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# Pulse Oximetry Knowledge in Congenital Cardiopathy Trial

## Conocimiento de la oximetría de pulso en la detección de enfermedades cardíacas congénitas

## Conhecimento da Oximetria de Pulso na Triagem da Cardiopatia Congênita

**ABSTRACT**

Objective: Conducting a survey on healthcare providers knowledge, at hospitals, Nursing and Medical school undergraduate students, regarding to pulse oximetry application on congenital heart disease neonatal triage in Paulista Northwest. Material and Method: This is a cross-sectional field qualitative study, from March to December/2017. The sample counted on 90 participants distributed in three groups: 55 Medical undergraduate students; 28 Nursing undergraduate students, seven Practitioners/Hospitals and seven hospitals. Data collections were through a questionnaire with thirteen questions answered by volunteers. Data were organized in spreadsheet by using Microsoft Office Excel, Word and Statistical Package for Social Sciences (SPSS) version/24.0 and using descriptive statistics. Results: It was found that only 63% of the participating hospitals screened neonatal patients. Regarding to training, 49% of Medical undergraduate students and nether from Nursing school were trained. Among practitioners assisting hospitals, only 28% were trained. Conclusion: It was verified low adhesion to pulse oximetry application by public maternity hospitals, in this region; as well as lack of personnel training. There is the necessity to spread knowledge about pulse oximetry to either Medical and Nursing academic community and practitioners assisting newborn babies in nursery.

**DESCRIPTORS:** Pulse Oximetry; Congenital Cardiopathy Trial; Little Heart Test.

**RESUMEN**

Objetivo: realizar una encuesta sobre el conocimiento de los profesionales de la salud, en hospitales y estudiantes universitarios de cursos de medicina y enfermería, relacionada con la aplicación de la oximetría de pulso en la detección neonatal de enfermedades cardíacas congénitas en el noroeste de São Paulo. Material y Método: Este es un estudio de campo transversal, cuantitativo, de marzo a diciembre / 2017. La muestra incluyó 90 participantes divididos en tres grupos: 55 estudiantes de medicina; 28 estudiantes de enfermería y siete profesionales / hospitales y la participación de siete hospitales. La recolección de datos se realizó a través de un cuestionario con trece preguntas, respondidas por los voluntarios. Los datos se difundieron utilizando Microsoft Office Excel, Word y el paquete estadístico para ciencias sociales (SPSS) versión / 24.0 y se utilizaron estadísticas descriptivas. Resultados: se encontró que solo el 63% de los hospitales participantes realizan pruebas de detección neonatales. Con respecto a la capacitación, el 49% de los estudiantes de medicina y ninguno en enfermería recibió capacitación. Entre los profesionales que trabajan en hospitales, solo el 28% recibió capacitación. Conclusión: Hubo una baja adherencia en el desempeño de la oximetría de pulso en los hospitales públicos, con maternidad, en esta región; así como el déficit de formación ofrecido a sus profesionales. Existe la necesidad de ampliar el conocimiento de la oximetría de pulso a la comunidad académica de los cursos de Medicina y Enfermería, y ofrecer capacitación a profesionales que atienden a recién nacidos en guarderías.

**DESCRIPTORES:** Oximetría de Pulso; Detección de Enfermedades Cardíacas Congénitas; Teste del Corazoncito.

**RESUMO**

Objetivo: Fazer um levantamento sobre o conhecimento dos profissionais da saúde, nos hospitais, e graduandos dos cursos de Medicina e Enfermagem, relacionados com a aplicação da oximetria de pulso na triagem neonatal de cardiopatia congênita no Noroeste Paulista. Material e Método: Trata-se de um estudo transversal, de campo, quantitativo, no período de março a dezembro/2017. A amostra contou com 90 participantes distribuídos em três grupos: 55 graduandos de Medicina; 28 graduandos de Enfermagem e sete Profissionais/Hospitais e participação de sete hospitais. A coleta de dados deu-se por meio de um questionário com treze questões, respondido pelos voluntários. Os dados foram planilhados por meio dos programas Microsoft Office Excel, Word e o Statistical Package for Social Sciences (SPSS) versão/24.0 e utilizado a estatística descritiva. Resultados: Foi constatado que somente 63% dos hospitais participantes realizam a triagem neonatal. Com relação ao treinamento, 49% dos graduandos de Medicina e nenhum de Enfermagem passaram por treinamento. Entre os Profissionais que atendem nos hospitais, somente 28% receberam treinamento. Conclusão: Constatou-se a baixa adesão na realização da oximetria de pulso pelos hospitais públicos, com maternidade, dessa região; bem como o déficit de treinamento ofertado aos seus profissionais. Há necessidade de ampliar o conhecimento da oximetria de pulso para a comunidade acadêmica dos cursos de Medicina e Enfermagem, e ofertar treinamentos aos profissionais que atendem os recém-nascidos nos berçários.

**DESCRITORES:** Oximetria de Pulso; Triagem da Cardiopatia Congênita; Teste do Coraçãozinho.

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## INTRODUCTION

Pulse oximetry is a non-invasive method for monitoring continuously or not, the concentration of oxygen being transported by hemoglobin that passes through capillaries. This monitoring is usually done at the ends of the body such as the earlobe, fingertips and, in newborns (NB), the hands and feet[1], and to perform this measurement, a device called an oximeter is used.

The oxygen concentration measured with the oximeter is called the oxygen saturation level - SapO2[2,3]. This method has been used by several countries, as a screening method for critical congenital heart disease (CCC), as it is a fast, easy, painless, inexpensive and well accepted method by those responsible for the newborn[4-6].

CCCs are malformations in the anatomical structure of the heart and of the great vessels that still occur in the embryonic period (critical period of cardiogenesis). The cardiogenesis period occurs in the middle of the third week at the end of the eighth week of pregnancy[7]. Channel-dependent heart diseases (which depend on patent ductus arteriosus) are known as CCC, and lead to hemodynamic decompensation in the neonatal period, which may occur in the first hours or the first days of life of the NB, with high morbidity and mortality when the canal closes. arterial[8-10].

Worldwide, the prevalence of congenital heart disease is 9.1 per 1,000 live births, in Brazil, 8 per 1,000 live births, with CCC representing 2 per 1,000 live births, causing high morbidity and mortality in the early neonatal period[11,12]. Timely diagnosis is important for the prognosis of these NBs, but current screening methods can lose up to 50% of affected NBs before birth, and those who are sent home before diagnosis often die or suffer a great deal of morbidity[13].

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In this sense, it is important to note that a characteristic of some CCCs is hypoxemia and / or the difference in saturation between the pre-ductal upper limb and the post-ductal lower limb, which can be measured using the oximeter[9].

After birth, fetal circulatory system structures (placenta, umbilical vessels, venous duct, foramen ovale and arterial canal) cease to exist and neonatal circulation is established. The ductus arteriosus, for example, has its functional closure between 12 and 15 hours of extrauterine life, and the anatomical closure between the fifth and seventh days, which can reach up to 21 days in some newborns[12].

In this way, patenting of the ductus arteriosus makes it possible for these newborns to survive with CCC, therefore, the need to take advantage of this "window", for a quick and accurate diagnosis, to maintain this patent ductus arteriosus, until it is established the definitive correction of heart disease[8]. Prostaglandin E2 - PGE2 is used to maintain patency of the ductus arteriosus (a drug that acts

on the smooth muscle of the blood vessel, promoting its relaxation). In order to enable a quick diagnosis, screening is performed using pulse oximetry between 24 and 48 hours of life of the newborn, before hospital discharge, and once hypoxemia is found, this newborn should be submitted to an echocardiogram. for the diagnosis of CCC to be established[5,6].

In this regard, the current evidence supports the introduction of routine screening in asymptomatic newborns before discharge from the nursery. The test appears feasible in several high- and middle-income countries and shows consistent accuracy. In Brazil, this method of screening using pulse oximetry is called "Little Heart Test" - TC [5].

The screening for CCC through the TC is regulated in Brazil by Law No. 4,163/13, since December 21, 2011, and its performance has become a national procedure in public health services, through the Unified Health System (SUS) ), since June 10, 2014, following the flowchart guided by the Ministry of Health as shown in Figure 1[2], and in private services.

The flowchart above assists health professionals in the early identification of CCC, since they are the most frequent causes of severe congenital anomalies (especially in the early neonatal period, of NBs with zero to seven days of life), being considered today a problem global public health[13,14].

Studies show the high specificity of 99% and moderate sensitivity 67% to 72% of this TC method[4,6,8,16]. Because it has high specificity and allows the diagnosis while the patient is still asymptomatic, without hemodynamic decompensation, all these factors make the TC a good screening method for CCC[10], it can be carried out by doctors and health professionals, such as nursing staff (nurses and nursing technicians), provided that they have qualification, knowledge, qualification and training for their accomplishment[4,10,16,17].

Thus, the present study aims to survey the knowledge of the application of TC as a screening for some CCC, by the hospital health team (Pediatricians, Nurses and Nursing Technicians) of hospitals in the Northwest region of São Paulo, and undergraduate students from the last year of Medicine and Nursing at a public university institution in the Northwest of São Paulo, from Santa Fé do Sul to São José do Rio Preto, who perform the screening through the TC in their services.

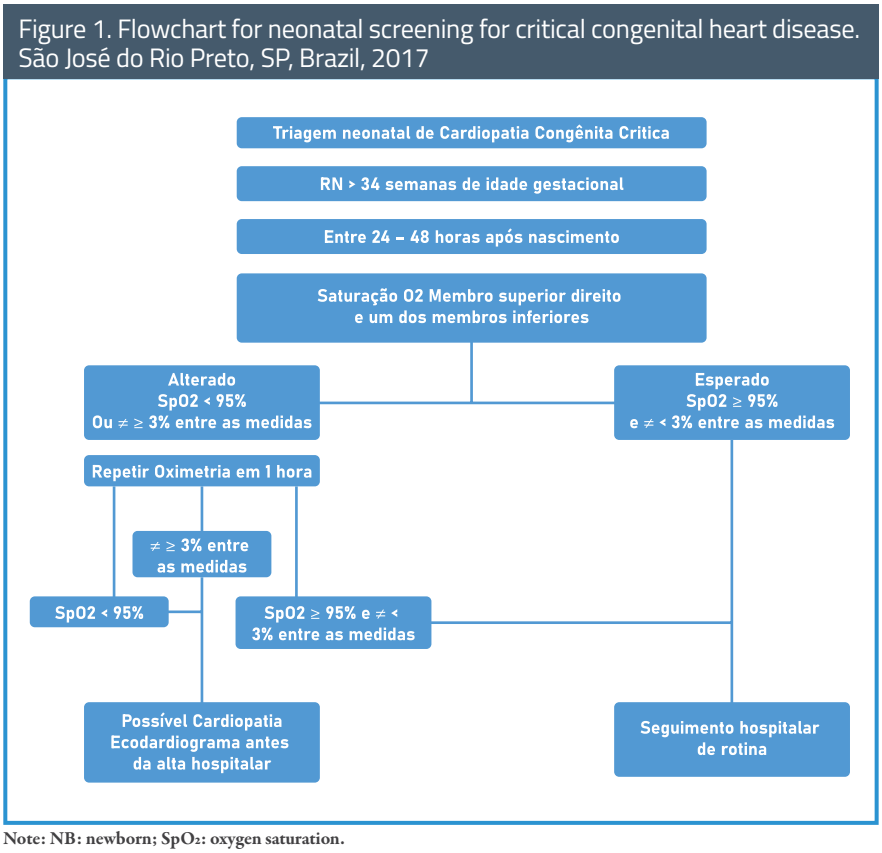
The objective was, based on the above, to survey the knowledge of health professionals, in public hospitals with maternity, and graduates of Medicine and Nursing courses, in the Northwest of São Paulo, related to the application of TC in the screening of CCC.

## METHODOLOGY

This is a field study, transversal, quantitative, carried out from March to December 2017. The study was approved by the Research Ethics Committee (CEP) with human beings of the Faculty of Medicine of Rio Preto (FAMERP), according to Resolution No. 466/2012 of the National Health Council (CNS), with CAAE 56675116.0.0000.5415 and opinion No. 1,646,502. All volunteers invited to participate in the present study signed the Free and Informed Consent Term (ICF) for later use of the data obtained and the confidentiality of the data collected, guaranteeing the anonymity of those involved.

The sample included 90 volunteers divided into three groups (G), named as follows: (G1) graduating seniors in Medicine; (G2) graduating seniors in Nursing; (G3) professionals responsible for applying TC in the nurseries of participating hospitals (public hospitals with maternity in the Northwest of São Paulo do Santa Fé do Sul to São

Figure 1. Flowchart for neonatal screening for critical congenital heart disease. São José do Rio Preto, SP, Brazil, 2017




Note: NB: newborn; $SpO_2$: oxygen saturation.

José do Rio Preto). The sample was obtained at random, according to the volunteers' acceptance to participate in the research.

For health professionals (Doctors, Nurses, Nursing Technicians), the criterion adopted was to have more than six months of experience in the practice of performing the TC. For undergraduate medical and nursing students who were taking the last year, supposedly, they already had prior knowledge of the application of TC, and public hospitals, with maternity, located between Santa Fé do Sul and São José do Rio Preto/SP , covering an area of 210 km.

The resource used for the survey data collection was a questionnaire, containing thirteen questions, among which three questions were about demographic data: age group, gender, time of profession (study/internship) and area of activity (study/internship); Seven specific questions related to knowledge about TC: 1 - Do you know what the Test of the Little Heart (TC) is? 2 - What does the TC evaluate ?; 3 - Did you go through training to do the TC ?; 4 - How many hours of the newborn's life do you have a TC scan ?; 5 - If it is necessary to repeat the TC how long do you redo it ?; 6 - Where is the oximeter sensor placed ?; 7 - If, after repeating the TC in 1 hour, it remains altered, is the conduct ?; Three questions related to the reality of the participating institutions (hospitals): 1 - Does this hospital have a cardio pediatrician ?; 2 - In case of transfer of the newborn, how many hours does the transfer take on average ?; 3 - How many monthly deliveries are performed, on average, in this hospital?

The coordinator of the medical course authorized the questionnaire to be applied by groups and individually in the places where medical students were doing an internship, after prior authorization from the preceptor responsible for the local internship. As for undergraduate nursing students, the questionnaire was applied after scheduling with the coordination of the Nursing course, on a test day, where the entire class of the last year was present, when they answered the questionnaire individually.

**For health professionals (Doctors, Nurses, Nursing Technicians), the criterion adopted was to have more than six months of experience in the practice of performing the TC.**

To apply the questionnaire in hospitals, a letter was sent to the Technical Director of the participating Hospitals requesting authorization to access the site. Prior contact was made with the physician responsible for the Pediatrics/Neonatology sector to make an appointment to authorize the application of the questionnaire to employees who performed the TC, in one of the shifts (the visit was allowed in the afternoon). All participants signed the consent form.

The researcher waited with the volunteers to complete the questionnaire. Undergraduate medical students enter the Pediatric specialty, according to the teaching plan of that institution, in the third year with a workload of 45 hours; in the fourth year Pediatrics and Childcare with a 75-hour workload and in the fifth year with Pediatrics a 257-hour workload, plus an internship in the specialty of 88 hours, making a total of 345 hours.

In the sixth year, the workload in the discipline is 180 hours for a 66-hour internship on duty. Classes on neonatal screening are taught in the fifth year.

Nursing undergraduates have access to a brief content about the TC in the teaching plan in the discipline of Health Policies, with the theme "Neonatal Screening" also included in the teaching plan of the subject "Child and Adolescent Health". Subjects taught in the third year of graduation, duration of one semester, total workload (225/270 hours), theory (60 to 72 hours), practice (165 to 198 hours). The students still participate in internships in the disciplines of Child Health and Women's Health in various scenarios, one of these scenarios is in the Joint Accommodation, of the teaching hospital of the institution they study.

The data were organized in a spreadsheet using Microsoft Office Excel, Word, and the Statisctical Package for Social Sciences (SPSS), version 24.0. For statistical analysis of the results, absolute and relative descriptive statistics were used. The results were displayed in tables.

Table 1. Distribution of demographic data. São José do Rio Preto, SP, Brazil, 2017

| Variáveis | G1 | | G2 | | G3 | |
|---|---|---|---|---|---|---|
| | N | (%) | N | (%) | N | (%) |
| **Gênero** | | | | | | |
| Feminino | 36 | 65,45% | 23 | 82,14% | 5 | 71,42% |
| Masculino | 19 | 34,55% | 5 | 17,86% | 2 | 28,58% |
| Total | 55 | 100% | 28 | 100% | 7 | 100% |
| **Faixa etária** | | | | | | |
| 18 - 24 anos | 30 | 54,5% | 27 | 96,4% | 0 | 0% |
| 25 - 34 anos | 23 | 41,8% | 1 | 3,6% | 2 | 28,6% |
| 35 - 44 anos | 2 | 3,6% | 0 | 0% | 2 | 28,6% |
| Acima de 45 anos | 0 | 0% | 0 | 0% | 3 | 43,0% |
| Total | 55 | 100% | 28 | 100% | 7 | 100% |
| **Tempo de atuação** | | | | | | |
| 6 meses a 1 ano | 0 | 0% | 1 | 3,7% | 1 | 14,3% |
| 1 a 5 anos | 1 | 1,8% | 0 | 0% | 1 | 14,3% |
| 5 a 10 anos | 0 | 0% | 0 | 0% | 1 | 14,3% |
| Acima de 10 anos | 0 | 0% | 1 | 3,7% | 4 | 57,1% |
| Estudo/Estágio | 54 | 98,2% | 25 | 92,6% | 0 | 0% |
| Não respondeu | 0 | 0% | 1 | 3,7% | 0 | 0% |
| Total | 55 | 100% | 28 | 100% | 7 | 100% |

Note: G: group; N: number; %: percentage.

Table 2. Perception by groups of undergraduate students and health professionals regarding the TC. São José do Rio Preto, SP, Brazil, 2017.

| Perguntas do conhecimento da aplicação do Teste do Coraçãozinho | Respostas | | | | | |
|---|---|---|---|---|---|---|
| | G1 | | G2 | | G3 | |
| | Sim (%) | Não (%) | Sim (%) | Não (%) | Sim (%) | Não (%) |
| 1. Você sabe o que é o TC? | 100% | 0% | 57% | 43% | 100% | 0% |
| 2. O que o TC avalia? | 75% | 25% | 39% | 61% | 57% | 43% |
| 3. Você passou por treinamento para fazer o TC? | 49% | 51% | 0% | 100% | 28% | 72% |
| 4. Com quantas horas de vida o RN, você faz o TC? | 43% | 57% | 11% | 89% | 60% | 40% |
| 5. Se for preciso repetir o TC, com quantas horas você o refaz? | 80% | 20% | 0% | 100% | 5% | 95% |
| 6. Se após repetir o TC e continuar alterado, a conduta é? | 44% | 56% | 0% | 100% | 5% | 95% |
| 7. No hospital que você trabalha ou faz estágio tem cardiopediatra? | 37% | 63% | 8% | 92% | 7% | 93% |
| Média geral de acerto frente ao TC | 61,15% | 38,85% | 16,43% | 83,57% | 37,42% | 62,58% |

Note: TC: little heart test; G: group; %: percentage.

## RESULTS

The present study had a population of 113 eligible individuals, accepting to participate in the research, a sample of 90 volunteers (79.64%), divided into: (G1) - of the 63 eligible undergraduate medical graduates, 55 participated ; (G2) - of the 39 eligible Nursing undergraduate students, 28 participated and (G3) - of the 11 public hospitals with maternity in the Northwest of São Paulo (from Santa Fé do Sul to São José do Rio Preto) eligible, 07 participated (Professionals responsible the application of TC in the nurseries of participating hospitals). The most prevalent gender in the three participating groups was female. Regarding the age group, the undergraduates had a prevalent age range between 18 and 24 years of age, while in relation to professionals the age group was more advanced, above 45 years. The professionals had a considerable time in the profession since most had been in the hospital for more than 10 years (Table 1).

In relation to specific issues related to the TC, there was a greater number of correct answers obtained by G1; the greatest difficulty in answering the questions was observed in relation to the G2 group (Table 2). All groups answered the same questionnaire that allowed to identify the perception of knowledge of the TC, as shown in (Table 2).

## DISCUSSION

This study highlights with relevance the knowledge of the application of TC by professionals and undergraduate students in the health area. The study showed that. despite appearing in the curricular grids of undergraduate courses in Nursing and Medicine of the evaluated educational institutions, this method of screening. The Nursing course showed low knowledge regarding the application of TC, in

relation to Medicine and health professionals, even if regulated in ordinances of the Ministry of Health with the implementation of TC universally by SUS, in Brazil[5,13,14]. TC, in Brazil, has added to its use evidenced in other countries(6,8-10), showing a good sensitivity rate (75 - 76.5%) and high specificity (99.99%) for CCC[8,10].

Screening can be performed by the pediatrician and the nursing staff, as long as they know the technique correctly, know how to handle the device for its performance and know what is being evaluated[8,16]. Several studies[9,16-20] make clear the need for screening by qualified personnel, trained in the use of the algorithm, and in monitoring pulse oximetry in newborns. The sensitivity and reliability of screening can be influenced by human factors, and the level of knowledge of staff[18].

In this study, it was observed that there is a great need for training of health professionals who work in public hospitals, with maternity, and who perform neonatal screening tests, especially TC. Another study shows that 77% of nurses did not know or had not heard of the TC, before its implantation in the hospital unit[16], which consolidates the data collected in this study (G2 - 43% of those who answered the questions).

Studies demonstrate that the understanding of TC by health professionals (doctors and nursing staff), who routinely deal with health care, is still very deficient, which can lead to undesirable outcomes[21]. Future studies are needed to evaluate the implementation of this screening method in Brazilian hospitals, and the training of professionals who perform TC in other states in the country.

**The Nursing course showed low knowledge regarding the application of TC, in relation to Medicine and health professionals, even if regulated in ordinances of the Ministry of Health with the implementation of TC universally by SUS, in Brazil[5,13,14].**

Scientific studies[16,19,21] make clear the lack of training, knowledge and interpretation of these professionals (doctors and nursing staff, as well as medical and nursing students), and the need for continuing education to deepen the broad knowledge of the use of this tool, which if misinterpreted can further burden the public health system in our country, SUS, and cause irreversible damage to newborns who underwent screening in a misinterpreted way[22].

## CONCLUSION

There was low adherence in the performance of the TC by public hospitals with maternity in the Northwest of São Paulo; as well as the lack of training and qualification offered to professionals working in these institutions, and to medical and nursing students. We propose a critical look at the educational institutions that train these professionals, and a reassessment of their curriculum. State Pediatric and Nursing Societies can contribute to continuing education and training programs for professionals located in areas further away from large cities.

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