Identifying at-risk children under five in the Sudan

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التعرف على الأطفال المعرضين للخطر دون سن الخامسة في السودان

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تشرح هذه المقالة طريقة بسيطة تيسّر لعمال الرعاية الصحية الأولية ذوي المهارات المحدودة، أن يستعرفوا على الأطفال الذين يرتفع احتمال تعرضهم للمرض، باستخدام قـائمة مراجعة معّدة لهذا الغرض. ولقد صممت قائمة المراجـعة لتطبّق في حالة المشكلات الصحـية ذات الأولوية لدى الأطفال دون سن الخامسـة. وبها بيان بمشعـرات (مؤشرات) احتـمال التعرض (الاخـتطار) الكبير بالنسبـة لكل مشكلة معـينة. ويمكن إدخال هذه الطريقة في برامج تدريب عمال الرعاية الصحية الأولية والمشرفين عليهم.

This paper describes a simple method to help Primary Health Care workers with limited skills to identify high-risk children by using a check-list. The check-list was designed for priority health problems of children under five years; for each problem the high-risk indicators were listed. The method could be incorporated into the training programme of Primary Health Care workers and their supervisors.

Identification des enfants de moins de cinq ans exposés aux risques au Soudan
Cet article décrit une méthode simplifiée permettant aux agents de soins de santé primaires, dont les compétences sont limitées, d'identifier les enfants "à risques" à l'aide d'une liste leur servant de référence. Cette liste a été conçue pour les problèmes de santé prioritaires des enfants de moins de cinq ans; pour chaque problème y sont notés les indicateurs de risque. Cette méthode pourrait être incorporée au programme de formation des agents de soins de santé primaires et de leurs superviseurs.

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Introduction

In the Sudan, infant mortality is 102 per 1 000 live births [1]. Health services in the country leave much to be desired, and in this situation, infants and children are the worst affected. An attempt has been made to develop a practical approach to screen out "high-risk" children for appropriate management. This approach takes advantage of the presence of high-risk indicators reflecting the presence of major child health problems in children aged 0 to 5 years in the Sudan. The adoption of this simple tool by the Primary Health Care workers (PHCWs) will help them concentrate on those children who need immediate attention and possibly referral care.

Materials and methods

The priority health problems in children under five years of age in the Sudan and the most important risk factors with each problem were identified by experienced paediatricians using methods described by WHO [2].

The criteria for selecting the risk factors that are also the best indicators were as follows:

1. the strength of association with the problem

2. the prevalence of the risk factor apart from the prevalence of the problem itself

3. the feasibility of early and easy detection of the risk factor by PHCWs

4. the feasibility of modifying or eliminating the risk factor or the problem.

Paediatricians with at least five years experience and who have also worked in different parts of the Sudan were requested to give ratings of 2, 1 or 0 according to the degree of association of the risk factor with the health problem, based on their personal experience.

A risk factor strongly associated with a health problem was rated 2; only moderately associated was rated 1; no association was rated 0.

Similarly, each risk factor was rated 2, 1 or 0 depending on whether it was highly prevalent, moderately prevalent or absent. A risk factor technically easy to control (e.g., through health education) was rated 2; more complicated techniques, such as management of immunological disorders (which are risk factors for respiratory tract infections), were rated 1 or 0 depending on complexity.

Table 1 illustrates a typical matrix used to identify risk factors associated with major child health problems in the Sudan.

Results

Seventeen paediatricians were recruited for the study. The results obtained are presented

Table 1 **An example of a matrix used to identify risk factors associated with major child health problems in the Sudan in 1988**

Health problem	Associated risk factor	Strength of association	Prevalence	Possibility of detection	Control Technical	Control Financial	Total rating
Malnutrition	Age < 3 years	2	2	2	1	1	8
	Low birth weight	2	2	2	1	0	7
	Poor transportation	0	1	2	0	0	3

The different criteria were given equal weights as indicators. The total score for each risk factor was then calculated as the sum of all criteria ratings. The average scores of the different paediatricians were obtained. Risk factors with the highest scores were then taken as the best indicators of that particular problem.

Table 2 A check-list of major risk factors to help identify at-risk children under five years of age in the Sudan

Antenatal period	Score*	Post-neonatal period (6–8 months+)	Score*
1. Serious maternal systemic infection *syphilis, hepatitis, etc.*	10	1. Failure to gain weight on growth monitoring	10
2. Placental insufficiency *eclampsia, hypertension, renal failure, etc.*	10	2. Repeated infections *diarrhoea, acute respiratory infections, etc.*	5
3. Pregnancy at the extremes of life *< 20 years and > 35 years*	10	3. Antenatal score of 1 or more *e.g., eclampsia*	1
4. Multiple pregnancy	10	4. Age below three years	1
5. High parity *> 4*	10	5. Bottle-feeding or failure of breast-feeding	1
6. Maternal malnutrition *anaemia, height < 150 cm, weight gain* *during pregnancy of < 0.5 kg/month*	5	6. Death of parent	1
7. Maternal systemic infection *e.g., malaria*	1	7. Sudden weaning or weaning at a weight of *< 10 kg*	1
8. Maternal exhaustion due to hard labour during pregnancy	1	8. History of malnutrition in a sibling	1
9. Short birth intervals *< 2 years*	1	9. Underweight or malnourished child *< 60% of expected weight for age*	1
		10. Unimmunized child	1
Intranatal and neonatal period	**Score***	11. Overcrowding *> 3–4 persons per 4 x 4 metre room*	1
1. Low birth weight *birth weight < 2.5 kg or* *gestation age < 37 weeks*	10	12. Poor socioeconomic status *family income < 100 Sudanese pounds* *at the time of the study*	1
2. Prolonged rupture of membranes *> 24 hours*	10	13. Uneducated mother	1
3. Major congenital malformations *e.g., meningocele*	10	14. Poor hygiene *abundance of flies, poor sanitation, etc.*	1
4. Minor congenital malformations *e.g., cleft palate*	5	15. Presence of family contact with typhoid fever	1
5. Maternal peripartum infections *e.g., urinary tract infection*	5	16. Malaria endemicity and lack of control	1
6. History of vaginal discharge *just before labour*	1	17. Schistosomiasis endemicity and lack of control	1
7. Poor sanitation	1	18. Presence of cerebrospinal meningitis epidemic and lack of control	1
8. Female genital mutilation	1		

The scoring system and cut-off points

(a) The following scores were given:

1. A risk factor manageable at hospital level was given a score of 10.

2. A risk factor manageable at health centre level was given a score of 5.

3. A risk factor manageable at the primary level of care was given a score of 1 or 2.

(b) The following cut-off points were chosen:

1. A total score of 10 or more necessitates hospital care.

2. A total score of 5 to 9 can be cared for at a health centre.

3. A total score of less than 5 requires home and primary care and close monitoring.

If there is more than one risk factor for each category, the base score for that category should be multiplied by the total number of risk factors for that category.

in the annex. Table 2 is the check-list to help identify at-risk children.

Discussion

The risk factors with the highest ratings are all well-known and are easy for PHCWs to detect. It would thus be easy to identify high-risk mothers and children who need extra or specialized care. Some of these risk factors are shared by more than one problem. Many of them are amenable to simple intervention even at the Primary Health Care level.

One of the most important variables directly and indirectly affecting the chances of survival is the socioeconomic status of an infant's family. This includes such variables as father's and mother's education, occupation and income. Parental education generally and mother's education particularly are closely associated with better child survival, more responsible childbearing and childrearing, and better reproductive behaviour.

Overcrowding increases the chances of droplet infections; family members should be spaced at least 2 metres apart. A room 4 x 4 metres should preferably not contain more than 3–4 persons [3].

Malnutrition in a child has been shown to be associated with a history of malnutrition in its siblings [4].

Poor hygiene, the presence of flies and poor sanitation predispose a community to many communicable diseases.

The presence of a family member with typhoid fever or any other infectious diseases should prompt the health worker to give health education regarding personal hygiene, food safety and environmental hygiene and also closely monitor other members of the family.

Tetanus neonatorum is a common problem in many tropical countries. It results from dirty management of the umbilical stump.

Health workers should be acquainted with local customs that are injurious to health, such as female genital mutilation, in order to give appropriate health education to ameliorate such harmful practices. Tetanus toxoid also protects the pregnant mother against tetanus.

Mothers are the most plentiful Primary Health Care workers around the world. Education improves their abilities and behaviour in health matters in general; nutrition, sanitation and disease management in particular. Education also influences the sociodemographic characteristics of these mothers: their age at marriage, parity, socioeconomic status in the family as well as in the community, for example. On the other hand, ignorance, unemployment and low income are important risk factors jeopardizing child survival. Based on recent experience in Sri Lanka and Kerala state in India, it has been suggested that for every year of normal schooling for girls, a reduction of 10% in infant mortality be reasonably expected [5]. In Indonesia and Pakistan, the infant mortality rate of children whose mothers had four years of schooling or more was found to be only 50% of that of infants born to illiterate mothers [6].

The death of a mother deprives the child from its breast, love, affection, protection and security. These are all important for its very survival, as well as socialization and normal emotional and intellectual development. Emotional deprivation is known to be one of the causes of the failure of a child to thrive.

The risks associated with childbirth are highest after the fourth child [7]. It has also been shown that maternal risks (ruptured uterus and haemorrhages, etc.) increase sharply after the fifth child [8]. Pregnancies at both extremes of life (< 20 and > 35) are associated with a higher incidence of obstetric complications and congenital malformations [9]. Many studies agree that the shorter the average interval between births, the higher the infant morbidity and

mortality rates. The minimum advisable interval between any two pregnancies is two years [10].

Maternal malnutrition and short stature are also predisposing factors to low birth weight [9].

Multiple pregnancy and maternal exhaustion during pregnancy predispose to low birth weight [9]. A study at the Naval Hospital, Naval City, North Carolina, has shown that active duty service women, despite defined limitations of work and ready access to health care, continue to represent a high-risk population for greater rates of primary caesarean section ($p < 0.001$), and transfer for complications ($p < 0.0001$) such as preterm labour and premature rupture of membranes [11].

Milk supplement may be required in the case of multiple pregnancy.

Problems such as eclampsia, hypertension and renal failure interfere with the circulation and efficiency of the placenta. They thus result in low birth weight. During intrauterine life the placenta serves as a barrier against infection. But it is not equally effective against all disease agents. Some agents like rubella and syphilis cross the placental barrier and affect the fetus.

Maternal urinary tract infections are associated with an increased incidence of disease in the neonate [9].

During the intranatal period many risk factors may predispose to neonatal sepsis. The newborn may get an infection (for example, *Candida albicans* or gonococci) while passing through the birth canal. Ruptured membranes may become infected especially if the rupture is premature (more than 24 hours before birth). Difficult and traumatic labour also predisposes to neonatal sepsis.

Hyperpyrexia of any etiology may precipitate premature labour. Malaria may cause abortion, premature labour, low birth weight, anaemia or congenital infection [12].

Falciparum malaria in nonimmune gravidae commonly induces uterine contractions, which may lead to preterm labour [13].

Maternal hepatitis B infection may cause congenital infection in the newborn. It has also been correlated with prematurity, especially when the infection occurs during the last trimester [9].

Congenital malformations like cleft palate may also predispose to infections such as otitis media.

Prematurity is the most important neonatal risk factor [9]. The problem with preterms is the immaturity of their body system functioning, especially feeding. They also have relatively low levels of immunoglobulins. The risk of death is greatest in the absence of facilities for resuscitation.

A newborn may acquire the infection from the external environment. Poor sanitation therefore predisposes to neonatal sepsis.

Almost all the risk factors in the antenatal period usually result in low birth weight. Low birth weight is also a risk factor for post-neonatal mortality. An antenatal score therefore of 1 or more is a reason for special care during the post-neonatal period. Low birth weight is a major cause of perinatal, neonatal and post-neonatal mortality. This is especially true when such children grow under poor socio-economic conditions. The presence of any of these risk factors during the antenatal period is a reason for concern and for special care for these newborns. Health workers should be well-acquainted with these risks in order to give appropriate care. Low birth weight may require hospital care.

Breast milk alone is the best food for a full-term baby for at least the first six months of life. After that solid food must be added to compensate for the low iron content of breast milk [9]. Breast milk is not only safe, economical and readily available, but is also free from pathogens. Both colostrum and breast

milk contains large amounts of immuno-globulins, white blood cells and anti-infective agents. It also supports the growth of useful bacteria, such as those which synthesize the B vitamins. Breast milk also has an inhibitory effect on the growth of *Escherischia coli* in the intestine [9]. Breast-feeding helps not only the child but also the mother. It helps the involution of the uterus. Breast-feeding protects against premature pregnancy. It is largely responsible for the long birth intervals observed in traditional societies. It also protects against allergies such as eczema. There is some evidence that it protects against coronary artery diseases [9]. In developing countries, in spite of the fact that the environment is sometimes grossly contaminated, breast milk remains and continues to be remarkably free from pathogens. Bottle-fed infants have three times the incidence of diarrhoea compared with breast-fed ones [14]. Breast-fed children enjoy a much greater chance of survival than bottle-fed ones.

Both the duration and severity, as well as the case fatality of any disease are greatly increased by malnutrition [15]. The early years of life are the period of greatest nutritional risk. There is a tendency for diarrhoeal disease, respiratory infections and other conditions to cluster around the early years of life. Weaning is another critical period for the nutritional status of the baby. Premature and sudden weaning puts children at a high risk of malnutrition, especially if they come from large and poor families. The weaning process itself should be gradual and spread over a number of months rather than a number of days. A child should not be weaned before it weighs 10 kilograms, preferably more [6].

A child with poor weight gain (less than 0.5 kilograms per month during the first three months of life or less than 0.25 kilograms per month during the second three months of life) is likely to develop malnutrition [4]. Early detection of such slowing of weight gain or failure to gain weight is critical for the early detection and prompt correction of malnutrition. Monthly weighing (growth monitoring), of children is therefore of critical importance. Poor growth *in utero* and also in childhood may adversely affect the intellectual development of the child. It is likely to perpetuate poor growth and poor development in the next generation, the so-called stunted growth syndrome [6]. The loss to the national economy is high because such children tend to be associated with poor educational attainment and poor productivity. Children are the future of any nation. If nations are to develop, they must take more care of their children.

Failure to immunize the child puts it at the risk of all the immunizable diseases, which are deadly and crippling. In developing countries where environmental and personal contamination is both widespread and heavy and the chances of infection are very high; immunization should be started as soon as possible after birth. Infections, especially repeated attacks of diarrhoea and of respiratory infections may predispose to or precipitate malnutrition. Measles is also an important cause of malnutrition. This is especially so if the child's nutritional status was already marginal—that is before the measles attack [4].

The majority of these risk factors may be eliminated by the child survival strategies such as GOBIFFFFF [15]. This acronym stands for growth monitoring (G), oral rehydration (O), breast-feeding (B), immunization (I), family planning (F), female education (F), food demonstration and weaning foods (F), food supplementation for the poor (F) and filth removal (F).

Conclusion

A child's health during the first five years of life is largely set by events occurring during the prenatal, intranatal and post-neonatal peri-

ods. The majority of the risk factors are amenable to simple inexpensive interventions and correction. Our field work has shown that the proposed check-list to identify the at-risk child is simple and easy to use even by the auxiliary health worker.

Recommendations

1. At birth, the total risk score for the newborn should be assessed and put on the right upper corner of the Road to Health Chart. This will indicate whether special care is needed. It should serve as an entry point to health care, health education and child survival strategy. All children with access to maternal and child health clinics will receive general care. But more and special care will be given to children at risk.

2. "How to identify children at risk" should be part of all basic training curriculums and retraining programmes for all doctors and Primary Health Care workers.

3. The risk profile differs from region to region. The leader of the health team in a health area should be able to identify the local risk profile. He or she should plan and implement proper relevant intervention, based on child survival strategies, as a comprehensive and practical package of essential services that every child should have.

Annex Major health problems, in order of priority, their most important risk factors and indicators and their average ratings

Health problem	Risk factor in descending order	Average rating
Diarrhoeal diseases		
	Age of child < 3 years	7.6
	Bottle-fed	7.5
	Sudden weaning or weaned when weight < 10 kg	6.9
	Poor hygiene	6.7
	Weight < 60% of expected weight-for-age	6.4
	Lack of latrines or safe water supply	6.1
	Orphan child (motherless child)	4.0
	Lack of immunization	3.0
Cerebrospinal meningitis (CSM)		
	Overcrowding > 3–4 persons per 4 x 4 metre room	6.5
	Presence of CSM epidemic	6.8
	Age < 15 years	6.7
	Malnutrition	6.5
	Lack of immunization	6.0
	Exhaustion	3.0

Health problem	Risk factor in descending order	Average rating
Malaria		
	Malaria endemicity	7.4
	Age < 3 years	7.0
	Presence of breeding places for mosquitoes	6.6
	Lack of control	6.5
	Lack of malaria prophylaxis	3.0
Immunizable diseases		
	Age < 3 years	7.6
	Not vaccinated	6.9
	Malnourished	6.5
	Ignorant parents	6.4
	Overcrowding	4.0
	Poor hygiene	3.0
Acute respiratory tract infections		
	Age < 3 years	7.5
	Overcrowding	6.9
	Not immunized	6.9
	Malnutrition	6.8
	Not breast-fed	6.4
	Low birth weight	6.2
	Immunocompromised	3.0

continued

Health problem	Risk factor in descending order	Average rating
Malnutrition		
	Age < 3 years	7.5
	Repeated infections like diarrhoea, measles, etc.	7.4
	History of malnutrition in a sibling	7.2
	Poor socioeconomic status	7.0
	Sudden or early weaning	7.0
	Death of mother	6.9
	Low birth weight	6.9
	Multiple pregnancy	6.8
	Large family (> 7 members)	6.7
	Birth interval < 2 years	6.6
	Failure to gain weight	6.5
	Not breast-fed	6.4
	Single parent child	6.3
	Not immunized	4.0
	Poor transportation	3.0
Neonatal infections		
	Maternal infection e.g., malaria, hepatitis	7.0
	Congenital malformation e.g., cleft palate	6.8
	Poor transportation	6.6
	Preterm baby or low birth weight < 2.5 kg or < 37 weeks gestation	6.5
	Low socioeconomic status	6.5
	History of vaginal discharge just before labour	6.4
	Premature rupture of membranes	6.3
	Certain local habits	6.2
	Difficult labour	4.1
	Lack of health facilities	4.0

Health problem	Risk factor in descending order	Average rating
Typhoid fever (TF)		
	Unsafe water supply	7.0
	Presence of a family contact with TF	6.9
	Poor hygiene	6.8
	Shallow pit latrines	6.5
	Fly abundance	6.4
Schistosomiasis		
	Living in or near irrigated areas	7.0
	Contaminated water supply	6.9
	Age < 15 years	6.9
	Absence of control measures	6.5
	Presence of snail vectors	4.5
Low birth weight		
	Early or late pregnancy < 20 years or > 35 years	7.6
	Short birth interval < 2 years	6.9
	Maternal malnutrition short stature or poor weight gain during pregnancy, say, < 0.5 kg/month	6.8
	Multiple pregnancy	6.5
	Maternal exhaustion during pregnancy	6.3
	Placental insufficiency e.g., eclampsia, renal failure	6.3
	High parity > 4 children	6.1
	Low socioeconomic status	3.2
Parasitic diseases		
	Age < 5 years	7.0
	Unsafe water supply	7.0
	Lack of hygiene	6.9

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