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A Translational Intervention for Reducing Infant Mortality in Mississippi: A Move to Eliminate Health Disparities

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Abstract

Therapeutic, technological, and medical advances have contributed to improve Infant Mortality Rates in the United States over the last 100 years. However, there are still geographical and racial disparities and challenges, and infant mortality remains higher in the Unites States than in many other developed countries. A formal death review process can identify causal, contributory and potentiating factors related to infant deaths. This article describes use of the PDSA Model for Improvement to develop a strategy for change that will result in reducing the Infant Mortality Rate within an organization.

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Introduction

As early as 1899, Sir Arthur Newsholme said that "Infant mortality is the most sensitive index we possess of social welfare and of sanitary administration" (Brosco, 1999). Since Newsholme's statement, changes have significantly reduced the rate of infant mortality, moving from an Infant Mortality Rate (IMR) in the United States of about 100 per 1000 live births in 1900 to 6.9 per 1000 in 2000 and to 6.83 in 2003 (CDC, *Eliminate Disparities in Infant Mortality*; CDC, *Overall Infant Mortality Rate in U.S. Largely Unchanged*; CDC, 1999).

The IMR in Mississippi was 32.1 in 1969 (MSDH, 2007). Since that time, Mississippi's IMR has been less than 30. The rate decreased by 58 percent between 1970 (29.1) and 1990 (12.1) (MSDH, 2007), which coincides with the advent of neonatal intensive care units (Rowley, Iyasu, MacDorman, & Atrash, 2007). According to Markestad et al. (2005), the increase in survival of pre-term infants in the last 20 years can be attributed to therapeutic, technological and medical advances.

Since the 1993 IMR rate of 11.4, some stabilization of the Mississippi IMR occurred. The rate has yielded a moderate variance of 1.7 from 1993 to 2004. In 2005, the IMR increased from the lowest ever, 9.7 in 2004, to 11.4, the highest in 11 years (MSDH, 2007). The dramatic 15 percent increase claimed the attention of many throughout the state of Mississippi and the nation.

Background

Historically, Mississippi has recorded one of the highest IMRs in the United States. In 2005, Mississippi had the highest rate in the United States and the District of Columbia (Mitchell,

2007). Although this overall rate is high, comparisons made with other states based on race indicate similar rates among certain racial groups.

For Mississippi, the distribution of the births based on race in 2005 was 54.4 percent   (n = 23,015) for the white population and 45.6 percent (n = 19,312) for the non-white population. The statewide IMR is the combined average of the two populations. Traditionally in the United States and around the world, the African-American rates are two to two and one-half times higher than the white rates (Alexander, Nabukera, Bader, & Slay-Wingate, 2007). States having a higher white population may have very similar outcomes based on race. However, states with higher minority populations (who record dramatically higher infant mortality) will see their statewide IMR influenced by the infant outcomes of their minority residents. More simply stated, the more residents with poor outcomes, the higher the IMR will be. Likewise, states with higher proportions of white residents will demonstrate an overall lower IMR (KFF, 2007).

Another notable comparison is the rate of neonatal deaths, defined as a death that occurs under 28 days of life (MSDH, 2007). Of the 481 infant deaths in Mississippi during 2005, over 58 percent (n = 283) occurred in the neonatal period. These findings are consistent with Rowley et al. (2007, p. 2), which states, "Neonatal mortality continues to account for the largest proportion (65.3%) of infant deaths." More significantly, 44 percent (n = 213) of the total infant deaths occurred among the non-whites during the neonatal period as compared to only 14 percent (n = 70) of whites (MSDH, 2007).

Over one-fourth of the 481 Mississippi infant deaths (n = 133) occurred at University of Mississippi Medical Center (UMMC) (D. Johnson, personal communication, April 17, 2007). In 2006, 120 deaths occurred in the Newborn Center.

UMMC is the only teaching hospital in Mississippi and the only tertiary facility providing comprehensive care for women and infants (UMMC, 2007). Boasting a 34-bed Newborn Nursery and a 74-bed neonatal intensive care unit (NICU) (UMMC, 2006), UMMC is a statewide referral source for high-risk women and infants. As a result, "More than 70 percent of the babies born at the Medical Center in any given year are high-risk and need the complex technology, the comprehensive care services and the multidisciplinary team that generally only a teaching hospital like UMC can provide"(UMMC, 2007).

In 2006, UMMC became part of University Health System Consortium (UHC), which focuses on improving performance in clinical, operational and patient safety performance. The Mission of UHC is to "advance knowledge, foster collaboration, and promote change to help members succeed in their respective markets" (UHC, 2007). Through UHC, the hospital mortality rate was noted to be higher than that of comparable facilities. This finding stimulated a response to begin a hospital wide death review process as a way to examine and improve quality. With the effort of several key stakeholders, the quality improvement efforts at UMMC can work toward continuous clinical and institutional excellence, while collaborating with similar academic medical centers to implement best practices.

Purpose

 The release of Mississippi's 2005 IMR in early January 2007 drew interest from state leaders and policy makers (Mitchell, 2007). In an effort to explore the mortality rates, hospital administration requested a formal process for in-house death review as part of a quality improvement initiative at UMMC. A project was begun to identify an adverse event assessment tool for measuring causal, contributory, and potentiating factors related to infant deaths. The

identified tool was intended to be an implementation-level component of an overall quality improvement initiative at UMMC.

Assessment

An assessment process included a review of potential and existing infant death review tools currently utilized by similar institutions. Two tools specific to NICU death review were identified and considered. Both tools could be specific to the NICU setting, but were flexible enough to be utilized in reviewing any Newborn Center death.

The National Fetal-Infant Mortality Review Program (NFIMR) and American College of Obstetricians and Gynecologists offer a number of case review instruments. Included in the program are several data abstraction forms, inclusive of maternal, infant and community data. The NFIMR forms are best utilized when viewing death from a community-based perspective, identifying problems, and finding resolutions for a community, region or state (NFIMR, 2007). The key steps in the NFIMR program are information gathering, case review team, and community action team (NFIMR, 2007). While these forms have much useful information and are thorough in the information sought, the tools are directed towards community involvement and review.

Another community-oriented program is The National Center of Child Death Review (NCCDR). The NCCDR provides a very detailed description of how to implement a child death review program specific to a community or state. Information for every potential aspect of a program is included. The manual can also serve as a reference tool for death review programs other than community-oriented programs. The NCCDR recommends a collaborative effort involving various levels within a system, including multidisciplinary teams to discuss cases individually.

The cases should include comprehensive information regarding the death and circumstance surrounding the death (NCCDR, 2005). Although an exceptional choice for a larger, population-based study, the community-based approach is not the best format for a facility-based intervention.

A collaborative effort by Child Health Corporation of America, Vermont Oxford Network, and the Institute for Healthcare Improvement produced the NICU Trigger Tool. This tool is specific to the NICU neonate. It measures the overall risk for harm within an institution and pinpoints potential adverse events in the NICU, including death. According to Matlow et al., (2005) patient safety problems increase the risk of death from 2 to 18 times more than in those patients who do not experience safety problems. Thus, the NICU Trigger Tool was chosen for this implementation-level activity. The tool can assist in the quality improvement initiative by determining a baseline for adverse events, determining the cause of death, and beginning the process for systems change (Child Health Corporation of America, 2007).

Validation of the appropriateness of the instrument for the previously described purpose was achieved through personal communication with Dr. Richard McClead of Columbus Children's Hospital, Division of Neonatology in Columbus, Ohio. Dr. McClead's expertise and consultation was sought due to his involvement in the original development of the tool. Dr. McClead viewed the tool as adequate and beneficial to the purpose and setting at UMMC.

The tool, developed to identify adverse events (AE), helps recognize the overall risk of harm within a facility. Common to most facilities is the problem of underreporting of adverse events (Sharek et al., 2006). The use of the trigger tool helps identify adverse events that are apparent, but may not have been reported as such.

The following information is included on the tool: patient number, gestational age, birth weight, gender, length of stay, 16 AEs common to the NICU, categorization of the harm and preventability (Child Health Corporation of America, 2007). The tool is designed for use by personnel with expertise in quality improvement and the NICU. Ideally, a nurse, pharmacist or a physician would review the charts and a neonatologist would confirm the identified adverse events (Child Health Corporation of America, 2007). A major benefit of the tool is that the time dedicated to each chart review should be 20 minutes. Dr. McClead indicated his preferred review personnel were a neonatologist and a representative from the QI department. Ideally, the triggers would be interfaced with information technology systems, resulting in real time reporting of certain adverse events.

In an effort to determine current death review practices at top performing hospitals, interviews were conducted with representatives from four hospitals, all ranked within the top 22 of America's Best Hospitals, Pediatrics, in the United States for 2006 by *U.S. News and World Report* (Comarow, 2006). The hospitals included Johns Hopkins Hospital-Baltimore, Children's Hospital of Philadelphia (CHOP), Lucile Packard Children's Hospital at Stanford, Palo Alto, CA, and Columbus Children's Hospital in Columbus, Ohio.

At Johns Hopkins, there is a review of each child death occurring in the facility. An interdisciplinary (ID) team participates in the monthly reviews. The team consists of Social Services, Faculty, Fellows, Nursing, QI representatives, Obstetrics, the Vice-President of the hospital and Director of Safety. Prior to the ID team death review two nurses, one from the department in which the death occurred and one from QI, review each chart. A faculty member will then review each chart, resulting in three complete reviews. The ID team seeks to identify

potential areas for performance improvement and each year the hospital establishes a QI focus. Through the year, the team targets the QI focus for the year and evaluates how well applications were made to that focus. Data are utilized in making QI applications and determining improvements for the overall hospital system.

At Children's Hospital of Philadelphia (CHOP) each department conducts its own death reviews. The NICU department tool is specific to the NICU and data collected include length of stay, complications, cause of death and autopsy verification.

Lucile Packard Children's Hospital at Stanford (LPCH), uses two methods of death review. One is a standard morbidity and mortality format. In the other, physicians within each department conduct peer reviews of departmental deaths. A standardized form is used in the peer review process defining four specific areas of review: outcome, management, causal analysis and documentation.

Columbus Children's Hospital (CCH) is a teaching hospital in a University setting, but its admitting physicians are from both academic and private practice settings. The two groups complete monthly peer reviews of infant deaths, each group reviewing the others' infant deaths with a few exceptions. Infants with birth weights < 700 grams and infants with certain congenital anomalies are eliminated from the review process. The purpose of the review is identification of practice issues. A simple form is employed to answer questions such as: "Are there any quality of care issues?" and "If so, what are they?"

Additionally, the Director of Quality Improvement reviews each infant death for the purpose of identifying process failures. He observes processes such as verifying that operating room

consents were in place prior to surgery and that the correct surgery was performed. A detailed summary of his finding is generated and distributed to affected departments and/or persons. Consistent among the four hospitals was the use of department-based, physician-conducted death reviews, also known as morbidity and mortality reviews. Other review methods, quality improvement efforts and review standards varied among hospitals. Johns Hopkins had the most comprehensive and objective process of the four hospitals. The process includes various disciplines, including the Vice-President of the hospital. This format provides for diverse perspectives, enhancing objectivity and this gives everyone ownership of the death as well as ownership of the solution.

Implementation

The overall purpose of this quality improvement project was to identify cause of death in the UMMC Newborn Center for 2006 and determine whether the cause was natural progression or a result of adverse events. The NICU trigger tool was chosen with a two-fold purpose— identification of the cause of death and utilization as a quality improvement tool. The former was easily obtained from most records while the latter proved more complex.

To control for bias and factors beyond UMMC control, certain groups of records were eliminated from the assessment process. Complications that could occur prior to UMMC admission could contribute to infant death. Therefore, out-born infants were excluded from the target group. Infants weighing less than 500 grams at birth and/or born prior to 24 weeks of gestation possess extremely high and substantially irreversible mortality risks. Therefore, extremely low birth weight infants weighing less than 500 grams and extremely premature infants born at less than

24 weeks gestation were excluded. It was estimated that as many as 50 percent of the deaths were included in these two exclusion categories.

Initially, a hard copy review of each chart was planned. While this method would be the most inclusive method, obtaining the complete chart from medical records proved to be a complex task. For example, records sometimes lacked relevant diagnostic information such as Radiology and Laboratory reports. Seven records were reviewed in the hard-copy format.

Net Access, an Electronic Record System for UMMC, was accessed to obtain some of the information needed. In Net Access, select reports are available for review. Most commonly found in the reports are the death summary report and surgical reports. Net Access also stores laboratory reports that provide a quick review of all laboratory results during a patient's stay. Autopsy reports are also available and are helpful in looking at the cause of death. Although Net Access limited the use of the trigger tool for quality improvement purposes, it was usually sufficient to review the cause of death.

All records except one were found to have electronic reports. The limited information found indicated that this infant was less than 24 hours old at the time of death with no laboratory or radiology reports, suggesting the infant was possibly never admitted to a unit due to expiring in the delivery room.

Another limitation involved the death summary. Within each summary is a section labeled "Death Information". The cause of death is generally indicated and appropriately labeled in this section. Some records did not specify the cause of death within this section, having only a note stating "died". The cause of death could usually be gleaned from one of the diagnoses listed. For

these patients, the cause of death was attributed to the diagnosis under which the events of the death were listed.

Results

Information collected from the trigger tool included: patient number, gestational age, weight, gender, length of stay, and cause(s) of death. Race was not an indicator on the trigger tool and was not included in the process, although it would have been a useful correlation. Of the 120 records reviewed, 35 were out-born and 20 were either less than 500 grams and/or less than 24 weeks gestation, leaving 65 records to review. Descriptive analysis of data showed the mean gestational age to be 30.27 weeks with a Standard Deviation (SD) of 5.084 weeks. The mean length of stay (LOS) was 33.94 days with a SD of 69.148 days. The mean birth weight was 1414.4 grams with a SD of 837.55 grams. The mean number of co-morbidities was 2.18 with a SD of 0.827. Of the 65 infants, 29 were female and 36 were male. Figure 1 depicts correlation analysis of birth weight for each sex.

Over one-half (16) of the female infants were very low birth weight (VLBW) and only 4 were greater than 2500 grams. All of the VLBW females were less than 30 weeks. Eighteen (50 per cent) of the male infants were VLBW and only 5 were greater than 2500 grams. Seventeen of the VLBW males were less than 30 weeks. The 34 VLBW deaths concur with the current principle that a major predictor of neonatal mortality is birth weight (Rowley et al., 2007).

Figure 1. Correlation Table of birth weight (WT.) and gestational age for female and male infants, 2006
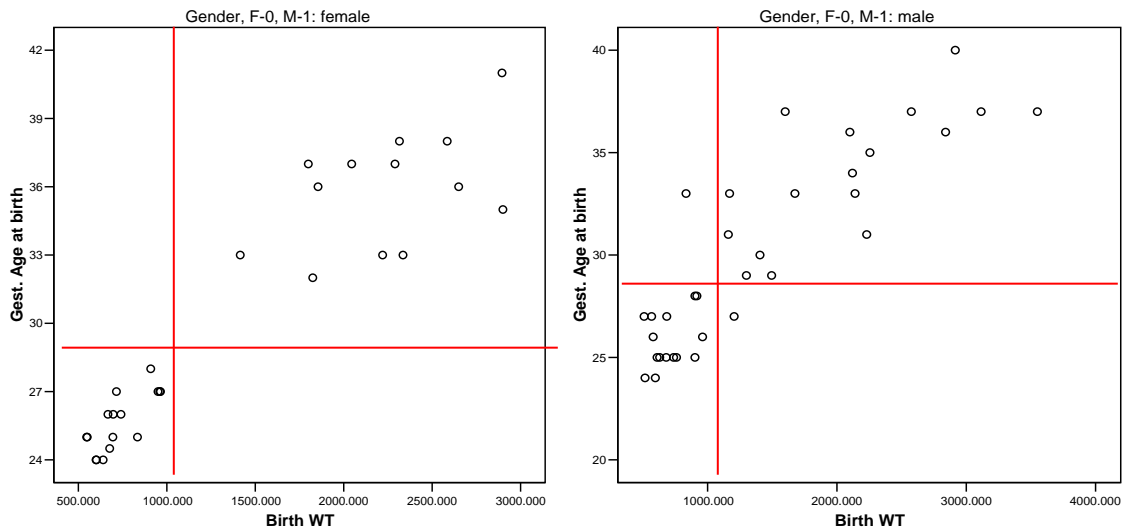
Congenital Anomalies were the second most frequent morbidity. Twenty-nine of the infants were found to have congenital anomalies—12 females and 17 males. Rowley et al. (2007) established that the leading causes of neonatal deaths were congenital anomalies, followed by complications from short gestation and low birth weight. Among African American infants, the leading cause is short gestation and unspecified low birth weight. The results obtained from the UMMC infants are congruent with those indicators. Table 1 displays the number of morbidities found to be the documented cause of death for UMMC infants. Some infants had two or more morbidities identified as the cause of death.

Table 1. Frequency Table for Morbidities

Morbidity	Gender	
	Female	Male
Extreme prematurity	16	15
Congenital Anomaly	12	17
Prematurity	8	16
Respiratory failure	6	13
Sepsis	7	7
Maternal Infection	5	2
Unsuccessful resuscitation	2	2
NEC	1	3
Other	3	5
Meconium Aspiration	1	1
N =	61	81

Recommendations

The theoretical framework used for this project was the Model for Improvement (Langley, et al, 1996). The Model for Improvement is based on three questions and the PDSA (Plan, Do, Study, Act) cycle. The three questions are:

1. What are we trying to accomplish?

2. How will we know that a change is improvement?

3. What changes can we make that will result in improvement?

Once improvement opportunities are identified, tests of change are tried in fast repetitive cycles called PDSA cycles. The Plan Phase (P) consists of planning the change or test of change. The Do Phase (D) is the process of carrying out the plan. The Study Phase (S) summarizes findings in the Do Phase. The Act phase (A) determines what changes are to be made and makes the changes (Langley et al., 1996). The quality improvement initiatives taking place within UMMC are fully engaged in this theory. Therefore, using this process provided commonality and consistency within the facility. Three PDSA cycles were accomplished and are as follows:

	First Cycle
P	Find tool and assess charts
D	Utilized tool to assess hard copy of charts of charts, 7 in Cycle 1
S	Difficulty in getting charts, limitations of the reviewer, time limitations
A	Try another process for reviewing charts

	Second Cycle
P	Use Net Access to review charts
D	NICU trigger tool used, Net Access used to review electronic reports
S	Limited access to electronic reports, quality improvement component eliminated due to limitations of reviewer and limited access to chart information
A	Determine problem of limited access and retry

	Third Cycle
P	Ask questions about access to electronic reports, retry Net Access and repeat previous plan
D	Asked questions of Director of Newborn Center regarding electronic reports in Net Access, no constructive solution found, Net Access re-attempted and more successful, NICU trigger tool used to determine cause of death and some morbidity indicators
S	Process is adequate for determining cause of death, but not for quality improvement component. Received insight into morbidities outside control of Newborn Center
A	Determine a method of reviewing the deaths, while also looking at quality improvement to improve the overall quality of the system.

Developing a strategy of change based on the issues of care could result in decreased mortality. When review of deaths is done in a system-wide effort, common themes across the system will sometimes develop. The themes allow opportunity for the whole system to improve based on commonality (Wright et al., 2006). Such a process could be developed by utilizing PDSA cycles until an effective process is developed.

Intervening factors prevented completion of the Model for Improvement within the planned timeframe, but possible answers were revealed. The first question, "What are we trying to accomplish?" has both a simple and complex answer. We are simply trying to decrease IMR in Mississippi by quality improvement initiatives at UMMC. The complexity of that issue is great.

The systems of needed improvement would be the Newborn Center, UMMC' s Hospitals and Clinics, the Mississippi Department of Health, individual providers of care and many other systems. For the purpose of this article, the focus will be specifically on the Newborn Center.

The second question, "How will we know that a change is improvement?" is also complex. Improvement would be demonstrated by the reduction in the number of adverse events in the Newborn Center and a reduction in the infants that die at UMMC, while maintaining that same patient population. As established previously, the majority of the deaths are related to prematurity, low birth weight and congenital anomalies. The cost of prematurity for this group can be extraordinary to the state. For infants less than 28 weeks gestation, the cost can be more than $270,000 (Cuevas et al, 2005). Neonatal deaths are highly attributable to prenatal factors and birth trauma (Brosco, 1999). The Newborn Center as a single entity has limited capability of improving many of the morbidities. However, changes in more than one system could improve quality, decrease the mortality rate and decrease healthcare costs and expenditures for the facility and the state. Mississippi is a poor state with limited healthcare resources. More efficient utilization of available services and improved funding could ensure access to these and other resources for more high-risk infants.

Even though there are problems outside the control of the Newborn Center, quality improvement is an area of focus that could result in decreased mortality and that is very much within the Newborn Center's control. According to Wright et al. (2006), the most fundamental goal in improving quality of care in hospitals is to eliminate unnecessary deaths. If decreasing infant mortality is the goal, changes in the system--resulting in improvement--are necessary. Analysis of deaths done via case reviews or departmental audits can be selective and, at times, judgmental

(Wright et al., 2006). A recommended change would include a multidisciplinary, system-wide review of deaths within the Newborn Center, as well as all areas of the hospital. This team approach could indicate opportunities for change that could result in improvement.

The third question, "What changes can we make that will result in improvement?" will require the greatest effort. The methodology includes three phases of activity: Assessment, Recommendations, and Translation (ART). The first phase consists of assessment of the adverse events including death. The second phase involves assembling an Infant Mortality Review Committee (IMRC) to propose recommendations for change. The third phase effects translation of recommendations into action.

   Phase I - Assessment: The death review process would begin by utilizing a multidisciplinary system-wide death review team of all infant death records from the Newborn Center for calendar year 2006 infant deaths. Of 120 Newborn Center deaths that occurred during that year, 90.83% (n = 109) were NICU patients. Barriers in the assessment phase could include: buy-in from stakeholders, availability of staff to devote to reviews, and cohesive team players committed and skilled in death review.

   Phase II - Recommendation: Upon completion of assessments, the findings should be summarized for presentation to the IMRC. The compilation of the review of Newborn Center infant deaths will benefit the IMRC in surveying the quality of infant care provided and identifying opportunities for improvement. The IMRC will evaluate findings and propose recommendations. Anticipated outcomes include a recommendation for continuation and expansion of the death review process.

   Phase III - Translation: This implementation-level component of the quality improvement initiative will lay the foundation for a formal infant death review process. The

IMRC recommendations will be translated into action via interventions that improve infant care quality at UMMC, thus reducing infant mortality among young Mississippians.

The formal death review process will be instrumental in developing a comprehensive system-wide agenda "to identify, to test, and to implement strategies for the prevention of preterm births" (Callaghan et al, 2006). The strategies developed will be instrumental in supporting strategic planning efforts for UMMC quality improvement, community outreach efforts, and other systems within the state. Changes in the death review process can establish UMMC as being a forerunner in a statewide challenge to reduce infant mortality in the state of Mississippi.

Appendix A—Key Terms

- Extremely Low Birth Weight—Birth weight of less than 1,000 gram (Cuevas et al, 2005)

- Extremely Premature—Gestational age of less than 28 weeks (Buck, 2000)

- Infant Mortality Rate—The ratio of the number of deaths among children less than one year old during a given year to the number of live births during the same year per 1,000 live births. (MSDH, 2007)

- Low birth weight—Birth weight between 1,501 grams and 2,499 grams (Cuevas et al, 2005)

- Neonatal Period—The period of infancy less than 28 days old (MSDH, 2007)

- Preterm Infants (Premature)—Birth less than 37 weeks gestation (Buck, 2000)

- System—An interdependent group of items, people, or processes with a common purpose (Langley, 1996)

- Very Low Birth Weight—Birth weight of less than 1,500 grams (Cuevas et al, 2005)

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