Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Public Health and Nursing

Jorge Boco Tusoy

A mHealth application as a screening tool for neonatal jaundice in Filipino neonates

Master's thesis in Master in Global Health
Supervisor: Jon Øyvind Odland
Co-supervisor: Anders Aune, Gabriela Jimenez Diaz.
Assigned Co-Investigator by GCGMH: Marivic S. Deluna
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Abstract

Background: NNJ is still considered a global health burden, with around 80% of preterm and 60% of full-term newborns most likely to develop jaundice. These cases are alarming as 10% of the affected newborn will most likely progress to high bilirubin levels, which can cause brain damage and other neurological disabilities. Data suggested that there is a need for a non-invasive and affordable screening tool for NJJ, particularly in LMIC's.

Objective: To assess the performance and accuracy of the mHealth application as a screening tool for neonatal jaundice among Filipino neonates.

Methods: Newborns ≥ 37 weeks gestation with or with clinical jaundice were included in the study. All less than 2500 grams, who had undergone phototherapy, and newborns with congenital abnormalities were excluded. Only newborn past 24 hours to 14 days of life were included. The correlation between mHealth and Kramer scale, TcB, and TSB was identified. In addition, a Bland Altman plot was performed to determine the agreement between the two tools. The accuracy of the innovation can help reduce disability cases related to neonatal jaundice. Furthermore, the sensitivity, specificity, and positive and negative predictive values were calculated for the App, TcB, and Kramer scale.

Result: Our finding revealed a positive moderate correlation between the that mHealth Application and the Kramer scale, 0.625 (95% CI 0.46-0.75, p <0.01), TcB, 0.608 (95% CI 0.43-0.74, p <0.01) and TSB 0.666 (95% CI 0.51-0.78, p <0.01). At the TSB cut off values of 200 umol/L. Sensitivity, Specificity, Positive Predictive Value(PPV), and Negative Predictive Value (NPV) of the mHealth application values shows 55.6, 90.0, 45.5 and 93.1 respectively. At 250 cut-off for TSB and mHealth application the Sensitivity and Specificity, 50.0% ,94.0% respectively.

Conclusion: Our findings revealed that the mHealth application could accurately detect neonatal jaundice by estimating the bilirubin level among Filipino neonates. It can be used as a screening tool to detect jaundice but not a confirmatory test. A high estimation result by the mHealth application signifies a blood test. Besides TSB is still the gold standard to confirm the bilirubin level of the neonates.

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The completion of the study could not be possible without Norwegian University of Science and Technology generosity and for giving me the opportunity to study on the Global Health master's program.

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I am extremely grateful to Gabriela Jimenez for giving me points on how to improve my papers and guidance throughout my clinical research in the Philippines. Your continuous undying support from the beginning to the end of the investigation was exemptional. Thank you so much.

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Abbreviations

CI	Confidence Interval
eHealth	Electronic Health
GCGMH	Governor Celestino Galleres Memorial Hospital
IBM	International Business Machine
LMIC's	Low-Middle Income Countries
M	Mean
mHealth	Mobile Health
MOA	Memorandum of Agreement
NPV	Negative Predictive Value
NNJ	Neonatal Jaundice
NVD	Natural Vaginal Delivery
OB-GYNE	Obstetrics and Gynecology
PCR	Polymerase Chain Reaction
PPV	Positive Predictive Value
Rh	Rhesus
RN	Registered Nurse
SD	Standard Deviation
SMS	Short Messages Services
SNJ	Severe Neonatal Jaundice
SPSS	Statistical Package for Social Sciences
TcB	Transcutaneous
TORCH	Toxoplasmosis, other viruses, rubella, cytomegalovirus, herpes (simplex)
TSB	Total Serum Bilirubin
WHO	World Health Organization

1. Introduction

1.1. Background

A large proportion of newborns worldwide experience neonatal jaundice (NNJ). It is a clinical condition that commonly occurs between the second or fourth day of a newborn's life. It is manifested as yellowish discoloration of the newborn's skin prominently visible on the chest and other parts of the newborn's body. The yellowish color on the newborn's oral cavity and sclera is suggested to have a high presence of bilirubin levels in the system. In most of the cases, this condition could be harmless; however, around 10% of affected newborns can progress to higher levels of bilirubin which can cause permanent brain damage[1,2]. It shows that 80% of Preterm newborns and 60% of full-term newborns developed jaundice. Small gestational age and newborns suffering from sepsis or hypoxia are at significant risk of developing jaundice[2].

It is usually benign; however, this could lead to severe neonatal jaundice(SNJ), associated with neurotoxicity and irreversible brain damage in situations characterized by higher bilirubin levels. NNJ may lead to acute and chronic bilirubin encephalopathy, kernicterus, and even death if severe hyperbilirubinemia is not detected and treated in time[3,4]. A 2020 retrospective study in China confirmed that the higher the bilirubin level in the system of the newborn, the higher the risk of possible damage to the brain/encephalopathy[5].

NNJ is considered a health burden, and its health impact has been reported to be higher in low and middle-income countries (LMICs) such as the African regions and Southeast Asia; the need for an immediate response has been highlighted because of its consequences, particularly neurodevelopmental disabilities[6]. Among children globally, neonatal jaundice is considered a silent cause of neurologic disabilities such as cerebral palsy, language difficulty, and others[7].

1.2. Risk Factors for Neonatal jaundice

Several maternal factors could contribute to neonatal jaundice, such as Rh incompatibility or blood type A,B,O, breastfeeding and drugs like diazepam and oxytocin. Maternal illness is another factor like gestational diabetes. It is also reported that ethnicity is a common factor, particularly among Native Americans, Asians, and Africans[6,8,9].

Neonatal factors include infrequent feeding and birth trauma like cephalohematoma, cutaneous bruising, and instrumented delivery. Some drugs could lead to NNJ, like sulfisoxazole acetyl

with erythromycin ethylsuccinate and chloramphenicol. At birth, excessive weight loss and infections: TORCH (Toxoplasmosis, other viruses, rubella, cytomegalovirus, herpes (simplex) viruses are other contributing factors. Race, blood type, polycythemia, and premature lung are the most common reasons newborns develop jaundice. A history of hyperbilirubinemia in the family, particularly older siblings, has been reported as a factor[6,8,9].

1.3. Global Burden of NNJ

According to Bhutani et al., [10] out of 134 million live births from 184 countries, 18 % were at risk of having NNJ-related problems, and 13% had kernicterus, resulting in more than 63,000 of them surviving with neurological disabilities. Moreover, in an evidence-based study conducted by Ip in 14 developed countries, newborns that had more than 20mg/dl developed kernicterus and were associated with a mortality rate of at least 10% and long-term morbidity of 70%[11]. In Thailand, a new effort has been implemented to prevent the further cause of neonatal jaundice. It reported that healthy newborns from 35 weeks and above have a more significant risk of developing neonatal jaundice[12]. Unfortunately, there is no said data on the prevalence of NNJ and NNJ-related mortality in the Philippines. However, data from Gov. Celestino Gallares Memorial Hospital showed that in 2017, there were 281 neonates out of 5,162 in-facility deliveries who developed neonatal jaundice[13].

1.4. Assessment tool for Neonatal Jaundice

1.4.1. Kramer scale

Before the modern technology and digital world, health care professionals utilized visual assessment tools such as the Kramer scale. This health assessment tool divides the body into five zones to identify the advancement of jaundice[14]. Each zone corresponds to a level and its range of serum bilirubin levels, respectively, as shown below.

Table 1. Visual Assessment of Kramer'smer's Scale

Area of the Body	Level	Range of Serum Bilirubin	
		umol/L	mg/dL
Head and neck	1	68 – 133	4 – 8
Upper trunk (above the umbilicus)	2	85 – 204	5 – 12
Lower trunk and thighs (below the umbilicus)	3	136 – 272	8 – 16

Arms and lower legs	4	187 – 306	11 – 18
Palms and soles	5	>306	>18

This scale shows estimates of the serum bilirubin according to the body area that shows jaundice.

Kramer scale has been recommended by the World Health Organization (WHO) to be used as a screening tool particularly in rural areas, where other methods such as measuring bilirubin are not possible. This visual assessment is vital to the primary health workers in low-resource locations. Due to the lack of measuring devices available in the low-middle income countries (LMIC), the Kramer rule is the most utilized to determine neonatal jaundice and identify the need for phototherapy in clinical investigation[15]. This technique has been used as a screening tool to identify the severity of jaundice for newbron[16]. Szabo et al.[17] reported that jaundice could be ruled out accurately using the Kramer scale if the yellowish discoloration will be just until zone 2; if jaundice reaches zone 3 to 5, a TSB is needed for a confirmatory test. Utilizing the technique in at-risk zones could overestimate or underestimate the bilirubin level[18].

1.4.2. Transcutaneous bilirubinometer

As technology advances, a method for detecting NNJ called transcutaneous bilirubinometer was developed. This is a non-invasive hand-held device which works by directing light into the skin and measuring the intensity of the wavelength of light returned[19] The measurement is taken by gently placing the light guide head of the device on the newborn's skin chest or on the forehead and pressing the start button. As this is a point-of-care device, this gives immediate results of bilirubin levels[20] and is cost-effective in the early detection of jaundice in newborn[21]. This method has been shown to be reliable according to the study of Ercan and Özgün in 2018; however, they cited in their research the high cost of the device as a disadvantage to this method[22]. However, other studies on transcutaneous bilirubinometer reported that the accuracy might be affected by gestational age, body weight, and skin color [23,24].

A study shows that a transcutaneous bilirubinometer overestimates the bilirubin level on dark skin tone and underestimates fair skin tone[25]. Bhutani et al.[26] compared the correlation between African Americans and Caucasians using the TcB with a TSB and suggested a strong association. Sanpavat et al.[27] reported that the TcB (Drager JM - 103) was found to be accurate in Thai neonates as they match the TSB result. Another study conducted by Akahira-Azuma et al.[28] in Mongolia using a TcB (Drager JM-103) showed a strong correlation with the TSB.

Neonates undergoing phototherapy are not advised to be monitored with a Kramer scale and transcutaneous bilirubinometer. Utilizing this equipment to observe the degree of jaundice could underestimate the level as it will change the bilirubin level dramatically, therefore it will affect the assessment using both TcB and Kramer scale[14].

1.4.3. Total serum bilirubin

The total serum bilirubin (TSB) is the gold standard for measuring bilirubin and is used as a confirmatory test for hyperbilirubinemia[29] . In most cases, TSB is performed if a newborn developed jaundice within 24 hours of life or after if it necessary, particulary if a visual assessment and transcutaneous results shows high[14].

There are reports that this method may affect the newborn's well-being; if the procedure is repeated, this method may inflict more pain and trauma as it involves drawing blood, leading to anemia, particularly in premature neonates[30,31]. In 2011, Lo et al.[32] found an inter-and intra-laboratory variability in TSB measurements, so monitoring newborn's bilirubin levels must be uniformly tested in the same machine in the laboratory.

1.5. mHealth

Digital technologies revolutionize how people manage their work and day-to-day living. Mobile technology is now almost universally used to channel messages, such as voice calls and short messaging services (SMS), in Africa, they smartly used the technology to improve connection to individuals and the market and improve economic development[33].

eHealth is an electronic communication tool used in health services to promote and deliver care[34]. In recent years innovators invented digital health or the eHealth, where consultation, examination, and health promotion can be done through the innovation[35]. Following the implementation, it showed increased use of eHealth and is considered a critical factor in promoting and carrying out care globally[36,37].

mHealth refers to the concept of mobile health and it is a branch of eHealth, this technology has the same function however, mHealth is the latest branch and most used. mHealth is a wireless communication tool between health care professional and the patients[38]. This is a smartphone application; it can be installed on mobiles or on any tablet and is used now to deliver care in healthcare services[39].

In 2011 WHO defined ‘’*mHealth as mobile devices to respond to and manage emergency and disaster situations such as natural disasters, disease outbreaks, and conflict’’*[40]. WHO has focused on mHealth innovation to respond to the high demand for care throughout the years. This innovation sought to increase access to safe and quality health services, reduce maternal, child and neonatal mortality, and increase global health security[41]. The WHO survey in 2011 revealed that there was a high adoption of mHealth innovation across the globe in the African region (48%), the American region(67%) and theSouth-East Asia (75%) in response to public health crises[40].

A significant advantage to mHealth is its convenience and at low cost[33]. Over the years since its inception, this type of technology has been used and tested in various health care services that range from disease prevention, mental health, chronic disease, treatment support, and disease surveillance[42]. It also enables users to continuously track and manage such data without seeing their healthcare provider and is a medium for both patients and physicians to communicate without meeting face to face[43]. A Deloitte study revealed that Physicians who used the technology responded that it improved access to care in 66%, improved patient satisfaction in 52%, and enhanced connectivity with patients and their caregivers in 45%[44].

1.6. Smartphone application as a Screening tool for NNJ

In 2014 a new mHealth application (BiliCam) tool designed to detect jaundice in newborns was investigated. It uses an embedded camera and a calibration card to estimate bilirubin. To adjust and correct the features of the images, it uses a paper-based calibration card to rectify the variances of the photos. Furthermore, the color calibration card was designed to illuminate and store the neonate's skin tone. The reliability of BiliCam was determined through TSB values of 530 newborns from different nationalities. It showed an overall correlation of 0.91; 84.6% and 100% sensitivities based on two decision rules, and specificities of 75.1% and 76.4%[45].

In early 2017, Another smartphone-based application *Biliscan* was investigated in India to assess the accuracy in estimating bilirubin levels in 35 newborns. The examination was conducted during the first seven days of life, and the images were obtained within 2 hours after blood extraction. It appears that there was a good correlation (0.60) between that Biliscan and TSB. The application concluded that it could be an alternative tool to assess NNJ.

Picterus is a mHealth application that was develop in Norway following Lyngsnes Randebrg study about in vivo spectroscopy on newborn with jaundice. She revealed that there was a high correlation between the TcB and TSB(r = 0.81 p = <0.05) and concluded that there is a promising result on assessing the bilirubin level on newborn using reflectance spectroscopy[46]. Then, a group of researchers headed by Dr. Anders Aune from the Norwegian University of Technology and Science founded Picterus.

Picterus is smartphone-based application that estimates bilirubin level on newborn, it is an advanced technology that's uses biomedical optics to estimates jaundice. The company offered a low cost and easy to use application to consumer[47].

Figure 1. Workflow of the Picterus Application

Using the Picterus application, a photograph is taken from the newborn's chest

Before the picture is taken a calibrated card is place on the newbow's chest and the colours from the calibrated cared are used to calibrate the images.

The calibrated colour are compared with the large database of colours and bilirubin pairs

The matching bilirubin estimates is presented to the relevant user.

In 2017 and 2019, picterus mHealth application to estimate bilirubin levels in neonates was investigated in Norway, This physics-based system estimates bilirubin from digital images[47] which is similar to BiliCam. The study included 342 Caucasian newborns conducted at two locations in Norway. They revealed a high correlation (0.84) between the bilirubin estimates smartphone application and the TSB. The sensitivity of the mHealth application to identify participants with severe jaundice is 100%, and the specificity is 69%[47].

In 2018, the application was validated in 166 Mexican newborns and revealed a high correlation between the estimated bilirubin levels using smartphone application and the total serum bilirubin levels was 0.87. At the TSB cut-off value of 255 umol/L and the app value of 186 and 200 umol/L, the sensitivity of Picterus was 100% and 90%, respectively, and the specificity was 79.5% 80.1%, respectively[48].

2. Statement of the Research problem:

2.1 The rationale of the study.

In recent years more incident of neonatal jaundice in a high-risk area such as Africa and South Asia has been reported. The Philippines is in Southeast Asia; though no data is recorded for neonatal jaundice, Filipino neonates are considered at high risk of developing jaundice.

The Philippines is the top exporter of nurses globally; nurses trained in the Philippines are very skilled and passionate. Filipino nurses are leaving the Philippines to find better opportunities and look for a place where their profession is valued. Health care professionals in the Philippines need reliable and inexpensive technology to help them deliver care to their patients, particularly in remote areas.

The struggle of delivering care and moving patients to another area is difficult because of the lack of infrastructure and machinery. The Philippines health care system needs to improve and focus on the workforce and technology in delivering care to be efficient and timely and prevent irreversible damage. Neonatal jaundice is one of the silent causes of neurologic disability if not timely detected. Prompt treatment is essential as it could damage the brain surface, which leads to a disability. Screening tools are inefficient, especially in remote areas in the Philippines.

The country's geographical location evidently requires non-invasive and reliable technology for its people. There is a need for an affordable, non-invasive tool to screen neonates for neonatal jaundice in the Philippines and other countries with poor resources.

Picterus is a mHealth technology that started in Trondheim, Norway. This innovation is a gamechanger in the care of neonatal jaundice due to its functionality to timely detect jaundice. The technology has been proven effective for Caucasian and Mexican neonates, so testing different skin colors is needed to verify its versatility and utilize this application for other skin colors.

As it shows from a different smartphone-based application study revealed that the mHealth application could underestimate or overestimate the levels of the bilirubin using the transcutaneous examination[14,18] and ethnicity has been reported to be a significant factor in skin bilirubin kinetics[49]. It is a concern whether other ethnic groups with darker skin and higher melanin content, like the Filipinos, would show a similar correlation between the estimated bilirubin levels using the Picterus mHealth app and the total serum bilirubin. Thus, this study was conceptualized.

2.2. Objectives

To validate the performance and accuracy of the Picterus mHealth application as a screening tool for neonatal jaundice in Filipino neonates and its correlation to transcutaneous bilirubinometer (TcB), total serum bilirubin (TSB), and Kramer scale.

2.2.1. Specific Objectives

1. Determine the correlation between the estimated levels of bilirubin detected by the Picterus mHealth application and bilirubin serum levels in Filipino neonates
2. Determine the correlation between the estimated level of bilirubin detected by the Picterus mHealth application and transcutaneous bilirubinometer results in Filipino neonates.
3. Determine the correlation between the estimated level of bilirubin detected by the Picterus mHealth application and those obtained using the visual Kramer scale in Filipino neonates.

4. Determine the sensitivity, specificity, and positive and negative predictive value between the estimated bilirubin level of the digital images, Kramer examination, and TcB.

2.3. Research Question

What is the correlation between bilirubin serum levels in a population of Filipino newborns with the estimated levels of bilirubin obtained using the new App?

2.4. Hypothesis

H1. There is a significant correlation between the estimated level of bilirubin detected by the Picterus mHealth application with the bilirubin serum level.

H0. There is no significant correlation between the estimated level of bilirubin detected by the Picterus mHealth application with the bilirubin serum level.

3. Methodology

3.1. Study design

Descriptive cross-sectional study was designed to understand the correlation between the variables. It was selected as it was appropriate to the research question.

3.2. Study setting

Department of Pediatrics, Pathology, Obstetrics, and Gynecology, newborn Screening Department at Governor Celestino Gallares Memorial Hospital (GCGMH)

3.3. Study period

The study was conducted from February 1 to February 28. Governor Celestino Gallares Memorial Hospital has an average of 600 births per month. So, the data collection was scheduled to finish in a week; however, the birth rate decreased 6 times due to the pandemic. At the end of the data collection, only 71 newborns were recruited; the two neonates were excluded due to birth anomalies.

3.4. Study Participants

Inclusion criteria

Healthy newborns, with or without jaundice, gestational age ≥ 37 weeks, age 24 hours to 14 days, and weight 2500 to 4500 grams.

Only Parents who understood the procedure and agreed to the research were included in the study and signed the informed consent. The parents have been given time to think and understand before signing the informed consent. The informed consent was discussed using the local dialect to understand the whole study fully. Their right was highlighted during the explanation of the research.

Exclusion Criteria

Newborns with life-threatening conditions or significant illness, with congenital malformation, diagnosed with inborn errors of metabolism, and jaundice newborns that have undergone phototherapy before the screening.

All parents who refused to participate were respected. There was no discussion after the parents decided not to participate, and they were reassured that there were no consequences if they refused, and all care would be rendered at the hospital.

3.5. Sample size

The sample size was calculated based on standard errors and confidence intervals described by Bland and Altman. The standard error of the 95% limit of agreement is approximately $\sqrt{s^2/n}$, where s is the standard deviation and n is the sample size. Using the standard deviation values reported in the previous study at Trondheim, and to attain a 95% confidence interval, a sample size of 150 neonates is considered appropriate for the study.

Unfortunately, due to the spread of coronavirus worldwide, more restrictions were implemented amid the study. It was even delayed for more than a year awaiting the ease of restrictions for the research to continue. Only 69 recruited have been recorded for the mentioned above at the end of the study.

3.6. Recruitment of the participants

Due to the pandemic, the recruitment process was challenging. The GCGMH was halted into the covid area and clean area. The Covid area was for patients who tested positive with polymerase chain reaction (PCR) test or patients waiting for their covid test result. A negative patient with (PCR) test from coronavirus- 19 can only be admitted to a clean area.

The mother and the newborn were required to shows a negative PCR test before they could be transferred to the clean area. In the Covid wing, if the mother had no complication during delivery or the newborn had no birth defects and had not been cleared from Covid 19 after 24 hours, the mother and the newborn were discharged and advised to isolate to their house for 14 days. Then the covid area was off limits to any non-staff members or any staff that were not on duty.

The hospital policy narrows the opportunity to recruit newborns since they can only accept patients with a referral. Individuals looking for medical attention are advised to visit their nearest health center before they can be admitted to GCGMH via a referral system.

The recruitment could only be done in the clean area, including the Pediatric Department, Obstetrics and Gynecology, and newborn Screening Department.

The recruitment was performed during the Pediatricians rounds in the morning. Prior to the rounds, the eligible newborns had been identified through the inclusion and exclusion criteria. During the rounds, the Pediatrician informed the parents about the study. After the rounds, the researcher had to go back to discuss and explain the research in detail, utilizing the local dialect and the rights of the participants. The parents were given time to think and read the informed consent and then proceeded to the other parents. If the parents agreed to sign the informed consent, a witness had to sign the document after the patient signed.

When the Pediatrician ordered a blood test from the newborn for any reason, the newborn would be evaluated through inclusion criteria; if matched, the parents would be informed to discuss the study with the researcher, then, for any reason if the father was not present on the day of the recruitment, the mother would have needed to call and ask consent from the father, only then would the mother's signature be enough. Then TSB result were included.

3.7. General data collection

When the informed consent is obtained, the researcher retrieved the neonate's demographic data, including date and time of birth, age at the time of the study, gestational age at birth and weight. This data was collected from the parent patient's chart and or neonate's immunization card.

Fitzpatrick scale was used to identify parents' skin type by comparing parents' skin with the numeral classification of skin color.

The researcher estimated the bilirubin level of the neonate through the use of a transcutaneous bilirubinometer placed on infant's chest.

The researcher obtained digital images from the neonate's skin. The infant was placed supine on the bed or held by his parents for better comfort at the treatment area. The calibration card was placed on the sternum of the infant. Using a Samsung S7 smartphone downloaded with the application, a total of 6 images, 3 with flash, and 3 without flash, will be obtained with the phone camera and uploaded wirelessly to the system for colorimetric analysis. The procedure was performed twice.

The researcher also assessed the level of jaundice by using the Kramer scale.

With the help of a pediatric resident and trained medical technologies with a laboratory request from pediatricians, 0.5 to 1-mL blood was extracted using a 26, 25, and 24 needle gauge from the newborn via venipuncture. It was within 60 minutes before or after obtaining the digital images. The blood was transported to the hospital laboratory in a red-top bottle wrapped in carbon paper to avoid light exposure and analyzed for total serum bilirubin levels by an automated chemistry analyzer (Selectra ProXL).

The Laboratory is on the same floor as the treatment room, 20 feet away from where the blood was extracted.

All the data from the study were recorded and stored in a proper format developed according to the study design.

3.8. Data Analyses

Descriptive statistics, including measures of central tendency, were used for demographic data, and the results will be presented through tables and graphs. Correlations between the different methods, i.e., TSB - app results, TcB – app results, Kramer scale- app result, were calculated by Pearson correlation coefficient. A relationship map was used to demonstrate the association of the four variables. Systematic over or underestimation of bilirubin levels was evaluated by Bland Altman analysis for TSB - app results, TcB – app results, Kramer scale- app . In addition, the sensitivity, specificity, and positive and negative predictive values will be calculated for the App, TcB, and Kramer scale. The researcher utilized Statistical Package for the Social Sciences (IBM SPSS Statistics 28).

3.9. Ethics

The research protocols have had ethical approval from the Research Ethics Committee of Gov. Celestino Gallares Memorial Hospital, the study center in Tagbilaran City, Bohol, Philippines, and the Norwegian University of Science and Technology Norway.

The researcher entered into a collaborative partnership with the Department of Pediatrics of Gov. Celestino Gallares Memorial Hospital with a memorandum of agreement (MOA).

An informed consent was obtained from the parents before data collection.

All the devices, including the transcutaneous bilirubinometer and Samsung S7 smartphone, were supplied by the researcher. The researcher shouldered the cost of the total serum bilirubin determination of the patients enrolled in the study.

4. Results

The data was gathered from 69 full-term newborn (37 weeks to 41 weeks) following the inclusion and exclusion criteria. A newborn was excluded due to a congenital deformity as reported by the Pediatrician post-physical examination 2 days after the TSB sample result. All blood samples were taken from the OB-Gyne treatment room, where all the images and other data were collected. All images from the 69 newborns were taken within 60 minutes after or before the blood extraction. Due to the covid restriction, all newborns were recruited at the

OB-Gyne ward and newborn screening on the same floor as the Laboratory. The Laboratory was 20 feet away from the treatment room.

Table 2, Outline of the Mean, standard deviation, minimum, and maximum of the variable.

Variable	Mean	Standard deviation	Minimum	Maximum
Birth weight	3104.75	301.57	2550	3890
Gestational Age in Weeks	38.58	.991	37	41
Age in Hours	53.78	58.90	24	302
TCB	181.67	51.01	37	317
Apps	162.23	48.70	43	292
TSB	146.22	45.64	35	317

The Fitzpatrick scale was obtained from both parents who were present during the day of the blood extraction. All mother's (100%) skin type was recorded; however, due to the policy covid restriction, only fathers (46%) are present due to the limit of visitors. Some of them are living and working abroad. Most of the mothers were identified as type III (65%) and the father (66) were type IV. So, the fathers are mostly darker color type of skin than the mothers.

Table 3 Fitzpatrick scale classification

Fitzpatrick scale	Father	Mother
II	0	6
III	3	45
IV	21	17
V	8	1
Missing	37	0
Total	69	69

Table 4. Degrees of jaundice estimated by the Kramer scale by the 69 newborns

Kramer Scale	Frequency	Valid Percent
0	21	30.4
1	28	40.6
2	17	24.6
3	1	1.4

4	2	2.9
5	0	0
Total	69	100

The correlation between the mHealth App and TSB among Filipino neonates was 0.666 (95% CI 0.51-0.78, p <0.01).

Table 5, The correlation between mHealth application and TSB.

Variable	Mean	SD	*R*	*p*
mHealth App	162.23	48.701	.666**	.000
TSB	146.22	45.636	.666**	.000

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation between the mHealth App and TcB among Filipino neonates was 0.608 (95% CI 0.43-0.74, p <0.01)

Table 6, The correlation between mHealth application and TcB.

Variable	Mean	SD	*r*	*p*
mHealth App	162.23	48.701	.608**	.000
TcB	181.67	51.012	.608**	.000

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation between the mHealth App and Kramer rule among Filipino neonates was 0.625 (95% CI 0.46-0.75, p <0.01). To determine the accuracy cut-off of the estimated bilirubin level using the Kramer rule, the range of its scale was added and then divided by two to get the mean. So, the mean was used to correspond to the bilirubin level present in the newborn.

Table 7, The correlation between mHealth application and Kramers Rule

Variable	Mean	SD	*r*	*p*
mHealth	162.23	48.701	.625**	.000
Kramer rule	86.83	64.911	.625**	.000

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 2. The relationship map between the mHealth apllication,Tcb, TSB and Kramer scale

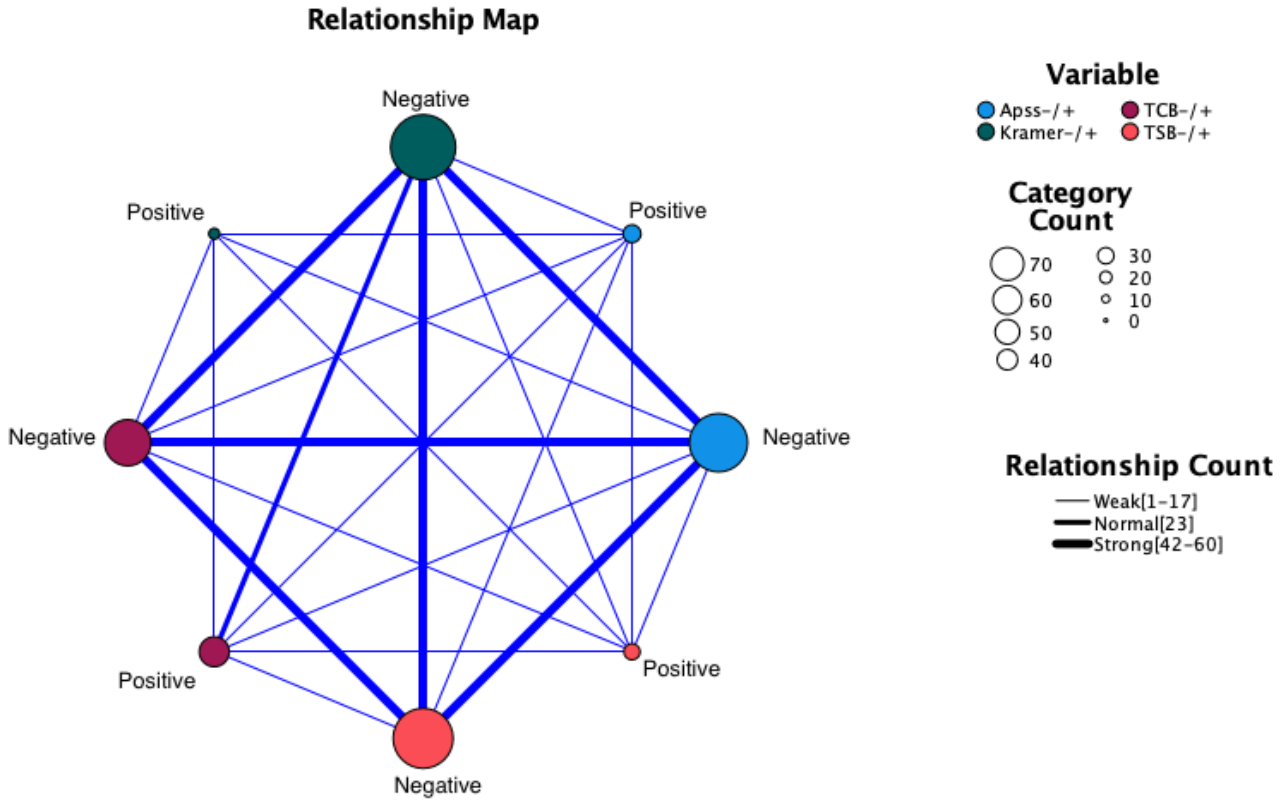

Figure 3, Correlation and Linear regression between TSB and Picterus apps

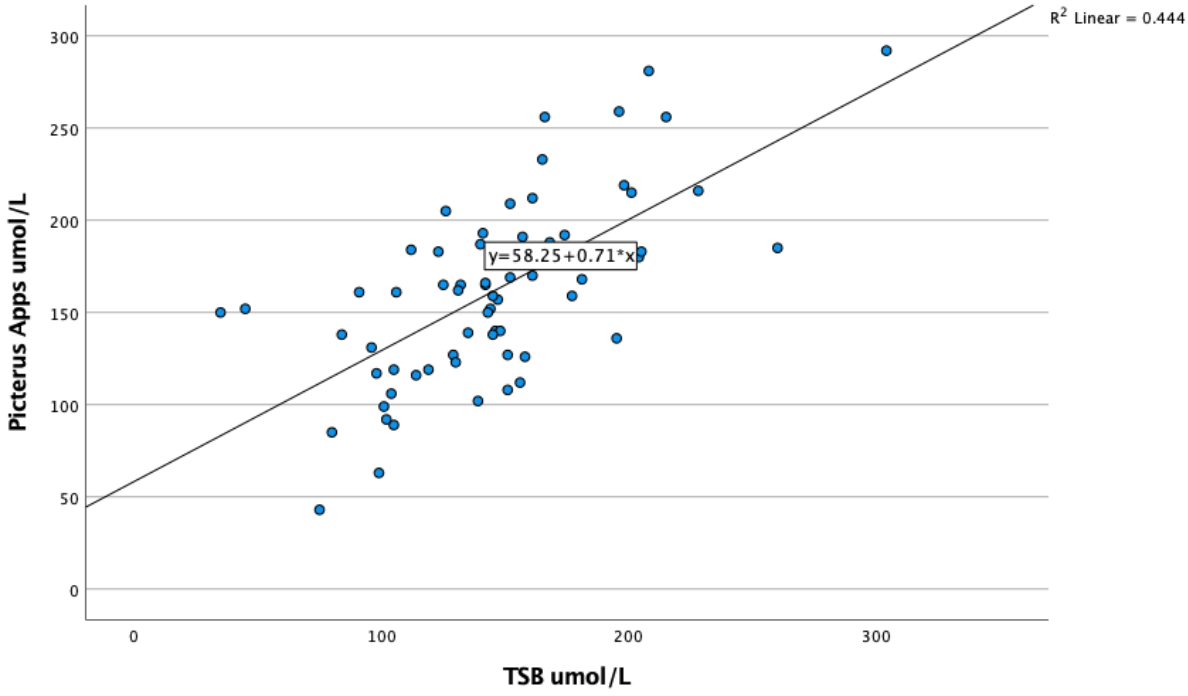

Table 8, Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) of mHealth, TcB, and Kramer Rule

Method	Sensitivity	Specificity	PPV	NPV
mHealth App	55.6	90.0	45.5	93.1
TcB	88.9	71.7	32.0	97.7
Kramer rule	33.3	100	100	90.9

The cut-off for the TSB, Kramer rule, TCB and mHealth application was 200 umol/l to be tested positive. Sensitivity, Specificity, Positive Predictive Value(PPV), and Negative Predictive Value (NPV) were calculated and are shown above. Linear regression was performed and showed the non-statistically significant result, which means no proportional bias. At 250 cut-off for TSB and mHealth application the Sensitivity and Specificity, 50.0% ,94.0% respectively

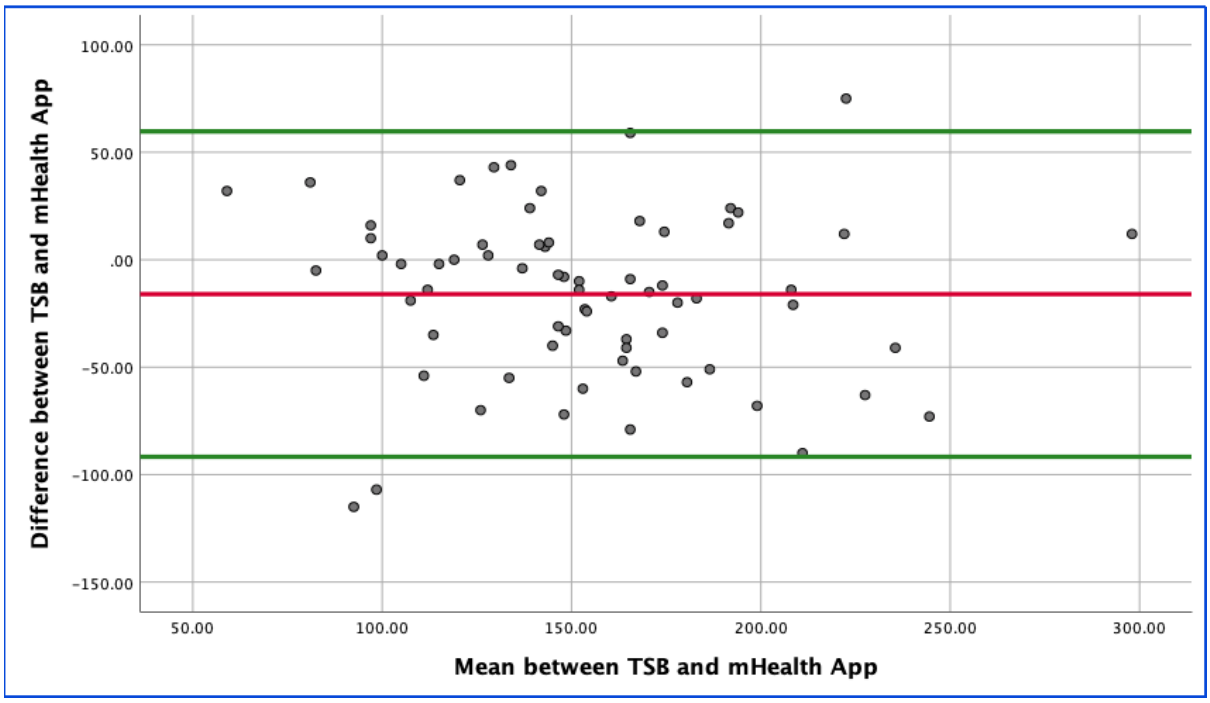

Figure 4. The Bland-Altman analysis compares the mhealth application estimates and TSB values in umol. The solid red line is the mean difference (-16.0145). The two green lines show the 95% upper (59.703) and lower (-91.732)limits of the agreement.

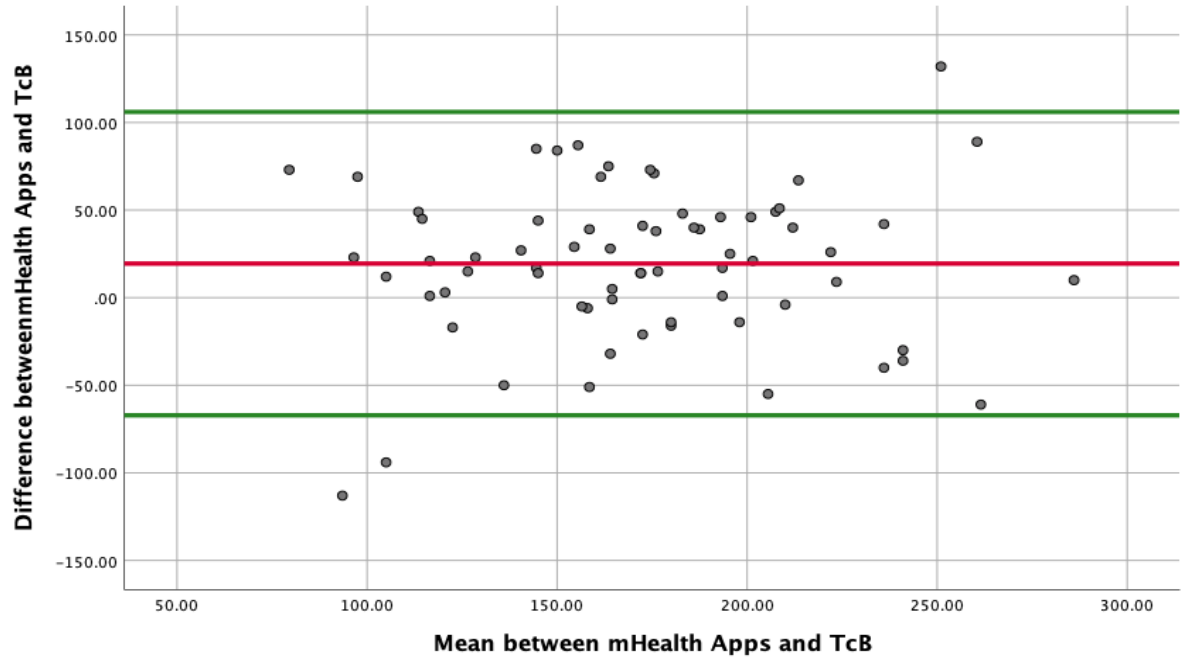

Figure 5. The Bland-Altman analysis compares the mhealth application estimates and TcB values in umol. The solid red line is the mean difference (19.4348). The two green lines show the 95% upper (106.051) and lower (-67.181)limits of the agreement.

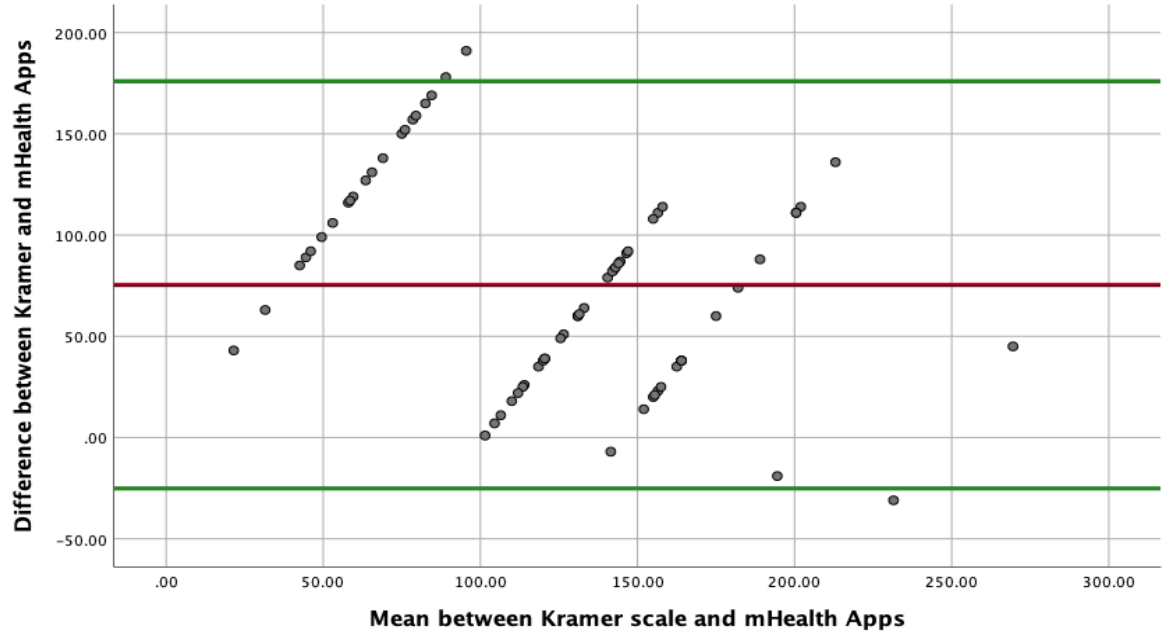

Figure 6. The Bland-Altman analysis compares the mHealth application estimates and Kramer scale values in umol. The solid red line is the mean difference (75.4058); the two green lines show the 95% upper (175.956) and lower (-35.1444)limits of the agreement.

5. General discussion:

Our finding shows that mHealth Application and the Kramer scale, 0.625 (95% CI 0.46-0.75, p <0.01), TcB, 0.608 (95% CI 0.43-0.74, p <0.01) and TSB 0.666 (95% CI 0.51-0.78, p <0.01) values among the Filipino neonates have a good correlation, therefore the null hypothesis is rejected.

All 69 newborns included in the study were thoroughly selected according to the inclusion and exclusion criteria. The data shows the average birth weight of newborns was 3104.75 grams, ranging from 2550 to 3890; all newborns are full-term (37 weeks to 41 weeks) and were 24 hours to 302 hours of life.

The common skin type for fathers is type IV and III for mothers. Enriquez-Macarayo et al. [50] agree among Filipinos; a study also reported that Fitzpatrick skin types III, IV, and V are the most common among south Asian countries[51]. The data shows mothers are lighter than fathers. There are several factors why women are lighter than men; most men are exposed to the sun due to their work as the primary industry. In Bohol this is agriculture, and for decades, Bohol used a carabao/wet-rice agricultural system[52], where farmers have more prolonged exposure to the sunlight because of manual labor. There is a booming skin whitening industry in the Philippines; most women use a whitening product which leads them to have lighter skin than men[53,54]. Culturally, having white or light skin means beauty in the Philippines, and most men are attracted to women with light skin[55]. The use of whitening products is not new in the beauty industry; it's even popular in other countries such as India, Indonesia, and other Asian countries since having light skin signifies high class in the society and beauty[56]. The newborn's skin was assuming the skin type of the parents through the Fitzpatrick scale.

Although the data are limited due to the pandemic, The data suggest a good significant correlation between mHealth (M = 162.23 SD = 48.701) and TSB (M = 146.22 SD = 45.636) (shown in table 5). The Pearson *r* data analysis revealed a moderate positive correlation of 0.666 (95% CI 0.51-0.78, p <0.01). Bland-Altman analysis showed the mean difference -16.0145 and the 95% limit agreement is upper (59.703 umol/L) and lower (-91.732umol/L) (shown in Figure 4), It shows a marginally wider limit of agreement, however it still demonstrates a good level of limit of agreement. The investigation in Norway about the mHealth application observed a strong correlation with TSB[47] which is associated to our study among Filipino neonates.

Most newborn tested with high bilirubin level through the mHealth application was parallel to the TSB method. The study finds a good correlation and consistency values of the mHealth App with the TSB values. The gold standard to determine the bilirubin level in clinical jaundice is TSB[57]. However, the TSB method may cause pain-stress, impacting newborns' growth and development postnatal[58,59]. TSB should be the confirmatory test only, and a screening test is the first line of test. A non-invasive and affordable screening tool is significantly needed to avoid trauma and neurodevelopment effects on newborns in LMIC's like in the Philippines.

Using the mHeath (M = 162.23 SD = 48.701) and TcB (M = 181.67 SD = 51.012), it shows a good correlation between the two methods (shown in table 6). The Pearson *r* data analysis revealed a moderate positive correlation of 0.608 (95% CI 0.43-0.74, p <0.01). Both methods can be used to identify newborns who have jaundice. The Bland-Altman analysis mean difference 19.43 between the two measures of µmol/L with broad limits of agreement (-67.18 - 106.05 µmol/L) (shown in figure 5)thought it shows a wider result the application can still be use as a screening tool for NNJ. Several studies proved that TcB provides accurate estimation, so it can be used as a screening tool to assess bilirubin level[60,61], which is the same in the study; however, some of the values were higher than the TSB values. A study revealed that TcB sometimes overestimated the bilirubin level; however, it is still reliable to screen jaundice[60,62]. Another study in Canada; TcB overestimates the bilirubin level among darker skincolor[25].

The relationship between mHealth (M = 162.23 SD = 48.701) and Kramer Scale (M = 86.83 SD = 64.911) resulted a good correlation (shown in table 7). The Pearson r data analysis revealed a moderate positive result of 0.625 (95% CI 0.46-0.75, p <0.01), The Bland-Altman analysis mean difference 75.41 between the two measures of µmol/L with broad limits of agreement (-35.14- 175.96 µmol/L)(shown in figure 6). Among the four tools the Kramer scale has the wider limits of agreement. These two methods are reliable for screening jaundice. Our study findings show that the Kramer scale underestimated the TSB value. A study in India has the same result in which the Kramer scale underestimated the TSB level of the newborn[63]. Most LMICs use the Kramer scale to measure the bilirubin level of newborns. In 2009, Keren et al.[15] reported that the Kramer scale inaccurately estimates the levels of hyperbilirubinemia, requiring treatment such as phototherapy. Furthermore, a study focusing on Indonesian infants found that the Kramer scale underestimated jaundice in darker skin[64].

There is a strong relationship count shown between the Kramer scale, TSB, TcB and the mHealth application, particularly newborns that was tested Negative, and a weaker relationship count that was tested positive (Figure 2).

At TSB cut off values 200 umol/L, mHealth sensitivity, specificity PPV and NPV values shows 55.6, 90.0 45.5 and 93.1 respectively (shown in table 8). The mHealth application identify 55.6 % of the sample that actually have NNJ and 90.0% of the sample do not have NNJ were correctly identify using the application. There is 45.5 % is the likelihood have NNJ when tested positive and 93.1 % is the likelihood of not having NNJ when test is negative. At 250 cut-off for TSB and mHealth application the Sensitivity and Specificity, 50.0% ,94.0% respectively.

This is the first study in the Philippines that focuses on neonatal jaundice using an innovative technology which is a smartphone application to measure bilirubin levels in newborns. Though this technology is relatively new, a good result with high correlation between the mHealth and TSB has been shown in Norway[47] and Mexico[48]. A similar smartphone application was trialed in China called BiliScan also revealed a promising result[65].

The technology is promising as it is non-invasive and affordable, which LMIC's can use[47]. TcB has been used in many countries worldwide; however, because of its staggering price, LMIC's cannot afford it. The Philippines tertiary hospital doesn't have a TcB because of its lack of resources and budget. So, this innovation can fill the gap as a screening tool, not just in the Philippines but also in other developing countries.

6. Limitation of the study

The study was conducted amid the pandemic. So, the study location provided a policy to restrict patients, hospital staff, and visitor movement inside the hospitals. The policy states that only referred patients from the province can be admitted to the hospital. From the pandemic's start, the hospital was divided into two areas the Clean and the Covid wing. Patients who are not cleared from Covid cannot be admitted to the clean area; following this rule, and most patients must stay in the covid area until cleared from Covid-19, then transferred to the clean area with their clearance. The Hospital policy: Mothers had a natural vaginal delivery (NVD) without complication for both mothers and newborns. The two can be discharged after 24 hours of delivery. Due to this, we have few respondents since part of our inclusion criteria is only 24 hours to 14days old newborns. Then most newborns are either at the covid wing or home since

they are discharged following the 24 hours rule. 24 hours after delivery, some mothers who were not clear with covid- 19 were sent home with their newborns from the covid wing, especially if they were well and had no virus symptoms since they could not stay longer at the hospital to avoid contamination and infection. Only cleared Covid-19 patient was recruited for the study. The Population target was not reached because of restrictions at the hospital and the study period was just a month.

Aside from not reaching the population target, most fathers were absent due to work and restriction policy, so some fathers' skin type using the Fitzpatrick scale was not recorded.

All recruited newborns are 24 hours to 14 days old, as the first 24 hours of bilirubin level are usually normal; however, these ages could affect the reliability of the application.

Another limitation is the researcher (Masters Student) had no prior experience using the Kramer scale, TcB, and the mHelath App in an actual newborn. However, training was provided using a dummy before departure to the Philippines. There is a possible misclassification of jaundice using the Kramer scale; however, during the study, a second opinion on the zone classification was confirmed by the Pediatrician or Health care professional during the classification.

7. Strengths of the Study

The Philippines has more than 120 to 187 dialects spoken, and English is the second language among Filipinos, but the researcher is a native Boholanos, so communication with the hospital staff, patients, and population was not an issue. Aside from being native the researcher is a registered nurse (RN) in the country. He is a vast knowledge of Physical examination.

All the examination was performed in the treatment room at the OB-GYNE ward. So, the lighting of the room was the same every investigation.

The blood was taken within 60 mins after or before images of the newborn were taken so that the TSB level would be parallel to the mhealth application. The Laboratory was 20 feet away from the treatment room, so there was no delay in sending the blood sample. The blood test was homogenous because it was examined on the same machine and Laboratory at the hospital.

The images were obtained using the same version of mHealth application by the researcher at the same place in the ward and lighting,

To identify the zone classification using a Kramer scale, the researcher as a second opinion to the Pediatrician or the Health care professional present at the location of the study.

Finally, GCGMH is a regional hospital, and it's open to all. It can cater to a wide range of populations, and it does not matter your tribe, social and economic status.

8. Implication

The study will be able to acknowledge the reliability of the application. However, the application has been tested on different skin types, such as Caucasian and Latino skin. This study in the Philippines could prove that the technology is versatile enough to screen a variety of skin colors in the future. The study shows significant potential in South Asian skin to be reliable.

This technology can fill the gap in newborn care; at the same time, it will address the lack of tools in newborn assessment, particularly jaundice in LMIC's. This tool is very suitable in LMIC's because of its feature and easy-to-use application. Besides is a friendly-user app. Its potential to be used as a screening tool is very significant. Suppose this innovation is out on the market. In that case, healthcare professionals will be able to promptly assess or screen the neonates and detect any bilirubin level in just a few seconds without inflicting pain on the newborn. This mHealth application can be used anywhere in the country as long as there is internet access. Nurses, Midwives, Doctors, and other healthcare professionals in the corner of the world can utilize the technology anytime if needed.

This innovation can be used in any care setting in the Philippines or any other country. Utilizing this application could help reduce newborns' neurodevelopmental effects and other disabilities caused by high bilirubin levels.

9. Conclusion

Our finding revealed that the mHealth application could accurately detect neonatal jaundice by estimating the bilirubin level among Filipino neonates. It can be used as a screening tool to detect jaundice but not a confirmatory test. A high result of estimation by the mHealth

application signifies a blood test. Besides, TSB is still the gold standard to confirm the bilirubin level of the neonates.

10. Recommendation

The mHealth application showed a good result in the study however this technology requires further investigation into more respondents to increase its validity of the technology. We do recommend testing the application to other skin type in Asia and other countries.

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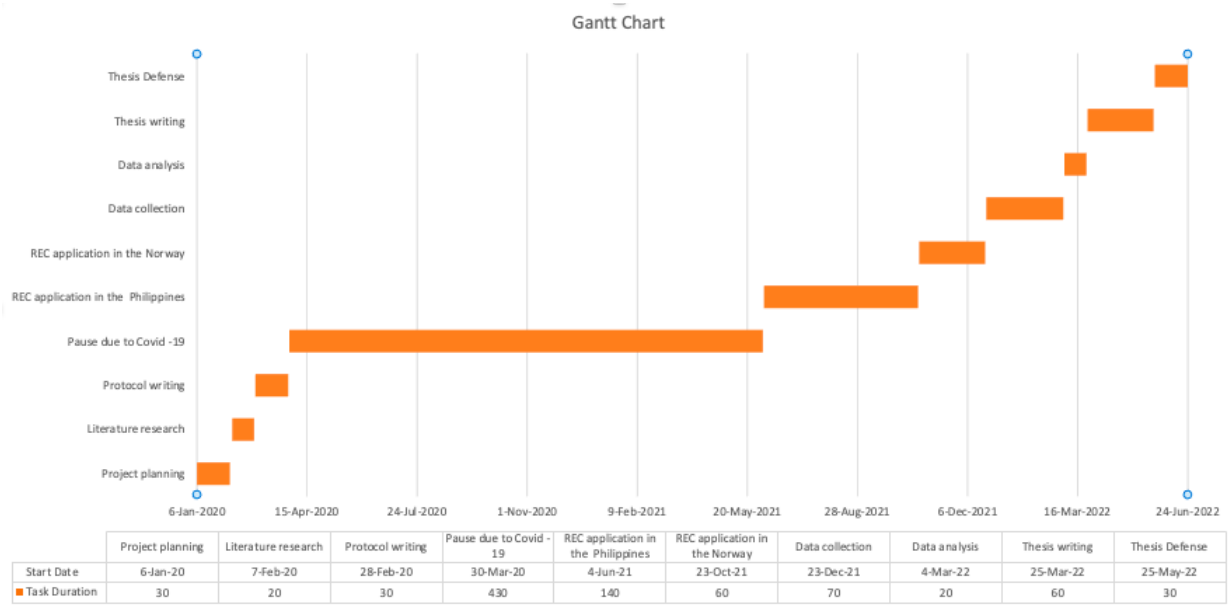
12. Appendix

Budget

Items	Reimburstment	Reimburstment in NOK
Flight ticket Trondheim -> <- Philippines	17,588 NOK	17,588 NOK
Accommodation and transportation the Philippines for 1 months and one week quarantine hotel for Covid-19 requirement.	27,700 PHP	4.625.90 NOK
Stationary	1232.25 PHP	205.78 NOK
TSB test	17,700 PHP	2,955.90 NOK
REC fee (Philippines)	3,000 pesos	501 NOK
PCR test	2,500 NOk	2,500 NOK
Travel Insurance	159.84 GBP	1815.78 NOK
	Total	30,237.36 NOK



	Project planning	Literature research	Protocol writing	Pause due to Covid - 19	REC application in the Philippines	REC application in the Norway	Data collection	Data analysis	Thesis writing	Thesis Defense
Start Date	6-Jan-20	7-Feb-20	28-Feb-20	30-Mar-20	4-Jun-21	23-Oct-21	23-Dec-21	4-Mar-22	25-Mar-22	25-May-22
Task Duration	30	20	30	430	140	60	70	20	60	30

INFORMED CONSENT

Jorge Tusoy
Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Public Health and Nursing
Master's Thesis

Introduction

My name is Jorge, a registered nurse, and a master student from the Norwegian University of Science and Technology in Norway. I'm researching a new smartphone-based screening tool that will detect the bilirubin level of your newborn. as parents. I'm inviting you to participate in this research to let your child participate in a research project where there is a new method for detecting neonatal jaundice. We have developed a prototype smartphone application (app), where we use the camera in the smartphone to assess the degree of jaundice. I'm going to give you information about this research. You don't have to decide today whether you will participate or not in the study. Please read and talk to anyone you feel comfortable with before deciding on this research.

I will go through all information about the research and take the time to explain the subject. There may be a confusing part; please do not hesitate to ask for clarification.

Background

Jaundice is a condition where the levels of a compound called bilirubin are elevated. Jaundice is common among newborns and is in most cases self-limiting and harmless. However, when severe and unrecognized it can be fatal or cause serious brain injury.
Traditionally, the measurement of bilirubin is done by blood samples. As the skin of a newborn with jaundice turns yellow, optical devices that measure jaundice through assessment of skin color have been developed. In many parts of the world, access to blood sample analysis is scarce. In addition, the optical devices available today are expensive and not affordable for many hospitals. This results in the need for low-cost, reliable and easy-to-use screening tools that can identify newborns with jaundice. The distribution of smartphones is increasing in all parts of the world. We want to develop an application that is a cheap and reliable tool that could have the potential to save tens of thousands of lives and reduce the number of children with disabilities. I am happy to answer any question regarding the study.

Purpose of the Study

We are inviting parents with their newborn to participate in the study. To understand and test the reliability of the smartphone application as a screening tool to determine the bilirubin level of the neonates. If the application proves reliable in detecting jaundice to neonates, this could help around the world, and it will be a low cost in detecting jaundice.

Type of Research Intervention

This research involves a single blood extraction to the newborn and six times snap of the newborn's body using the smartphone-based screening tool. Kramer rule assessment will be used as a visual examination of the infant.

Participants Selection

We are inviting parents together with their neonates at Governor Celestino Galleres Memorial Hospital and patients at the Out-patient Department to participate in the study using the new smartphone App in detecting neonatal jaundice.

Inclusion criteria:

- Healthy newborns with or without signs of jaundice
- Gestational age ≥ 37 weeks
- Age 1 – 14 days
- Weight ≥ 2500 g to 4500 g
- Absence of congenital malformations

Participation is Voluntary

Participating in this study is voluntary and will involve a single blood extraction, (blood extractions are not part of standard care for your newborn whilst they are at the hospital, however, they are part of this study). If there is a blood test ordered from the physician for a routine check, there is no need for another blood extraction, the TSB level will be included on the test. If you wish not to participate, your decision will have no consequences for the further treatment and care for your child at Governor Celestino Galleres Memorial Hospital.

Procedure and Protocol

To make sure that the mobile app is reliable, we need to test it on newborns with various degrees of jaundice and other criteria. A healthy newborn with or without signs of jaundice. A neonate age 1 -14 days, the gestational age ≥37 weeks, Weight ≥ 2500 g to 4500 g and with absence of congenital malformations.

1. The researcher will obtain digital images of the neonate's skin. The infant will be placed supine on the bed or held by his parents for better comfort. The calibration card

will be placed on the sternum of the infant. Using a Samsung S7 smartphone downloaded with the application, a total of 6 images, 3 of which are with flash, and 3 without flash, will be obtained with the phone camera and uploaded wirelessly to the system for colorimetric analysis.

2. The researcher will also assess for the presence and/or level of jaundice by using the Kramer scale.
3. The researcher will also estimate the bilirubin level of the neonate through the use of a transcutaneous bilirubinometer placed on the infant's chest
4. With the help of a pediatric resident, a 1-mL blood will be extracted from the infant within 60 minutes before or after obtaining the digital images. This blood will be transported to the hospital laboratory in a red-top bottle wrapped in carbon paper to avoid light exposure and analyzed for total serum bilirubin levels by automated chemistry
5. Fitzpatrick scale will be used to identify the parents skin type with numerical classification of skin.
6. In addition, to identify the newborns skin type a spectrophotometer will be used by placing it on the baby's chest. The researcher will click the button three times to get three samples.

Risk

Participating in this research shows no risk however a result from the venipuncture may occur—for example, redness of the injection site or a temporary swelling around the injection site.

Study Related Injuries

If an injury occurs from the procedure performed from the study or infections and other conditions that could be directly traced to the participation in this study happen to your child, all costs related to treatment will be covered by the project. Please don't hesitate to call one of the following:

- Jorge Tusoy RN
  - email: jorgebtu@stud.ntnu.no
  - Phone no:+447700358505
  - Local no: 09507042434

- Dr. Jon Øyvind Odland MD, PhD
    - email: jon.o.odland@ntnu.no
- Dr. Valeria S. Sulatra MD, MPH, CSEE
    - email: gcgmhirb@gmail.com
    - Phone no: (038) 411-4868 loc. 282

Confidentiality

The picture of your newborn's skin will be stored together with the results of the blood test and the optical skin test for jaundice. In addition, we will collect and store information about your child including age, birthweight, and due date. As different levels of skin pigmentation could influence the result of our analysis, we also want to include the ethnicity of the parents in our study. Your child will be given an identification number in the study, and it will not be possible to identify your child in the data set. All information will be stored on secure computers.

Benefits

Your participation to study will help to determine if the smartphone app is reliable on detecting neonatal jaundice and we will be able to improve the application using the data. If the application is in the market, the masses will benefit from the device, especially in low-income countries that are expensive to determine the bilirubin level of the neonates. Using this device community health care workers will be able to monitor and detect the early signs of jaundice. Other benefits of participating in the study is if the neonate shows a high bilirubin level after the test the project will help if possible.

Right to Refuse or withdraw

You do not have to take part in this research if you do not wish to do so and refusing to participate will not affect your treatment at Gov. Celestino Galleres Memorial hospital in any way. You will still have all the benefits that you would otherwise have at this hospital. You may stop participating in the research at any time that you wish without losing any of your rights as a patient here. Your treatment at this hospital will not be affected in any way

Who to Contact

The data and images will be collected by Jorge Tusoy, master student of Global Health . The study's main supervisor is Jon Øyvind Odland MD, PhD (specialist in obstetrics and gynecology) and Professor of Global Health at the Department of Public Health and Nursing

in Norwegian University of Science and Technology in Trondheim. If you have questions, or would like to withdraw your child from this study, you can contact:

- Jorge Tusoy RN
  - email: jorgebtu@stud.ntnu.no
  - Phone no:+447700358505
  - Local no: 09507042434
- Dr. Jon Øyvind Odland MD, PhD
  - email: jon.o.odland@ntnu.no
- Dr. Valeria S. Sulatra MD, MPH, CSEE
  - email: gcgmhirb@gmail.com
  - Phone no: (038) 411-4868 loc. 282

What happens with the analysis and information?

The information that is collected will only be used as stated above. We want to publish the results of this study in a scientific journal. It will not be possible to identify your child in this published document.

CERTIFICATE OF CONSENT

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked to have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research and I allow my child to participate in this research project.

Print Name of Participant: _____

Signature of Participant: _____

Date:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness_____ Thumb print of participant/parents

Signature of witness _____

Date:

STATEMENT BY THE RESEARCHER OR PERSON TAKING CONSENT

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1.

2.

3.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the permission has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Print Name of Researcher or person taking the consent _____

Signature of Researcher or person taking the consent _____

Date:

INFORMED CONSENT FORM PARA SA MGA GINIKANAN

Jorge Tusoy
Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Public Health and Nursing
Master's Thesis

Pasiuna/ Introduction

Ako si Jorge Boco Tusoy, nakahuman ug usa ka kursong nursing diri sa atong probinsya sa Bohol. Nagpadayon ako sa pagpalapad o master sa akong kurso sa Norway.

Sa pagtungha nako sa unibersidad na diskubre namo ang usa ka himan o butang na mao ang cellphone application(app) nga gamit sa camera makita na dayon kung unsa na ang kataas sa bilirubin sa nag yellow na bag-ong himugso nga bata. Sa mga ginikanan naghangyo ko sa inyong suporta ug kooperasyon sa pagpalambo niini. Kung dili pa maka desisyon nga mu apil or dili karon adlaw kami musabot. Palihog ug basa ug gusto mu makig istorya sa uban before mu mudesisyon pwedi kini,

Ako maghatag ug impormasyon kabahin niini ug andam ko makigstorya o mutubag sa inyong mga pangutana mahitungud niini.

Bakground/Background

Ang jaundice usa ka kondisyon sa bata nga ang level of a compound nga gitawag ug bilirubin taas. Kini kasagaran makita sa bag- ong himugso nga bata, ang uban maayo ra bisag walay tambal o dili kaayo dilikado. Pero, kung grabe na ang sitwasyon unya gibaliwala lng sa usa ka ginikan makahimo kini ug grabeng kadaot sa utok o pagkamatay sa bata. Sa unang panahon ang gigamit sa pagsukod sa bilirubin ang pagkuha sa dugo sa bata o blood samples. Apan sa kasayuran sa tanan ang pagkuha ug blood sample para mabasa ang resulta taas ang proseso ug nanginahanglan ug dakong kantidad .Busa ako naningkamot nga magamit kini nga himan o butang na barato, kasaligan, ug sayon ra kaayo gamiton sa pag- sukod sa bilirubin sa bag-ong himogso na bata. Ang tanan tawo nigamit na ug cellphone karon. Mao kini ang akong

usa ka dakong tumong sa pagpalambo sa usa ka application (app) nga barato, kasaligan nga himan nga muluwas sa libo- libong kinabuhi.

Ako maghatag ug impormasyon kabahin niini ug andam ko makigstorya o mutubag sa inyong mga pangutana mahitungud niini.

Katuyuan sa Pagresearch /Purpose of the Research

Amung gini imbitar ang mga ginikanan ug ilang mga bag-ong panganak na bata sa pag apil sa mga study para mahibal an kung kasaligan ba ang smartphone application sa pag test kung taas ang bilirubin level sa bata. Kay kung kini kasaligan dili na magbayad ug mahal ug dali na ang pagkahibalo kung kinahanglan ang bata ug tambal(treatment).

Mga Gipangbuhat sa Pagresearch / Type of Research Intervention

Ang study magkuha ug dugo sa bata pinaagi sa ugot sa bag-oo nga himogso. Muhuka ug Unom ka litrato dughan sa bata pinaagi sa celphone. Mugamit usab ug Kramer scale para magexamina ang panit sa bata kini pagabuhat pinaagi sa mata.

Pagpili Sa Mga Partisipanti / Participant Selection

Kami naghatag ug imbitasyon sa tanan inahan ug ilang bag-ong himogsong anak nga naa sa Gov. Celestino Galleres Memorial hospitalug mga pasyient na nag visita sa outpatient department sa pag apil sa pag gamit sa bag- ong himan pinaagi sa smartphone- based screening technology.

Kung ang iyung anak:

- Himsog naa may jaundice or wala pwede mu apil
- Edad 1 ka adlaw hangtod 14 ka adlaw
- ≥ 37 weeks og pataas gipanganak
- Timbal ≥ 2500 g hangtod 4500 g
- Walay sakit sa pagpanganak

Boluntaryo Ang Pag Apil / Voluntary Participation

Inyong kabubut-on ang pag apil niining pagtulun-an, labina nga magakuha kami ka-isa ug dugo sa bata (ang pagkuha sa dugo dili kini apil sa naandan nga pag-atiman sa bata diri sa hospital, pero kini apil sa niining pagtulun-an). Kung naa nay order para sa blood test, dili na mukuha og utro, iapil nasa ang test. Kung dili mo moapil, dili kini makaapekto sa pagpatambal sa inyong bata sa Gov. Celestino Galleres Memorial Hospital.

Pamaagi Og Protokol/ Procedures and Protocol

Aron makasiguro sa mobile app nga kasaligan, kinahanglan nga magamit kini sa mga bag ong himug-so na bata nga naay kalain- laing degree sa jaundice, pwede ug walay jaundince pwedi sad kung nay jaundice, ages 1 to 14 ka adlaw, gipanganak ≥ 37 weeks ug pataas, human nagatimbang ug ≥ 2500 g - 4500 g og wala sakit sa pag panganak.

1. Pagkuha sa litrato, ang bata nakabutang sa plat nga posisyon sa higdaanan or gikubtan sa ginikanan para comfortably ang bata. Ibutang a calibration nga kard sa dughan sa walay sinina nga bata duol sa sternum. Gamit ang sumsung S7 nga cellphone mukuha ug 6 ka litrato, 3 ka nay flash ug 3 ang walay flash, human kini iupload sa system human ang colormetric mu basa sa resulta.
2. Mugamit usab ug "Kramer rule kini ginabuhat pamaagi sa mata human icompara kini sa usa ka sukaranan(Kramer scale) para mahibal an kung adunay jaundice ang bata
3. Transcutaneous bilirubinometer gamiton para mahibal an kung pila ang bilirubin level sa bata. Ang tumoy sa himan ibutang sa chest unya tuplokon ang start button para mubasa ang human kung pila ang level sa bilirubin.
4. Tabang sa isa ka pambata nga doctor. Ang doctor, nurse or MedTech mukuha og dugo 1.0 ml pinaagi sa ugat or kanyula para masukod ang TSB. Ang dugo dapat dal on sa laboratory human sa pagkuha, ang sudlanan sa dugo nakabalot oh carbon na paper para dili ma hayagan sa adlaw or suga. Kini e analisar sa laborator sa hospital.
5. Mugamit usab ug Fitzpatrick scale para mahibal an klase sa panit sa ginikanan pinaagi sa compara sa Fitzpatrick scale.
6. Dugang pa, aron mailhan ang tipo sa panit sa bag-ong natawo usa ka spectrophotometer ang gamiton pinaagi sa pagbutang niini sa dughan sa bata. Ang i-klik sa researcher ang pindotanan tulo ka beses aron makakuha og tulo ka mga sample.

Peligro / Risk

Ang pag apil niini nagpakita walay peligro pero naay ubos na epekto- pananglitan, mapula ang gitusukan sa dagom o muburot gamay pero kini normal kay naa mai ginatusuk.

Epekto sa Research / Study Related Injuries

Kung naa man gani epecto or injury ang bata tungod sa study, andam ang proyecto nga mutabang sa pamilya. Kung ang bata mag ka inpeksyon tungod sa gibuhat sa study, ang Proyecto andam mutabang sa pamilya. Ang pamilya kinahanglan mu contact dayon nila (sa ubos) aron ang angay nga aksyon mahimo.

- Jorge Tusoy RN

    - email: jorgebtu@stud.ntnu.no
    - Phone no:+447700358505
    - Local no: 09507042434
- Dr. Jon Øyvind Odland MD, PhD
    - email: jon.o.odland@ntnu.no
- Dr. Valeria S. Sulatra MD, MPH, CSEE
    - email: gcgmhirb@gmail.com
    - Phone no: (038) 411-4868 loc. 282

Kumpidensyalidad / Confidentialty

Ang nakuha nga mga impormasyon sama sa litrato sa panit sa inyong bata ug ang resulta sa blood test itago o ibutang kini sa maayong siguridad. Uban niini mukuha usab kami ug impormasyon sa bata sama sa edad,adlaw nga paabot sa pag anak, timbang sa paghimugso sa bata. Tungod sa kalain- lain ang kolor sa panit amo usab iapil pagkuha ang kagikan sa ginikanan. . Ang inyung anak tagaan ug numero tas dili na kini mahibal an kay numero nalang ang naka butang sa amung datos. Human tanang inpormasyon ibutang sa isa ka kompyuter na kami lang ang maka open.

Benepisyo / Benefits

Ang inyung partisipasyon makatabang sa pag lambo sa project or the smartphone app kay ug kini ma human unya maibutang na sa merkado daghan ang maka benepisyo labi sa mga pamilya ug lugar na walay himan para dali ra mahibal an kung kinahanglan na tagaan ug tabal ang bata kay taas na kaayo ug bilirubin level. Gamit niini produkto mamonitor na ninyo ang bilirubin level sa bata sa balay or sa community health center. Sa pag apil niining kalihukan, Isa sa benipesyo kon adunay jaundice ang bata sa panahon sa pagapil niining kalihukan or nadiskubrehan nga taas ang jaundice level sa bata kami andam nga mutabang.

Katungod Sa Pag-Atras/ Rigth To Refuse Or Withdraw

Dili pugsanay sa pag apil niining kalihukan, ug ikaw mubalibad dili kini makaapekto sa pagpatambal dinhi sa Gov. Celestino Galleres Memorial hospital. Palihug ug contaka ang nagpasimuno sa study, mao kini ang naka lista sa ubos.

Kinsay Dapat Kontackon/ Who To Contact

Sa pagkuha sa mga litrato pagabuhaton kini ni Jorge Tusoy, master student of Global Health. Ang study's supervisor si Jon Øyvind Odland MD, PhD (specialist in obstetrics and gynaecology) and Professor of Global Health at the Department of Public Health and Nursing at Norwegian University of Science and Technology in Trondheim.

Kung naam oy mga pangutana or gusto mu withdraw sa study, Palihog contact nila:

- Jorge Tusoy RN
    - email: jorgebtu@stud.ntnu.no
    - Phone no:+447700358505
    - Local no:09507042434
- Dr. Jon Øyvind Odland MD, PhD
    - email: jon.o.odland@ntnu.no
- Dr. Valeria S. Sulatra MD, MPH, CSEE
    - email: gcgmhirb@gmail.com
    - Phone no: (038) 411-4868 loc. 282

Unsay mahitabu sa pa-analysa ug sa impormasyon?

Ang mga impormasyong nakuha gamiton lang kini niining pagtulun an nga gihimo.Tungod kay gusto namo na magamit kini nga himan o butang nga kasaligan sa gamit pang medikal.

CERTIFICATE SA PAGHATAG UG CONSENT

CERTIFICATE OF CONSENT

Ako nakasabot ug maayo sa mga impormasyon sa taas nga akong gibasa. Naa ako'y katungod sa pagpangutana labina kung nay gikalibugan bahin sa kalihukan..Ako niuyon sa pag apil isip usa ka partisipante aning pagtulun-an ug nagtugot ako sa akong anak sa pag apil usab niining pagtulun-an.

Ngalan sa Partisipante : _____

Pirma sa partisipante: _____

Petsa:

Ako nakasaksi sa maayong pagbasa ug pagsabot sa consent form sa mga partisipante ug ang matag usa gitugutan sa pagpangutana kun adunay gikalibugan. Ako nagpamatuodd na matag usa nila wala pugsa sa pag apil ug niuyon kini.

Ngalan sa witness_____ Thumb print sa ginikanan

Pirma sa witness _____

Petsa:

Pamahayag sa Mananaliksik /Statement by the Researcher

Akong gibasa ang tanan information sheet sa tanan participante ug akong gisiguro nga silang tanan nakasabot sa tanan buluhatonon:

1.
2.
3.

Ako nagpamatuod na ang tanan mga participante gitugutan sa pagpangutana ug siguruon ko na matubag ang ilang gikalibugan bahin sa kalihukan. Ako nagpamatuod usab na wala sila gipugos sa pag- apil sa kalihukan kundili ilang kaugalingon kabubut-on kini.

Ang tanan na partisipante naay kopya sa Informed Consent Form.
Print Name of Researcher or ang nagexplained og nakuha sa consent

_____

Signature of Researcher or ang nagexplained og nakuha sa consent

_____

Petsa:

NTNU
Norwegian University of Science and Technology

Norwegian Version ICF

DO YOU WANT TO PARTICIPATE IN THE RESEARCH PROJECT

A smartphone application as a screening tool for jaundice in Filipino newborn

This is a request to you as parents, to let your child participate in a research project, where a new method for detecting neonatal jaundice is being evaluated. We have developed a prototype smartphone application (app), where we use the camera in the smartphone to assess the degree of jaundice.

WHAT DOES THE PROJECT ENTAIL?

Jaundice is a condition where the levels of a compound called bilirubin are elevated. Jaundice is common among newborns and is in most cases self-limiting and harmless. However, when severe and unrecognized it can be fatal or cause serious brain injury. Traditionally, the measurement of bilirubin is done by blood samples. As the skin of a newborn with jaundice turns yellow, optical devices that measure jaundice through assessment of skin color has been developed. In many parts of the world, access to blood sample analysis is scarce. In addition, the optical devices available today are expensive and not affordable for many hospitals. This results in the need for low-cost, reliable and easy-to- use screening tools that can identify newborns with jaundice.

The distribution of smartphones is increasing in all parts of the world. We want to develop an application that is a cheap and reliable tool that could have the potential to save tens of thousands of lives and reduce the number of children with disabilities.

PURPOSE OF THE PROJECT AND WHY YOU ARE BEING INVITED TO PARTICIPATE

METHODS

To make sure that the mobile app is reliable, we need to test it on newborns with various degrees of jaundice. We would like to take a picture of your child with a smartphone and analyze the skin color in the picture. This analysis will be compared with the result from a

blood test that we will obtain from your child. The amount of blood needed is 1.0 ml and can be obtain by venous puncture. Sample will be obtained by Pediatrician with the use of a sterile equipment. We will take a picture of the skin of the chest while your baby is lying on its back on the examination table. The face of your child will not be visible in the picture. We will also use a standard medical device for measuring jaundice through the skin of your newborn such as transcutaneous bilirubinometer, Kramer scale and Fitzpatrick scale.

The picture of your newborn's skin will be stored together with the results of the blood test and the optical skin test for jaundice. In addition, we will collect and store information about your child including age, birthweight, and due date. As different levels of skin pigmentation could influent the result of our analysis, we also want to include the ethnicity of the parents in our study.

Your child will be given an identification number in the study, and it will not be possible to identify your child in the data set. The gathered data will stored store for five years and it will not be available to any project group for further research. All information will be stored on secure computers.

POSSIBLE ADVANTAGES AND DISADVANTAGES

Your participation to study will help to determine if the smartphone app is reliable on detecting neonatal jaundice and we will be able to improve the application using the data. If the application is in the market, the masses will benefit from the device, especially in low-income countries that are expensive to determine the bilirubin level of the newborn. Using this device community health care workers will be able to monitor and detect the early signs of jaundice. Other benefits of participating in the study is if the newborn shows a high bilirubin level after the test the project will help if

possible and it will treated according to hospital protocol or local standard. This is applied to all newborns identified with a high bilirubin level.

Participating in this research shows no risk however a result from the venipuncture may occur—for example, redness of the injection site or a temporary swelling around the injection site. If an injury occurs from the procedure performed from the study or infections and other conditions that could be directly traced to the participation in this study happen to your child, all costs related to treatment will be covered by the project. Please don't hesitate to call us (see the contact details at the end of this document).

VOLUNTARY PARTICIPATION AND RIGHT TO WITHDRAW CONSENT

Participation in the project is voluntary. If you would like to participate, please sign the consent form at the end of this document. You can withdraw your consent at any time without giving a reason. There will be no negative consequences for you or your newborn's treatment, if you do not want to participate or if you choose to withdraw at a later stage. If you withdraw your consent, your health data and biological material will not be used in any further research. You can request access to the data held on you, and this will be provided within 30 days. You can also apply for your data in the project to be deleted.

The right to have your data and material destroyed, deleted or returned does not apply if the material or data are anonymised or have already been published. Access may also be restricted if the data have been included in analyses already performed, or if the material has been processed and is part of another biological product

If you want to withdraw at a later stage or have questions about the project, you can contact the project manager (see the contact details at the end of this document).

WHAT HAPPENS TO THE DATA HELD ON FROM YOU AND YOUR NEWBORN?

The data registered about you will only be used as described under the purpose of the project and is planned for use in five years. Use and storage time can only be extended after approval from the Regional Committee for Medical and Health Research Ethics and other relevant authorities. You have the right to access the information that is registered about you and to have any errors in this information corrected. You also have the right to information about the data security measures that apply to the processing of the data. You can lodge a complaint about the processing of your data to the Norwegian Data Protection Authority and the institution's Data Protection Officer.

All data will be processed without names and personal identification numbers or other directly identifiable information (= coded data). A code links you to your data through a list of names. Only Jon Oyvind Odland, Anders Aune, Gabriela Jimenez and Jorge Tusoy has/have access to this list.

After the research project is completed, the data held on you and from your newborn will be stored for five years for control purposes.

SHARING DATA AND TRANSFERRAL ABROAD

As part of the implementation of the project, it may be relevant to transfer data held on you to other countries. All the data gathered from the project will be transfer to Norway for analysis except the blood sample. All information will be coded, and it will be anonymous. Picterus and Norwegian University of Science of Technology are responsible for ensuring that data are transferred in accordance with Norwegian law and the EU General Data Protection Regulation (GDPR). The code linking your newborn and you to your personally identifiable information will not be disclosed.

WHAT HAPPENS TO SAMPLES TAKEN FROM YOUR NEWBORN

The blood sample taken from your newborn will be disposed of at the laboratory after examination.

INSURANCE

Participation in this study involves no costs for the family, and all expenses including blood samples will be paid for by the project. Should by any chance infections or other conditions that could be directly traced to the participation in this study happen to your child, all costs related to treatment will be covered by the project.

APPROVALS

1. The Regional Committee for Medical and Health Research Ethics has considered the research ethics in the project and given its approval. Committee's case number 322016
2. ResearchEthicsCommitteeofGovernorCelestinoGallaresMemorialHospital has considered the ethics research project in the project and given its approval. Committee's case number GCGMH-IRB-of-2021-20 (v.03)

Norwegian University of Science of Technology, Picterus and the project manager Jon Øyvind Odland are responsible for privacy and data protection in this project.

Our data processing is based on The Personal Data Act and the General Data Protection Regulation and will take place via NTNU´s system

CONTACT DETAILS

If you have questions about the project or want to withdraw your participation, you can contact:

Jorge Tusoy RN
email: jorgebtu@stud.ntnu.no
Phone no:+447700358505
Local no:09507042434
Dr. Jon Øyvind Odland MD, PhD
email: jon.o.odland@ntnu.no
Dr. Valeria S. Sulatra MD, MPH, CSEE
email: gcgmhirb@gmail.com
Phone no: (038) 411-4868 loc. 282

If you have questions about data protection in the project, you can contact the Data Protection Officer at the institution: thomas.helgesen@ntnu.no

As the parent/guardian of_ (Full name), I consent to his/her participation in this project.

Place and date

Signature of parent/guardian
Name of parent/guardian in block capital letters

Signature of parent/guardian
Name of parent/guardian in block capital letters

Place and date :

I confirm that I have provided information about the project

Place and date Signature :
Role in the project :

October 18, 2021

Mutya Kismet T. Macuno M.D F.P.P.S., F.P.S.Nb.M., M.D.M
Medical Center Chief II
Governor Celestino Gallares Memorial Hospital
53 Miguel Parras St, Tagbilaran City,
6300 Bohol, Philippines

Thru:

Valeria S. Sulatra, MD, MPH, CSEE
Chief of Medical Professional Staff

Luciano J. Sarabosing, Jr., MD, FAAP, DPPS, MBA-HA
Chief Training Officer

Maribeth M Jimenez MD, FPPS, MPA
Head Pediatric Department

Annette L. Salillas MD, FPSP, FASCP, MIAC
Head Pathology Department

Subject: Request cooperation with my research.

Dear Dr. Macuno,

I am writing to formally request cooperation with my research **'' A mHealth application as a screening tool for neonatal jaundice in Filipino neonates.''** I aim to validate the reliability of the Picterus mhealth application as a screening tool for neonatal jaundice in Filipino neonates and its correlation to transcutaneous bilirubinometer (TcB), total serum bilirubin (TSB) and Kramer scale.

To achieve this, I need to examine blood to determine total serum bilirubin (TSB) level from the neonates. In as much as the order for the total serum bilirubin (TSB) determination needs a physician's order for it, I am hereby requesting cooperation from the Pediatric Department.

Moreover, since the total serum bilirubin (TSB) determination is part of the study, the project will pay for it. There will be a total of 150 total serum bilirubin (TSB) test for the research.

Thank you for accommodating my request letter. If you have any questions, please do not hesitate to reach me at contact number: 09507042434 or my email address: jorgebtu@stud.ntnu.no

Sincerely Yours,

Jorge Tusoy RN
Master Student
Norwegian University of Science and Technology

ID: PHL-	Registered by	
	Location	
	Date of registration (dd/mm/yy)	

Date of Birth (dd/mm/yy)		Time of birth (hh:mm)	
Gestational age (weeks + days)		Weight (g)	

Fitzpatrick scale	I	II	II	IV	V	VI	Unknown
Mother							
Father							

Kramer scale	0	1	2	3	4	5

TSB (umol/l)		Time blood taken (hh:mm)	
TSB obtained by	Venipuncture	Cannula	----------

Transcutaneous bilirubinometer TcB (umol/l)	

Picterus #1		Estimate number	

Comments:

Guideline

ID : Unique ID number for each newborn. ID appears on smartphone application after finishing image sampling.

Birth weight: Enter **birth** weight in gram. (*Not current weight*)

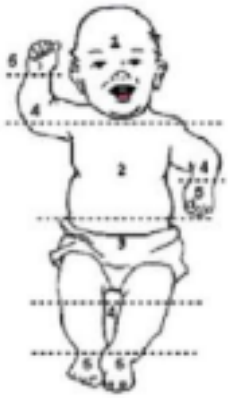
Gestational Age: Enter gestational age. If unknown leave blank.

Date and time of birth: Enter date and time of birth to closest hour.

Fitzpatrick scale: Tag appropriate box.

If not known, tag *unknown*.

Kramer's scale: Visual determination of jaundice. Has to be performed before other analysis are made. Grade degree of jaundice after following scale:



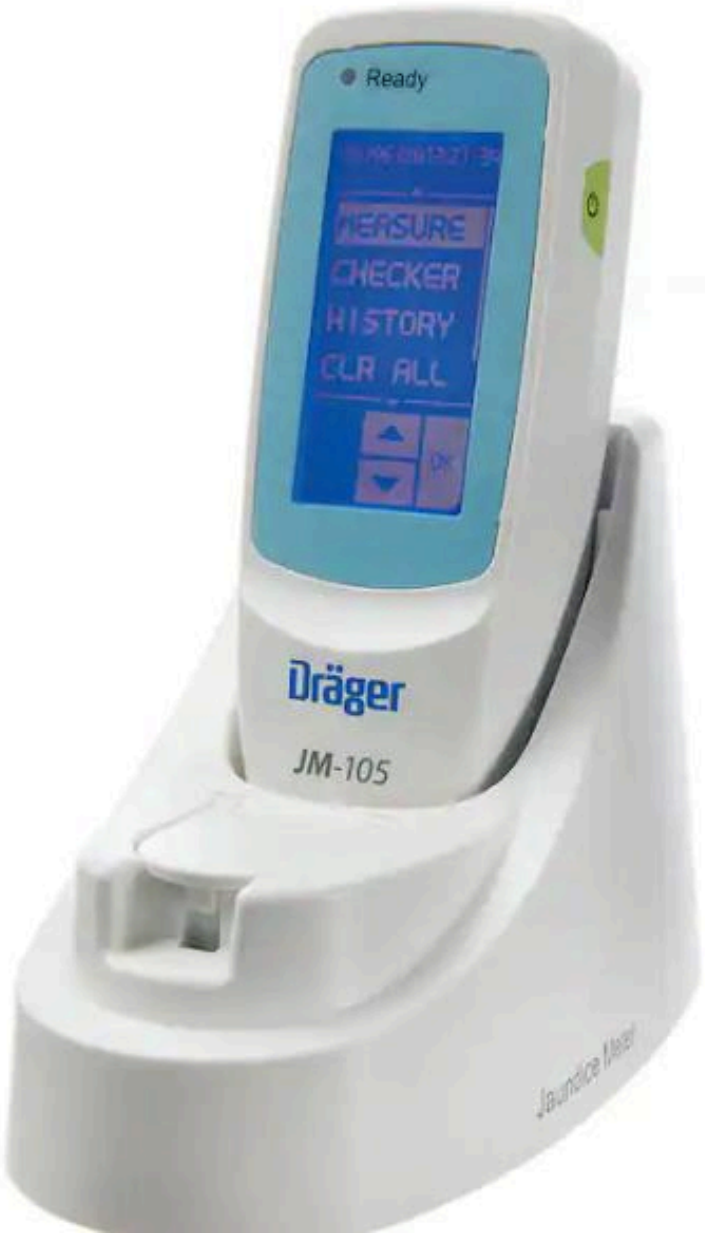
Clinical Extent	Grade
None	0
Limited to the head and neck	1
Involves the (chest and upper abdomen) and/or back	2
Involves the abdomen below the umbilicus to the knees	3
Involves the legs below the knees and/or upper and lower arms	4
Involves hands and/or feet	5

Transcutaneous bilirubin: Enter result of measurement from transcutaneous bilirubinometry

Bilirubin in blood sample: Enter result of measurement of bilirubin in blood sample

Time for blood sample: Enter time for blood sample. Should be within 60 minutes from obtaining images.

Fitzpatrick Scale:



NTNU
Fakultet for medisin og helsevitenskap
Institutt for samfunnsmedisin og sykepleie

Vår dato | Vår referanse
Deres dato | Deres referanse

Trondheim 09.03.2021

Att.
Director of PETRO- Research and Innovation Section (Maria Lux Joanna B: Soria MD, FPCP, FPCC).

Letter of Request.

Dear Director.

My Master student Jorge Tusoy will write his Master thesis under my guidance as part of the Master program in Global health, Faculty of Health Sciences, NTNU, The Norwegian University of Science and Technology, Trondheim, Norway.

The study is planned to be conducted in the Governor Celestino Gallares Memorial Hospital (GCGMH). My team in Norway hope for a close collaboration with you. The protocol will be developed to secure all ethical guidelines, as well as the scientific quality of the study.

The economic side is also covered by our side.

Do not hesitate to contact me for any questions.

Sincerely,

Prof. Jon Øyvind Odland,
Professor of medicine and global health
Specialist OB/GYN

Program leader Master program in Global health, Faculty of Health Sciences,
NTNU, The Norwegian University of Science and Technology
N-7001 Trondheim
Norway

Tel. +4790953887
Mail: jon.o.odland@ntnu.no

NIDA Clinical Trials Network

Certificate of Completion

is hereby granted to

Jorge Tusoy

to certify your completion of the six-hour required course on:

GOOD CLINICAL PRACTICE

MODULE:	STATUS:
Introduction	N/A
Institutional Review Boards	Passed
Informed Consent	Passed
Confidentiality & Privacy	Passed
Participant Safety & Adverse Events	Passed
Quality Assurance	Passed
The Research Protocol	Passed
Documentation & Record-Keeping	Passed
Research Misconduct	Passed
Roles & Responsibilities	Passed
Recruitment & Retention	Passed
Investigational New Drugs	Passed

Course Completion Date: 12 March 2021

CTN Expiration Date: 12 March 2024

Tracee Williams, Training Coordinator
NIDA Clinical Coordinating Center

Good Clinical Practice, Version 5, effective 03-Mar-2017

This training has been funded in whole or in part with Federal funds from the National Institute on Drug Abuse, National Institutes of Health, Department of Health and Human Services, under Contract No. HHSN27201201000024C.

From: Veileder (eva.skovlund@ntnu.no)
Sent: 07.05.2020 11:26:17
To: postmottak@mh.ntnu.no
CC:

Subject: Vurdering av protokoll for masteroppgave / Review of protocol for Master's thesis [#22]
Attachments:

Oppgavens tittel / Title of the thesis A mHealth application as a screening tool for neonatal jaundice in Filipino neonates	
Studenten(e)s navn / Student(s) name Jorge Boco Tusoy	
Generelt / General	
Oppgaven faller innenfor retningslinjene / The thesis meets the requirements	Ja / Yes
Oppgaven er akseptabel fra et forskningsetisk synspunkt / The thesis is acceptable from a research-ethical perspective	Ja / Yes
Kommentarer / Comments	
1. Forskningsmessig verdi av prosjektet / Significance of the research project	Tilfredsstillende / Satisfactory
2. Valg av forskningsmetode / Choice of research method	Passende / Appropriate
3. Omfanget av oppgaven / The scope of the thesis	Tilfredsstillende / Satisfactory
4. Fremdriftsplan / Progress plan	Tilfredsstillende / Satisfactory
5. Økonomisk overslag / Budget estimate	Rimelig / Reasonable
6. Er formalitetene ovenfor REK, NSD, Biobank ivaretatt? / Have all the formalities regarding REK, NSD, Biobank etc. been considered?	Ja / Yes
Konklusjon / Conclusion	
Konklusjon (til studenten) / Conclusion (for the student)	Aksepteres i nåværende form / Accepted as it is.
Skjemainnsender / Transmitter of form ID fra TIA / ID from TIA	
Navn innsender / Name transmitter	Eva Skovlund
E-post / E-mail	eva.skovlund@ntnu.no

GOV. CELESTINO GALLARES MEMORIAL HOSPITAL

CERTIFICATE OF APPROVAL

Date 10/26/2021

This is to certify that the following protocol and related documents have been granted approval by the Governor Celestino Gallares Memorial Hospital IRB for implementation

IRB Protocol No.	GCGMH-IRB-OF-2021-20 (v.03)	Sponsor Protocol No	N/A
Principal Investigator/s	**Mr. Jorge Tusoy**	Sponsor	N/A
Title	A mHealth Application as a Screening Tool for Neonatal Jaundice in Filipino Neonates		
Protocol Version No.	Version 03	Version Date	10/25/2021
ICF Version No.	Version 03	Version Date	10/25/2021
Other Documents	N/A		
Member of research team	CA - Ms. Marivic Deluna, MAN, RN		
Study sites	Gov. Celestino Gallares Memorial Hospital		

Type of review		Duration of Approval From (date) To	Frequency of continuing review
	☑ Expedited ☐ Full board Meeting date: 10/26/2021	October 26, 2021 to October 25, 2022	Annually

IRB Chair Person Name	Signature	Date
Valeria S. Sulatra, MD, MPH, CSEE		10/26/2021

Investigator Responsibilities after Approval:

- Submit document amendments for IRB approval before implementing them
- Submit SAE and SUSAR reports to the IRB within 7 working days
- Submit progress report every 12 months
- Submit final report after completion of protocol procedures at the study site
- Report protocol deviation/violation
- Comply with all relevant international and national guidelines and regulations
- Abide by the principles of good clinical practice and ethical research

Received by: _____

Name _____

Signature _____ Date _____

GOV. CELESTINO GALLARES
MEMORIAL HOSPITAL
Republic of the Philippines | Department of Health

Nursing Service

July 8, 2021

MARIA LUZ JOANNA B. SORIA, M.D., FPCP
Director, Research and Innovation Section
GCGMH Professional Education, Training and Research Office

RE: Endorsement of research protocol for TRB Approval

Dear Dr. Soria,

Respectfully endorsing to your office for **TECHNICAL REVIEW APPROVAL** the protocol of **MR. JORGE BOCO TUSOY**, a Non-GCGMH Staff, and **MARIVIC DELUNA, MAN, RN**, GCGMH Official Co-Investigator from Nursing Service Research and innovation Unit, with the title:

A MHEALTH APPLICATION AS A SCREENING TOOL FOR NEONATAL JAUNDICE IN FILIPINO NEONATES.

The study was initially reviewed and thereafter accepted by the Co-Investigator. It is deemed that the aforementioned study can provide new or refined scientific knowledge for the improvement of the hospital services and operation, thus , this endorsement.

Thank you very much.

ROCKY M. CAMALIGAN, MAN, MAEM, RN, LPT, FPCHA
Nursing Department Research Coordinator

TITA S. ARANETA, MAN, RN
Chief Nursing Officer

So Gallares, So Kind. ™
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Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK midt	Hilde Eikemo	73597508	16.12.2021	322016

Jon Øyvind Odland

Prosjektsøknad: En mHelse applikasjon for å undersøke neonatal gulsott hos filippinske nyfødte
Søknadsnummer: 322016
Forskningsansvarlig institusjon: Norges teknisk-naturvitenskapelige universitet

Prosjektsøknad godkjennes med vilkår

Søkers beskrivelse

The purpose of the study is to test the reliability of the Picterus smartphone application. The study is designed for Filipino neonates, but implemented in other LMIC. The participants include newborns with or without jaundice, Gestational age >37 weeks, Age0–14days, Weight >2500 gram and absence of congenital malformations. Demographic data of the neonates will be collected together with all the performed tests and it will be stored in a secured system. Blood will be drawn and measure the bilirubin level of the neonates in a standard clinical routine and will be compared to the estimated bilirubin performed with the Picterus smartphone application.

A descriptive cross-sectional study will be the method to understand the correlation of the modalities and to determine the reliability of the application.

It will provide an answer to whether the Picterus smartphone application is reliable to other populations, especially to darker skin and with high melanin content such as Filipino neonates

We refer to your application for prior approval of the above-mentioned research project. The Regional Committee for Medical and Health Related Research Ethics Mid Norway (REC Mid Norway) reviewed the application at its meeting taking place Nov 1, 2021. The review was conducted in accordance with Section 10 of the Health Research Act *[Helseforskningsloven]*.

REKs vurdering

Evaluation

The committee's project description

The Picterus smartphone application is an app estimating bilirubin from digital images. The intended use is to detect neonatal jaundice. The aim of the study is to test the app's reliability on neonates with dark skin tones, and determine the correlation between the bilirubin level as measured by the app against bilirubin serum level, transcutaneous bilirubinometer and the Kramer scale. 150 Filipino neonates will be recruited. Data will be collected from the parents, the child's hospital record and/or immunization card. The study is based on consent from both parents.

Responsible conduct

The Committee has reviewed the application, research protocol, objective and plan for implementation. We have some comments regarding the informed consent sheet, but no major ethical objections to the project. Participation involves being photographed in the chest region. For some of the participants it will also involve taking an extra blood sample. Assuming only sterile equipment will be used for this procedure, participation represents a minimal risk. We do not regard the data to be collected as sensitive, and the identification key will be stored at the local health institution. Consent will be collected from both parents. The potential benefit of the project appears to be great, as the app can be an effective, inexpensive and non-invasive diagnostic method in low- and middle-income countries. Furthermore, it appears to be relevant and sufficient competence in the project group, and a clear distribution of responsibility. Provided that the following conditions are met, the project appears to be justifiable and the participants' welfare and integrity are protected.

Revision of the informed consent sheet

To make sure the information to the potential participants is informative and easy to read, we ask you to revise the informed consent sheet as follows:

1. Use REC's template which you can find on our webpage.
2. Avoid using technical terms and difficult words, such as e.g. neonates, visual, gestational age and supine.
3. Include information about the use of sterile equipment for blood sampling, and that all neonates where jaundice is detected will be treated according to local standard.

Conditions for approval

1. Only sterile equipment can be used for the blood sampling procedure.
2. In the case of positive findings of jaundice, we presuppose that the children will receive standard local treatment.
3. You must submit a revised informed consent sheet. Please use rekportalen.no. The new sheet cannot be used for inclusion before we have acknowledged that the revision is in accordance with the instructions above.
4. The study cannot start inclusion of participants before a local ethics approval has been obtained.
5. You must ensure that no personally identifiable information are revealed in publications.
6. You and all the project staff must follow the regulations of your own institution to ensure information security and the participants' privacy when collecting, using,

storing and sharing their personal information. The provisions must be in accordance with REC's conditions for approval.

7. For documentation purposes, the project data must be stored for five years after the end of the project. Access to the project data is restricted to supervisory authorities, and it will not be available to the project group for further research. You as the principal investigator together with the responsible institution must ensure that the personal information is stored indirectly identifiable during this period, that is separately in an identification key file and a data file. After this five-year period the data must be deleted or anonymized. Please note that anonymization is more comprehensive than simply deleting the identifier key, cf. the Data Inspectorate's guide on anonymization techniques.

Vedtak

Approved with conditions

Sluttmelding
Prosjektleder skal sende sluttmelding til REK på eget skjema via REK-portalen senest 6 måneder etter sluttdato 31.10.2025, jf. helseforskningsloven § 12. Dersom prosjektet ikke starter opp eller gjennomføres meldes dette også via skjemaet for sluttmelding.

Søknad om endring
Dersom man ønsker å foreta vesentlige endringer i formål, metode, tidsløp eller organisering må prosjektleder sende søknad om endring via portalen på eget skjema til REK, jf. helseforskningsloven § 11.

Klageadgang
Du kan klage på REKs vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes på eget skjema via REK portalen. Klagefristen er tre uker fra du mottar dette brevet. Dersom REK opprettholder vedtaket, sender REK klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Yours sincerely,

Steinar Krokstad

Professor, MD, PhD

Deputy chairman, REC Mid Norway

Hilde Eikemo

Head of Secretariat, PhD

NTNU
Norwegian University of
Science and Technology