

Systematic Review

Present Status of the Iranian Newborns' Health, Survival, and Care and Future Challenges

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Abstract

Introduction: Providing, maintaining, and improving the health of newborns is one of the most important goals of the health care system in the Islamic Republic of Iran. On the eve of the 40th anniversary of the Islamic Revolution of Iran, we will review factors affecting the health of Iranian neonates over the past 40 years.

Methods: We investigated the evolution of neonatal health and contributing factors in all reports, documents, and articles published by the Iranian Ministry of Health and Medical Education and the former Iranian Ministry of Health as well as WHO, and UNICEF databases from 1970 to 2018. The main topics of the present study include recent developments in reduction of maternal and neonatal mortality, major measures taken to decrease risk of neonatal death, and future challenges.

Results: We have reviewed more than 3500 pages of documents and articles published by authoritative sources before and after the Islamic Revolution. A neonatal mortality rate (NMR) of 9.6 per 1000 in 2017 was recorded in Iran, demonstrating a reduction of over three-quarters compared with the pre-Revolution period. Improved prenatal care and nutrition, tetanus vaccination of pregnant mothers, performance of 96.4% of deliveries by trained individuals, circulation of clinical protocols for the integration of midwifery and maternity services, provision of neonatal resuscitation equipment in delivery rooms, promotion of breastfeeding from the first hour after birth onward, establishing and equipping NICUs, increased training of specialists and sub-specialists, prevention and treatment of infections, increasing awareness in families and family-centered neonatal care focused on neonatal brain development, the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) and Kangaroo-Mother Care (KMC) are examples of progress made in neonate healthcare after the Islamic Revolution.

Conclusion: Despite 8 years of war and a variety of sanctions being imposed against I.R. of Iran, very substantial improvements have been achieved in neonatal health and relevant underlying factors. However, we are still faced with challenges that require the engagement of experts and researchers in neonatal medicine.

Keywords: Challenges, Health, Iranian newborns, Survival

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Introduction

Forty years after the victory of the Islamic Revolution of Iran in February 1979, we decided to review the neonatal health improvement in the I.R. of Iran. Following the revolution, the U.S. government encouraged Saddam Hossain to attack Iran, and subsequently imposed different kinds of sanctions against Iran. Despite all the animosities, the country has remained safe and secure; the literacy rate has improved drastically, particularly among women; there is almost universal access to safe drinking water and better nutrition; there is reduced poverty and improved infrastructure such as road access, telephone lines, electricity, public and private transportation,¹ sewage system, and sanitation.²

In 1983, the Ministry of Health launched the Expanded Program on Immunization (EPI). In 1984, by using the experiences gained from the pilot study in the Urmia

district, a law for expansion of the Primary Health Care Network (PHC) was passed by the Iranian Parliament. The implementation of the PHC system led to a much more equitable health care and improved health indices drastically.

As the country was suffering from shortage manpower in health services, and the Ministry of Higher Education was unable to solve the problem, a law was passed which separated all health related schools and institutions from the Ministry of Higher Education and integrated them into the Ministry of Health, creating the Ministry of Health and Medical Education (MOHME). Immediately afterwards, at least one university of medical sciences and health services was established in each province. This move led to a growing number of students in various disciplines of medical sciences as well as a movement toward Community Oriented Medical Education (COME). These

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two revolutionary laws (i.e. establishing and expanding the PHC throughout the country and also integration of medical education into the health services) lead to a marked reduction of maternal mortality ratio (MMR) and neonatal mortality rate (NMR) as well as improving and promoting mother and newborn health status. In this review, we examined factors that have affected the health of Iranian neonates over the past 40 years.

Materials and Methods

In this review of the literature, we considered reports and documents published by the MOHME and the former Ministry of Health as well as related articles published in Iranian and international journals from 1970 to 2018 indexed in Google Scholar, WHO, PubMed, and SID. We also conducted interviews with officials in the Neonatal Department of the Ministry of Health. In order to better present the information collected, we categorized them, and in each category, we compared the situation in the past to the present. These categories are as follow.

1. The trend of MMR and NMR in Iran and its most important causes
2. Major measures taken to decrease risk of early neonatal death (in the first day and first week of life)
3. Major measures taken to decrease risk of late neonatal death (after the first week of life)
4. Future challenges

Results

In this study, we have reviewed more than 3500 pages of official documents published after the Revolution by the former Ministry of Health as well as the Ministry of Health and Medical Education. The statistics provided on the health of newborns and mothers in this article are mainly cited from articles published by Iranian researchers in academic journals. We have also examined 35 scientific papers. The results are as follows.

1. Trend of Neonatal and Maternal Death in Iran and its Most Important Causes

MMR declined from 254 per 100 000⁴ live births in 1978 to 19 in 2018. With efforts of all countries to achieve the Millennium Development Goals, the decrease in U5MR and IMR accelerated. However, the drop in NMR was much slower. Thus, by 2015, a much higher percentage of the global U5MR was related to neonatal mortality.³

This occurred in Iran as well. The oldest relevant statistics in Iran are the U5MR and the infant mortality rate (IMR) prior to the Revolution which was 154 and 104 per 1000 live births respectively.⁴ Also, in a report by Barzegar and Djazayeri in a PHC pilot in Urmia in the period of 1977–1978, NMR was determined to be 68 per thousand live births.⁵ With gradual reduction in risk factors over the course of 5-year national development

programs, the NMR had reached 10 in 1000 live births by the end of 2015.⁶ These indicate that the NMR in Iran had fulfilled MDG 4, i.e. a two-thirds reduction in child mortality rate. Fortunately, over the past years, we have seen a further decrease in this rate with the United Nations estimate for 2017 being 9.6 (CI = 90%: 6.3–14.4).⁷ Recently MOHME's reports, indicate that NMR has reached 8.8 per 1000 live births.

Neonatal tetanus was one of the major causes of neonatal death in the years before the Revolution and even the early years after the Revolution. According to the estimates, in the early 1980s, there were reports of nearly 11 000 infant deaths per year from tetanus. It should be noted that in these years, there was no compulsory illness reporting system and thus the number was possibly higher. In 2006, the number of neonatal tetanus in Iran was reported as 9.⁸ In a 2007 article about the causes of neonatal death in a hospital of Tehran, about 84% of infant deaths were related to prematurity and approximately 82% had LBW. The most common causes of death were prematurity and associated complications such as neonatal respiratory distress syndrome (RDS), intracerebral hemorrhage, and even air leak syndrome, which is a consequence of using ventilation devices to treat RDS. Septicemia, pneumonia, congenital anomalies, and asphyxia were less frequent causes of death.⁹

2. Major Measures Taken to Decrease Risk of Early Neonatal Death (in the first day and first week of life)

Considering that 25%–45% of neonatal deaths occur in the first 24 hours and three-quarters of deaths occurs in the first week of life,^{3,9,10} consideration of risk factors in this period of life will probably have the greatest effect in the reduction of neonatal mortality. The most important measures in this regard are as follow.

Prenatal Care

In designing and expanding the PHC network in Iran, maternal health care was considered as one of the most important focuses, and in the first published report of the PHC pilot in Iran, each mother was visited 3–4 times during pregnancy.⁵

Prenatal and postnatal cares as well as recording data on pregnant mothers were among the primary tasks of the network.⁴ Presently, 96.9% of pregnant mothers are covered under prenatal care and 73.9% are under postnatal care.²

Improving the Nutrition of Pregnant Mothers and Providing Micronutrients

All pregnant women are provided with iron, iodine, folic acid, and various vitamin supplements including vitamins A and D from the fourth month of pregnancy onward. Consultation is prescribed for better nutrition and, in the

event of insufficient weight increase due to malnutrition, nutritional support is provided. In addition to pregnant women, adolescent girls are also covered by free iron supplementation, such that by 2007, 100% of high school girls in Iran were receiving these supplements.¹¹

Tetanus Vaccination of Pregnant Mothers

At the start of the EPI program (1984), only 3% of women of reproductive age in cities and 5% in rural areas had received tetanus immunization.⁴ With the spread of immunization and PHC, Iran has been able to keep tetanus vaccination coverage above 95% in women of reproductive age.

Prescribing Antenatal Steroids

Utilization of antenatal steroids over the past decade has effectively reduced RDS and consequently the NMR.

Safe and Healthy Delivery Due to Sufficient Numbers of Trained Individuals

One study shows that, in 1987, four years after the launch and expansion of the PHC network in Iran, a total of 32.7% of births occurred at home, with 59.7% of births in the rural areas occurring at home. Results from the Demographic and Health Survey in 2000 and 2005 show that 89.6% and 97.3% of deliveries in Iran, respectively, were performed in hospitals or maternity centers.² The latest data show that presently only 0.5% of births occur at home (mostly among immigrants).

Clinical Protocols

In 2009, MOHME developed a set of guidelines to be implemented nationwide for providing standardized, modern midwifery and delivery services, making the process of pregnancy and childbirth safer for both mothers and infants.¹²

Standard Delivery Rooms with Appropriate Equipment

In order to improve quality of care, it is essential that delivery rooms and equipment meet standards and that personnel be well trained. It is a challenge to maintain the body temperature of the mother and especially the newborn in the first minutes and hours of life. The effect of hypothermia in death of newborns has been proven.¹³ In a study in a Tehran hospital, it was demonstrated that 53.5% of infants suffered from hypothermia at birth and that the incidence of hypothermia in very low birth weight infants was approximately 80%. The mortality rate in hypothermic neonates was 6 times greater than normothermic infants.¹³ In the accreditation standards for Iranian hospitals that were last revised in 2013, equipment and facilities designated as necessary for delivery rooms are far beyond UNICEF recommendations, including central suction, intelligent control system for radiant heating, and

neonatal electroshock.¹⁴

Neonatal Resuscitation

Roughly one million newborns annually die from asphyxia throughout the world.³ According to a different report, more than 600 000 neonatal deaths, i.e. 4.56 per 1000 live births, in the world are due to intrapartum events.¹⁵ A WHO report on causes of U5MR in 2010 in Iran states that 9% of the causes of death are directly related to neonatal asphyxia.¹⁶ In early 1997, the Neonatal Resuscitation Committee was established in the MOHME.¹⁷ This committee was appointed to use cascade training to train many neonatal resuscitation trainers throughout Iran so that at the birth of every newborn at least one person trained in and familiar with neonatal resuscitation would be present at all times.¹⁸ Every year, countless resuscitation workshops are being held nationwide by medical universities in Iran.¹¹ In addition to awarding certificates showing participation in neonatal resuscitation workshops, this training is a mandatory part of the curriculum for pediatrics, obstetrics and gynecology, anesthesiology, neonatology, and perinatology residents as well as nursing and midwifery students in Iran.¹⁹

Breastfeeding from the First Hour of Life

There is no doubt about the role of breastfeeding in the reduction of NMR. In 1991, the WHO advised promotion of breastfeeding from the very first hour of birth. The law for protection of breastfeeding mothers and promotion of breastfeeding was first approved by the Iranian Parliament in 1995. In 1996, executive regulations for this law were circulated to health departments in all medical universities. This issue is also evaluated during periodic monitoring for hospital accreditation.¹⁹

Providing Healthy Infant Care Guidelines in Hospitals

This set of guidelines, which was developed in 2011, provides infant carers with a simple and practical guide for the care of babies from birth and aids in the identification and referral of apparently healthy newborns with risk factors and sick infants at birth.¹²

Use of Surfactants in the First Minutes after Delivery

The importance of using surfactant in the delivery room in the very early moments after birth in preterm infants is due to the fact that according to the estimation of WHO, 75% of neonatal deaths occur in the first day and the first week of life, and the most important cause for such deaths is immaturity.¹⁰ Lung dysfunction due to prematurity affects the infant from the first moment after birth. Multiple studies have demonstrated the effectiveness of using nasal continuous positive airway pressure and intra-lung surfactants to save premature babies from RDS. In Iran, surfactant was first used in 1995¹⁷ and is currently

widely used, as needed, for premature infants within the first 15 minutes of birth in hospitals that have neonatal intensive care units (NICUs) beside delivery rooms.

3. Major Measures Taken to Decrease Risk of Late Neonatal Death (after the first week of life)

Fighting Infections

According to statistics released by the WHO in Iran, neonatal septicemia accounted for 4% of the deaths of children under the age of five in 2010.¹⁶ The most important measures taken to reduce deaths from infection over the past 40 years in Iran are as follow:

Rooming-in Policy

This method of infant care has been mandated in hospitals by the MOHME since 1986⁴ Since then healthy infants with no risk factors have been taken care of by their own mothers and can freely breastfeed. The colonization of defenseless infant skin with normal maternal microbial flora concurrent with early breast milk, which is very abundant in antibodies, performs an important role in the prevention of infections, especially of the hospital type.

Promotion of Washing Hands

Personnel are obligated to wash their hands each time before handling infants, and a clinical care system has been instituted in all hospitals since 2009 to implement this regulation.²⁰ In addition, this is an important item in hospital assessment for accreditation.¹⁶

Nosocomial Infection Reporting System

One of the mandatory committees in all Iranian hospitals is the infection control committee which investigates reported cases and prevention methods, and reports data to higher departments.⁴

Promotion of Breastfeeding

The Iranian National Committee for Promotion of Breastfeeding was formed in 1991. Development of educational booklets in collaboration with UNICEF, distribution of these booklets in all healthcare centers and hospitals, organization of thousands of breastfeeding workshops for healthcare personnel and medical practitioners, and widespread promotion in the media has led to increased health awareness among the general public as well as healthcare personnel. The committee's efforts also led to the establishment of national laws to support breastfeeding and to the implementation of policies to decrease consumption of formula milk,⁴ which has reduced the supply cost of formula milk in Iran by 90%. In addition to preventing infection and resultant death, breastfeeding also prevents malnutrition during infancy, further reducing IMR.

Improvement of Health Services Throughout the Country

A. Routine physical examination of the newborns after birth, during the first day of life and prior to discharge, helped to recognize if the newborn was facing a health problem.

B. *The training of a large number of pediatricians, neonatologists, obstetricians, gynecologists, perinatologists, and nurses specializing in neonatal care.* Prior to the Islamic Revolution, and for several years afterward, human resources were grossly inadequate in health related services. Therefore a large number of expatriate physicians (mostly MBBS) were employed. They were unfamiliar with the Iranian culture and language, so they were unable to effectively meet the medical needs of the country. At the time, some provinces did not even have one Iranian doctor in some specialties. With the establishment of the MOHME, the training of medical staff dramatically increased such that currently more than 4000 obstetrics and gynecology specialists, 4,418 pediatricians, 212 neonatologists, and many perinatologists are working in Iran. In addition, Iranian universities have been offering courses in MSc Neonatal Nursing since 2009, so that nurses with greater knowledge and experience can care for very sick and very premature infants.

C. *Establishment of numerous units for Level II and Level III neonatal care (NICU).* Since the beginning of the Revolution until the present day, a large number of Level II infant care beds have been provisioned, thereby increasing public access to infant treatment. Concerning NICUs, it should be noted that until 1973, there were no Level III care beds in Iran. In 1973, several Neonatal Intensive Care beds were implemented next to the pediatric ward in Namazi hospital in Shiraz, and in 1975, the first independent NICU in Iran was established in Ali Asghar hospital, Tehran. According to the MOHME, by the year 2011, the number of NICU beds reached 1973.¹⁷

D. *Establishment of Pediatric Surgery Departments.* Prior to 1971, pediatric surgery was essentially nonexistent, and children with congenital anomalies or acquired diseases requiring surgery either died or underwent surgery by general surgeons. From 1971 to 1980, a number of Iranian practitioners who had completed courses abroad in general and pediatric surgery returned to Iran and began performing pediatric surgery and training surgeons in this specialty. Through efforts of these surgeons, all major and minor surgical procedures for congenital anomalies, even fetal surgery, are performed in Iran.

E. *Family-Centered Neonatal Care with a Focus on Brain Development.* Since 2000, the NIDCAP and KMC have gradually been implemented into Level II and III infant care facilities, resulting in better outcomes,¹⁷ i.e. healthier infants with better brain development. With the increase in the survival rate of premature and critically ill neonates, there can be a rise in the number of infants

with complications such as neurodevelopmental delay.³ The innovative methods of KMC and NIDCAP have significantly reduced these complications by involving parents in infant care during hospital stay, strengthening their physical and emotional bond with their infants, and offering individualized services to newborns in accordance with their needs. Since 2000, thousands of KMC workshops have been held, and thus a large number of nurses and doctors working in neonatal units and NICUs have become familiar with the method and utilize it in their departments. Additionally, with the membership of Iran in the NIDCAP Federation International in 2015, several Iranian special care units have started trials of this method.

F. Screening for congenital hypothyroidism, retinopathy of prematurity, and neonatal hearing loss. Hypothyroid screening has been mandatory in Iran since 2005 for all newborns between 3 to 5 days of age. With timely diagnosis and early treatment, impaired brain development can be prevented in these infants. Also, in 2005, national guidelines have been developed to screen for deafness using otoacoustic emission and for retinopathy of prematurity to prevent blindness. These guidelines have been circulated and implemented in all infant care units nationwide.

G. Increasing literacy among mothers. Numerous sources emphasize the role of the general and health literacy of mothers in the reduction of NMR and even complications of neonatal illnesses.^{3,21}

Our investigations show that according to the 1977 census, literacy in Iran was about 35.5%.²² In 2016, the literacy rate in Iran among people aged 10-49 years was 94.7% and in the Iranian population aged 6 years and above, the literacy rate was 87.6%. The average years of schooling in Iran was approximately 8 years in 2016, and 22.7% of women had postgraduate degrees (master's degree or higher).²² In a study conducted in 2016 to assess the health literacy in Iranians aged 18-65, over half of the subjects had an acceptable level of literacy.²

4. Present Challenges to the Health of Iranian Infants

A. High Rate of Cesarean Section in Iran

Numerous studies show that higher cesarean rates are associated with higher rates of infant mortality.²³ The most important consequence of cesarean section is birth of premature infants.¹⁰ Unfortunately, Iran has one of the highest rates of cesarean sections in the world. Two meta-analyses and systematic reviews estimated the total rate of cesarean deliveries in Iran at 48%.^{24,25} However, a recent estimate by the relevant department at the MOHME reported it at 50%.

B. High Death Rate of Premature and LBW Infants

There is still a high mortality rate in neonates with

gestational age of less than 32 weeks and weight below 1500 g. Some predisposing factors are as follow.

Absence of Perinatal Regionalization

Care for newborns, especially those with low birth weight or low gestational age, requires expensive high-tech facilities. Thus, it is not cost-effective to establish many NICUs all over the country. Perinatal regionalization is a system that allows all infants in need access to timely and appropriate services by personnel with sufficient experience. According to this system, high-risk infants are delivered in specialized and sufficiently equipped centers based on early examinations and estimates. In addition, hospitals with NICUs (Level III care) are each in charge of several Level I and II hospitals, and a well-equipped and competent transport system conveys ill infants delivered in lower level hospitals to higher level hospitals as soon as possible. In 2004, the Iranian Association of Neonatologists developed a domestic system and proposed it to the MOHME, but it has yet to be implemented in Iran.

Lack of Transportation System for Ill Infants

The absence of a regionalization system results in infants born in inappropriate hospitals suffering from severe hypothermia during transfer in unsuitable ambulances with inadequate facilities and untrained personnel. Hypothermia begins a cycle of pathological phenomena which may even lead to the newborn's death. The best way to transport infants is intrauterine transport (i.e. before birth). In Iran, systems for the transfer of high-risk infants and expectant mothers were launched in 2004 in Babol and later in 2012 in Kerman; however, unfortunately these systems have not been implemented in other provinces, and ill infants continue to be transferred in ambulances for adults and without specially trained personnel.¹⁷

Insufficient Staff-to-Bed Ratio in NICUs

According to international standards, NICUs must have at least one nurse per bed in each shift. In most NICUs in Iran, this ratio is often approximately 1/3 to 1/4 nurses per bed in afternoon and night shifts and 1/2 nurses per bed in morning shifts. Some consequences of the lack in expert human resources include transmission of most hospital infections, increased mortality especially in preterm and LBW infants, increased hospitalization length, shortage of NICU beds for subsequent newborns, increased use of broad-spectrum antibiotics, increased hospitalization costs, and increased fungal infections.²⁶⁻²⁹

C. Challenge in Congenital Anomalies

According to a WHO report in 2008, after prematurity, congenital anomalies are the second leading cause of

neonatal death in Iran, causing an estimated 6422 deaths per year.³⁰ In the last 5 years, a congenital anomalies registry system has been developed in East Azarbaijan province and is gradually being expanded to other provinces with the support of the MOHME. Better decisions can be made by analysis of the data in this registry system. Establishment of a regionalization system and introduction of main centers responsible for neonatal surgery can be an effective way to reduce death due to anomalies.

D. Asphyxia

Though according to WHO and UNICEF reports in 2008, more than 15% of neonatal deaths in Iran are due to neonatal asphyxia,³⁰ the challenges associated with asphyxia are not limited to extreme cases leading to death. There is a probability of brain damage or hypoxic ischemic encephalopathy in infants surviving mild to moderate asphyxia, leading to increased burdens on the patient, family, and community. According to a research in a neonatal unit and NICU in Tehran, among infants admitted for asphyxia, only 22% suffered from severe forms and 78% of cases had mild or moderate forms of asphyxia.³¹

E. Low Attention to Improvement of Neurodevelopmental Disorder

In spite of the increased survival rate of newborns and considering the high-risk status of ill, premature, and LBW infants, consistent widespread measures have not yet been taken in Iran for the prevention of developmental disabilities such as learning disorders, neurosensory disorders, and behavioral problems.³² In a survey of neonatologists in Iran, only 65.4% were able to follow-up on neurodevelopment in high-risk infants, and there was a specialized neurodevelopmental clinic in only one hospital.³³ Recently, neurodevelopmental testing, i.e. the Ages and Stages Questionnaire (ASQ) and Bayley, has been standardized for Iranian children by the Children's Department of the MOHAME. Since 2002, ASQ has become standard procedure in childcare monitoring in healthcare centers throughout Iran, but Bayley is still in the early pilot stages.

F. Psychological Support for Parents and Palliative End-of-Life Care for Newborns

The birth of high-risk or ill infants may involve long-term NICU hospitalization while mothers are in their postpartum period; dealing with somatic problems and emotional fragility, and the hospitalization of their infants causes mothers great stress. Fathers are not immune to this stress either. Taking into account available facilities, NICUs must reduce such stress as much as possible in order to obtain better outcomes for the care of infants. Unfortunately, this type of facility is still uncommon in

most NICUs in Iran. In the case of end-of-life palliative care in seriously ill neonates whose treatment has failed, efforts have recently been made to develop and implement a protocol.

G. Challenges in Exclusive Breast Feeding

Exclusive breastfeeding rates in infants under the age of 6 months increased from 9.5% in 1991 to 53.1% in 2010 and continuation of breastfeeding until one year and two years of age has reached 84.1% and 51.1%, respectively, which is still inadequate.²⁴ Since exclusive breastfeeding is very advantageous, extensive efforts are needed to routinely implement it in NICUs.

Discussion

Following the Islamic Revolution of Iran, the country has enjoyed an acceptable level of political stability. Despite the eight years of war and various sanctions imposed on the country by the U.S. government, Iran has progressed in all aspects of development, including health. Due to a high political will, major steps were taken few years following the revolution. The first step was expanding the Primary Health Care Services throughout the country. The second major step was the integration of medical education into the health services and establishing the Ministry of Health and Medical Education, which was followed by establishing a University of Medical Sciences and Health Services in each province. Those major steps moved health care in the country closer to health equity. This major progress along with other aspects of development including drastic improvement in literacy rate, particularly among women, led to a fairly rapid improvement in health indices.² MMR decreased from 254 per 100 000⁴ live births in 1978 to 19 in 2018. In the same period of time, NMR decreased from 68 per 1000 live births in 1978 to 9.6 in 2017.⁷

Obviously, a decline in mortality rate of premature infants can lead to some increase in the morbidity rate among those who survive. Therefore, problems such as retinopathy of prematurity, chronic lung diseases of prematurity and neurodevelopmental disorders are on the rise and require proper management. In order to reduce the MMR, NMR and perinatal mortality and morbidity more quickly and also to promote maternal and neonatal health status, the country should establish a regionalized system. Fortunately some steps are being taken in this regard, however, it is not fast enough.

Authors' Contribution

Suggestion of the subject and supervision of the implementation was performed by SAM. FSN designed and directed the project; NF, RM and GR reviewed literature and collected the information; MS and FSN wrote the manuscript; Finally SAM edited the manuscript.

Conflict of Interest Disclosures

None.

Ethical Statement

As this is a systematic review on available resources, it is free from the ethical process.

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