



Review Article

Apps in Neonatology

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ABSTRACT

We all stand at the threshold of the digital era where mobile and digital health is going to be the norm. A number of apps are available on the iOS and android platforms for health workers in neonatology. In this article, we have compiled the information regarding various apps related to neonatology available for android and iOS mobile devices.

Keywords: Apps, Android, iOS, Neonatology, Digital

INTRODUCTION

mHealth is a quite fascinating new branch of health care which refers to the utilization of mobile and wireless devices to support health care.^[1] The World Health Organization (WHO) recognizes mHealth as a form of eHealth with the potential to improve the delivery of health care in the world, especially in developing countries.^[2] mHealth includes data collection and management, service delivery, health communication, and diagnostics. Applications or “apps” are programs which deliver health care-related information to health care workers in a coherent manner so that they can help in management of the patient. This review focusses on the application of these apps in the Indian work environment and makes no claim to be applicable to all set ups.

Many apps available are free but some have to be paid for [Tables 1 and 2]. These apps were searched for in Google Play Store and iOS platform using keywords such as apps in neonatology, neonatology, newborns, calculators in neonatology, apps in NICU, neonatal resuscitation, and apps for parents of premies. We categorize these apps into three categories as follows. Point-of-care utility apps exist to assist in measurements for intubation, central line insertion, and drug and fluid calculations including parenteral nutrition. Some help in clinical management of jaundice, neonatal resuscitation, drug formularies, and standard treatment protocols. Educational apps are focused on examinations with practice materials, question banks, etc. Productivity apps are useful for the parents in monitoring the feeding, growth parameters, developmental milestones, as well as useful for trainees in maintaining their daily activities. In the tables, the available user ratings of individual app are mentioned [Tables 1 -3]. These are not exhaustive list of apps as there is constant evolution and innovations happening in the tech-world.

APPS RELATED TO POINT-OF-CARE UTILITY

Measurements and calculations

In emergency situations including resuscitation calculation of drug dosages, umbilical line measurements, endotracheal tube size, and depth of insertions are vital bits of data. Probably,

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the best app is NeoMate which provides the size of endotracheal tube, dosage of medicines for rapid sequence intubation, the size and distance of insertion of UAC and UVC, and doses and preparation of vasopressors. It helps in IV fluid calculations and has neonatal transport check list. This app also gives the TOBY checklist and provides a centile calculator for follow-up of growth till corrected gestational age of 42 weeks. However, it does not provide total parenteral nutrition (TPN) or fluid deficit calculation. SANTA NICU is a similar app and scores over because it gives a target checklist for BP and HR. It has the following drawbacks. The app does not give the calculations for emergency drug infusions, neonatal transport checklist, TPN or fluid deficit calculation, growth chart, or cooling criteria. "Neonatology" is a paid app and has a free version called neonatology lite which only gives the ET size, UAC, UVC length, and doses of a few drugs. The paid version "Neonatology" provides a lot of other information except for anti-seizure treatment algorithm. Coombe Neonatal Guidelines provide information and protocols related to neonatal problems except seizure treatment protocol. These protocols are based on Coombe Women and Infants University Hospital Guidelines. "Neonatal Seizures causes and management" app contains details about causes, classification, diagnosis, management, and home care of seizures but it fails to provide drug doses and algorithmic management of neonatal seizures.

Online calculators

MedCalc is a collection of online clinical calculators which includes APGAR score, Ballard score, fluids, TPN calculation, quick drip and quick IV, growth charts, and immunization related to neonatology.^[3] MDCalc is a similar website which provides calculators for AaDo₂, anion gap, ABG analysis, blood volume for partial exchange transfusions, QTc, and risk assessment for NNH.^[4] Nicutools is a browser-based neonatal and infant calculators providing calculations of AaDO₂, survival probability of extreme preterm neonates, diaphragmatic hernia, low flow O₂ Fio₂, glucose delivery, central lines, nitric oxide delivery, partial exchange transfusion, infusion calculation, as well as for EOS risk prediction. It also gives audit tool for nutrition and phlebotomy losses.^[5] Calculators are also available in Up-to-date which includes neonatal jaundice assessment, APGAR score, fluid calculation, growth charts, GFR estimation, and QTc calculation.^[6] Medscape is similar to Up-to-date in providing the calculators.^[7] Pediatric Oncall provides calculators for Ballard score, Bruce Resolved unexplained Events Criteria for Infants, Hyperbilirubinemia Risk Nomogram, Maternal-Fetal Hemorrhage Rh(D) Immune Globulin Dosage, Natural Porcine Surfactant, Phototherapy Nomogram, and Umbilical arterial line placement.^[8]

Apps for neonatal jaundice

Probably, the most frequent use of apps is for the management of neonatal jaundice. "Phototherapy calculator" uses AAP guidelines whereas "Phototherapy" uses NICE guidelines for prediction of jaundice in newborns. Both of these are available in the android play store after payment of Rs. 250/- and Rs. 95/-. There are variety of applications available freely such as Biliapp (NICE), Bilirisk (AAP), Biliguru (NICE), Bilibaby (AAP), jaundice curve (AAP), Neonatal indirect hyperbilirubinemia (Emory university/AAP guidelines). In Biliapp, bilirubin values should only be entered in mmol/L whereas in Biliguru, values can be entered in both mmol/L and mg/L. However, in Biliguru, the exact date and time of birth cannot be entered hence exact time hours have to be entered manually. Newborn weight loss/weight gain calculator, though available only in kilograms/grams, is a simple app to calculate weight loss/gain and percentage change in weight.

Sound and light in the NICU environment

"Noise meter" measures the sound level in decibels in NICU, however, there is a reported inaccuracy of ± 10 dB. "Sound meter – Decibel meter and Noise meter" is an app available in play store to measure the sound level in and out of the NICU surroundings quite accurately and it is possible to save the recording. The cons of this app are it contains intrusive ads and cannot measure higher decibels. We find these apps useful to ensure that the noise level in the NICU is kept within the permissible limits as per our developmental supportive care norms.

Light measuring apps include Lux Light Meter Free, Lux meter (Light meter), Smart Luxmeter, and Illuminance: light Luxmeter. Light Meter measures the light level in lux units over a period of time. Smart Luxmeter measures the light level in lux and foot candle units. Lux light meter provides the light measurement values in lux units but it contains intrusive ads. We rarely use these apps. These apps DO NOT measure the output of phototherapy accurately and are NOT recommended for this use.

Fluid calculations and TPN

Fluid calculations are vital part as well as time consuming in a NICU, especially in very low birth weight infants as the chances of errors are high. All the applications are available freely. Neoliq is used for fluid and TPN calculations but amino acids and lipids are mixed with IV fluids. Hence, it would be difficult in usual settings as proteins and lipids are given separately in most NICUs as well as 50 ml syringes are used for infusions. Other applications available are "Neonatology fluid calculator," "NICU calculator," and "TPN." "Dextrose Calc and calories" is used only for calculation of dextrose

calories and GIR calculation, while “Newborn fluid therapy” is used for fluids and electrolyte calculation. Both are not used for TPN calculation.

Neonatal resuscitation

“NRP app” is based on NRP 7th edition AAP/AHA guidelines and it has illustrations with videos and posters that are easily understandable. “Neonatal Resuscitation” is a paid app provided by NHS Scotland for pediatricians, neonatologist, and NICU care nurses. Both the applications needed registration for initiation. eNRI is a free application designated for step-by-step approach during neonatal resuscitation based on the recent NRP guidelines. “LIFE: Neonatal Resuscitation Training” is a simulation training application but has only limited scenarios. “APGAR score” is an application to calculate the APGAR score in newborns immediately after birth. “NRP Vitals” is a neonatal monitor simulator application which displays heart rate, spo₂, temperature, and timer and can be connected through Bluetooth/Wi-Fi to other mobile devices. SimMON is a simulator app which can be used to mimic a monitor during simulation exercises including neonatal resuscitation and ICU crash drills.

Interpreting arterial blood gases

Arterial blood gas interpretation has been made simple by an app called “Complete ABG.” “Complete ABG” is a freely available application in IOS and android platforms that provides a handy tool for interpreting the printout of arterial blood gas report. It also has option of calculating the anion gap if the electrolyte values are fed in.

Drug doses

NeoMate and other apps provide dosages of drugs used in resuscitation. IBM Micromedex NeoFax is a comprehensive paid app which provides all the information as its printed version. DrugDoses is another paid app which mimics the drug dosage book published by the Royal Children’s Hospital, Melbourne, Australia. It incorporates drug doses, pediatric calculators, and PICU guidelines. The Harriet Lane handbook is a paid app with even more features including photographs and illustrations, and is ideal for pediatric trainees. The British National Formulary also comes as a paid app. Depending on your budget and practice, it is worth subscribing to one of the apps.

EDUCATIONAL APPS

Learners guide from AIIMS WHO CC

A handy group of apps released by AIIMS is useful ready references for newborn care at the bedside in SCNUs.

Applications provided by AIIMS WHO CC are free and includes “AIIMS WHO CC ENBC,” “AIIMS WHO CC PTC,” “AIIMS WHO CC STPs,” “HBS ECSB,” “Essential Newborn Care App,” and covers essential newborn care, preterm care, and standard treatment protocols. The national neonatology forum has released an app “NNF CPG” which provides the latest recommendations January 2020 related to certain NICU treatment practices.

Learning echocardiography

TnECHO is an immensely popular learning tool which teaches functional echocardiography to the neonatal practitioner. It includes videos of probe position, 2D echo loops, color Doppler loops, and labeling of the various structures and is aimed at familiarizing neonatologists with basic echocardiography views and aiding self-directed learning. Echocardio is another app which provides pictures of various probe positions and the structure visualized. However, no videos are available. Echocalc is a free app for key echocardiographic calculators and reference tool for echocardiography. Echo UW app from the University of Wisconsin provides step-by-step instructions for performing a normal pediatric echocardiogram and uses video clips, images, and illustrations to aid in instruction.

Learning ultrasonogram

“Cranial Ultrasound” is a paid educational neonatal medical quiz app designed for medical student, doctors and healthcare professionals. This app solves over 50 real clinical cases and provides 250 high-quality images. “Ultrasound A2Z” provides very limited information about neonatal cranium. “NeoHead” is paid app in apple play store which provides interactive information on neurosonography. “iSonographer Ultimate Atlas” is a useful paid app which comprehensively covers reference ultrasound measurements of vascular and general ultrasound including echocardiography and USG of neonatal brain. Other apps useful for neonatal imaging includes “Radiology,” “Pediatric Radiology,” “Pediatric XR,” “Pediatric Ultrasound,” and “pedsMRI.”

Atlas

“Clinical Pediatrics” is an app provides information about history, examination, spot diagnosis, X-rays, and CT scan. Most of the pictures, radiological images provided are related to neonates.

Neonatology books

Oxford Handbook of Neonatology provides bedside accessible practical advice to the treating clinician, however, the cost is high around Rs.3529/-. Essential Neonatal

Table 1: List of neonatology apps available on payment.

S. No.	Apps	Cost in Rs.	Uses	Remarks	Ratings (/5)
1.	Neonatology	300	Airway, intubation, emergency medications calculations, umbilical lines measurement	- Anti-seizure treatment not included - Gestation wise doses not mentioned	4.9
2.	Oxford handbook of neonatology	3529	- Bedside accessible - Delivers practical advice to the clinician	High cost (soft copy easily available)	Nil
3.	NICU Neonatal Intensive Care Unit test bank+4200 MCQ	170	Practice tests, study cards for nurses, students		Nil
4.	Neonatal Intensive Care Unit NICU	220	Practice tests, study notes, flash cards	Able to add own study notes and cards in the app	Nil
5.	NICU Neonatal Intensive Care Unit Exam Review app	170	Flash cards and study notes		Nil
6.	Phototherapy calculator	250	AAP Guidelines	Used in both micromol/L and mg/dl	3.6
7.	Phototherapy	95	NICE Guidelines	Used in both micromol/L and mg/dl	4.5
8.	Essential neonatal medicine 5 ed.	2500	Reference with calculators, high-resolution pictures	High cost	Nil
9.	Neonatal resuscitation	270	NHS Scotland	Registration must before use of the app	Nil
10.	Cranial ultrasound	60	Neonatal medical quiz app		Nil
11.	Neonatal formulary 7 ed.	5351	Drug use in pregnancy and the 1 st year of life	High cost	Nil

Medicine 5 ed. is another paid app which provides quick reference to common neonatal problems, high-resolution pictures and has calculators for drug dosages. Drugs used during pregnancy and 1st year of life are available in Neonatal Formulary which costs Rs.5351/- [Table 1]. Pediatrics and Neonatology Book is a pocket manual which delivers concise evidence-based information, albeit it is available for 1-day free trial. Neodiagnosis is useful in providing quick link to relevant sites for over 700 neonatal diagnosis. Neonatal care contains two modules for basic and advance neonatal care which opens as separate pdf documents. IMNCI 2018 ed. is based on recent IMNCI guidelines and has illustrations with videos and posters. “Neonatal care and information” application provides information about basic newborn care, however, developmental aspects are not available. Gomella’s Neonatology is an excellent pocket guide for treating common and rare neonatal problems. However, only limited content is available freely and needs upgradation for full content that costs very high.

Preparing for examinations

For nursing students and neonatal fellows, some apps help prepare for the examinations. “NICU Neonatal Intensive Care Unit Test Bank + 4200 MCQ,” “Neonatal Intensive Care Unit NICU,” and “NICU Neonatal Intensive Care Unit Exam Review App” are the paid apps and “NCA Neonatal care

Academy,” “NICU Neonatal Intensive Care Unit Test Bank Ltd.,” “CCRN Neonatal Pocket Preparation,” “Neonatal Nursing Review,” and “Neonatology Intensive Care Unit for Learning and Exam” are the free apps used for students, nurses to learn neonatology through practice tests, study notes, and flash cards.

PRODUCTIVITY APPS

Log book for trainees

“My logs” is an app which functions as a log or notebook. No internet connection is required once the app is downloaded. Entries can be categorized; files can be attached and the log entries can be viewed in a list or calendar view.

Apps related to genetic diagnosis

“Genetics 4medics” is a free version with access to 50 genetic conditions, 50 clues, and 3 chromosomes in mapping. Paid version would give access to full resources including basic genetic concepts and gene teasers. “PediaGene: AAP Genetics Guide” is a one-stop app for a wealth of genetic screening information, patient care, and quick reference. “Face2Gene” app is designated solely for health-care professionals that facilitate comprehensive and precise genetic evaluations based on the phenotype.

Table 2: List of apps available for free.

S. No.	Apps	Uses	Remarks	Ratings (/5)
1.	Neomate	Checklists, calculations based on London NTS	Deficit calculations, electrolyte imbalance not included	Nil
2.	SANTA NICU	Southern Alberta Neonatal Transport App for airway, intubation, emergency medications calculations, umbilical lines measurement	Deficit calculations, electrolyte imbalance not included	Nil
3.	Neonatology lite	Airway, intubation, emergency medications calculations, umbilical lines measurement	Limited number of results compared to the paid neonatology version	3.6
4.	Coombe neonatal guidelines	Coombe women and infants university hospital guidelines	Anti-seizure treatment protocol not available	Nil
5.	Neonatal seizures causes and management	Contains details about causes, classification, diagnosis, management, home care of seizures	Drug doses and algorithm not mentioned in treatment	Nil
6.	Pediatrics and neonatology book	Pocket manual delivers concise, evidence-based information	Only 1 day free trial	4.4
7.	Neonatal illustrations	Provides illustrations and rare pathophysiology in neonatal medicine by Dr. Satyan Lakshminrushima	Cover limited topics	5
8.	Neodiagnosis	Quick link to relevant sites for over 700 neonatal diagnoses	Does not provide direct results	4.2
9.	AIIMS WHO CC ENBC	Learners guide for bedside newborn nursing by Dr. Ashok Deorari	Though videos can be downloaded, posters not downloadable	4.5
10.	AIIMS WHO CC PTC	Preterm care by Dr. Ashok Deorari	Needs registration	4.5
11.	AIIMS WHO CC STPs	Standard Treatment Protocols		4.3
12.	HBS ECSB	Essential Newborn care by Dr. Ashok Deorari AAP/WHO CC	Covers only the essential care	5
13.	Essential newborn care App	WHO current guidelines (AAP)	Covers only the essential care	4.6
14.	NNF CPG	January 2020 NNF CPG guidelines		5
15.	NCA neonatal care academy	Neonatal care topics by NATUS	Needs registration	4.8
16.	NICU neonatal intensive care unit test bank Ltd	Practice tests, study notes, flash cards	Upgradation required for more questions otherwise only limited questions	Nil
17.	CCRN neonatal pocket preparation	Practice tests for nurses	Upgradation required for more questions otherwise only limited questions	4.3
18.	Neonatal nursing review	Nurse examination style	Upgradation required for more questions otherwise only limited questions	Nil
19.	Neonatology intensive care unit for learning and exam	Practice tests, study notes, flash cards	Upgradation required for more questions otherwise only limited questions	Nil
20.	Neoliq	Neonatal parenteral nutrition solutions	Amino acids and lipids are mixed with IV fluids. Difficult in usual settings as 50 ml syringes are used for infusions	4.7
21.	Neonatology fluid calculator	Can be used separately for individual electrolyte calculation	Difficult to calculate TPN infusions	4.6
22.	NICU calculator	Developed by Cleveland medical center	Need to enter the volume of TPN, fluids	Nil
23.	Total parenteral nutrition	Neonates/Pediatrics	Amino acids and lipids are mixed with IV fluids. Difficult in usual settings as 50 ml syringes are used for infusions	Nil
24.	Dextrose Calc	GIR and calories calculator	Not used for TPN calculation	4.9
25.	Newborn fluid therapy	Fluids and electrolytes calculation	Not used for TPN calculation	4.9

NTS: Neonatal transfer service, TPN: Total parenteral nutrition

Table 3: Miscellaneous apps.

S. No.	Apps	Uses	Remarks	Ratings (/5)
1.	NRI/eNRI	Neonatal resuscitation	NRP 7 th edition	4.7
2.	Complete ABG	Assist nurses, students for interpreting ABG		3.6
3.	NRP App	NRP 7 th edition - AAP/AHA guidelines	Illustrations with videos/poster Needs registration	4.3
4.	LIFE: Neonatal resuscitation training	Simulation training app	Limited scenarios	Nil
5.	NRP vitals	Neonate monitor simulator app; HR, Spo2, temperature, and timer	Respiratory rate not available	3.3
6.	APGAR score	Simple app for calculation of APGAR at birth		4.6
7.	Guide to NB care	Provides information about basic newborn care	Developmental aspects not available	Nil
8.	Neonatal care	Neonatal modules	Opens pdf document with two modules	4.8
9.	IMNCI 2018 ed.	Based on recent IMNCI guidelines	Illustration with videos/posters available	4
10.	Neonatal care and information	Provides information about basic newborn care	Developmental aspects not available	Nil
11.	Neonate	Canadian Neo learning resources	App is in development stage	Nil
12.	Gomella's neonatology	Pocket guide for treating common and rare neonatal problems	Only limited content available free. Upgradation needed for full content.	4.4
13.	IBM Micromedex NeoFax	Drug information, interactions, doses	Needs frequent update	4
14.	Biliapp	NICE Guidelines	Only in mmol/L	4.3
15.	Biliguru	NICE Guidelines	Both in mg/dl and mmol/L. Option of entering exact time of birth and date not available so exact hours cannot be calculated on its own	4.5
16.	Bilibaby	AAP Guidelines; Available in mmol/L and mg/dl	Only for >35 weeks GA	3.9
17.	Bilirisk	AAP guidelines; available in mmol/L and mg/dl	Only for >35 weeks GA	4.3
18.	Jaundice curve	AAP guidelines	Only for >35 weeks GA; Graph is available, exact range is not marked	3.9
19.	Neonatal indirect hyperbilirubinemia	Emory university guidelines AAP guidelines	For GA>35 weeks	4.5
20.	Newborn baby weight loss/weight gain calculator	Simple app to calculate percentage of weight loss and weight gain	Only in kg/grams	4.4
21.	Sound meter – Decibel meter and Noise meter	Measures the sound level quite accurately and save the recording	Intrusive ads, cannot measure higher decibels	4.5
22.	Noise meter	Measures the volume of sounds	Inaccuracy +/- 10 dB	4.5
23.	Peekaboo ICU Premies	App for parent of premies. Contains information about prematurity, various organ systems, milestones, growth charts, nutrition logs, discharge	Technical issues related to growth chart	3.7
24.	My NICU newborn	Parent of premies for tracking baby's progress, events, monitor feeding	No information about vaccination, growth charts, milestones	Nil
25.	Infant care	Feeding, growth, vaccination guide for parents	Does not provide information about neonatal jaundice	4.8

Apps for parents

Illustrative Neonatology by Prof. Satyan Lakshminrusimha is a free app aimed at neonatologists and parents and provides

simple illustrations which can be used to understand neonatal diseases. "Peekaboo ICU premies" is an app for parent of premies which contains information about prematurity, growth of various organ systems, milestones, growth charts,

nutrition logs, and discharge. It is an excellent app except for a small technical glitch related to growth chart. “My NICU newborn” is a free app useful for parents whose babies are admitted in NICU for tracking baby’s progress, events, and monitor feeding, however, there are no information available about vaccination, growth charts, and milestones. NICU companion helps by giving information about breathing support for babies and breastfeeding in the NICU. It helps hear stories from NICU families, see the equipment used to help babies breathe, use the feeding tracker, use the Kangaroo Care tracker. My preemie app is a pocket guide to parents of premature babies. It provides details about basics of preterm care, parenting, growth, development, feeding, equipment, complications, and management plan. In addition, it gives a diary of events, treasured moments, growth chart. “Infant care” gives information about feeding, growth, vaccination guide for parents except for neonatal jaundice. “Baby tracker – feeding, sleep and diaper” helps in tracking the feeding, sleep, and diapering for infants but the information cannot be shared which is overcome by another application, “Baby feeding tracker – newborn feeding and care” where both parents can update the information in the same profile using different devices. “Baby care week by week tips” provides limited information to the users about feeding, growth, and milestones. “Care for a newborn baby” application in android play store provides most newborn care from birth till development and available as a book format. This app could be of good help to new parents.

CONCLUSION

Various apps have come to the aid of neonatologist and trainees in emergency and bedside management of neonates. It is conceivable tele-medicine, e-medicine and mHealth will converge and smart equipment and monitors will interact with neonatal health-care providers in future.

Declaration of patient consent

Patient’s consent not required as there are no patients in this study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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