



# Telehealth Systems for Midwifery Care Management during the COVID-19 Pandemic: A Systematic Review

Ahmadreza Shamsabadi<sup>1</sup>, Kowsar Qaderi<sup>2</sup>, Pegah Mirzapour<sup>3</sup>, Hengameh Mojdeganlou<sup>4</sup>, Paniz Mojdeganlou<sup>5</sup>, Zahra Pashaei<sup>3,6</sup>, Fateme Bahador<sup>7</sup>, Akram Zhianifard<sup>8</sup>, Ali Abedi<sup>9</sup> and Esmaeil Mehraeen<sup>10\*</sup>

1. Department of Health Information Technology, Esfarayen Faculty of Medical Sciences, Esfarayen, Iran
2. Department of Midwifery, School of Nursing and Midwifery, Kermanshah University of Medical Sciences, Kermanshah, Iran
3. Iranian Research Center for HIV/AIDS, Iranian Institute for Reduction of High Risk Behaviors, Tehran University of Medical Sciences, Tehran, Iran
4. Department of Pathology, Urmia University of Medical Sciences, Urmia, Iran
5. Shahid Beheshti University of Medical Sciences, Tehran, Iran
6. School of Nursing, University of British Columbia, Vancouver, Canada
7. Department of Health Information Technology, Ferdows Paramedical School, Birjand University of Medical Sciences, Birjand, Iran
8. Department of Medical Education, School of Medicine, Iran University of Medical Sciences, Tehran, Iran
9. Department of Nursing, Esfarayen Faculty of Medical Sciences, Esfarayen, Iran
10. Department of Health Information Technology, Khalkhal University of Medical Sciences, Khalkhal, Iran

## Abstract

**Background:** Intrinsic features of COVID-19 disease, including the severity of the virus transmission and mortality rates, make it difficult to provide obstetric care to pregnant women. In this regard, telemedicine can provide comprehensive midwifery care relying on new technologies, such as virtual clinic, telehealth, tele-monitoring, m-Health, wearable sensors, and the internet of medical things. The objective of this study is to identify the application and requirements of a telehealth system for midwifery care.

**Methods:** We conducted a literature search from 2019/12/1 to 2022/10/1 using the following electronic scientific databases: Web of Science, Scopus, PubMed, Science Direct, and Google Scholar. We carried out hand searches from the reference lists of retrieved studies of journals.

**Results:** We showed that, during COVID-19 pandemic, prenatal care via telehealth increased and telehealth is a good strategy for prenatal and post-partum disease managements. Mental health services are also feasible via telehealth. These new technologies also reduce the risks associated with interpersonal contacts in COVID-19 pandemic.

**Conclusion:** With the COVID-19 pandemic, telehealth became the norm. The future of medical services will be built around this technology and that is a great opportunity to move toward a great evolution.

**Keywords:** COVID-19, m-Health, Midwifery care, Pregnancy, Telehealth, Telemonitoring, Virtual clinic

## \* Corresponding author

**Esmaeil Mehraeen, PhD**

Department of Health Information Technology, Khalkhal University of Medical Sciences, Khalkhal, Iran

**Tel:** +98 45 3242 6801

**Fax:** +98 45 3242 2305

**Email:** es.mehraeen@gmail.com

**Received:** 1 Aug 2022

**Accepted:** 5 Dec 2022

## Citation to this article:

Shamsabadi AR, Qaderi K, Mirzapour P, Mojdeganlou H, Mojdeganlou P, Pashaei Z, et al. Telehealth Systems for Midwifery Care Management during the COVID-19 Pandemic: A Systematic Review. *J Iran Med Council.* 2022;6(2):240-50.

## Introduction

COVID-19 pandemic with more than 235 million confirmed positive cases and 4.8 million deaths since the after emergence has put a lot of pressure on the health systems globally (1-3). The increasing burden of infection and the high mortality and morbidity rate has caused health systems to combat it. In the affected countries, national health services are partially close to collapse (1,4,5). The COVID-19 pandemic has had direct and indirect effects on health service provision in all parts of the health system, including reproductive health services, such as maternity care (6). Coronavirus infection and its complications in mothers directly affected health services by increasing the need for special care in the obstetrics ward. Fear, stigma, quarantine, and socioeconomic factors indirectly affected the access to essential health services (7-9).

All pregnant women and newborns should receive high quality healthcare throughout the pregnancy, childbirth, and the postnatal period (10). Recently, around 303,000 women and youngster girls died as a result of pregnancy and childbirth-related problems. Approximately, 99% of maternal deaths occur in restricted-resource organizations and most can be prevented. In the same way, around 2.6 million babies were stillborn, mainly in low-resource settings (11).

Telehealth, as delivering remote medical services can be used by healthcare providers via technology to communication, education, diagnosis, treatment, through virtual visits in the COVID-19 pandemic (12). Moreover, portable devices such as pulse oximeters, glucometers, portable cardiotocography (CTG), and sphygmomanometers are implemented to monitor mother and fetus wellbeing (13,14). Since telehealth formerly had been proposed as a means to overcome difficulties related to medical care provision (13,15), it may be utilized by medical professionals as a means of maintaining patients' access to care in the setting of COVID-19 during social isolation (16).

Telehealth has been supported by health care organizations due to the potential to reduce costs and improve access to intensive care (17). In the field of obstetrics and gynecology, Telemedicine also has been used to report ultrasounds and interpretation of tests, patient counseling and tele-consultation, diabetes management, postpartum depression management,

and support for postpartum parents and children (18). Several studies have been done in the field of telehealth system in pregnancy care (19-21). However, no study was found to identify the requirements of a comprehensive telehealth system for midwifery care. Alves *et al*, in a related study aimed to identify advances, contributions and limitations of obstetric tele-monitoring using mobile technologies (22). In another study, Daly *et al* determined the effects of using mobile app interventions, during pregnancy, on healthy maternal behaviors and improving prenatal health outcomes (23,24). The use of different technologies in the provision of midwifery services and care needs to be investigated. Finding their strengths, weaknesses, characteristics, and requirements will help improve their quality in the future. The COVID-19 pandemic has presented an opportunity for the use of telehealth. This is the best opportunity to analyze the use of these technologies in the provision of midwifery services and care, and to review and revise them and fix their flaws for future versions to provide quality services to improve the health of mothers and babies. In this review, we aimed to identify the common requirements, capabilities and requirements of a telehealth system for midwifery care in the COVID-19 pandemic era.

## Materials and Methods

We conducted a literature search from 2019/12/1 to 2022/10/1 using the following electronic scientific databases: Web of Science, Scopus, PubMed, Science Direct, and Google Scholar. We carried out hand searches from the reference lists of retrieved studies of journals.

### Search strategy

The detailed search strategies were carried out by the first and correspondence authors with input from all authors and complementary a skilled research librarian. A comprehensive search using keywords headings and all fields for each database was carried out. Search subject headings included the following: COVID 19, SARS-CoV-2 prenatal, pregnancy, telemedicine, telehealth, m-health, and virtual clinic. The search strategy is shown as follows:

A: COVID-19 OR "coronavirus" OR coronavirus OR SARS-CoV-2 OR COVID

B: Tele-health OR tele-care OR tele-monitoring OR m-health OR “virtual clinic” OR e-Health OR “virtual visit” OR telemedicine OR tele-homecare OR tele-consultation OR tele-education

C: Prenatal OR pregnancy OR gestation OR childbirth OR postpartum OR midwifery OR antenatal OR parturition

D: [A] AND [B] AND [C] (search strategy of PubMed database mention in appendix 1)

### **Eligibility criteria**

Articles retrieved from above-mentioned databases should meet the following eligibility criteria to be included in this study.

Having a care of prenatal, delivery, postpartum and other midwifery care

The studies examining tele-monitoring or the use of telemedicine for the management of midwifery care

The studies reporting a system or application for telemedicine of midwifery care

Peer-reviewed publications and articles whose full text is available

The studies published from the beginning of the COVID-19 to August 2021

The excluded criteria were as the following:

Other formats of articles including editorials

Abstract papers, conference abstracts, and articles without accessible full texts

Non-English language.

### **Data retrieval**

The EndNote software was used to organize the identified studies in the literature review. Search outcome from the databases were combined in a single EndNote library and duplicate articles were removed.

### **Data screening**

First and correspondence authors screened the titles and abstracts of the retrieved articles to find out if they meet inclusion and exclusion criteria of the selected studies.

### **Data extraction**

In this study, data extraction title included: study design, study title, year of publication, country, study object, requirements, and usages. After selecting

the studies, two of the authors extracted data from the articles using standard forms. For this purpose, a standard form was designed to extract the data required for quality assessment and synthesis of evidence, and summary tables were completed. The full text of the articles was read by three authors. Each author thoroughly reviewed the summary tables for relevance and accuracy. Any disagreement between these authors was resolved by the fourth author. The data was entered into the Review Manager software and checked for accuracy.

### **Quality assessment**

The quality and relevance of the articles were reviewed by three independent and experienced authors. Any differences in judgment were reviewed by the fourth author to reach a consensus.

### **Results**

In this study, 369 articles were retrieved using a methodical search strategy from scientific databases. After a preliminary review of the retrieved articles, 128 duplicates were removed, and the title and abstract of the remaining 241 resources were reviewed. After applying the selection criteria, 203 articles were excluded, and only 17 articles met the inclusion criteria and were included in the final review (Figure 1).

Of the 17 studies on Telehealth, 8 were from the US, 3 from Australia, and the remaining 6 studies were from China, Canada, Poland, Indonesia, N/A, and Sri Lanka. Three studies were conducted by Interventional method (Clinical trial), 2 studies by qualitative and other studies by observational methods, such as time series, cross-sectional study, retrospective cohort study, case report, A Pilot Study Cross sectional and review.

Study population was pregnant or postpartum women in all studies except 2 studies from Indonesia & USA in which study populations were midwives and healthcare providers, respectively.

Studies reported that virtual video visits were used as a tele-visit in 11 studies, telephone in 10, and web-based programs and applications in 10 studies. These technologies provided remote monitoring of patients and fetus in pregnant women, encouraged patients to make antenatal care visits in timely manner, and

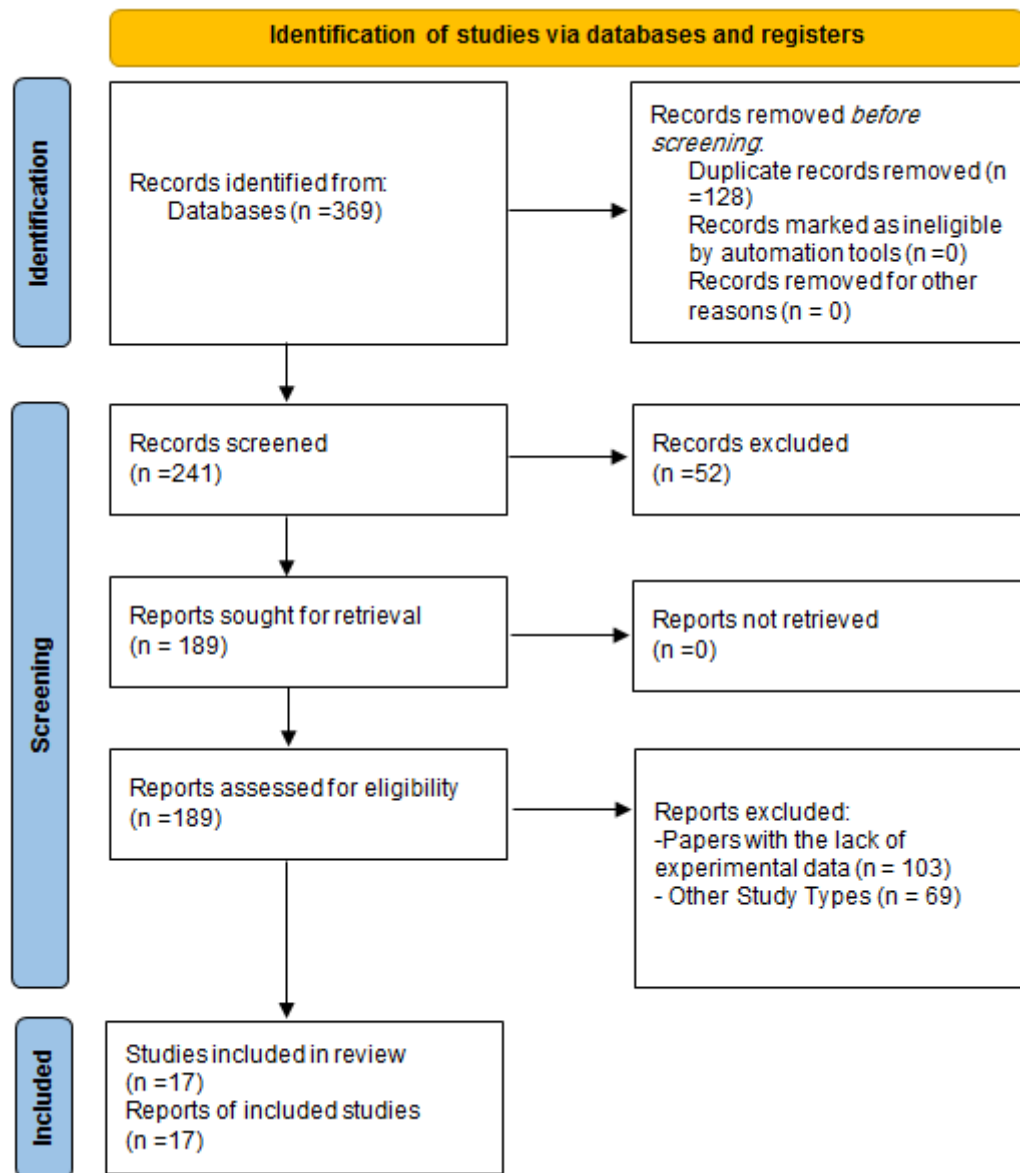


Figure 1. PRISMA 2020 flow diagram of the study retrieval process.

helped the patients to monitor serum glucose and blood pressure to manage their weight, diet, physical activity, and improve their life style.

As mentioned in table 1, these remote services require some facilities including high-speed internet access, tablets, smart phones, and special equipment such as blood pressure measuring devices.

Most of the studies reported that virtual video visits are used as a tele-visit. Others reported telephone, web-based programs and applications. These technologies provided remote monitoring of patients and also fetus, encouraged patients to make antenatal care visits in a timely manner, and improved the lifestyle

and pregnancy outcomes. During the COVID-19 pandemic, prenatal care via telehealth increased. This strategy leads to decreases in the morbidity, mortality and hospital admissions. These new technologies also reduced the risks associated with interpersonal contacts in COVID-19 pandemic.

## Discussion

In this study, we summarized available data from 13 articles on telehealth systems and midwifery care. The majority of articles were about tele-visits via applications while other studies reported cost and benefits of tele-visits through video calls. Reviewing

**Table 1.** Identified features of tele-health systems for midwifery care in the pandemic COVID19

First author (ref, no.)	Type of study	Country	Study Population	Type of technology	Applications	Capability	Requirement	Summary of findings
Zork, Noelia M (25)	Cohort	USA	Prenatal	Virtual visit	Prenatal visits & remote monitoring (physical exams, genetic counselling & screening, delivery counselling) & also no obstetrics counselling (cardiology endocrinology, ...)	Remote monitoring of patients does not require inpatient encounters to provide care	It requires computers/ smartphones/ tablets/ high speed internet access), Information technology support Patient needs to purchase special equipment Staff training is also required	Reducing inpatients' encounter and risks associated with repeated exposures
Zhu, Xu-Hong (26)	Retrospective investigation	China	Prenatal	Virtual visit	Prenatal visits & remote monitoring	Application provides online health education also for Fetal development monitoring, offering pregnant women good guidance and improving the health outcomes of mothers and infants	Smart phones and some specific applications needed	Proportion of scar uterus, hepatitis B virus carrier, and maternal mortality and prenatal neonatal mortality decreased in telemedicine group
Yanti, Irma (33)	Cross sectional	Indonesia	Midwives	Teleconsultation	Remote nursing & midwifery care	Providing long distance nursing & health service	High speed internet access smartphones (for video call)	Among respondents who were interested in providing midwifery care through teleconsultation midwives with good knowledge and perception of midwifery care, <35 years of age are greater than who have less knowledge or poor perception of midwifery care and >35 years of age
Slomski, Anita (27)	Clinical trial	N/A	Prenatal	Lifestyle intervention (2 in-person and 11 telephone sessions)	Lifestyle intervention for pregnant women	Strategies to improve weight, diet, physical activities, and stress management	Interventional group must attend 2 in-person and 11 telephone sessions.	Interventional group reduced total caloric intake, sedentary behaviour, and insulin resistance markers. Interventional group also gain less weight per week compared to average weekly weight gain

Contd. table 1

Sanjeewa, R Dias (34)	Clinical trial	Sri Lanka	Pregnant women >32 gestational weeks	Tele health service (telephone and social media communication) to improve the maternal pregnancy outcome	Collecting information about any change in residence, availability of delivery plan, and transport arrangement in case of an obstetrics emergency Other information including: parity risk factors is also collected	Advice on specific questions related to maternal care, clinical advice to mothers according to their stage of pregnancy, and coordination of transportation	It requires purchasing devices with video facilities.	Providing comprehensive maternal care and preventing adverse outcome of pregnancy. It is a better way to continue maternal services in situations where there is limited access to health care
Palme, Kirsten R (28)	Time series analysis	Australia	Antenatal, intrapartum, postpartum	Telehealth consultation via video calls or telephones	Antenatal, intrapartum, postpartum screenings, and assessments	Safety of telehealth care	Patients require to purchase automated blood pressure monitors	
Mallampati, Divya (35)	Cross-sectional study	USA	Maternal care providers	Telephone & virtual videos visits	Prenatal care televises	Remote monitoring and visits	N/A	Prenatal care via telehealth during COVID-19 pandemic increased. Maternal fetal medicine providers conducted more telehealth visit than other providers
Hoppe, Kara K (30)	Prospective single-cohort feasibility study	USA	Pregnant and postpartum	Telehealth telephone visits	Remote blood pressure monitoring	Bluetooth	Tablet device, blood pressure cuff, and oxygen sensor. Central monitoring platform allowing for Bluetooth transmission of all home vitals	Results indicate that telehealth is a promising strategy for postpartum hypertension management to decrease maternal morbidity and hospital readmission
Huang, Rae-Chi (29)	Unblinded RCT	Australia	Women between 8 and 11 weeks gestation	E-health tele-monitoring	Promoting healthy lifestyle and preventing excess weight gain in early pregnancy	Wireless activity monitor	Web-based program accelerometer	A lifestyle intervention starting in the first-trimester pregnancy utilising e-health mode of delivery is feasible
Jakubowski, Dominik (14)	Cross-sectional study	Poland (Szczecin)	Pregnant and women given birth	Telehealth REDCap electronic data capture tools	- Access to fasting glucose tests - Access to tests and screening procedures during pregnancy	- Remote appointment - Monitoring glucose	- Web-based	To reduce the risks associated with movement and interpersonal contact, some appointments can be arranged in the form of telehealth



Contd. table 1

Lackie, Madison E (32)	Focus Groups and Qualitative Research	Canada (vancouver)	Postpartum	Web-based and Mobile Health Interventions	Mental Health Services	Tele visit (Skype) Tele consultation	Web-enabled intervention	Participants believed that a web-enabled intervention could help meet mental care need
Limaye, Meghana A (36)	Retrospective cohort study	USA	Patients who had at least one obstetric visit (pregnancy)	Telehealth	Telehealth visits	- Strongly recommended, but patients were able to select in-person visits if they preferred. - Conducted via a Health Insurance -Portability and Accountability	Act-compliant Smartphone	Patients with public insurance were less likely to have at least one telehealth visit than women with private insurance
Madden, Nigel (31)	Quantitative study	USA	Preconception, pregnant, and postpartum women	Telehealth	Virtual visit and tele-consultation	Application on their phones or other portable devices	Epic Haiku and Canto and Epic Connect and My Chart	Approximately one third was performed by telehealth
Tozour JN (37)	Cross sectional	USA	Maternal-fetal medicine services	Telemedicine	- Visits of: - Poor obstetrical history, -Maternal comorbidities, genetics, and preconception counselling - Nutrition counselling, fetal indications	-Video visits	-Requires computers/ smartphones or tablets - High speed internet access. - Webcam - Cellular/WiFi connection	People who wanted future telemedicine had meaningfully greater agreeability that they were able to see and hear their provider simply
Henry A (38)	Mixed-Methods Study	Australia	Antenatal	Telehealth	Service provision and screening for mental health and domestic and family violence (DFV)	- Larger service delivery from the viewpoint of local maternity service providers	-Requires computers/ smartphones/ tablets/ high speed internet access	Telehealth may have a continuing, post-pandemic role in Australian pregnancy care. Staff believe that this should be inadequate in scope, regularly for low-risk pregnancies
Krenitsky NM (39)	Cross sectional	USA	Obstetric patients	Virtual tele-monitoring	Measurement of: respiratory illnesses, temperature, heart rate, and oxygen saturation, and gestational hypertension or preeclampsia	-Virtual visit of the main complaints including: Fetal monitoring, Vaginal discharge, Vaginal bleeding, Headache, dizziness	Thermometers, blood pressure cuffs, and portable pulse oximeters	Major barrier to close tele-monitoring demonstrated to be inconsistent follow up

Contd. table 1

Aziz A (40)	Cross sectional	USA	Prenatal & postpartum	Virtual visit	<p>Recommendations are made for the following situations: hypertensive disorders, pre-gestational and gestational diabetes, maternal cardiovascular disease, maternal neurologic conditions, history of preterm birth, fetal conditions, genetic counselling, obstetric anesthesia consultations, and mental health services.</p> <p>-Conducting tests and services virtually instead of in-person. - Reduces nearly one-half of in person visits for low-risk patients.</p> <p>-Requires computers/ smartphones/ tablets/ high speed internet access -Specific applications needed</p>	Virtual visits do not completely substitute in-person encounters during prenatal care. They suggest a means of reducing pregnant women's and provider's exposure to COVID-19.
----------------	--------------------	-----	--------------------------	---------------	---	---

these articles revealed that high-speed internet is the main requirement for these visits. Zork *et al* in a related study reported that tele-visits' prenatal care in the USA, reduce inpatients encounter and reduce risks associated with repeated exposures. They also found that computers, smart phones, tablets, high-speed internet access, and information technology support patients' needs to purchase special equipment. Staff trainings are also required (25).

Study of Zhu *et al* showed that prenatal visits and remote monitoring by tele-visits causes presentation of health education also for fetal development monitoring and offering pregnant women good guidance and improve the health outcomes of mother and infant. By tele-visits proportion of scar uterus, hepatitis B virus carrier, maternal mortality and prenatal neonatal mortality decreased in the telemedicine group (26).

These tele-visits need high internet access, through which you have the opportunity of talking to health care provider, discussing the problems and receiving advice for the following weeks. This kind of tele-visit through video calls seems more cost effective than other types of tele-health monitoring methods, since it only needs an access to high-speed internet and a

mobile phone. Another advantage is that no special education is needed for making video calls. Slomski *et al* reported that the lifestyle intervention for pregnant women through this intervention, strategies for improving weight, diet, physical activity, and stress management were provided. As a result of these sessions, changes were made to improve total calorie intake, reduce sedentary behaviors and insulin resistance markers, and lose weight (27). In a similar study, Palmer *et al*, pointed that the automated blood pressure monitors is essential to promote healthcare of antenatal, intrapartum, and postpartum (28). The method which is studied by Slomski's team was done through telephone sessions; nowadays, everyone has a mobile phone and access to telephones. This has made this intervention so easy and feasible. But the participants should have the compliance of following the intervention advice to improve their lifestyle and gain the expected results. Anyone who follows the instructions can take advantages of improving insulin resistance, expecting the acceptable weight and a normal pregnancy period and delivery with a lower risk of complications. The greatest advantage of these methods is that they decrease the individual contacts, in-person visits and risk of COVID-19 infection



during the pandemic.

Huang *et al* studied women between 8- and 11-week gestation in Australia. They reported that tele-monitoring promotes healthy lifestyle and prevent excess weight gain in early pregnancy. By utilizing the web-based programs, lifestyle intervention in the first-trimester of pregnancy is feasible (29). Jakubowski *et al* also studied pregnant women in Poland who utilized web-based programs to have access to fasting glucose tests and screening procedures during pregnancy. They suggested that the risks associated with movement and interpersonal contact reduced and patients can arrange some appointments in the form of telehealth (14). The web-based applications are other techniques which were used during pandemic. Although these applications are at hand, they need minimum education and learning, thus the applicants can use it properly.

Study of Hoppe *al.* demonstrated that remote blood pressure monitoring could be performed through telehealth. Patients must have some special medical devices, including blood pressure cuff, and oxygen sensor besides smart phones and tablets (30). To achieve the best results, it should be a pre-education for the patients who want to use these medical instruments. They should have some sessions to practice how to use these devices in order to reduce the errors and the measurements (*e.g.*, blood pressure) become more accurate. Their results indicated that tele-health is a promising strategy for postpartum hypertension management to decrease maternal morbidity and hospital readmission. The above-mentioned studies represent that tele-health could be an effective strategy to reduce the risks of pregnancy in patients who have access to technologies and facilities including high speed internet, electronic devices, and

medical equipment. Study of Madden *et al* in the US showed that, up to two-thirds of visits performed via tele-health for genetic counseling appointments and over the study period, the proportion of tele-health visits also increased significantly. This means that tele-health became more popular among the patients and healthcare providers (31). Lackie *et al*, described the effective implementation of web-based programs and intervention in maternal care (32).

## Conclusion

It can be concluded that where telehealth is available to patients, prenatal care visits via tele-visits increased, prenatal morbidity and mortality decreased and better prenatal and postpartum care was achieved. With the pandemic of COVID-19, telehealth becomes the norm and telemedicine will have a great revolution in the future. It is improved and many new techniques and models of health care will be innovated. Considering that the future of medical services will move towards new technologies and it will be a great opportunity to a great evolution, therefore, physicians, healthcare providers and patients should adopt with these changes.

## Acknowledgements

The present study was extracted from the research project with code HYPERLINK “<http://ethics.research.ac.ir/IR.ESFARAYENUMS.REC.1398.015>” IR.ESFARAYENUMS.REC.1398.015 entitled “Tele-monitoring and telehealth systems in prenatal care” conducted at Esfarayen University of Medical Sciences in 2021. We thank the statistical population and all the participants for taking the time to contribute to the study.

## References

1. Organization WH. COVID-19 related mortality and morbidity among healthcare providers—based on information as at 14 February 2021. World Health Organization. Regional Office for Africa 2021.
2. Coronavirus WH. Dashboard [<https://covid19.who.int/>]. Accessed March. 2021 Mar;15.
3. Dadras O, Alinaghi SAS, Karimi A, MohsseniPour M, Barzegary A, Vahedi F, et al. Effects of COVID-19 prevention procedures on other common infections: a systematic review. *Eur J Med Res* 2021 Jul 3;26(1):67.

4. Armocida B, Formenti B, Ussai S, Palestra F, Missoni E. The Italian health system and the COVID-19 challenge. *Lancet Public Health* 2020 May;5(5):e253.
5. Dadras O, Afsahi AM, Pashaei Z, Mojdeganlou H, Karimi A, Habibi P, et al. The relationship between COVID-19 viral load and disease severity: a systematic review. *Immun Inflamm Dis* 2022 Mar;10(3):e580.
6. Mehraeen E, Salehi MA, Behnezhad F, Moghaddam HR, SeyedAlinaghi S. Transmission modes of COVID-19: a systematic review. *Infect Disord Drug Targets* 2021;21(6):e170721187995.
7. Krubiner CB, Keller JM, Kaufman J. Balancing the COVID-19 response with wider health needs: key decision-making considerations for low-and middle-income countries. 2020.
8. McDonnell S, McNamee E, Lindow SW, O'Connell MP. The impact of the Covid-19 pandemic on maternity services: a review of maternal and neonatal outcomes before, during and after the pandemic. *Eur J Obstet Gynecol Reprod Biol* 2020 Dec;255:172-6.
9. Townsend R, Chmielewska B, Barratt I, Kalafat E, van der Meulen J, Gurol-Urganci I, et al. Global changes in maternity care provision during the COVID-19 pandemic: a systematic review and meta-analysis. *EClinicalMedicine* 2021 Jun 19;37:100947.
10. Tunçalp Ö, Were W, MacLennan C, Oladapo O, Gülmezoglu A, Bahl R. Improving quality of care for mothers and newborns—the WHO vision. *BJOG* 2015 Jul;122(8):1045-9.
11. Organization WH. WHO recommendations on antenatal care for a positive pregnancy experience: World Health Organization; 2016.
12. Mehraeen E, Safdari R, Mohammadzadeh N, Seyedalinaghi SA, Forootan S, Mohraz M. Mobile-Based Applications and Functionalities for Self-Management of People Living with HIV. *Stud Health Technol Inform* 2018;248:172-9.
13. Lurie N, Carr BG. The role of telehealth in the medical response to disasters. *JAMA Intern Med* 2018 Jun 1;178(6):745-6.
14. Jakubowski D, Sys D, Kajdy A, Lewandowska R, Kwiatkowska E, Cymbaluk-Płoska A, et al. Application of telehealth in prenatal care during the COVID-19 pandemic—a cross-sectional survey of Polish women. *J Clin Med* 2021 Jun 10;10(12):2570.
15. Mehraeen E, Ayatollahi H, Ahmadi M. Health information security in hospitals: the application of security safeguards. *Acta Inform Med* 2016 Feb;24(1):47-50.
16. Hollander JE, Carr BG. Virtually perfect? Telemedicine for COVID-19. *N Engl J Med* 2020 Apr 30;382(18):1679-81.
17. Dol J, Richardson B, Murphy GT, Aston M, McMillan D, Campbell-Yeo M. Impact of mHealth interventions during the perinatal period on maternal psychosocial outcomes: a systematic review protocol. *JBHI Database System Rev Implement Rep* 2019 Dec;17(12):2491-8.
18. Magann EF, McKelvey SS, Hitt WC, Smith MV, Azam GA, Lowery CL. The use of telemedicine in obstetrics: a review of the literature. *Obstet Gynecol Surv* 2011 Mar;66(3):170-8.
19. Haddad SM, Souza RT, Cecatti JG. Mobile technology in health (mHealth) and antenatal care—searching for apps and available solutions: a systematic review. *Int J Med Inform* 2019 Jul;127:1-8.
20. Rasekaba TM, Furler J, Blackberry I, Tacey M, Gray K, Lim K. Telemedicine interventions for gestational diabetes mellitus: a systematic review and meta-analysis. *Diabetes Res Clin Pract* 2015 Oct;110(1):1-9.
21. Rivera-Romero O, Olmo A, Muñoz R, Stiefel P, Miranda ML, Beltrán LM. Mobile health solutions for hypertensive disorders in pregnancy: scoping literature review. *JMIR Mhealth Uhealth* 2018 May 30;6(5):e130.
22. Alves DS, Times VC, da Silva ÉMA, Melo PSA, de Araújo Novaes M. Advances in obstetric telemonitoring: a systematic review. *Int J Med Inform* 2020 Feb;134:104004.
23. Daly LM, Horey D, Middleton PF, Boyle FM, Flenady V. The effect of mobile application interventions on

influencing healthy maternal behaviour and improving perinatal health outcomes: a systematic review protocol. *Syst Rev* 2017 Feb 8;6(1):26.

24. Daly LM, Horey D, Middleton PF, Boyle FM, Flenady V. The effect of mobile app interventions on influencing healthy maternal behavior and improving perinatal health outcomes: systematic review. *JMIR Mhealth Uhealth* 2018 Aug 9;6(8):e10012.

25. Zork NM, Aubey J, Yates H. Conversion and optimization of telehealth in obstetric care during the COVID-19 pandemic. *Semin Perinatol* 2020 Oct;44(6):151300.

26. Zhu XH, Tao J, Jiang LY, Zhang ZF. Role of usual healthcare combined with telemedicine in the management of high-risk pregnancy in Hangzhou, China. *J Healthc Eng* 2019 May 6;2019:3815857.

27. Slomski A. Telehealth reduces excess weight gain in pregnancy. *JAMA* 2020 Jul 28;324(4):327.

28. Palmer KR, Tanner M, Davies-Tuck M, Rindt A, Papacostas K, Giles ML, et al. Widespread implementation of a low-cost telehealth service in the delivery of antenatal care during the COVID-19 pandemic: an interrupted time-series analysis. *Lancet* 2021 Jul 3;398(10294):41-52.

29. Huang RC, Silva D, Beilin L, Neppe C, Mackie KE, Roffey E, et al. Feasibility of conducting an early pregnancy diet and lifestyle e-health intervention: the pregnancy lifestyle activity nutrition (PLAN) project. *J Dev Orig Health Dis* 2020 Feb;11(1):58-70.

30. Hoppe KK, Williams M, Thomas N, Zella JB, Drewry A, Kim K, et al. Telehealth with remote blood pressure monitoring for postpartum hypertension: a prospective single-cohort feasibility study. *Pregnancy Hypertens* 2019 Jan;15:171-6.

31. Madden N, Emeruwa UN, Friedman AM, Aubey JJ, Aziz A, Baptiste CD, et al. Telehealth uptake into prenatal care and provider attitudes during the COVID-19 pandemic in New York City: a quantitative and qualitative analysis. *Am J Perinatol* 2020 Aug;37(10):1005-14.

32. Lackie ME, Parrilla JS, Lavery BM, Kennedy AL, Ryan D, Shulman B, et al. Digital health needs of women with postpartum depression: focus group study. *J Med Internet Res* 2021 Jan 6;23(1):e18934.