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When Technology is Scarce: Assessing Maternal Child Anemia in Rural India

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Introduction

The World Health Organization estimates that in 2011, the last year for which we have global data, 800 million women and children are anemic. Within the Southeast Asia World Health Region, which includes India, the focus of this article, this accounts for nearly half of the maternal-child population. There are a number of underlying causes of anemia including heomoglobinopathies either inherited or acquired, macronutrient deficiencies, infections such as hookworm infestations, HIV and malaria or diseases such as cancer and malaria. Globally, the most common cause is insufficient dietary iron related to malnutrition (World Health Organization, 2015). Of immediate and pressing concern is that while iron-deficient anemia is eminently treatable, in India, anemia remains the sixth leading cause of death (Dandona et al., 2017).

Daru et al. (2018) suggests that a disproportionate burden of the sequela of anemia falls to low-income and middle-income countries defined by World Bank (2018) as those countries where the annual per capita income was less than $996 (low-income) in 2017 and $996 to $3895 in middle income countries. India, a middle-income country well-posed to tackle this condition has made tremendous strides yet it clearly remains a public health concern particularly among underserved populations. Iron-deficient anemia, a condition which can be assessed and treated has thus risen as a health priority in India including calls for more point-of-care research to ascertain the data needed to create comprehensive policy (Sinha et al., 2018). This article suggests a specific strategy utilizing community-based nursing care and point-of-care technology to assess and treat iron-deficient, maternal-child anemia in rural mountainous villages of one of the northeastern states of India, Himashal Pradesh.

Prevalence and Health Burden of Maternal-Child Anemia within India

In 1991 the Indian Ministry of Health and Family Welfare began collecting data on the health of their population. To date there have been four National Family Health Surveys with data available from 1992 to 93 (NFHS-1), 1998–99 (NFHS-2), 2005–06 (NFHS-3) and 2015–16 (NFHS-4) examining a number of key MCH health variables including maternal literacy rates, numbers of antenatal visits, place of birth, neonatal and childhood mortality rates, and childhood immunizations (NFHS, 2018). This data which is tracks the health of both the urban and rural population includes the percentages of people who are anemic. A fifth survey, NFHS-5 (2018–19) is currently being conducted with results likely available by 2020. Beginning with the second NFHS (1998–99) data was available at the state level. [See (Table 1) *Percent of Rural Maternal-Child Anemia, India and Himachal Pradesh 2005–2006 and 2015–2016 (NFHS-3, NFHS-4)* which compares the changes in rural maternal-child anemia from 2005 to 06 to the latest available data, 2015–16].

Strides have been made with the overall percent of anemic preschool children dropping by 21% throughout India in the years 2005–06 to 2015–16. Within Himachal Pradesh, which started with a lower percent of anemic children (63% compared to all-India 80%) the drop has been by 10%. Similar progress has been made among pregnant women across India with a 7% percent drop. However, of concern the percentages of anemic women in rural Himachal Pradesh have risen. The percentages of non-pregnant women have risen from 44% to 53%; the rise in pregnant women who are anemic is even more dramatic. Whereas in 2005–06 39% of pregnant women were anemic now it is one in every two women.

Burden of the disease

Anemia during pregnancy places women and children at serious risk. Daru et al. (2018) who examined the health records of more than 300,000 women from 29 low and middle income countries found that compared to women who were not anemic, women who were severely anemic (<7 g/dL) were more than twice as likely to die either during or within the first week following their births. Specifically within India, Nair et al. (2016) studied a sample of just over one thousand hospitalized pregnant women from Assam, a similar, rural state in the same general northeastern region of India as Himachal Pradesh. Using the WHO criteria of moderate anemia as Hb level 7–9.9 g/dL and severe as Hb < 7.0 g/dL, 35% of these women were either moderately or severely anemic. When compared to women who were either not anemic or mildly anemic the moderately to severely anemic women were nine times more

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Table 1
Percent of Rural Maternal-Child Anemia, India and Himachal Pradesh 2005–2006 and 2015–2016 (NFHS-3, 2005–06, 2018; NFHS-4, 2015–16, 2018).

	India		Himachal Pradesh	
	2005–2006	2015–16	2005–2006	2015–2016
Preschool children <11 g/dL	80.1	59.5	63.3	53.3
Pregnant women 15–49 y <11 g/dL	59.0	52.2	38.6	50.5
Non-preg women 15–49 y <12 g/dL	58.2	54.4	43.6	53.5

International Institute for Population Health Sciences (2018). The national family health survey, India, National report 1–5, Retrieved from http://rchiips.org/NFHS/index.shtml.

likely to have a postpartum hemorrhage and had a sixteen-fold higher odds of death during the perinatal period. Their babies were also at risk. Moderately to severely anemic women were six times more likely to have a low birthweight baby and nine times more likely to have a baby who was small for gestational age.

Iron-deficient anemia during childhood can affect a child for the rest of their lives. They are particularly vulnerable prenatally, during the first three years of life and during adolescence. The first two periods, prenatally and during early childhood are crucial as this is a time of rapid neurological development. Insufficient iron stores are associated with changes to the child's physical and mental development including their temperament, a decreased ability to process information, impaired memory and lower IQ scores. Long-term effects include decreased motor skills and the potential for poor academic performance. Despite early intervention strategies these alterations in the child's neurological functioning can persist throughout life (Cusick, Georgieff, & Rao, 2018).

Measuring Hemoglobin Levels in Rural India

In 1995 the World Health Organization reported the development a non-invasive, visual tool which could be used to estimate hemoglobin levels in rural areas where more sophisticated methods were less easily obtained. This tool, the Hemoglobin Color Scale (HCS) involves placing a drop of the patient's blood onto blotting paper and then comparing the color of the blood to the colors determined by the WHO to correlate with hemoglobin levels 3–14 g/dL (Stott & Lewis, 1995). Subsequent studies have comparing the HCS to standard laboratory equipment with Darshana and Uluwaduge (2014) finding that nearly half of the time (47%) the HCS was more than ±1 g/dL off. They attributed the differences to interrater reliability and subjective differences when comparing the patient's blood to the WHO tool. Yadav et al. (2018) found that the HCS was able to diagnose anemia 80% of the time but went on to suggest that more reliable technology such as the portable hemoglobin monitor developed by HemoCue was significantly more accurate.

HemoCue (HemoCue Hb301) is a relatively inexpensive (just under $ 500) portable monitor which uses a small drop of the patient's blood to measure hemoglobin from capillary, venous or arterial blood samples. This technology, while imperfect, is significantly more reliable with sensitivity of the monitor's ability to accurately measure hemoglobin ranging from 82% to 99%. Despite older literature suggesting that HemoCue overestimates the patient's hemoglobin from 0.5 g/dL (Tondon, Verma, Pandev, & Chaudhary, 2009) to 1.0 g/dL (Bhaskram, Balakrishna, Radhakrishna, & Krishnaswamy, 2003) researchers currently working in India recommend HemoCue for clinicians without access to more sophisticated laboratory equipment (Yadav, Jacob, Ahamed, Mandal, & Kant, 2018). Cautioning against adverse field conditions such as humidity and the use of older micro-cuvettes which may lead to a loss of sensitivity of the results, scientists working in India and thus best able to make recommendations conclude that of the currently available tools HemoCue Hb301 may be the most practical and least expensive for anemia screening (Yadav et al., 2018).

Implications for Nursing Practice

Nursing faculty and their students from Eternal University, located in Baru Sahib, India are current providing care to villagers in the mountainous regions of Himachal Pradesh. With the help of their faculty, licensed registered nurses who are enrolled in a two-year post baccalaureate program created an evidence-based health history screening tool which is being used in house-to-house surveys in the village of Nanu, Himachal Pradesh. In the spring of 2018 they began head-to-toe physical exams of the Nanu residents with the aim of continuing this work in the seven other local villages who receive care from Eternal University providers. The graduate nursing students and their faculty are currently using low-technology resources to conduct this work: stethoscopes, blood pressure cuffs, one portable scale to weigh the children and adults and measuring tapes for anthropomorphic measurements.

While current evidence suggests that more than half of the mothers and their children of this region are likely anemic knowing their precise hemoglobin would allow the clinicians to most appropriated and accurately diagnose, treat and refer as necessary. More to the point, Nair et al. (2016) noted in their study of over one thousand Indian women in a region similar to the villages served by the clinicians of Eternal University that only one in four pregnant women were likely to take iron-folic acid tablets. Of greater concern 62% of the women were diagnosed in their third trimester as severely anemic when it is too late for iron supplementation. The grave risks of maternal mortality and long-term childhood neurological sequelae due to severe anemia reinforces the need for community-based education, on-going assessments using available technology, early intervention, treatment and referrals as necessary. All of these interventions are within the purview of the Eternal University clinicians, what is needed is the technology.

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