SPECIAL ARTICLE

1. Fetal Intervention Division. Department of Gynecology, Obstetrics, and Reproductive Sciences. John P. and Kathrine G. McGovern Medical School. University of Texas Health Science Center at Houston. ORCID code. 0000-0003-3666-9593

Author and ethical approval: Yes

Declaration of conflict of interest: The authors declare no conflict of interest

Funding: Author's resources.

Declaration of use of artificial intelligence to produce the article: Yes.

Permission to publish: Yes

Source of the Figures:
Figure 1. https://commons.wikimedia.org/w/index.php?curid=9097872
Figure 2. Larco Museum, Lima, Peru.

Recibido: 7 June 2025

Aceptado: 16 September 2025

Online publication: 27 October 2025

Correspondence:
Percy Pacora Portella
ppacorap@gmail.com

Cite as: Pacora P. La The history of fetal medicine and surgery in Peru gives meaning to the eternity of life. Rev peru ginecol obstet. 2025;71(2). DOI: https://doi.org/10.31403/rpgo.v71i2792

The history of fetal medicine and surgery in Peru gives meaning to the eternity of life

La historia de la medicina y cirugía fetal en el Perú da sentido a la eternidad de la vida

Percy Pacora Portella[1]

DOI: https://doi.org/10.31403/rpgo.v71i2792

ABSTRACT
Human beings are born with an innate perception of the eternity of life and an awareness of the struggle between good and evil, where evil symbolizes illness and death, and good symbolizes health and hope for eternal life. The phrase "there are no illnesses, only sick people" reflects a vision centered on the human person, not just on the illness, and has its roots in Peruvian and global medical history. Before the advent of writing, Peruvian doctors knew the properties of medicinal plants and developed intervention procedures, especially in the care of pregnant women, which are still used today. The arrival of writing and Western education delayed the incorporation of this knowledge due to colonial prejudices. However, thanks to the compassionate spirit of Peruvian and foreign teachers, generations of Peruvian doctors were trained who now offer high-quality fetal care, comparable to that of developed countries. Modern medicine, especially in fetal surgery, depends on interdisciplinary work based on trust, respect, and collaboration between professionals, families, and communities, following international medical protocols. The healing power of the physician lies in their faith in life and in understanding the laws that sustain it, acting in cooperation with the family and respecting human dignity. Only with knowledge of the factors that affect health before pregnancy can we transform the environment into a healthier one, thus continuing the legacy of the ancient Peruvian inhabitants.
Keywords. Human health, human disease, fetus, medical care, life, knowledge.

RESUMEN
El ser humano nace con una percepción innata de la eternidad de la vida y una conciencia de la lucha entre el bien y el mal, donde el mal simboliza enfermedad y muerte; y el bien, salud y esperanza en la vida eterna. La frase "no existen enfermedades, sino enfermos" refleja una visión centrada en la persona humana, no solo en la enfermedad, y tiene raíces en la historia médica peruana y mundial. Antes de la escritura, los médicos peruanos conocían las propiedades de plantas medicinales y desarrollaron procedimientos de intervención, especialmente en el cuidado de mujeres embarazadas que se emplean en la actualidad. La llegada de la escritura y la educación occidental retrasó la incorporación de estos conocimientos, debido a prejuicios coloniales. Sin embargo, gracias al espíritu misericordioso de profesores peruanos y extranjeros, se formaron generaciones de médicos peruanos que actualmente ofrecen atención fetal de alta calidad, comparable con la de países desarrollados. La medicina moderna, especialmente en cirugía fetal, depende de un trabajo interdisciplinario, basado en la confianza, respeto y colaboración entre profesionales, familias y comunidades, siguiendo protocolos médicos internacionales. El poder curativo del médico radica en su fe en la vida y en comprender las leyes que la sostienen, actuando en cooperación con la familia y respetando la dignidad humana. Solo con el conocimiento de los factores que afectan la salud desde antes del embarazo podremos transformar el ambiente en uno más saludable, continuando así el legado de los antiguos habitantes peruanos.
Palabras clave: Salud humana, enfermedad humana, feto, atención médica, vida, conocimiento.

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"A scholar of the law asked Jesus: What must I do to inherit eternal life? Jesus asked him about what is written in the law. 'You shall love the Lord your God with all your heart and your neighbor as yourself,' replied the scholar. The scholar then asked, "Who is my neighbor?" Jesus told the story of the man who was wounded on the road and helped only by a compassionate Samaritan, whose act of mercy saved his life. Jesus concluded, "Go and do likewise."

Luke 10:25-37 (The Bible in American English Abridged)

Introduction

The first people to arrive in South America came from Asia via the Bering Strait or by boat along the Pacific coast more than 15,000 years BC[1–3]. The Andean region, where Peru is located, is one of the most rugged and difficult in the world, and it would have taken thousands of years for its first inhabitants to master the Andes mountain range. The territory of the Incas, which encompassed Ecuador, Peru, Bolivia, and parts of Chile and Argentina, was divided into coast, highlands, and Amazon rainforest[4] (Figure 1). Despite geographical difficulties and natural disasters, pre-Columbian Peruvian societies were very advanced. After Spanish colonization, African, Asian, and European immigration increased, creating a mestizo culture known as "chola," where Peruvians are not distinguished by their skin color or size, but by a character of enormous physical, intellectual, and spiritual energy that allows them to worship the creator of the sun, moon, and mountains, qualities inherited from all the bloodlines that have merged in this territory.[5] The supplementary table summarizes the most relevant facts in this journey to continue defending human health and life.

Ancient Peru

Peru is one of the most biodiverse countries, with 28 of the 32 existing climates and 10% of the world's flora, many of which have been used medicinally since ancient times[6,7]. Among them are coca, maca, sangre de grado (dragon's blood), and cat's claw (cat's claw), many of which are still under investigation[6,8]. Medicine emerged in ancient times when humans began to learn about the properties of plants and natural objects for healing ailments. In pre-Hispanic culture, diseases were attributed to sins, and confession and sacrifices were practiced for healing. Huacas, sacred objects such as stones and burials, also had supernatural power[9]. The Incas believed that divine forces were present in material objects, and priests and healers, called hampicamayoc, had a deep knowledge of medicinal and poisonous plants[9].

Traditional midwives, responsible for childbirth, used plants and ancestral techniques, involving the father in the pregnancy process and promoting upright childbirth[10–13], as seen in the ceramic representation of the Mochica culture (Figure 2). In pre-Inca times, cultures such as Chavín, Huari, and Moche stood out for their art and knowledge of medicine, represented in ceramics, mummies, and weapons[4,14]. The Moche culture, in particular, showed anatomical and medical details in their ceramics[14, 18], and

Figure 1: Inca Empire
https://commons.wikimedia.org/w/index.php?curid=9097872

Figure 2: Larco Museum, Lima, Peru.

they performed trepanations with high survival rates, demonstrating advanced knowledge of surgery[15]. Medicine in Peru has always been linked to religion and magic, with offerings and rituals surrounding pregnancy and health[16, 20, 21]. Since ancient times, Peru has demonstrated a deep knowledge of medicinal plants, surgery, and care practices, leaving a legacy that still amazes today for its antiquity and perfection[14].

The colony

After the conquest of the Inca Empire, European culture predominated in Peru, disparaging and persecuting indigenous knowledge, which was considered superstition[16]. Medical training was centered at the Royal University of San Marcos, founded in 1551, which prioritized theology and rhetoric, relegating anatomy and physiology to the background, which led to the discrediting of the profession and the proliferation of charlatans[16]. Obstetrics was seen as a minor branch, with no formal teaching, leaving childbirth in the hands of uneducated women, where empiricism prevailed[16].

Childbirth complications and maternal mortality were alarming, leading Carlos III to issue rules for performing cesarean sections in 1781, and the priest Francisco Gonzales de Laguna promoted cesarean sections in necessary cases. Although there is no evidence of cesarean sections in colonial Peru, one was reported in Tucumán in 1794. At that time, doctors such as José Manuel Dávalos, who had trained in France, described pregnancy pathologies and practices such as the administration of colostrum and hygienic management of newborns[16].

José Hipólito Unanue, founder of modern medicine in Peru, attempted to incorporate obstetrics into teaching, but a lack of teachers and resources prevented its implementation[16,17]. The indigenous population maintained its ancestral practices, many of which are still in use in rural communities[16].

19th century

After independence in 1824, obstetric practice suffered a setback due to political and military chaos[16]. However, in 1826, the Lima Maternity Home was created, directed by French obstetrician Benita Cadeau de Fessel, who promoted the training of highly skilled midwives. Knowledge of anatomy was at the core of the teaching at the Lima School of Childbirth[16]. This medical knowledge allowed Peruvian midwives to distinguish themselves from traditional midwives. Future midwives studied for four years what future doctors studied in one year at the Lima School of Medicine. Future midwives studied the same obstetric topics as male students, namely natural and dystocic deliveries, and diseases of parturient women and newborns. Benita de Fessel also required her students to learn French so that they could read the works of the great obstetricians of the time. This requirement remained in force even after Benita de Fessel returned to France[17]. Following this educational model, hundreds of Peruvian midwives highly qualified in both theory and practice were trained during the 19th and 20th centuries[17].

In 1836, Mrs. Fessel returned to France for health reasons, leaving the management of the Obstetrics School to Francisco Faustos, who had been working at the Santa María de la Caridad Hospital since 1816[16]. In 1841, they moved to the Santa Ana Hospital, where in 1847 the Lima Charitable Society reported their decline, stating that they had almost disappeared and that it was necessary to train new generations of professionals in obstetrics[16]. Therefore, in that same year, it was agreed to create a new school of obstetrics and to clearly delimit the maternity section in the hospital[16,18,19].

The history of medical education in Peru was marked by figures such as Cayetano Heredia, who reorganized the San Fernando Faculty of Medicine, promoted professionalization, and sent his best students to Paris on scholarships to learn modern trends[18]. In 1848, obstetrics began to be taught at the Colegio de la Independencia, initially by Francisco Faustos, who practiced until 1850. Heredia also sent his best students to Paris, including Camilo Segura, to acquire advanced knowledge in surgery and obstetrics[18]. In 1856, the San Fernando School of Medicine was formally founded, becoming part of the Universidad Mayor de San Marcos, with Segura as professor of obstetrics[16,18].

Advances in surgery were consolidated with the arrival of anesthesia in 1847[19] and antisepsis in the 1860s[20]. In 1878, José Lino Alarco performed the first successful intraperitoneal surgery[21].

During the regime of Nicolás de Piérola, in 1897, the chair of gynecology was created in San Fernando, with resources from the Santa Ana Hospital, and it was Tendulio Constantino Carvallo Loli who contributed all his income from the University and established the first modern operating room in the country, revolutionizing obstetric and gynecological surgery in Peru[16, 41]. However, in many regions, traditional midwives continued to attend births without Western knowledge[16].

20TH CENTURY

Maternal and child health care in Peru experienced significant advances thanks to the work of prominent doctors and the creation of specialized institutions. On May 31, 1900, Alberto Barton, then an intern at Santa Ana Hospital, performed the first cesarean section on a deceased pregnant woman, successfully delivering a baby boy who survived; this event marked a milestone in Peruvian medical history[22]. Later, in 1910, Dr. Belisario Sosa Artola performed the first cesarean section in which both mother and child survived, at the San Juan de Dios Hospital in Callao[22]. In 1909, Enrique Febres Odriozola joined the Maternity Hospital of Lima, which at that time was part of the Santa Ana Hospital, as a senior physician. Thanks to his efforts, in 1915 the Lima Charitable Society approved improvements to the Maternity Hospital, which moved to new premises at the San Andrés Hospital in 1916. In 1921, Febres was appointed director of the Maternity Hospital, achieving its institutional autonomy, and in 1922 he founded the Obstetric and Gynecological Institute within the hospital, offering specialized services and a pioneering incubator room in Peruvian neonatology[16].

During the first half of this century, other important milestones occurred: the first segmental cesarean section in 1939 by Víctor Bazul[22]; the operation of Lina Medina, the youngest mother in history, in 1939; and the first exsanguination transfusion in 1949[16]. In addition, in 1924, the Arzobispo Loayza Hospital was inaugurated, directed by Dr. Constantino Carvallo, who was one of the founders of the Peruvian Society of Obstetrics and Gynecology, created in 1947. The institution consolidated its presence with publications such as the journal Gynecology and Obstetrics, founded in 1955, and included prominent figures such as Abraham Ludmir Grimberg, Jorge Vidal Amat, and José Pacheco Romero, who promoted the training of residents, research, and the unification of the specialty in the country.

HEALTH IN THE ANDES

At the same time, health in the high altitudes of the Andes was the subject of intensive study. Approximately 81.6 million people live at more than 2,500 meters above sea level, in an environment that has been a natural laboratory for understanding the effects of hypoxia on human health. Since the 19th century, French scientists such as Jourdanet, Bert, and Viault have investigated how life at these altitudes affects physiology, establishing concepts such as polycythemia and erythrocyte adaptation. Bert, in particular, concluded that low oxygen concentration caused fatal manifestations, but also that changes in the blood allowed for greater tolerance, and he designed hemoglobin and oxygen curves that formed the basis of these studies. In 1889, Viault observed polycythemia as an adaptive mechanism in the inhabitants of Morococha, at 4,540 meters above sea level.

Peruvian research, led by Carlos Monge Medrano in 1928, introduced concepts such as Adaptation-Acclimatization-Disadaptation and described Andean Disease or chronic mountain sickness, which affects those who remain at high altitudes. Monge argued that the native inhabitants were fully acclimatized, developing superior physical qualities, and that their resistance derived from physiological mechanisms such as increased chest volume, polycythemia, and hyperventilation, consolidating the idea of an Andean biology.

REPRODUCTIVE CAPACITY AT HIGH ALTITUDES

Reproduction at high altitudes is particularly sensitive to hypoxia[1]. Since colonial times, it has been documented that Spaniards faced reproductive difficulties, delaying births in high altitude regions. Recent studies show that fertility in women and animals is affected by altitude, with lower birth weight, higher incidence of small for gestational age, and higher risks of complications such as preeclampsia.

Fertility is affected at high altitude, with later births and lower birth weight. The history of colonization and miscegenation influences ad-

aptation, and in regions such as Cerro de Pasco, women with generations at high altitude show better oxygen saturation and higher neonatal weight. Male reproductive function is also affected, with decreased sperm quality, changes in testosterone, and testicular vascularization, although genetic adaptation helps mitigate these effects.

Physiological adaptations to altitude and complications in fetal development

People living in high altitude areas have adapted to a degree that provides them with a certain level of protection[23], such as greater chest volume, more red blood cells, and better gas exchange. Thus, populations such as the Tibetans and Andeans show resistance to hypoxia, with better births and fewer complications[23]. However, hypoxia can limit fetal growth[1, 2], cause alterations in organ formation, congenital anomalies, preeclampsia, and increase the risk of fetal and neonatal death[1, 2]. Altitude reduces uterine blood flow, affects placental function and metabolism, which limits fetal development and increases mortality[23].

Maternal-Fetal Medicine

Peru's contributions to the field of fetal health and medicine are vast and structured across different areas. Below is an organized summary of this knowledge.

1. Definition of human health

   Health is the ability of human beings to adapt biologically, psychologically, socially, and spiritually to their environment. This ability to adapt allows them to maintain homeostasis, achieving inner peace that enables them to receive and offer social cooperation, which are fundamental characteristics of well-being[24].

2. Determinants of health

   Health depends on the interaction between heredity and environment. These factors depend on the individual, the family, the community, and society[25].

3. A family history of high blood pressure and diabetes mellitus is associated with premature birth, preeclampsia, cesarean delivery, antenatal hospitalization, and gestational diabetes[26].

4. The stressors that influence the pathogenesis of diseases are diverse in nature:

   1. Social: A critical aspect of maternal health in Peru is violence against women, which begins in childhood and continues into adulthood, affecting reproductive health. Violence, along with low educational attainment, economic dependence, and delays in seeking care, increases the risk of complications such as hemorrhage, preeclampsia, premature birth, and maternal mortality. Delays in seeking health services, especially in rural areas, and the quality of care are also important causes of maternal mortality and morbidity.

   2. Psychological: Characterized by anxiety, depression, post-traumatic stress, childhood violence, suicidal ideation, and problems in adolescence, which influence obstetric outcomes and birth weight. Violence and abuse increase the risk of premature births and low birth weight. Mental health is therefore a key component of comprehensive care for pregnant women.

   3. Nutritional: Anemia, malnutrition, underweight, overweight, and obesity are factors that affect maternal and neonatal health in Peru. Maternal hemoglobin below 9 g/dL and above 13.5 g/dL is associated with increased risks of small for gestational age (PEG - CIR) newborns. However, in high-altitude areas, hemoglobin values may be adjusted for adaptation to altitude, and lower levels do not necessarily indicate anemia, but rather a physiological adaptation that favors higher birth weight.

   4. Morphological: Structural abnormalities, genetic disorders, multiple pregnancies, short cervix, and amniotic fluid clumping are factors that influence maternal and perinatal health. Early detection and intervention are essential to reduce risks and improve perinatal outcomes.

5. Metabolic: Includes gestational hyperglycemia, prediabetes, diabetes mellitus, obesity, thyroid disease, depression, migraine, and excessive exercise.

6. Vascular: Includes all complications of pregnancy. Although preeclampsia and eclampsia are manifestations of vascular disease, greater education and social support for women allows for the diagnosis of preeclampsia; lack of social support favors the onset of eclampsia.

7. Infections: The vaginal microbiome, urinary tract infections, syphilis, tuberculosis, brucellosis, malaria, dengue, HIV, Zika, and COVID-19, among other microorganisms, can affect maternal and fetal health.

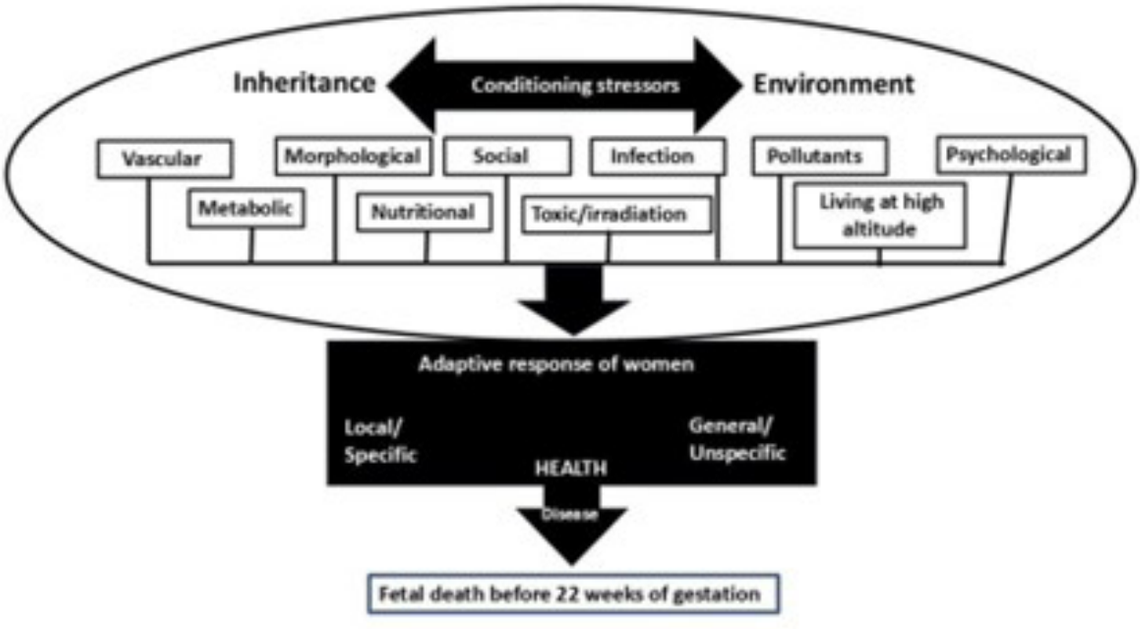
8. Toxic substances and radiation: The consumption of tobacco, alcohol, drugs, and endocrine disruptors increases the risk of obstetric complications and congenital anomalies, especially in rural areas where the use of biomass for cooking increases exposure to air pollutants.

9. Environmental pollutants: Pollution from particulate matter, ozone, carbon monoxide, sulfur and nitrogen oxides, and lead affects health in areas with homes that use biomass fuels. Exposure to these pollutants in rural and elevated urban areas can further reduce birth weight and increase the frequency of pregnancy complications, such as early fetal loss.

10. Living at altitude: Living at an altitude above 999 meters is associated with a higher frequency of abortions in public hospitals in Peru, and this frequency increases progressively as the altitude increases. The average birth weight of full-term newborns is significantly lower at altitudes above 2000 meters in the 29 hospitals of the Peruvian Ministry of Health in 2008[2]. In addition, living above 3500 meters is associated with four times more heart abnormalities than at sea level[1].

5. The origin of disease and human death

Figure 3 shows that health results from an interaction between heredity and the environment, which generate specific stressors that modulate the physiological responses of the human development system (maternal-fetal-placental unit). These ten specific stressors, described above, act independently or synergistically to influence the human development system. In response, this system employs adaptive mechanisms—shaped by genetic predispositions—that can manifest locally, such as decreased perfusion of vital organs and developmental abnormalities, or



systemically, including the development of metabolic syndrome, increased proinflammatory cytokines, and cellular oxidative stress. These systemic responses can promote vascular alterations such as atherosclerosis. When the cumulative burden of these responses exceeds the adaptive capacity of the system, pathological processes occur that lead to fetal disease. Fetal death occurs unless timely intervention is taken to halt the deleterious effects of these stressors[27].

6. Technological advances and clinical strategies

   The use of anesthesia, blood transfusions, prophylactic antibiotics for emergency cesarean sections, Pap smears, the Peruvian labor curve, prenatal sonography, minimally invasive surgery using endoscopy, techniques such as compressive suturing of the uterus during cesarean sections, fetal growth curves, and the diagnosis of hypertension and gestational hyperglycemia have contributed to reducing complications in maternal health and improving perinatal outcomes[28].

Since the introduction of ultrasonography in 1977[16], prenatal diagnostic techniques have been developed, including three-dimensional ultrasound, Doppler, and fourth-dimensional fetal echocardiography, which improve the detection of abnormalities and allow for more accurate monitoring. The use of new care strategies such as early care in pregnancy, the use of new diagnostic criteria, lung maturation therapy with corticosteroids, the use of non-invasive ventilation, and parenteral nutrition have improved the survival of extremely premature infants since the 1970s[29].

Fetal Therapy and Surgery

Advances in prenatal therapy and fetal surgery in Peru reflect a history of dedication, research, and interdisciplinary cooperation that has transformed care for high-risk pregnancies and congenital malformations. From the early years, prenatal diagnosis was key to successful interventions, supported by clinical knowledge, animal models, and advanced technology.

A pioneer in fetal therapy was Albert William Liley, who in 1963 in Auckland performed fetal peritoneal transfusions in fetal hemolytic disease due to Rh isoimmunization. In 1972, Graham Liggins and Ronald Howie achieved fetal lung maturation with glucocorticoids, a crucial advance in reducing mortality in premature infants. Modern fetal surgery began in the United States with Michael Harrison at the University of San Francisco, who initially focused on congenital diaphragmatic hernia, which had a mortality rate of 50%. Harrison noticed a "hidden mortality": many newborns died before 1982, the first international conference on fetal surgery was held, where it was agreed to share data, create registries, and establish guidelines, strengthening the discipline. Harrison proposed recording all cases to evaluate benefits and risks, a practice that still continues today. Advances in imaging and prenatal diagnosis in recent decades have facilitated fetal interventions, many using fetoscopic techniques, thanks to the miniaturization of instruments and advances in digital optics.

Work on animals was essential to understanding and perfecting techniques. The list of treatable conditions grew over time, including structural malformations, genetic defects, and progressive diseases, with the goal of saving lives or preventing permanent damage. The International Fetal Medicine and Surgery Society (IFMSS) established selection criteria based on benefit-risk, probability of improving prognosis, and safety for mother and fetus. Ethics in fetal surgery are fundamental: interventions should be invasive only when there is a high probability of success, low risk for both, and informed and autonomous consent from the pregnant woman.

Fetal pain control is a priority. Analgesics such as fentanyl, atropine, and vecuronium are used, adjusted to fetal weight, to reduce nociceptive responses and bradycardia, always monitoring fetal cardiac function by ultrasound. Clinical surveillance and ethics committees ensure transparency and compliance with international standards[30].

In conclusion, the scientific, ethical, and technological foundations of fetal medicine in Peru have been driven by compassionate individuals who promoted teaching, interdisciplinary collaboration, learning, and technological innovation, making healthcare comparable to that of developed countries. The Peruvian legacy reflects a vision centered on respect for the dignity of the

individual and belief in the healing capacity of the physician, working in cooperation with the family and society.

By understanding the factors that determine health and disease conditions before pregnancy, we can transform the environment into a healthy one. This is the main challenge, and it is the legacy left to us by the ancient Peruvians, who acted as good Samaritans, as highlighted in the preamble to this article.

Acknowledgement

This article is dedicated to Delia Moreno Baanante MD and Robert Feldman MD, Anthony Johnson MD, and Roberto Romero MD, individuals of integrity and noble spirit, whose friendship has been a comforting reference point for all who know them, exemplifying the enduring spirit of life.

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