

## ORIGINAL ARTICLE

## Safe neonatal transport in the state of Jalisco: impact of the S.T.A.B.L.E. program on morbidity and mortality

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### ABSTRACT

**Background.** Transporting newborn infants to third-level units is often disorganized, thus entailing several risks that may further compromise the health of newborn patients.

**Methods.** A prospective study was designed in order to assess the impact of the S.T.A.B.L.E. program (Sugar and Safe Care, Temperature, Airway, Blood, Lab work, Emotional support) from 2005 to 2009 in regard to morbidity and mortality rates of newborn patients who needed to be transferred from other regions within Jalisco state or within Guadalajara's metropolitan area to the Neonatal Intensive Care Unit of the Civil Hospital in Guadalajara. The intervention process was based on applying the S.T.A.B.L.E. program to all newborns who needed to be transferred and was achieved with the intervention of the physicians regulating the Emergency Medical Assistance System (SAMU) of the state of Jalisco. A training course, as well as an educational brochure, was given to medical and paramedical staff from the medical assistance centers referring patients to our unit in order to provide them with information on the S.T.A.B.L.E. program and its implementation.

**Results.** A total of 3,277 newborn infants were included in the study, 384 before the intervention program and 2,893 once the S.T.A.B.L.E. program was implemented. Within the group transferred after the implementation of the program, we observed a greater incidence of patients with normal body temperature upon admission to the receiving unit [516 (87%) vs. 227 (59%);  $p < 0.01$ ] as well as with blood glucose figures within the normal range [690 (93%) vs. 173 (45%);  $p < 0.001$ ]. Mortality during the hospitalization period in the receiving unit was lower in the group treated after the program's implementation [405 (14%) vs. 84 (22%);  $p < 0.05$ ]. After the intervention process, more patients were transported in incubators [2,806 (97%) vs. 200 (52%);  $p < 0.001$ ] and equally, pulse oximetry monitoring methods were applied in a greater number of patients [2,575 (89%) vs. 235 (61%);  $p < 0.01$ ]. With regard to the number of transfers of newborns that were regulated and authorized by the SAMU system, we also observed an increase in such numbers for the group treated after the intervention program [2,806 (97%) vs. 234 (61%);  $p < 0.001$ ]. There was no difference in the incidence of death during the newborns' transport [30 (1%) vs. 10 (2.6%);  $p = \text{NS}$ ].

**Conclusions.** Transfer of ill newborns to third-level medical care units in the state of Jalisco was safely undertaken with a significant improvement in morbidity rates. The S.T.A.B.L.E. program was highly effective and easy to implement. The decrease in mortality during the hospitalization period of patients treated after the intervention program merits further studies especially designed to establish possible associations.

**Key words:** newborn transfer/transportation, newborn morbidity/mortality rates, referral systems, training for newborn transfer.

### INTRODUCTION

A significant number of infants demonstrate some type of problem that may require special neonatal care. High-risk pregnancy births must be treated in hospitals with neonatal units trained for this purpose. Ideally, a high-risk fetus should be born in a hospital equipped for appropriate care.<sup>1</sup>

Approximately 40% of perinatal problems, including those that occur during childbirth, are not predictable and must be addressed initially at the time of presentation.<sup>2</sup> The birth of premature or ill children in medical units not equipped with specialized neonatal care creates the need for their transfer to tertiary care centers. The neonatal

transfer is done with the resources available to address the emergency. To ensure that a newborn enters the final health care facility under the most optimal general conditions, the ideal transport should be done in utero. Unfortunately, in many cases this is not possible and the conditions under which patients are transferred generate problems that may increase their morbidity and mortality.

The current distribution of resources in Mexico and in the state of Jalisco precludes the availability of specialized neonatal units in all places where births occur, especially in the general population.

In the state of Jalisco there are first- and second-level care units as well as private clinics, which provide medi-

cal services to a portion of the population. Some of these have no resources for neonatal transport and intervention by private services is required. Geographical conditions and the communications infrastructure in some of these hospitals make adequate neonatal transport to specialized neonatal tertiary centers even more difficult.

An informal and disorganized neonatal transport system is dangerous and compromises the health status of the newborn; therefore, certain steps must be followed to do so in a timely and safe manner.<sup>3-6</sup>

The program known as S.T.A.B.L.E. (Sugar and Safe Care, Temperature, Airway, Blood, Lab work, Emotional Support) is widely recognized worldwide. It was developed to improve the quality of care in infants before and during transport as well as to reduce neonatal complications due to inadequate neonatal transport.<sup>6</sup> The high number of infants whose health status deteriorates during transport prompted us to collaborate in the organization of a neonatal transport system that would allow the transport of patients from the birth center or first contact to our neonatal intensive care unit in a safe and organized manner.

Due to the frequent transfer of ill neonates within the state of Jalisco and the metropolitan area of Guadalajara to our unit, we decided to investigate further in regard to morbidity and mortality of these patients and to understand the impact of the S.T.A.B.L.E. program when implemented as an integral part of the Healthcare System (SAMU) of the state of Jalisco.

## PATIENTS AND METHODS

We studied infants who were transferred from within the state of Jalisco and Guadalajara metropolitan area to the Neonatal Intensive Care Unit-External (NICU-EX) of the former Civil Hospital of Guadalajara Fray Antonio Alcalde. The infants who participated in the S.T.A.B.L.E. program applied during the period of January 1, 2005 to December 31, 2009 were prospectively analyzed.

Infants who were transferred during the period from January 1 to December 2004 and who did not have the intervention process applied were retrospectively studied. The study included all neonates admitted to our unit who were referred by first-level medical units and in whom government regulation was established for this purpose, obtaining prior SAMU authorization for transfer of the neonate.

The objective was to analyze the impact of the S.T.A.B.L.E. program on morbidity and mortality of the patients. The intervention was based on the implementation of the S.T.A.B.L.E. program on all newborns requiring to be transferred (Figure 1).<sup>6</sup> With the support of physician coordinators of SAMU, a communication system was organized among the units of primary and secondary health care and private clinics in the NICU-EX where the best time for neonatal transport was decided.

Referral units with less technological capacity and those that did not have an ambulance for transport and/or incubators had to rent equipment for this purpose, which involved an extra expense for the patient's family or the reference center because many of them still do not comply with official regulations.<sup>2</sup>

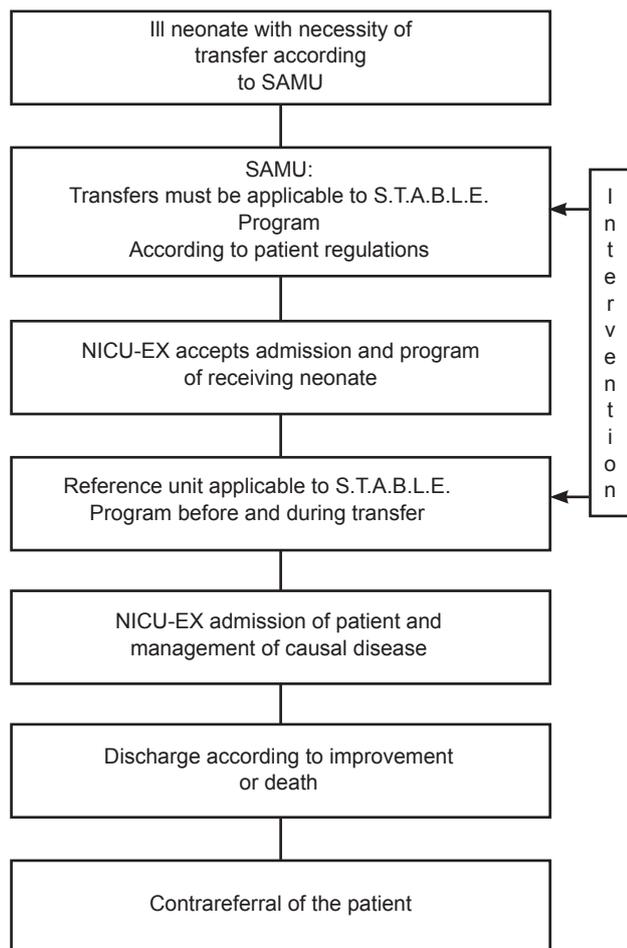
Through the implementation of training courses taught for 5 years by physicians of the Association of Neonatologists of the state of Jalisco and a nurse practitioner, and the development of an educational pamphlet, four physicians in social services, 22 pediatric residents, 23 pediatricians and 11 neonatologists as well as 77 nurses and three paramedics who work in neonatal care centers that refer patients to our ICU were trained and certified in implementing the S.T.A.B.L.E. program. Training courses included S.T.A.B.L.E. theoretical education program guidelines and practical work, for which training dummies were used. Learning was evaluated through a written assessment and practice with the dummy. Similarly, in the Ministry of Health of the State of Jalisco, pediatric

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Received for publication: 6-28-10  
Accepted for publication: 10-19-10



**Figure 1.** Critical route for obtaining safe neonatal transport in the open population of Jalisco, Mexico.

residents who each year go on to provide social service to secondary hospitals in the state have been trained in implementing the S.T.A.B.L.E. program, which reinforces the training previously received.

The process for a transfer was executed using the following steps:

1. Call the SAMU telephone number.
2. Notify the operator of the case and the need for transfer of an ill neonate.
3. The medical coordinator prepares a report and initiates the notification process of the case. Request for admission and transfer of the infant to tertiary care is made by telephone according to the availability of beds in the receiving hospital.

4. Once a bed is available, the coordinator asks the referral center for implementation of the S.T.A.B.L.E. program for transfer of the infant.
5. The reference center applies the S.T.A.B.L.E. program for neonatal stabilization and transport and confirms the status of the patient and vital signs prior to patient transfer.
6. The staff caring for the infant prior to the transfer is the nurse and physician and during transportation the physician and paramedic.

As a priority of patient care, it was required that prior to and during transfer the patient must have six stable points verified by the responsible coordinating physician:

- Open airway and adequate ventilation
- Skin and lips pink
- Pulse rate of 120-160/min
- Rectal temperature 37°C or axillary temperature of 36.5-37°C
- Corrected metabolic problems
- Special problems managed

On admission to the neonatal ICU, the patient's biophysical profile was evaluated. Blood gas studies, blood glucose and vital signs were checked according to the format previously designed, which served as a source of information and uptake for the database developed for the study. Also recorded in the clinical record were the principal aspects to stabilize according to studies performed.<sup>5-7</sup>

To perform the statistical evaluation, the STAT v 1.0 program was used. Statistical analysis used the variables for body temperature and blood glucose was the Z test of Kolmogorov-Smirnov for unpaired population averages and, for the other variables, chi square test, considering as significant a *p* value 0.05.

## RESULTS

A total of 3277 infants were included in the study, 384 before applying the intervention program and 2893 after the implementation of the S.T.A.B.L.E. program as an interventional strategy. Of these infants, 1998 (69%) were male and 895 (31%) females. With the implementation of the intervention strategy, patients with normal body temperature on admission to the receiving unit were more

frequently observed: 2516/2.893 (87%) vs. 227/384 (59%) ( $p < 0.01$ ). Normal blood glucose levels were found more frequently in the intervention group 2690/2893 (93%) vs. 173/384 (45%) ( $p < 0.001$ ). Mortality rates during the period of hospitalization in the receiving unit were lower in the intervention group 405/2893 (14%) vs. 84/384 (22%) ( $p < 0.05$ ). More patients were transported in an incubator, 2806/2893 (97%) vs. 200/384 (52%) ( $p < 0.001$ ); and most patients were monitored with pulse oximetry, 2575/2893 (89%) vs. 235/384 (61%) ( $p < 0.01$ ). Regarding the number of regulated and authorized neonatal transports by the SAMU system, we also observed an increase in the intervention group, 2806/2893 (97%) vs. 234/384 (61%),  $p < 0.001$ ). Other parameters studied, which showed no significant differences, were the frequency of deaths during the neonatal transport (30/2893 (1%) vs. 10/384 (2.6%)  $p$  NS), the number of transports by road (2887/2.893 (99%) vs. 383/384 (99.7%)  $p$  NS) and by air (6/2893 (0.2%) vs. 1/384 (0.26%)  $p$  NS) (Table 1).

During the period studied the number of admissions to the receiving unit were increased from 2005-2009.

## DISCUSSION

Neonatal transport is an integral part of the regionalization program. Its main objective is to lower the morbidity and mortality in this group of patients.<sup>3-5</sup> Our 5-year experience in the implementation of the S.T.A.B.L.E. program<sup>6</sup> through a process of education and coordination, connecting care units of different decision-making capacity

through the SAMU emergency system, is unprecedented in Mexico. It shows great benefit in the care of infants from the general population requiring transfer to tertiary care centers in the state of Jalisco and especially the Guadalajara metropolitan area.

The study allowed us to identify, by neonatal transport regulation, the discipline and adherence to the implementation of the six-step S.T.A.B.L.E. program before and during the transport of the newborn.<sup>3-8</sup> We can expect significant stability in the parameters related to blood glucose and body temperature, parameters that affect the prognosis of our patients, reflecting a higher quality of care for this population group.<sup>9,10</sup>

No transfer was made with mechanical ventilatory support. In cases requiring supplemental oxygen, face mask was used, bag and endotracheal tube or nasal CPAP (continuous positive airway pressure), which reduced the baro-trauma complications and, in accordance with the international scientific evidence, is more beneficial to infants.<sup>3-7</sup>

With regard to overall mortality of patients, we do not know if there is any relationship between the implementation of the S.T.A.B.L.E. program and the decline in mortality during the study period.

In other studies such as that of Spector et al.<sup>11</sup> and O'Neill and Howlett<sup>12</sup> where the same intervention program was applied, only differences in the numbers of body temperature and none in serum glucose levels and mortality in the first study were observed, and no differences with the implementation of the second study. In our study

**Table 1.** Behavior of the evolution before and after interventional strategy

Variables	Without S.T.A.B.L.E.	With S.T.A.B.L.E.	Statistical significance
Year	2004	2005 - 2009	
No. of admissions	384 (100%)	2893 (100%)	
Mortality in NICU-EX	84 (22%)	405 (14%)	$p < 0.05$
Transfers in incubator	200 (52%)	2806 (97%)	$p < 0.01$
Transfers with oximetry monitors	235 (61%)	2575 (89%)	$p < 0.01$
Adequate glycemia at admission	173 (45%)	2690 (93%)	$p < 0.001$
Adequate body temperature at admission	227 (59%)	2516 (87%)	$p < 0.01$
Transport by land	383 (99.7%)	2887 (99%)	NS
Transport by air	1 (0.26%)	6 (0.2%)	NS
Transports regulated and authorized by SAMU	234 (61%)	2806 (97%)	$p < 0.001$
Deaths during transport	10 (2.6%)	(1%)	NS

NICU-EX, Neonatal Intensive Care Unit-External; SAMU, System for Urgent Medical Care; NS, not significant.

we found differences in temperature levels, glucose levels and mortality rates. Possibly, these differences are due to small sample size of both studies mentioned above.

### Actions for Prevention

Implementation of the S.T.A.B.L.E. program with intervention from the SAMU medical coordinator represented a strategy that protected the infants from the general population in the state of Jalisco who required to be transferred to a tertiary neonatal care facility. Implementation of a strategy for teaching and learning through training of medical and paramedical staff of the hospitals that refer neonatal patients to tertiary level hospitals represented a fundamental aspect so that the infants were referred under the best possible conditions. SAMU intervention played a key role in liaison and coordination among medical units referring neonatal patients and the tertiary medical units receiving them, avoiding time waste and resource consumption that we observe when patients are transferred without prior coordination.

In light of the results obtained in this study, we strongly recommend that all staff and medical and paramedical personnel serving infants in medical units without the resources necessary for their definitive care learn and master the methodology of the S.T.A.B.L.E. program to ensure the best conditions of the patient during transport and thus increase the therapeutic efficiency and reduce the morbidity and sequelae of these patients.

The limitations found in this study are related to the component of emotional support that parents should receive, laboratory studies that should be carried out prior to patient transfer and that should be transported with the patient to the receiving medical care center, as well as transfers arriving at NICU-EX, which were not

coordinated via the SAMU system due to uncertain acts of good faith.

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