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# Assessment of WHO Hemoglobin Color Scale for accuracy in diagnosis of anemia among pregnant women by health care providers in peri-urban settings in Karachi

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# Introduction

- Anemia is the world's second leading cause of disability
- Around 38% of pregnant women are anemic worldwide
- Highest prevalence in SEAR (48.7%) followed by Africans (46.3%)
- Anemia in pregnancy can lead to various adverse outcome (Maternal, fetal & perinatal death, preterm birth, LBW babies)
- WHO has introduced a simple, rapid and low cost technique, Hemoglobin Color Scale (HCS)

# WHO Hemoglobin Color scale

## Using the Haemoglobin Colour Scale

1. Use only approved test-strips.
2. Add a drop of blood to one end of a test-strip - just enough to completely cover an aperture in the Colour Scale.
3. Wait about 30 seconds; then read immediately by comparing the blood stain with the Colour Scale to find the best colour match:
  - Keep the test-strip close to the back of the Colour Scale
  - Avoid direct sunlight
  - Avoid marked shade
  - Avoid your own shadow or any other shadow.
4. If the blood stain matches one of the shades of red exactly, record the haemoglobin value. If the colour lies between two shades, record the mid-value. If in doubt between two shades, record the lower value.
5. Discard the test-strip after use. Wipe the back surface of the Scale at the end of each session or if it becomes soiled during use.

Haemoglobin equivalent g/dl

14

12

10

8

6

4

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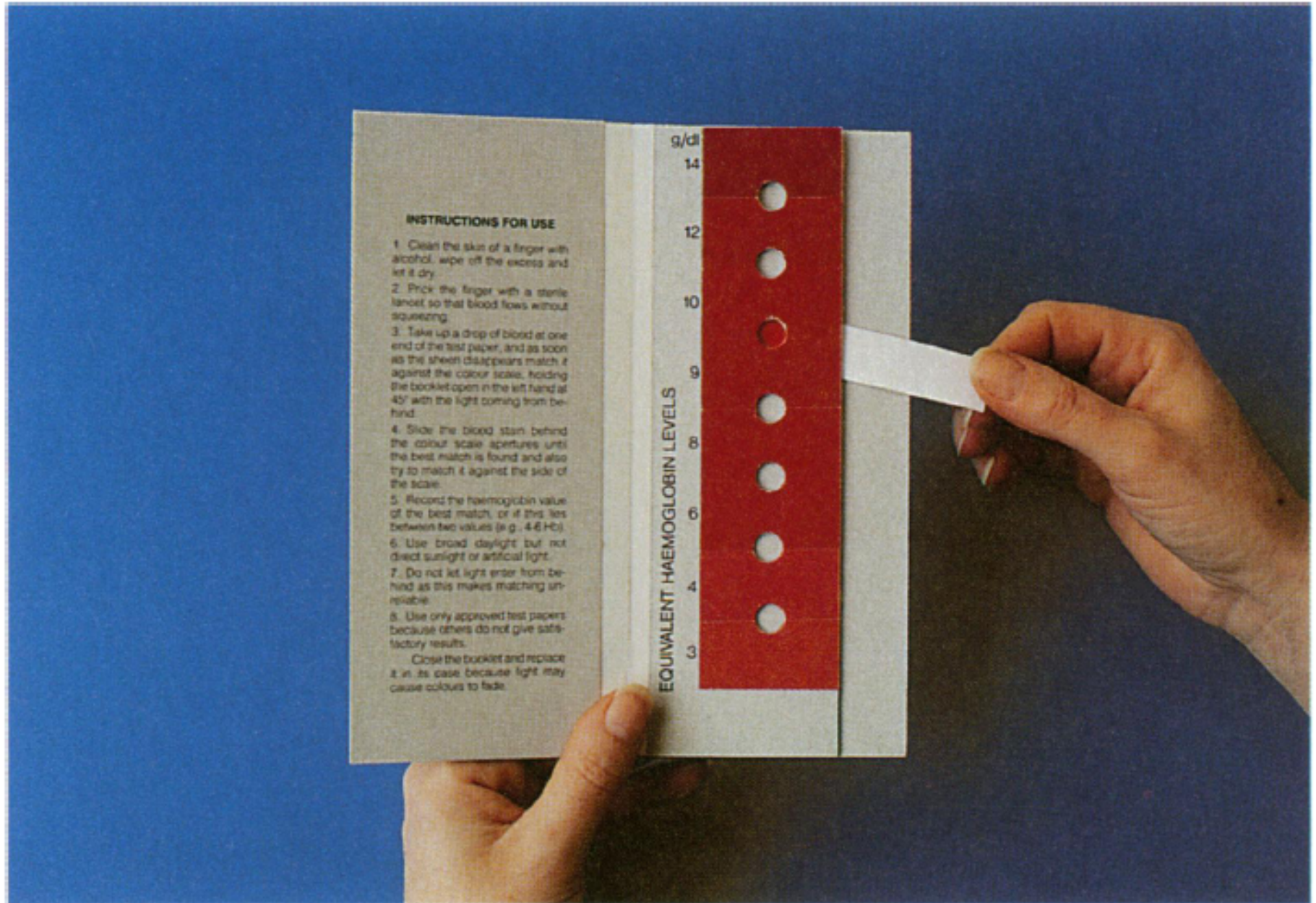


Registered





An example of a colour scale using eight colours (with apertures between the colours).



# Rationale



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- Clinical examination has been widely used which demands high expertise and vast clinical experience to be most accurate
- In low and middle income countries where resources are limited;
  - High cost, inadequate training and lack of facilities generally prevent the use of technologically advanced equipments
  - Health workers need a simple, cheap, robust device for measuring hemoglobin concentration



# Objective

To measure the diagnostic accuracy of Hemoglobin color scale (HCS) and clinical signs assessment technique (CSAT) in diagnosing anemia used by health care providers against the gold standard of Laboratory Hemoglobinometry



# Materials and Methods

- Cross sectional survey (Validation Survey)
- Duration of study:
  - July 2012-Feb 2013
- Community based antenatal clinics in
  - Maternal child health centre Old Thano, Gadap Town
  - UP Sindh Govt. Hospital, New Karachi Town
- Non-probability consecutive sampling







# Methods *cont.*

- Sample size was calculated by Dr Lin Naing calculator for sensitivity and specificity
  - Expected sensitivity and specificity of HCS as 79% and 94%,
  - Prevalence of anemia as 45.5%,
  - Confidence level of 95% and
  - Desired precision of 0.10,
  - Final sample size: **189**
- Ethical approval was taken from ERC AKU (2058-CHS-ERC-11)





# Data Analysis

- Data was analysed using software of SPSS version 19 and Medcalc version 12.4
- The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) were calculated for HCS and CSAT by using laboratory hemoglobinometry as gold standard

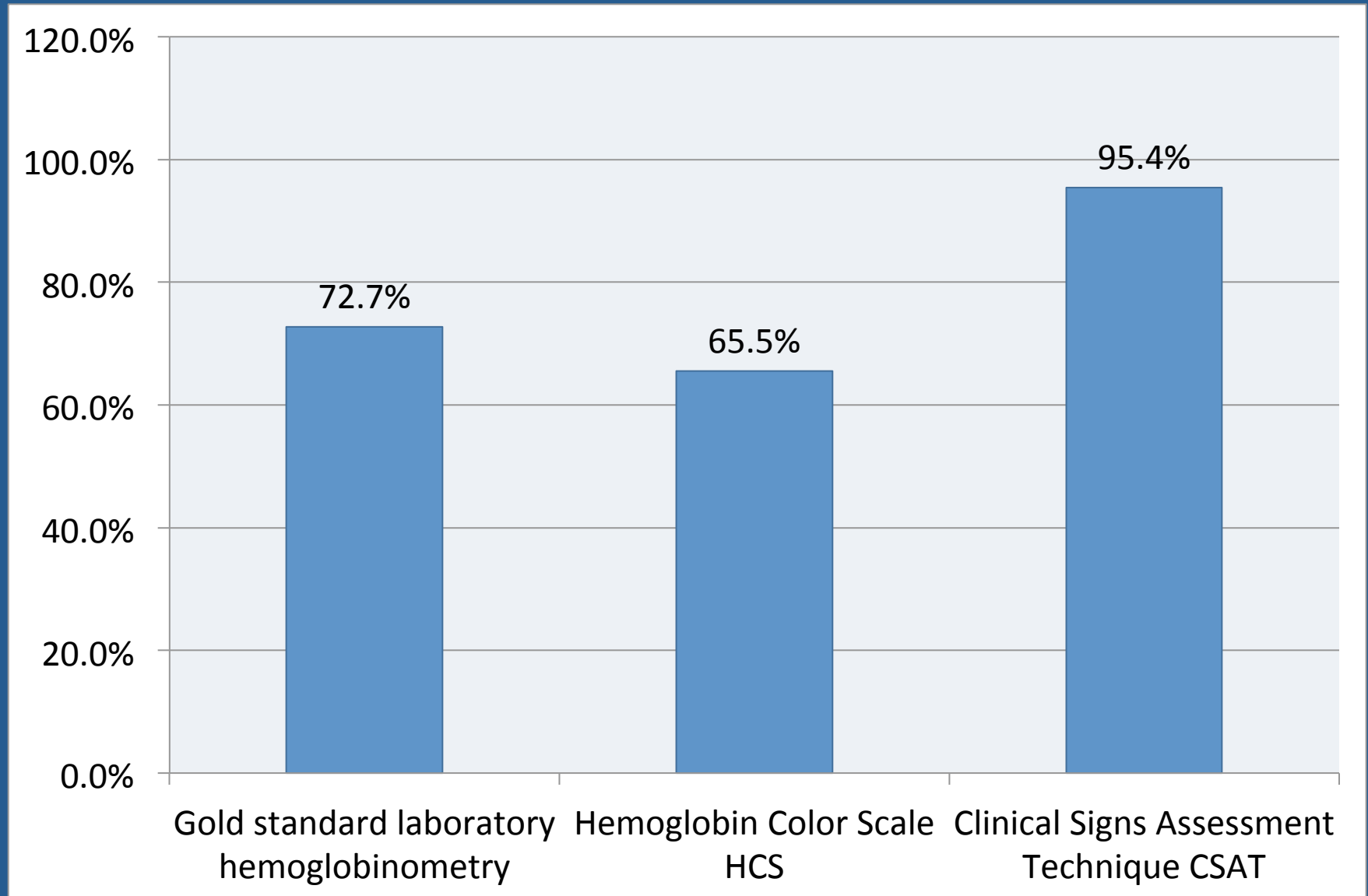
# RESULTS

**Table 1. Socio-demographic characteristics of pregnant women enrolled for assessment of WHO Hemoglobin Color Scale (n= 194)**

<b>Characteristics</b>	<b>Frequency (n)</b>	<b>Percentage %</b>
<b>Age (years) Mean (SD)</b>	25.69 (4.42)	
<b>Health facility</b>		
Old Thano MCH Gadap Town	94	48.5
UP Sindh Govt. Hospital New Karachi	100	51.5
<b>Residence</b>		
Gadap Town	66	34.0
New Karachi	82	42.3
Malir Town	33	17.0
Others <sup>i</sup>	13	6.7
<b>Educational Status</b>		
No education	52	26.8
Education in Madarsa only	30	15.5
Formal education	112	57.8
<b>Monthly household income (in thousands PKR)</b>		
< 10	142	73.2
> 10	52	26.8

<sup>i</sup> included Lyari, Landhi, N. Nazimabad, Bin Qasim, Gwadar Baluchistan, Gulshan-e-Iqbal

**Figure 1. Proportion and severity of Anemia by all 3 methods among the study population (n = 194)**

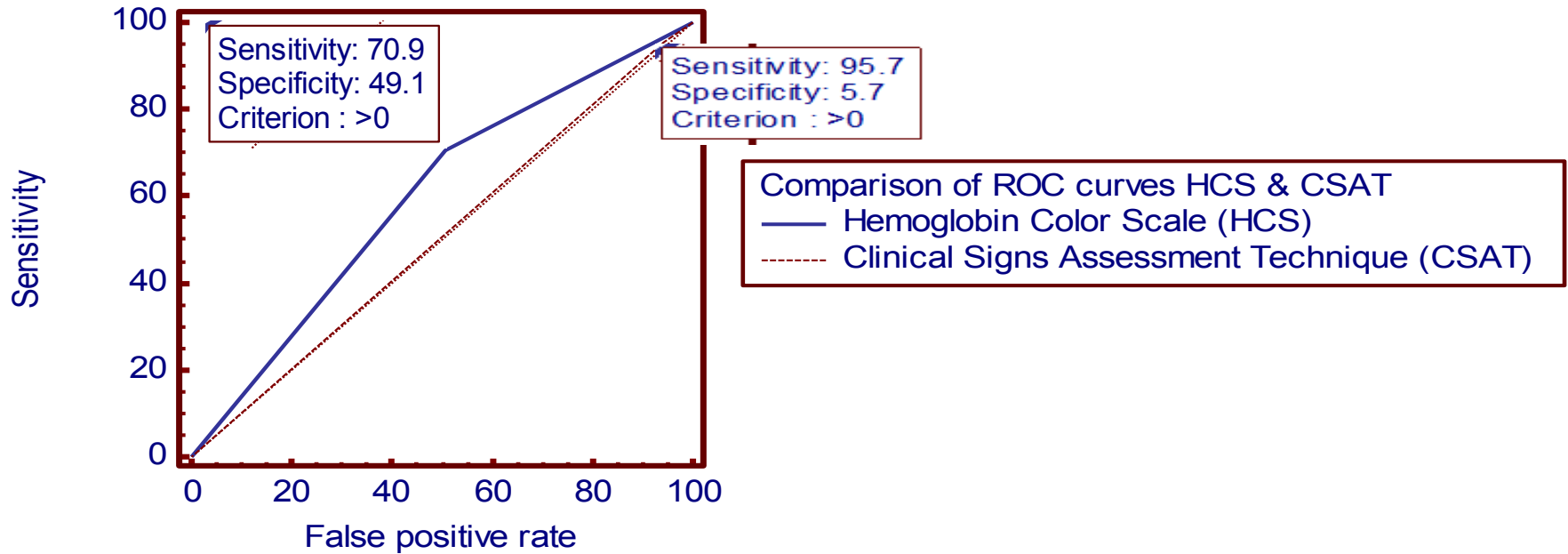




**Table 1. Validity indicators of Hemoglobin color scale & clinical signs assessment techniques (CSAT) against Gold standard laboratory hemoglobinometry (n = 194)**

<b>Validity indicators</b>	<b>Hemoglobin Color Scale (HCS)</b>	<b>Clinical Signs Assessment technique (CSAT)</b>
<b>Sensitivity % (95% CI)</b>	70.92 (62.68-78.26)	95.74 (90.97-98.42)
<b>Specificity % (95% CI)</b>	49.06 (35.06-63.16)	5.66 (1.18-15.66)
<b>PPV % (95% CI)</b>	78.74 (70.60-85.50)	72.97 (65.97-79.23)
<b>NPV % (95% CI)</b>	38.81 (27.14-51.50)	33.33 (7.49-70.07)

Figure 2. Comparison of ROC curves constructed from Hemoglobin color scale (HCS) and Clinical Signs assessment technique (CSAT) for diagnosis of anemia (n=194)





# Discussion

- Assessment of anemia by HCS has low yield but found better than CSAT
- Majority of individuals were labeled anemic by CSAT
- Other studies have mixed findings regarding sensitivity & specificity of HCS but comparison is difficult
  - India (Sensitivity 83% & Specificity 33%)
  - Brazil (Sensitivity 75% & Specificity 53%)
  - Kenya (Sensitivity 60% & Specificity 94%)
- Can also be used as a tool to increase the awareness and recognition of anemia among pregnant women



# Strengths & Limitations

## Strengths

- This study is first of its kind in Pakistan
- We compared the accuracy of HCS with laboratory hemoglobinometry
- Blinding of investigator & health care provider ensured that they were not aware of each other assessment

## Limitations

- HCS measurement done by principal investigator, ideally would be by health care provider at their settings
- Only one person did the assessment of HCS
- Small sample size



# Conclusion



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- Scope of HCS seems to be limited but found to be better instrument than existing technique
- Can be recommended at primary health care settings with precise and more stringent training for the health worker
- Further research can also be done with the use of HCS by community based health workers in resource-poor settings

# Accuracy and Use of WHO Hemoglobin Color Scale for Diagnosis of Anemia Among Pregnant Women by Health Care Providers in Periurban Settings in Karachi, Pakistan

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## Abstract

The study assessed the diagnostic accuracy of the Hemoglobin Color Scale (HCS), comparing clinical signs assessment technique (CSAT) of health care providers against the gold standard of laboratory hemoglobinometry. A cross-sectional validation study was conducted among 194 pregnant women located in 2 towns of periurban settings in Karachi, from June 2012 to February 2013. Anemia was assessed by HCS and CSAT by health care providers and compared with laboratory hemoglobinometry. The sensitivity and specificity of HCS were 70.9% (95% CI = 62.7-78.3) and 49.1% (95% CI = 35.1-63.2); for CSAT they were 95.7% (95% CI = 91.0-98.4) and 5.7% (95% CI = 1.2-15.7), respectively. The area under the curve for HCS for diagnosis of anemia was 0.60 (95% CI = 0.52-0.66), compared with 0.50 (95% CI = 0.43-0.57) for CSAT ( $P = .01$ ). The accuracy of HCS is better than CSAT for assessing anemia by health care providers among pregnant women.

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