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# Digitalization and Automation of APGAR Assessment for Improved Neonatal Care in Low-Income Rural Areas

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**ABSTRACT**: *The Apgar assessment, developed by Dr. Virginia Apgar in 1952, is a widely used tool to evaluate the physiological condition and general health status of neonates at one and five minutes after birth. However, in low-income countries with limited access to expert neonatologists, the application of the Apgar assessment in rural areas is challenging. This scholarly article introduces a method for digitalizing and automating the Apgar assessment, aiming to facilitate its implementation in home or low-resource delivery centers. By providing instant scoring and automated feedback, the digitalized version has the potential to improve decision-making and prevent neonatal deaths. This article discusses the design, algorithm, limitations, and benefits of the proposed digitalized Apgar assessment.*

**KEYWORDS**: Apgar assessment, Digitalization, Rural areas, Neonatal care, Automation, Low-income countries.

## INTRODUCTION

The Apgar assessment, known as the Apgar score, was developed by Dr. Virginia Apgar in 1952 as a tool to evaluate the physiological condition and general health status of newborns. It has since become widely used globally in clinical settings [1]. The purpose of this article is to propose a method for digitalizing and automating the Apgar assessment, specifically targeting its application in rural areas of low-income countries where the majority of births occur at home or in delivery centers with limited access to expert neonatologists.

### Design and Method

The Apgar assessment is based on five vital criteria: Appearance, Pulse, Grimace, Activity, and Respiration. Each criterion is assigned a score ranging from zero to two, resulting in a total score ranging from zero to ten [2]. However, it is important to note that a score of ten is extremely rare in practice.

**Basic Algorithmic Design**

To digitalize and automate the Apgar assessment, an algorithmic design is proposed. The basic algorithm consists of three components: input, algorithm, and output. Individuals on site provide the necessary responses to the assessment criteria, the algorithm applies a pre-configured scoring system, and the output generates remarks based on the calculated score.

**Contents of the Basic Algorithm**

The digitalized Apgar assessment includes specific criteria [3] and response options for each criterion. At one minute after birth, the following criteria are evaluated:

Skin Color:
- Option A: Blue or pale allover
- Option B: Blue at the extremities but the body is pink in color
- Option C: Both body and extremities are pink in color

2. Pulse:
- Option A: Absent
- Option B: Less than 100 beats per minute
- Option C: More than 100 beats per minute

3. Grimace:
- Option A: No response to stimulation
- Option B: Grimace on suction or aggressive stimulation
- Option C: Cry on stimulation

4. Activity:
- Option A: Not flexing arms and legs at all
- Option B: Slight flexion of arms and legs
- Option C: Flexed arms and legs, resisting extension

5. Respiration:
- Option A: Absent
- Option B: Weak, irregular, gasping
- Option C: Strong and the infant is crying robustly

A scoring system is applied, with options A, B, and C corresponding to scores of 0, 1, and 2, respectively. The total score obtained from adding the scores of each criterion provides an assessment of the neonate's condition.

**Representation of Sample Application**

To illustrate the digitalized Apgar assessment, a sample application is provided. The individual on site selects the most appropriate response for each criterion based on their observation of the newborn. For instance:

- Skin Color: Both body and extremities are pink in color
- Pulse: More than 100 beats per minute
- Grimace: Cry on stimulation
- Activity: Flexed arms and legs, resisting extension
- Respiration: Strong and the infant is crying robustly

Based on these responses, the algorithm calculates the Apgar score, which in this case would be 10. The output then generates remarks indicating that the infant should be kept warm, observed keenly, and that the assessment should be repeated at 5 minutes for further evaluation. It also suggests seeking immediate medical attention if the score is fairly low or critically low, along with the initiation or continuation of resuscitation measures if already started.

**Limitations**

While the Apgar score provides valuable information about the neonate's condition, it is important to acknowledge its limitations. Various factors can influence the score, such as maternal sedation or anesthesia, congenital malformations, gestational age, trauma, and inter-observer variability. Additionally, significant biochemical disturbances are required before the score is affected[4]. These limitations should be taken into account when interpreting the results of the digitalized Apgar assessment.

## DISCUSSION

The digitalization and automation of the Apgar assessment offer several potential benefits[5]. It enables quick and efficient performance of the assessment, providing instant scoring and automated feedback. This not only facilitates decision-making for individuals on site but also has the potential to be a life-saving tool in preventing neonatal deaths. However, it is crucial for individuals using the digitalized assessment to be observant and use the tool appropriately, as sound clinical judgment is still necessary. Furthermore, the digitalized assessment allows expert neonatologists to remotely access and perform the assessment, which is particularly valuable in rural areas with limited transportation options. In emergency situations, healthcare providers can remotely complete the assessment and provide on-site individuals with digital instructions for life-saving maneuvers, such as resuscitation.

## CONCLUSION

The digitalization and automation of the Apgar assessment offer a promising solution to improve neonatal care in low-income rural areas. By providing instant scoring, automated feedback, and the potential for remote access by expert neonatologists, this approach has the capacity to enhance decision-making and contribute to reducing neonatal mortality rates. However, it is important to consider the limitations of the assessment and ensure proper utilization by individuals on site. Continued research and development efforts are needed to refine and validate the digitalized Apgar assessment for effective implementation and impact on neonatal care in resource-limited settings.

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