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The Iot Based Tag-NRP© App and Data Logger for Cognitive Database in Neonatal Care.

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Abstract: The United Nations Convention on the Rights of the Child (commonly abbreviated as the CRC or UNCRC) is a human rights treaty which sets out the civil, political, economic, social, health and cultural rights of children. The four core principles of the Convention are non-discrimination; devotion to the best interests of the child; the right to life, survival and development; and respect for the views of the child. Article 6 on conventions on rights of child (CRC) states that children have the rights to live and government must ensure that children survive and live healthy. Unless the first right to survival is preserved we can't protect the remaining three. Hence improving IMR is the most important aspect as the children are the future of mankind and human race on this planet.

The global statistics show that there is a great divide in Infant Mortality Rate between developed, developing and backward countries. The technology is moving with rapid pace and helping to develop countries to improve on all aspects of life including child survival right. The technical revolution and digitization are two important tools for this success. Now it is up to us to pass on the advantages of latest tools and life saving systems to all corners of globe.

NRP is one such program which aims at improving IMR. The program is designed to accommodate all concepts and suggestions which are in the interest of neonatal resuscitation. The TAG-NRP© system is one such simple tool which can be used to train every individual associated with neonatal resuscitation and child birth. The mobile app with IOT based panel provides much needed training assistance and guidance during actual delivery process. The TAG-NRP© system aims to provide best possible options and suggestions during crucial 3 minutes just after child birth and assist the staff attending the mother and child.

Keywords: NRP, Neonatal Resuscitation, IOT, Child Birth, IMR, Infant Mortality Rate

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I. INTRODUCTION

The NRP or Neonatal Resuscitation Program (NRP) was developed and is maintained by the American Academy of Pediatrics. It is an educational program which focuses on basic resuscitation skills for newly born infants.

There are various organizations who are running some training programs and courses to improve the skills of all those associated with process of child birth in labour room. The training programs are very important for saving life of baby in first few minutes of birth. Various procedures and methods are followed all over the world with different type of training tools. The proposed TAG-NRP© system is one such innovative and easy to use tool for most important life saving program. The Tag–NRP© system is designed and developed for healthcare providers who perform resuscitation in the delivery room or newborn nursery. The proposed TAG-NRP© system is flexible to allow providers to complete specific modules directly related to their practice. The TAG-NRP© system for Neonatal Resuscitation Program (NRP) uses an evidence-based approach at time of birth and facilitates effective team-based care for healthcare professionals who care for newborns at the time of delivery. The TAG-NRP© system trains assists and guides every individual using the inbuilt artificial intelligence algorithms to generate best possible solution for a given problem.

The TAG NRP system covers following key points

- Provides overview and principles of resuscitation
- Explains about Initial steps in resuscitation

- Use of resuscitation devices for positive-pressure ventilation
- Chest compressions
- Tracheal intubation
- Medication
- Special considerations
- Resuscitation of babies born pre-term
- Ethics and care at the end of life

With more and more research in medical science the training format and course containts keep on changing. The 6th edition of NRP reflects the guidelines provided by American Heart Association of 2010 for resuscitation. The course or training which used to be a full day program including lectures, written tests and hands on skills is now being replaced by online examination where students are allowed to study and prepare independently. This reduces the classroom time required and focus now shifts more on practical skills need to resuscitate the neonate.

Now we have new guidelines of 2015. With advancement in medical technology and with parallel evolution of digital technology for diagnosis and treatment, the techniques are always going to get upgraded. The data collected from existing tools add scope for improvement. Every new development in science and technology asks for up gradation in training rule book. The 2015 recommendations and improvements in NRP are given are available in published charts.

With the emergence of scientific evidence from developing countries, these studies from resource-limited countries are forming the basis of major changes in clinical practice guidelines. Also, specific and separate recommendations are being made for resource-limited settings, as many of the standard recommendations may not be feasible in these settings.

The major points where up gradation or improvements are suggested are given below.

- Umbilical cord management.
- Normal Temperature of newborn in delivery room.
- Interventions to maintain normal temperature.
- Warming of unintentionally hypothermic newborns.
- Maintaining normothermia in resource limited setting.
- Clearing the airway when me conium is present.
- Assessment of heart rate.
- Administration of oxygen in preterm infants.
- Positive pressure ventilation. (PPV)
- Spontaneously breathing preterm infants with respiratory distress.
- Chest compression.
- Induced therapeutic hypothermia.
- Sodium bicarbonate infusion.
- Prognostic tools.
- Guidelines for withholding resuscitation.

MAJOR CHANGES IN UPDATED GUIDELINES

• A suggestion of delayed cord clamping was given. It works for term and pre-term infants where resuscitation at birth is not required. For infants who are born at less than 29 weeks of gestation, the routine use of cord milking is not recommended except under a proper research setting.

• As a predictor of outcomes, temperature should be recorded. The recorded temperature can also act as a quality indicator. The temperature range of newly born non-asphyxiated infants is recommended to be maintained between 36.5°C and 37.5°C after birth.

• For prevention of hypothermia in preterm infants, various strategies like radiant warmers, plastic wrap with a cap, thermal mattress, warmed humidified gases, and increased room temperature plus cap plus thermal mattress are suggested. It is observed that in resource-limited settings during first hours of life simple measures like use of plastic wraps, skin to-skin contact, and even placing the infant after drying in a clean food-grade plastic bag up to the neck can prevent hypothermia.

• It is recommended for neonates who are born through meconium-stained amniotic fluid and who are non-vigorous at birth to be placed under a radiant warmer. If needed, the PPV procedure should be initiated. It is no longer recommended to go for routine intubation for tracheal suction.

For ensuring oxygenation and ventilation, Intubation and suction of the airway may be used as needed.

• In some cases, for assessment of heart rate in first minute, a 3-lead ECG can be used. However, to evaluate the newborn's oxygenation, the need for pulse oximetry is must and it cannot be replaced with ECG.

• For newborns of less than 35 weeks of gestation, it is recommended that resuscitation should be initiated with low oxygen (21% to 30%) and the oxygen titrated to achieve pre-ductal oxygen saturation approximating the range achieved in healthy term infants.
• In place of routine intubation for administering PPV, CPAP may be offered to spontaneously breathing preterm infants with respiratory distress.
• It is recommended to use 100% oxygen at any time when chest compressions are provided.
• In facilities with the capabilities for multidisciplinary care and follow-up, it is recommended to use therapeutic hypothermia. But this should be done in resource limited settings under clearly defined protocols.
• It is highly recommended to go for Neonatal resuscitation task training more frequently rather than the current 2 year interval.

The above recommendations are for recourse limited countries like India. The recommendations show that with experience and exposure to various cases, the experts in the field of NRP program will continuously upgrade the procedure the child birth and NRP is to be managed. Hence we need a tool which can quickly adapt to recommendations and without mush complexity switch to new flow chart of procedures. In such situation we must build and invent economical and viable products which everyone associated with neonatal practices should be able to use and adapt to.
This is possible only in software driven systems. The proposed TAG–NRP© is one such best suitable product which can adjust to any new changes and suggestions within 3 to 4 working days and continue the training program without much modification in hardware or software level.
Before starting to develop this new training/guiding/assisting tool for NRP, we tried to gather more data and details regarding necessity and mindset of medical practitioners for new technology. The next section of this paper is dedicated to literature survey for the product.

II. LITERATURE SURVEY

To gather the information and need for proper training tool we first took help of web based data and collected first hand opinions and views of academic coordinators from various states in India. All views are available on following url

http://www.iapnrpfgm.org/cms/index.php

We have collected infant mortality rates from official government sites like NITI Ayog and other related sites on health science programs. http://niti.gov.in/content/infant-mortality-rate-imr-1000-live-births#

Here are some of the views from state academic coordinators followed by IMR from NITI Ayog for last 16 years.

Dr. L Basanta
State Academic Coordinator Manipur

Why is NRP so important for you?
"This is the only Program/Mission, which can reduce Asphyxia, IMR & NMR in India, which is the main problem, we the Pediatricians are facing".

What motivates you to be part of NRP?
"Asphyxia Free India Slogan motivates me to be a part of NRP."
Why are you so committed to the NRP?
"As a Pediatrician I want to contribute my Best to make this Mission successful in my state."

Dr. Pradeep Suryawanshi
State Academic Coordinator Maharashtra

Why is NRP so important for you?
"One of the difference between developed nation & us is our neonatal mortality rate. I feel IAP NRP FGM Project will reduce NMR & we will be able to create a good society for our nation."

What motivates you to be part of NRP?
"Its national mission so as a part of NRP team I feel motivated to work towards this mission to reduce Neonatal Mortality."

Dr. Aditya Mohapatra
State Academic Coordinator Orissa

Why is NRP so important for you?
"NRP is a program which helps to reduce the neonatal mortality rate and hope this project will improve the image of Orissa state by reducing NMR."

What motivates you to be part of NRP?
"I found many neonatal deaths and morbidity due to faulty resuscitation in Labor rooms. This prompted me to teach the staffs of LR on resuscitation."

Why are you so committed to the NRP?
"To reduce the NMR in Orissa State through NRP program."

Dr. Akash Bang
State Academic Coordinator Maharashtra

Why is NRP so important for you?
"Every 3rd newborn dying in the world is an Indian!
3 lakh Indian newborns die every year in their 1st hour of life- most of them just because they didn't get their first breaths in time! Another 3 lac stillbirths in India every year are due to asphyxia! And how simple is the solution for this mind boggling problem? Just training everyone to be able to give a newborn its first breath in time if the newborn is not able to breathe on its own!"

What motivates you to be part of NRP?
"The realization of the grave situation (and its simple solution!) and an overwhelming desire to be a part of such a noble cause that keeps motivating me on a continuous basis."

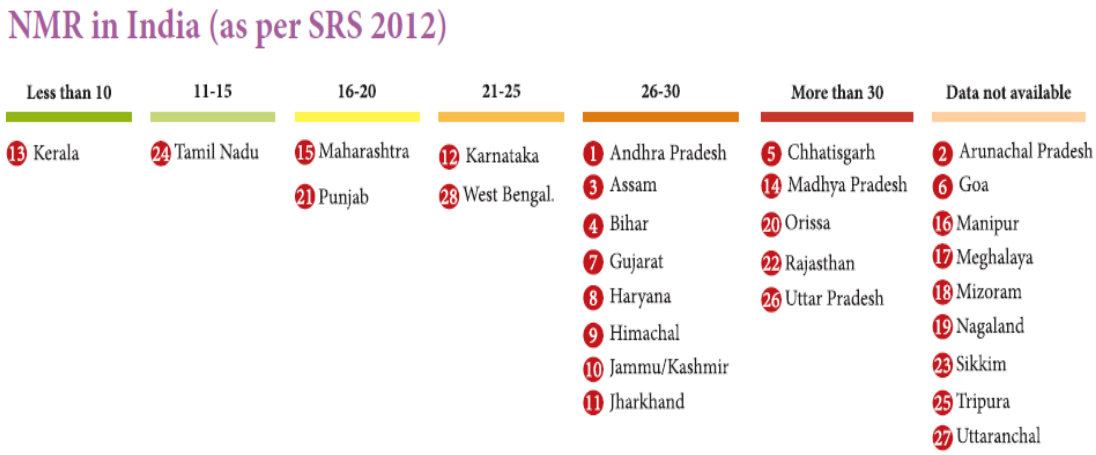
Why are you so committed to the NRP?
"I have realized that I can contribute a lot to NRP mission"

Estimates of child deaths in India for years 1990, 2000, and 2012

Deaths (in thousands)	1990	2000	2012*	Relative reduction from 1990 to 2000	Relative reduction from 2000 to 2012	Relative reduction from1990 to 2012
Neonatal deaths	1354	1118	758	17%	32%	44%
Infant deaths	2333	1751	1097	25%	37%	53%
Under-5 child deaths	3325	2414	1359	27%	44%	59%

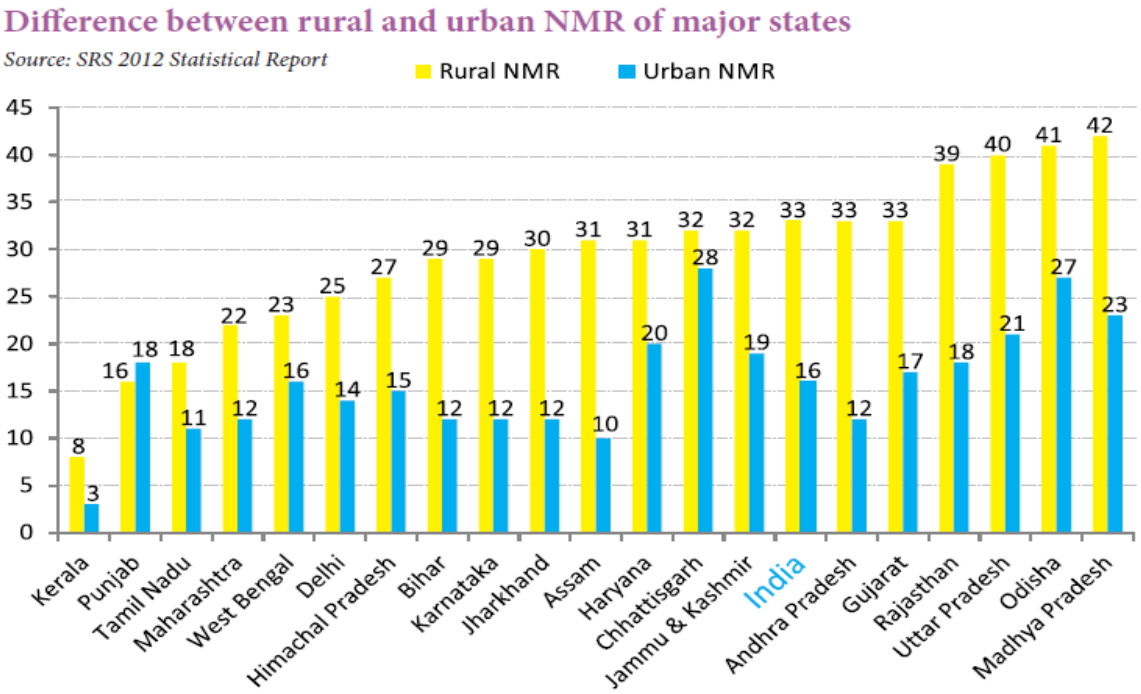
*Source: UN inter-agency group *Source: MoHFW estimates*

In 2006, for the first time, the number of children in the world, dying before their fifth birthday fell below 10 million, to 9.7 million annually. However, South Asia's contribution to this figure remained a staggering 3.1 million while 2.1 million under five deaths occurred in India. This means that India bears around 21 per cent of the global burden of deaths of children under five years of age(SOWC 2008). Hence the onus is on Indians to develop better and effective training tools for improving IMR. We must be able to provide every child his/her fundamental right – A right to survive. Proposed TAG–NRP© system is one step towards achieving this goal.



The proposed TAG-NRP© project will help in accelerating and bringing down of Infant and under-5 Child Mortality Rates and reaching the goal of National Population Policy (NPP) 2000 of reduction infant mortality rate to below 30 per 1000 live births. This TAG-NRP project aims to train all health professionals in Basic Newborn Care and Resuscitation across globe with ultimate aim to have one person at every delivery trained in neonatal resuscitation.

From above statistics we can focus on areas where the system is needed the most. All areas with NMR above 20 need better equipped staff and experts. We also need to collect every minute information and sequence of events during every child birth. This data can provide vital information which may be of great importance to medical fraternity.



The data collected from TAG-NRP© can also help to bridge gap between rural and urban health care system and procedures. The TAG-NRP© system can be helpful in developing better digital connect with all those who assist mother and the child during delivery.

India Newborn Action Plan (INAP)

The child health division, ministry of health and family welfare, Government of India, has published a India Newborn Action Plan in September 2014 which reads as follows

• Builds on existing commitments under the National Health Mission and 'Call to Action' for Child Survival and Development

• Aligns with the Global Every Newborn Action Plan (ENAP); defines commitments based on specific contextual needs of the country
• Aims at attaining Single Digit Neonatal Mortality Rate by 2030, five years ahead of the global plan
• Emphasizes strengthened surveillance mechanism for tracking stillbirths
• Focuses on ending preventable newborn deaths, improving quality of care and care beyond survival
• Prioritizes those babies that are born too soon, too small, or sick—as they account for majority of all newborn deaths
• Aspires towards ensuring equitable progress for girls and boys, rural and urban, rich and poor, and between districts and states
• Identifies major guiding principles under the overarching principle of Integration: Equity, Gender, Quality of Care, Convergence, Accountability, and Partnerships
• Defines six pillars of interventions: Pre-conception and antenatal care; Care during labour and child birth; Immediate newborn care; Care of healthy newborn; Care of small and sick newborn; and Care beyond newborn survival
• Serves as a framework for states/districts to develop their own action plan with measurable indicators.

The above literature survey for the need of smart training tools clearly emphasizes need of researched products for training purpose. We also need scientifically generated data for applying algorithms of artificial intelligence. The proposed TAG–NRP© system is designed to fulfill exact needs of NRP program.

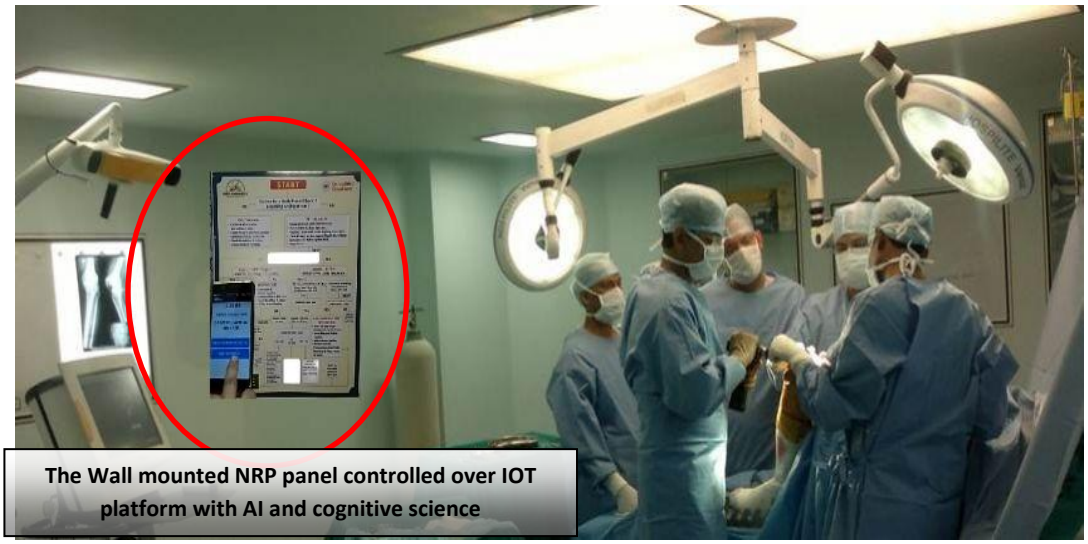
The proposed system

Dr. Satish Deopujari is working in this system since last 3 years. In its first version, he has focused on software aspect of the system and came up with simple informative app. The feedback collected from experts prompted him to take the app further and club the features of Artificial Intelligence, cognitive science and IOT to produce a national database of all child births. This database can be used by all medical practitioners for research and for improving NMR. The proposed system has capacity to develop a national database which can be helpful and accessible to everyone associated with child birth. The Tem of Jigyasa Research and Development Society under Expert guidance of Dr. Satish Deopujari and with technical experience of Mr. Manish Karandikar has successfully developed a first version of proposed system.

Dr. Satish Deopujari at conference in Nashik explaining the importance of NRP program

Initially, the digital system was designed with basic feature of explaining the NRP flowchart. In the later version of TAG–NRP© system, the app was linked to a IOT enabled panel. The mobile app is now converted into control device and a data logger. The most important development to the concept of NRP is inclusion of AI and cognitive science.

The proposed system comprises of a 4X3 foot training / assistance / guidance TAG panel. The panel highlights all steps to be followed within first 3 to 4 minutes of child birth. The panel will take into account data from all previous cases and with algorithms of artificial intelligence and cognitive science, will try to provide best possible solution in case of emergency.



The proposed system is shown in figure. When doctors and attendants are busy in performing their duties, one person can use the app and panel to key in all events occurring during child birth.

A blue tooth device connected with panel will assist and guide all attendants and concerned staff about best possible solution and steps to be followed in given operating condition.

The system will store all activities/events and steps taken during delivery in centralized database. This data will be of great importance for smart algorithms which will provide effective and proven solutions using self learning tools from cognitive science.

To begin with, we have developed a NRP panel as test version. This panel is connected to mobile app through IOT. The mobile app guides the operator and highlights the best possible next step to be taken under given circumstances.

The complete flow chart developed for test version is given below. The app stores every activity and generates a complete log file. This file and data is stored in database.

The algorithms of AI will use the collected data. The algorithms will provide best possible solutions and will guide every one present during childbirth for saving life of new born.

The project aims to reduce infant mortality rate and at the same time generate sufficient data of every delivery for future use. This data will be very important for medicine industry as well as for all research professionals in medical profession.

III. CONCLUSION

The test version of TAG–NRP© is ready for use. Now we will be collecting original and onfield data using this system. Once we have sufficient cases loaded in database we will be able to test our Artificial intelligence algorithms. The algorithms are developed to improve the performance of system as data grows. With use of digital science and IOT we expect to build a national database of neonatal research and bring down the NMR as close to zero as possible.

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