

The Score of Seven: Will Resuscitation Selection Criteria Improve the Survivability at the Limit of Viability of Neonates Born at Twenty-Three Weeks Gestation?

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ABSTRACT:

Aim:

To evaluate the outcome of a cohort of infants born at 23-weeks' gestation age after introducing a new resuscitation selection score (The Score of Seven) for infants born at 23 weeks gestation.

Methods:

This is a population-based, retrospective cohort study using data from Pearl-Peristat Maternal and newborn registry, Vermont Oxford database related to WWRC-THE NICU and patient's chart for infants born since 2016 until mid-2018 of ELBW infants born at 23 weeks gestation age. Infants with significant lethal congenital anomalies were excluded. In February 2018, we introduced a new protocol to streamline the delivery room resuscitation decision making regarding ELBW infants born in 22-24 weeks gestation. This pilot protocol did include a designed score specific to 23 weeks gestation age. The score components were chosen to address the most relevant factors associated with poor outcome at this gestation age. Seven elements were chosen: four antenatal and three immediate postnatal. Each component received a zero, one or two according to its presence or absence at or soon after birth.

Using this scoring system a baby would not be resuscitated if the score below 7 and will receive active resuscitation and admitted to the NICU if the score is equal to or above 7. A short satisfaction survey was conducted after six months from the application of the guideline to identify the comprehension, practicality and ethical comfort of the medical staff using this scoring system guideline.

Results:

Sixty infants delivered from January 2016 until June 2018 were investigated for mortality associated risk assessment. The DR death rate was 23/60 (38.3%). The NICU admission was 37 infants (61.7%). Half of the admitted infants died before two weeks of age. Survival rate to discharge was 37% (13/37). From only 37/60 infants were we able to retrieve the full description of the selected components of the "score of seven," and these were subjected to the analysis. However, infants who died in the DR with a score < 7 were 13/20 (65%) versus 0/17 when the score was ≥ 7. Amongst those infants admitted to the NICU (37), seven infants were admitted with a score less than 7; 2/7 infants survived to discharge (~29%) while among 17 infants admitted with a score ≥ 7, nine infants survived to discharge 51%. A satisfaction survey was administered to thirty-three neonatal physicians, and thirty-two felt that the score was easy to comprehend, and 26 concluded that it was easy to implement. Thirty physicians found that using the resuscitation provided ethical relief and moral comfort.

Conclusions

While managing 23 weeks' gestational age at delivery, a decision using resuscitation score (and a score of seven or more) was associated with improved survival rate until discharge. The score was described by the NICU physicians as functional and convenient. It offers ethical reassurance to the dedicated medical staff and provides a practical platform for delivery room resuscitation decision making. Applying the score was not associated with an

increase in the number of delivery room deaths and did not differ from that reported in the literature.

Abbreviations:

DR	Delivery room
ELBW	Extreme low birth weight
NICU	Neonatal intensive care unit
PNX	Pneumothorax
PIE	Pulmonary Interstitial Emphysema
VD/CS	Vaginal delivery/Cesarean section
WWRC	Women's Wellness and research center

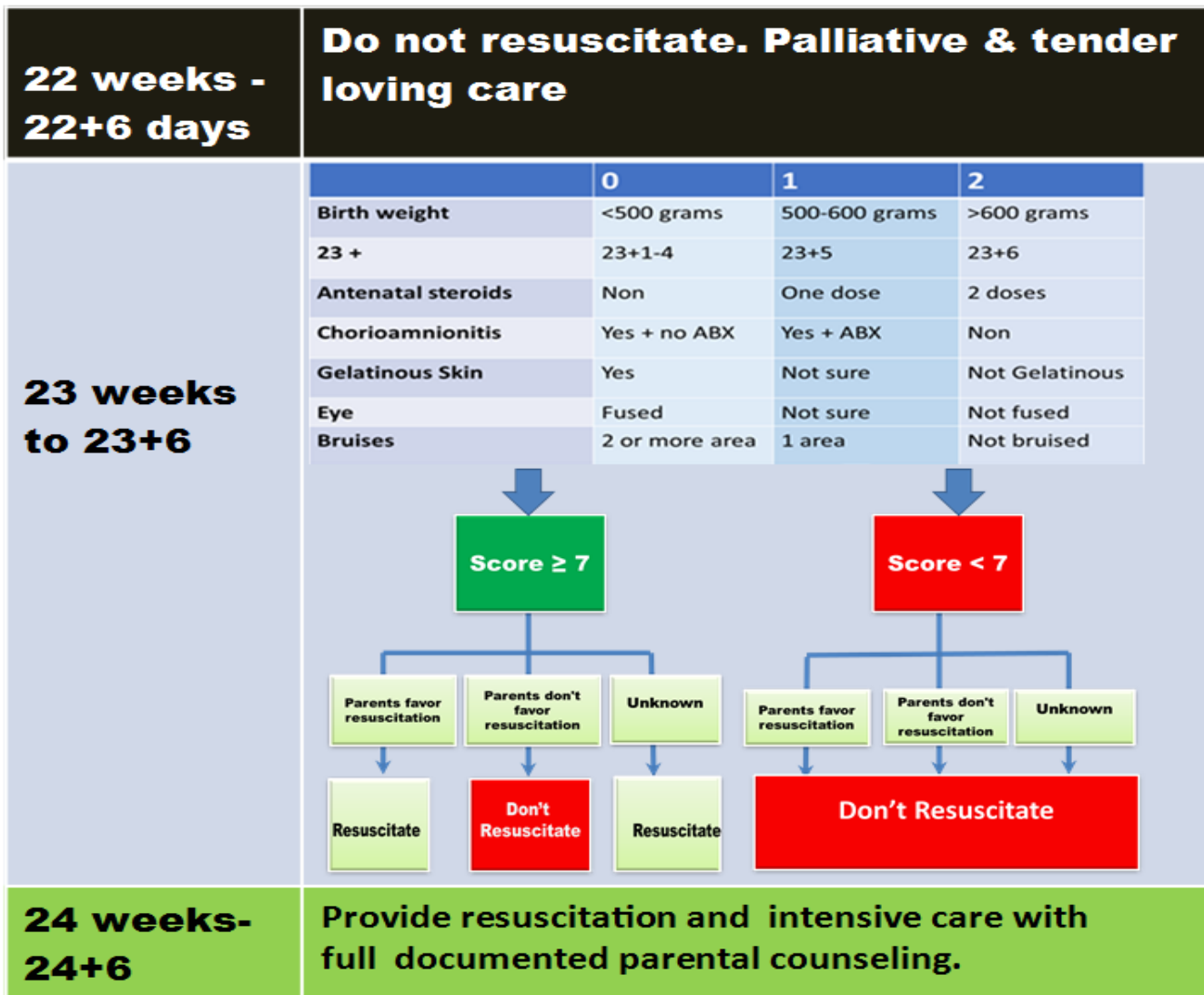
Introduction:

Neonatologists operating in tertiary NICUs have mixed feelings toward resuscitation, admission and managing newborn infants born at 23 weeks' gestation age. NICU services are judged by their level of sophistication in managing infants born at the limits of viability and their survival until discharge. These NICUs are keen to achieve a favorable two-year neurodevelopmental outcome showing minimal developmental handicap among these infants. (1) This approach was undertaken based on published reports regarding the survival of infants born at 23 weeks and their outcomes, as well as ethical and cultural obligations to provide care for all infants, and social and political expectations of being good stewards of the healthcare dollar. Hence it was reasonable for advanced health care policymakers to demand similar outcomes in their NICUs (2) In Japan, Nazomi et al. reported survival of 65% and cerebral palsy as low as 18%. These encouraging reports drive expectations in other tertiary NICUs to achieve similar outcomes. It is crucial to comprehend the embryology and physiology of this gestation age, the immaturity of the body organs and its impact on the survival of those tiny infants and evidence-based medical practice to care for these immature infants. (2) The American Academy of Pediatrics published a guideline report in 2009 which was updated in 2015 that noted wide variation of approaches, outcomes, and decision-making process when managing infants born at the limits of viability. (3)

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Over the past several decades, advances in perinatal and neonatal care have improved the survival of even the most immature infants, increasing and diversifying our knowledge of the causes of death in preterm infants. (3, 4) The Epicure study reported that 64% of infants

Figure 1: limits of viability 22-24 weeks gestation resuscitation decision-making guideline



Unknown:

1. Rapid delivery without meeting parents.
2. No antenatal consultation.
3. Mother cannot be approached (in active labor) or unapproachable husband/partner.
4. Multiple pregnancies: each is evaluated as an individual case.

Chorioamnionitis: active clinical symptoms within one week of labor.

Assisted pregnancy due to extended infertility (IVF): needs special consideration

Significant bruises: bruises involve 2 or more of (head & scalp), trunk & limbs.

Figure 2. Total number of infants died within the first 2 weeks versus those died after two weeks versus lived till discharge (infants)

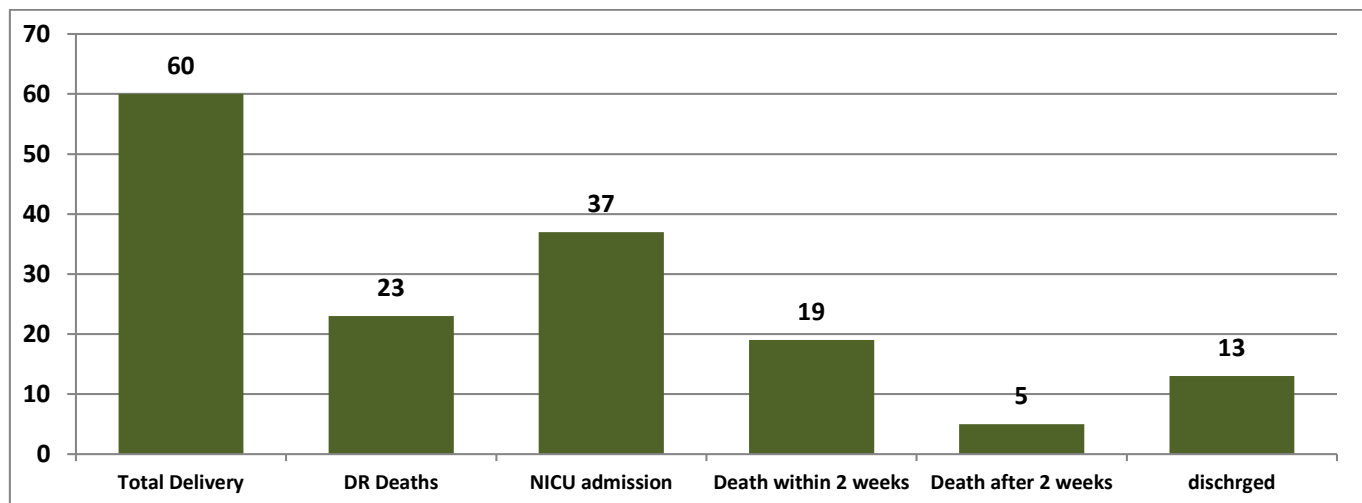
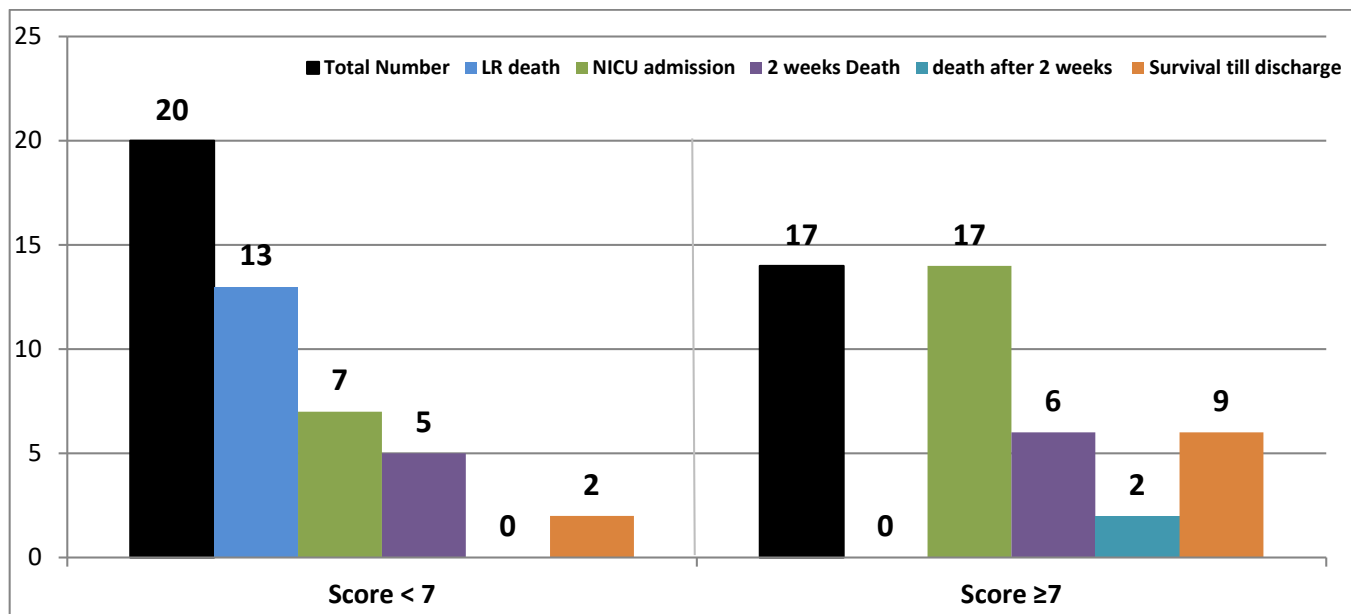


Figure 3. Impact of applying resuscitation score on the 23 weeks gestation infants*



* Only 37/60 received the full score characteristics.

born at 23 weeks were resuscitated and admitted alive to The NICU, and 40% of them survived until 28 days, while 30% survived to be discharged home. (5) In the Epicure study review in 2014, the number of live births, infants born at 23 gestation age with intended care was 284, while the number of those infants admitted to the NICU was 217 (76%), and infants died before discharge was 151(69%).

Few publications addressed and focused on this particular gestation age. (6,7) Our hospital is a "state of the art," new tertiary referral women's hospital where 40 to 50 deliveries occur daily. WWRC accom-

modate 214 Maternity beds and 110 The NICU cots distributed on two floors. WWRC is a referral hospital for three governmental and five private maternity services. In 2004 and 2005, 12 infants at 23 weeks gestation were admitted to our the NICU, and only one baby survived to discharge (9%). Since 2009, we have been encouraged to admit infants of this gestation age to our NICU, but the cumulative survival rate throughout ten years did not exceed 18%, with an average length of stay is 140 days for those who survived. In this study, we measured the probability of death before and after introducing the resuscitation score (The score of seven) targeting the 23 weeks gestation age.

Methodology:

This population-based retrospective study was designed to assess mortality and survival rate of all ELBW infants born at 23 weeks gestation delivered among residents of Qatar in WWRC from 2016 to mid-2018. We evaluated the outcomes of these infants after introducing the resuscitation guideline concerning the limits of viability 23 weeks gestation. We retrieved the data from the medical records of each infant, the Pearl-Peristat Maternal and newborn registry and Vermont Oxford database related to our hospital. We defined cases as live-born at 23 weeks plus zero days to 23 weeks plus six days who were born, died or admitted to the NICU. The estimation of the gestation age was verified from the maternal ultrasound, in-vitro fertilization dates, first-trimester ultrasound and or from menstrual dating confirmed by second-trimester ultrasound. The study excluded confirmed intrauterine fetal death and infants with significant anomalies. The study included infants in whom resuscitation was attempted in the delivery room. The rate of NICU admission, death before two weeks of age and death before discharge were assessed. In this study, we as well evaluated complications during the first two weeks associated with death to measure the probability of dying in case such complications occurred.

We evaluated the best evidence available from the world's literature (19-27) reflecting antenatal risk factors associated with death in this gestation age and level of intrauterine growth maturation. We selected seven parameters which are supported by the evidence as the most crucial for potential survivability or death in this gestation age (figure 1). We allowed room for the ambiguity of the clinical features and subjectivity of the evaluation. We as well, left a window to accommodate unknown clinical information.

The designed score took in consideration, parental wishes not to proceed with the resuscitation based on the information conveyed to them before delivery, but this score did not allow the parents to dictate resuscitation in case of score less than seven as this was an adopted policy of the institution's NICU. We relaxed this policy in exceptional circumstances such as an in-vitro fertilization case and a history of infertility. We omitted the influences of gender, multiple births and birth order or ethnicity from the decision score component. Each baby was assessed independently from those three factors. Before applying the score, we obtained the approval of the NICU then Women's Hospital Board of Ethics. Seven elements were chosen, four antenatal before delivery (gestation age, chorioamnionitis, estimated birth weight, and antenatal steroids) and three immediate postnatal (confirmation of birth weight, bruises, skin friability and fusion of the eyelids). Each component received zero, one or two according to its presence, "not sure," or absence. Babies were not to be resuscitated if the score was below 7 and actively resuscitated and admitted to the NICU if the score was greater than or equal to seven.

A satisfaction survey was conducted six months after the application of the score to identify the comprehension, practicality and ethical comfort of the NICU medical staff.

Results:

Sixty infants delivered from January 2016 until June 2018 were investigated for mortality associated risk assessment. The DR death rate was 23/60 (38.3%). The NICU admission was 37 infants (61.7%). Half of the admitted infants died before two weeks of age. The Survival rate to discharge was 35% (13/37). Only 37/60 infants were able to retrieve the full description of the baby's selection components of the "score of seven" and subjected to the analysis of the survival rate using this score. However, infants died in the DR with a score below 7 was 13/20 (65%) versus 0/17 when the score was equal to or above 7. Amongst those infants admitted to the NICU (37), seven infants admitted with a score less than seven; 2/7 infants survived till discharge (~29%) while among 17 infants admitted with a score equal to or greater than 7, 9 infants survived to discharge (51%). A survey was conducted that

included full-time thirty-three neonatal physicians. Thirty-two indicated that the scoring system was easy to comprehend, twenty-six said it was easy to implement, and thirty physicians indicated that the guideline provided ethical support for both parents and medical providers leading to less moral distress over what is the best evidence-based care for these extremely premature infants.

Discussion:

Birth at less than 24 weeks gestation remains frightening and ethically challenging for both parents and caregivers. Parents often lack knowledge of the outcomes and complications among these very premature infants and have ambiguity regarding the future and fear of having a disabled child. While for caregivers, there is the medicolegal and ethical responsibility to each infant and family, the concern regarding resources availability and consumption, the high possibility of an unfavorable outcome, as well as, the need for utmost and vigilant attention to outcome measures for a very long time.

The 'optimal' perinatal care of infants born at the limits of viability remains unclear and vary significantly among several reports (2,3,8-11). These complexities are well established, but there is increasing evidence from NICUs in Japan and other regions of a more favorable outcome. However, in the State of Qatar and across the world, there is no formally agreed upon national consensus in practice, leading to variation between tertiary institutions and their referring regional hospitals at this particular gestation. Differences in local and international practice make comparisons between centers difficult. In some centers, it might reflect the level of deficiency in expertise and technology. Many centers report widely different rates of antenatal corticosteroid use, operative birth and other perinatal care strategies that may explain the variation in morbidity and mortality (9,11,12).

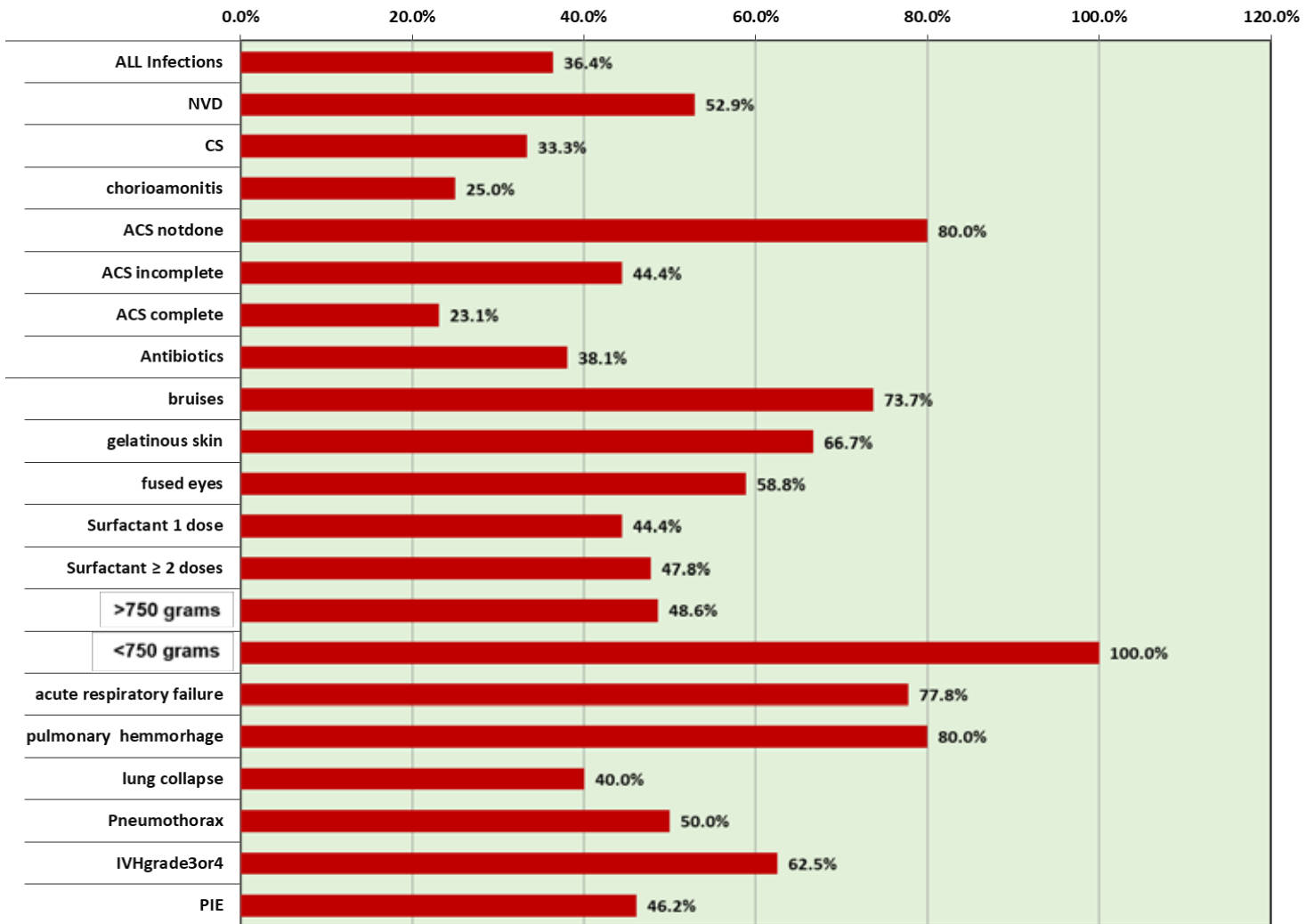
Furthermore, early trimester dating scans have a margin of error of at least one week. This margin undermines treatment threshold decisions based on gestational age alone (13)

Similarly, the effect of other variables, including corticosteroid exposure can modify survival risk significantly (14). The medicolegal conflicts, the very long hospital stay, the eventual death after long days of struggle, the parent's frustration including separations and even divorce are crucial factors to consider when developing and imple-



Figure 4. death related risk factors in 60 preterm 23 weeks gestational age infants

Risk Factors related to death (%)



menting a meaningful scoring system. Evidence-based knowledge is complicated by human subjectivity and possible sub-optimal decision-making skills. The score of seven distinguishes those infants with a strong potential to resuscitate while providing more guidance for those who present with less potential. The score was designed to accommodate unsure physical signs, particularly when addressing signs of maturation. We report the survival rate rather than the two-year outcome as the primary objective in this study. Applying this score did not increase labor room deaths, which were marginally less than before applying the score (by 7%). The score may have helped the physicians decide when to attempt resuscitation before birth, as four out of seven components of the score are calculated before delivery. Support by the hospital administration and ethical reassurance from the Board of Ethics approval helped the attending resuscitation team to more comfortably take on overwhelming ethical decisions and responsibilities. In the current study, we report a survival rate of 35% to discharge. It is lower than some centers (15,16) and equivalent or higher than other centers. (2,17, 18)

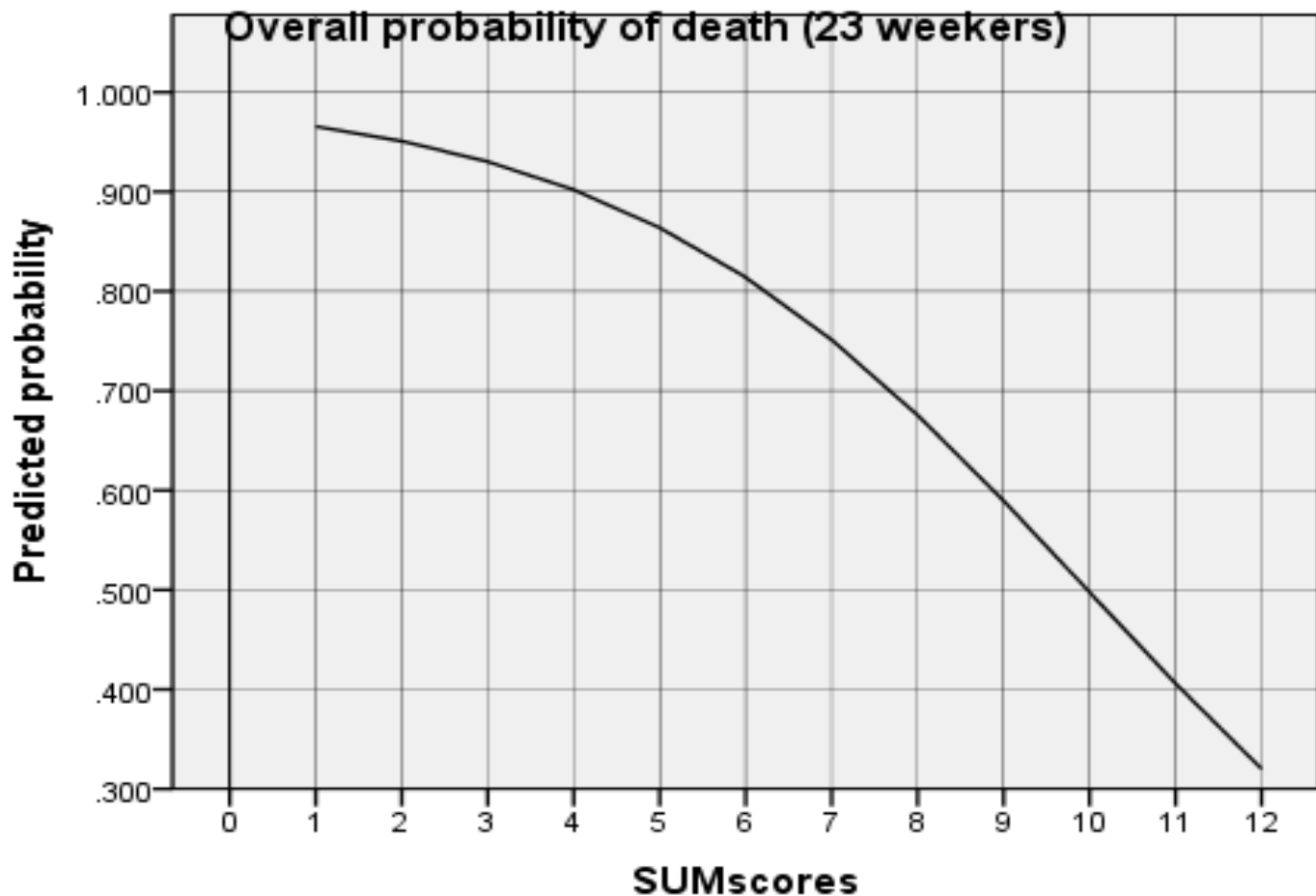
We propose a practical, convenient and ethically sound approach to this particular gestation age founded on evidence-based literature that

can solve significant confusion among health caregivers. Although this score should be applied consistently to achieve maximal benefit, an individual approach and custom decision making must be used where applicable.

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PLOTS = probability of death *100 (P value =0.126)



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Table 1. Odds Ratios for death at two weeks of 60 infants at 23 weeks Gestation.

		OR	95% C. I
Maternal infection	No	0.21	(0.05 - 0.87) [†]
Maternal antibiotics	No	8.9	(1.56 - 51.18) [†]
Antenatal steroids	None	13.3	(2.19 - 81.23) [†]
	Incomplete	2.7	(0.42 - 16.83)
Bruises	Yes	7.7	(1.66 - 35.69) [†]
Gelatinous skin	Yes	2.2	(0.55-9.02)
Fused eyes	Yes	1.4	(0.38 - 5.44)
Birth weight	≤750g	1.9	(0.305-13.02) [†]
Age at intubation	≥5 mins	1.0	(0.20 - 4.96)
IPPV & Fio2 > 50 % at 2 weeks of age	Yes	22.8	(3.55 - 145.8) [†]
Surfactant doses	≥ 2 doses	1.15	(0.24-5.39)
Blood transfusion	Yes	0.1	(0.02 - 0.49) [†]
Pulmonary hemorrhage	Yes	5.0	(0.49 - 50.83)
IVH III/IV	Yes	2.5	(0.46 - 13.52)
Mode of delivery	NVD		
	CS	0.44	(0.04 - 5.38)
Lung collapse	Yes	0.6	(0.09 - 0.32)
Pneumothorax	Yes	1.1	(0.07 - 20.02)
Pie	Yes	0.8	(0.21 - 3.47)

† Statistically significant at p<0.05

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TOP 10

RECOMMENDATIONS FOR THE PSYCHOSOCIAL SUPPORT OF NICU PARENTS



Essential evidence-based practices that can transform the health and well being of NICU families and staff

based on the National Perinatal Association's Interdisciplinary Recommendations for Psychosocial Support of NICU Parents

1 PROMOTE PARTICIPATION

Honor parents' role as primary caregiver. Actively welcome parents to participate during rounds and shift changes. Remove any barriers to 24/7 parental involvement and avoid unnecessary separation of parents from their infants.



2 LEAD IN DEVELOPMENTAL CARE

Teach parents how to read their baby's cues. Harness your staff's knowledge, skills, and experience to mentor families in the principles of neuroprotection & developmental care and to promote attachment.



3 FACILITATE PEER SUPPORT

Invest in your own NICU Parent Support program with dedicated staff. Involve veteran NICU parents. Partner with established parent-to-parent support organizations in your community to provide continuity of care.



4 ADDRESS MENTAL HEALTH

Prioritize mental health by building a team of social workers and psychologists who are available to meet with and support families. Provide appropriate therapeutic interventions. Consult with staff on trauma-informed care - as well as the critical importance of self-care.



5 SCREEN EARLY AND OFTEN

Establish trusting and therapeutic relationships with parents by meeting with them within 72 hours of admission. Follow up during the first week with a screening for common maternal & paternal risk factors. Provide anticipatory guidance that can help normalize NICU distress and timely interventions when needed. Re-screen prior to discharge.



6 OFFER PALLIATIVE & BEREAVEMENT CARE

Support families and NICU staff as they grieve. Stay current with best practices in palliative care and bereavement support. Build relationships with service providers in your community.

7 PLAN FOR THE TRANSITION HOME

Set families up for success by providing comprehensive pre-discharge education and support. Create an expert NICU discharge team that works with parents to find specialists, connect with service providers, schedule follow-up appointments, order necessary medical supplies, and fill Rx.



8 FOLLOW UP

Re-connect with families post-discharge. Make follow-up calls. Facilitate in-home visits with community-based service providers, including Early Intervention. Partner with professionals and paraprofessionals who can screen families for emotional distress and provide timely therapeutic interventions and supports.

9 SUPPORT NICU CARE GIVERS

Provide comprehensive staff education and support on how to best meet families' psychosocial needs, as well as their own. Acknowledge and address feelings that lead to "burnout."



10 HELP US HEAL

Welcome the pastoral care team into your NICU to serve families & staff.

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