain from a sterile site (eg. blood, cerebrospinal fluid, urine, or closed body space. However due to the unavailability of the results of bacterial cultures in a short space of time and the serious consequences of neonatal sepsis oscillating from neurodevelopmental defects to deaths (Stoll, Hansen, Adam- Champman et al (2004); Klinger, Levy, Sirota et al (2010); Benjamin, DeLong, Cotton et al. 2004); Fanaroff, Korones, Wright et al, 1998), physician often administer empirical antibiotics to symptomatic infants and infants at high risk while awaiting culture results (Clark et al 2006).

The overuse of antibiotics, however, has permitted bacteria to evolve defenses, making some antibiotics inadequate against strains of bacteria that continue to appear in hospitals. Those strains include *Clostridium difficile*, Multidrug-Resistant *Staphylococcus Aureus* (MRSA), and Carbapenem-Resistant Enterobacteriaceae (CRE), which Frieden, CEO, Center for Disease Control, branded as “nightmare bacteria.”

### **Solutions to drug resistance**

Experts have suggested that health care facilities play an important role in the solution to drug resistance. Frieden suggests that every hospital should have a strong antibiotic stewardship program to help solve this problem. “Antimicrobial stewardship programs are a critical step toward stemming the tide of antibiotic resistance and ensuring patients are receiving the right antibiotic, at the right dose and for the right duration” (Cosgrove 2014). CDC notes that, “hospitals should commit to antibiotic stewardship with accountability, expertise, action, education, and tracking of antibiotic prescribing practices and hospital infection rates” (CDC 2014).

### **Electronic health history**

A health history can aid both individuals and health care providers by supplying essential information that will assist with diagnosis and treatment decisions in the neonate. This current collection of organized information includes biographical, demographic, physical, mental, emotional, socio-cultural, sexual, and spiritual data is unique to an individual. The health of the infant is similarly influenced by many factors including the physical and mental health of parents. Therefore, the ease of access to information on maternal record can have significant benefits in the holistic care of every newborn. Assessment of family health history, one component of a complete health history, for example, allows determination of an infant's inherited disease risks and has gained recognition as an important tool in the prevention of disease and an integral part in health promotion of the all category of patients (Valdez et al. 2010; Yoon et al. 2003).

### **Health information technology**

Health information technologies, such as electronic health record, have been considered by health care experts, and policy makers as well as consumers, to be critical to transforming the

health care industry (Chaudhry et al 2006). Information management is fundamental to health care delivery for many reasons including (1) the fragmented nature of health care, (2) the large volume of transactions in the system, (3) the need to integrate new scientific evidence into practice, and (4) the presence of other complex information management activities.

In a systematic review on the Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care conducted by Chaudhry et al 2006, literature has identified many important benefits of health information technology such as increased delivery of care based on guideline, enhanced monitoring and surveillance activities, reduction of medication errors, and decreased rates of utilization for potentially redundant or inappropriate care (Chaudhry et al 2006).

### **Diagnosing bacterial infection in newborn**

To date, there exist no specific marker suitable for the early diagnosis of bacterial infection in the newborn. In the majority of cases and in the absence of blood culture results clinical presentation of infants are used to make an early diagnosis. Weber et al 2003 reported however that there is limited specificity in using clinical signs as the basis for antibiotics use because of the nonspecific nature signs and symptoms of neonatal sepsis in the neonate. Laboratory data on infants with bacterial infection may reveal leukocytosis, increased immature to total neutrophil (I/T) ratio elevated C-reactive protein but have been found to be nonspecific to neonatal bacterial infection. Other possible markers although more reliable and shows promising results; have been found to be either too expensive or time-consuming. These include interleukin (IL)-6, IL – 8, tumor necrosis factor-alpha, interferon gamma, procalcitonin.

### **Administering antibiotic in neonate**

The decision to administer antibiotics as Yang, et al. 2012 proposed, should be based on the clinical presentation of infants, as well as the maternal health history and laboratory investigation result. This information can be made available to the physician in computerized form omitting the need for the physician to browse through a considerable amount of paper record often from different sources. The technologies ensure that all information surrounding the infant's health is available in one place.

In order to reduce the rate of antibiotic use in the NICU Yang et, al 2012 developed the Neonatal Bacterial Infection Screening Score (NBISS) tool which is the first to incorporate maternal risk factors, clinical presentation and laboratory data of infants in order to determine the need for antibiotic treatment. The tool was developed in order to determine the appropriate score or cut off points to guide antibiotic use by physicians. A maternal health history is essential to successfully determine the infant risk of infection. Maternal risk factors such as premature rupture of membranes of more than 18 hours, maternal pyrexia, meconium stain amniotic fluid or chorioamnionitis are components of the tool and have been found to be stand-alone characteristics in determining the infants need for antibiotic therapy.

In response to the growing problem of antibiotics usage the World Health Organization (WHO) has published guidelines for the management of neonatal sepsis. WHO suggests that prophylactic antibiotics for prevention of sepsis in neonate with risk factors for infection (i.e. membranes ruptured >18 hours before delivery, mother had fever >38 °C before delivery or during labor, or amniotic fluid was foul smelling or purulent) should be treated with the prophylactic antibiotics ampicillin (Intramuscular – IM – or intravenously, IV) and gentamicin for at least two days. After two days, the neonate should be reassessed and treatment continued only if there are signs of sepsis or a positive blood culture

Neonates with signs of sepsis should be treated with ampicillin (or penicillin) and gentamicin as the first line antibiotic treatment for at least 10 days.

If a neonate with sepsis is at greater risk of staphylococcus infection (e.g. extensive skin pustules, abscess, or omphalitis in addition to signs of sepsis), they should be given cloxacillin and gentamicin instead of penicillin and gentamicin.

Where possible, blood cultures should be obtained before starting antibiotics. If an infant does not improve in two to three days, antibiotic treatment should be changed, or the infant should be referred for further management.

Dr. Sara Cosgrove, chair of the Society for Healthcare Epidemiology of America's Antimicrobial Stewardship Taskforce and an associate professor of medicine and epidemiology at Johns Hopkins University believes that antibiotics are a precious resource, and the lack of a systematic approach in hospitals to control its use has created problems. The problem may stem from the belief that the immediate risk to the patient outweighs the long-term disadvantages of the liberal use of antimicrobial drugs held by most physicians (Harbarth&Samore 2005).

## Conclusion

Overuse of antibiotic in the neonatal period is a problem of major concerns. These group of patients present with unique circumstances which leads to the use of these drugs. However, the use comes with major risk to the infants and adds to the problem of antibiotic resistant microorganisms. Maternal health history is a crucial factor in determining the health of a newborn infant. A complete maternal health record delivered by information technology can provide pediatrician and other health care providers with pertinent information which can potentially guide health care provider in the decision on antibiotics use which has the potential to decrease overuse and curb the effects on the neonates.

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