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RESEARCH ARTICLE

Comparing the Effectiveness of Aloe Vera Gel and 2% Chlorhexidine Gluconate Solution in Preventing Phlebitis Caused by Peripheral Vein Catheters in Hospitalized Patients

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Abstract

Background: Intravenous treatment is one of the most important medical treatments and the most common invasive methods.. Phlebitis is the most common complication caused by catheters. Among the medicinal and non-medicinal methods for treating phlebitis is the use of 2% chlorhexidine solution and aloe vera gel. This study aimed to compare the effectiveness of aloe vera gel and 2% chlorhexidine gluconate solution in preventing phlebitis caused by peripheral vein catheters in hospitalized patients.

Methods: This study is a three-group clinical trial on 90 hospitalized patients who met the inclusion criteria and were randomly selected into three groups: aloe vera gel, 2% chlorhexidine solution, and the control group (30 people each). they got. Information was collected using demographic information form and phlebitis checklist. In the aloe vera gel intervention group, first the skin was disinfected with 70% ethyl alcohol, and after placing the angioket, it was fixed with glue, the upper part of which was covered with half a cc of aloe vera gel, and in the second group, the catheter was first placed with 70% ethyl alcohol. After placing the angioket with glue, its upper part was smeared with 2% chlorhexidine gel, and in the control group, only 70% ethyl alcohol disinfection catheter was inserted. The date, time and name of the researcher were recorded on the adhesive. Every 12 hours to 72 hours, the angioket insertion site in all three groups was controlled and recorded by the researcher in terms of the presence of symptoms and the degree of phlebitis. Data analysis was done with SPSS 25 statistical software at a significance level of 0.05 with chi-square tests and one-way analysis of variance.

Results: Both supportive treatments of aloe vera gel and chlorhexidine solution are effective in reducing the incidence of phlebitis in the intervention groups, but the frequency of phlebitis in the aloe vera group was significant compared to the control. No significant difference was observed between the aloe vera gel group and the control group at 24 and 48 hours after the intervention ($p<0.05$), but a statistically significant difference was observed 72 hours after catheterization ($p<0.05$).

Conclusion: A comparison of the effect of 2% chlorhexidine solution and aloe vera gel showed that the incidence of

phlebitis in the long term in the aloe vera gel group was lower than in the control and chlorhexidine groups. Accordingly, nurses can use non-pharmaceutical methods, including aloe vera compounds that have anti-inflammatory properties, to reduce the incidence of phlebitis during catheterization.

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Introduction

Intravenous therapy is one of the most important medical treatments and the most common invasive methods performed on 80% of patients during their stay in the hospital [1][2]. In addition, more than 500 million intravenous catheters are inserted annually in the world to provide a more effective treatment [3]. Intravenous injections have saved the lives of many people so far [4]. Despite the widespread and daily use of these catheters, they are associated with many complications including liquid leakage, venous inflammation, fluid accumulation in the body, and bleeding and infection in the injection area. Moreover, phlebitis is the most common complication and infection is the most dangerous complication of these catheters [5]. Phlebitis means inflammation of the inner layer of blood vessels with symptoms such as redness, pain, swelling of the injection area, and even fever [6]. Various factors influence phlebitis, including age, sex, and duration of catheterization [7]. Previous studies have shown that the prevalence of phlebitis ranges from 0.1% to 63.6% in California [8], 20% to 80% in Britain[9], and 27% to 70% in Iran[8], while the American Nurses Association (ANA) considers a prevalence of 5% or less to be acceptable [5]. Phlebitis, in addition to being dangerous on its own, leads to the formation of clots, thrombophlebitis, embolism, and shortens the life of venous cannulas [1], disrupts venous treatment, causes pain and discomfort for the patient, imposes additional costs, wastes medical staff's time [10], and causes problems such as infection, premature removal of the catheter, and re-catheterization. Re-catheterization, in turn, limits the vessels suitable for catheterization, postpones the injection of intravenous drugs, and prolongs the patient's stay in the hospital [11]. Phlebitis is also a potentially dangerous source for causing systemic infections so the chance of systemic infections

increases up to 8 times in the presence of phlebitis [10]. The skin around the catheter insertion site is one of the main sources of microorganisms that can lead to the formation of microbial biofilms on the external surface of the catheter and cause infection and phlebitis [12]. It affects more than half of the patients and is considered a potential risk factor for fatal infectious complications [13]. Moreover, patients in intensive care units (ICUs) are much more sensitive to acquiring infection than other units [14]. Furthermore, mortality and other complications caused by infections in ICUs are more serious. Phlebitis is a serious complication of fluid therapy which can easily have negative effects on the health status of ICU patients [5]. Nurses are one of the most important healthcare providers and they need to-date information and skills to provide optimal care. Besides, the quality of nurses' care depends on their performance [15]. Nurses' performance in caring for intravenous injections in 80% of cases reduces the incidence of complications such as phlebitis [16]. What is certain is that many complications of intravenous injections can be prevented [17]. However, the choice of the best disinfectant for dressing the catheter site has not yet been resolved, and despite the many advances that have been made in the prevention of phlebitis, the problems associated with it remain and no definitive solution has been provided to prevent these consequences. Some studies have recommended chlorhexidine to disinfect the catheter site [18][19]. Brunner and Suddarth's books and the Center for Disease Control and Prevention have also recommended chlorhexidine gluconate-based solution as the disinfectant of choice to prevent infections related to venous catheters [20][12] and its main advantage over other antiseptics is its long-term activity that can last up to 6 hours or more [21]. However, the results of several clinical trials showed that the use of hydrocortisone filters, heparin, local corticosteroids, and local anti-inflammatory gel at the intravenous injection site can reduce the phlebitis caused by the catheter. Nevertheless, none of these methods are fully acceptable due to concerns about their economic costs and safety. Thus, there is a need for simpler, safer, and more affordable methods [8]. One of these methods is non-invasive and local procedures such as the use of different gels, including aloe vera gel. Aloe vera has healing, anti-inflammatory, immune system strengthening, moisturizing, antiaging, and antiseptic properties [22]. This plant belongs to the Liliaceae family which grows in tropical regions. Elongated aloe vera leaves contain sticky gel. Along the length of the leaves, many connecting hair fibers make the plant strong. Healing wounds and superficial skin damage are some of the effects of fresh aloe vera gel [23]. Phlebitis has a high prevalence among hospitalized patients and phlebitis caused by venous catheters can be a source of stress, fear, and pain for patients, which is usually left untreated. Moreover, the recovery process of phlebitis usually requires a relatively long time. Thus, it is essential to pay attention to an auxiliary substance that accelerates the recovery of phlebitis [24]. The question always asked by nurses is, 'What is the best and least complicated method of phlebitis prevention?' [8]. Given that aloe vera is a traditional, natural, and anti-inflammatory plant and 2% chlorhexidine is an antiseptic solution, so far no study has compared the effect of aloe vera gel and chlorhexidine solution on the prevention of phlebitis. Accordingly, the present study aims to compare the effectiveness of aloe vera gel and 2% chlorhexidine gluconate solution in the prevention of phlebitis caused by peripheral vein catheters in patients admitted to Amir al-Momenin Hospital in Zabul in 2023.

Methodology

This three-group clinical trial study was conducted on patients who were admitted to the ICUs of Amir al-Momenin Hospital

in Zabul due to heart disease, high blood pressure, etc. in 2023. The inclusion criteria were patient cooperation and absence of phlebitis at the site before venipuncture and underlying diseases such as diabetes and skin diseases. The exclusion criteria were non-cooperation of the patient, discharge from the hospital earlier than 72 hours after the start of the intervention, and worsening of the patient's condition for any reason.

Following the study by Mohammadian et al.[8] and taking a 95% confidence interval and 80% test power, the sample size was estimated as 25 patients per group using the following formula. However, taking into account patients' dropout and following similar studies, a total of 90 patients were examined (30 patients in the aloe vera gel group, 30 patients in the chlorhexidine group, and 30 patients in the control group).

$$n = C \times [(p1(1\_p1) + p2(1\_p2)/(p2\_p1)2]$$
$$P1 = 0.20; P2 = 0.56; C = 7.9$$

In the first phase, 90 patients were selected using convenience sampling from among the patients admitted to the two ICUs who met the criteria for entering the study, and then the selected patients were systematically and randomly placed into three groups each with 30 members: aloe vera gel, chlorhexidine solution, and control groups. After visiting the ICUs, examining the patients, and assessing their eligibility based on the inclusion criteria, the first to third patients were randomly assigned to one of the groups. To do so, the first patient was placed into the aloe vera group, the second patient into the control group, and the third patient into the chlorhexidine group.

The data were collected using a demographic information form with 4 items that assessed the patient's age, gender, occupation, and underlying diseases and the phlebitis checklist of the Iranian Nursing Association. The validity of the checklist was measured by evaluating its content validity. To this end, the first draft of the checklist was reviewed by several professors at Zabul University of Medical Sciences and its content was revised based on their feedback. The reliability of the checklist was assessed using the equivalence or inter-rater reliability [8]. The observations were conducted by two raters using the same procedure on ten patients. To conduct the intervention, the researcher washed her hands for 30 seconds with soap and water and wore non-sterile gloves to protect herself. The skins of the patients in the aloe vera gel group were first disinfected with 70% ethyl alcohol, and after the alcohol dried and the angiocath placement, the angiocath was fixed with glue, and its upper part was smeared with 0.5 cc of aloe vera gel. In the 2% chlorhexidine solution intervention group, the catheter insertion site was first disinfected with 70% ethyl alcohol, and after placing the angiocath, it was fixed with glue and its upper part was immersed with 0.5 cc of 2% chlorhexidine gel. In the control group, only the catheter insertion site was disinfected with 70% ethyl alcohol, the catheter was fixed using glue in the standard fix method, and the date, time, and name of the researcher were recorded. The angiocath insertion site was controlled and recorded in terms of the presence of symptoms and the degree of phlebitis every 12 to 72 hours. The serum sets in the three groups were changed every 24 hours and the duration of intravenous catheter maintenance was 72 hours.

SPSS-25 software was used for data analysis. First, the normality of the data was checked using the Shapiro-Wilks test and parametric tests. The data were analyzed using the chi-square test and one-way ANOVA at a significance level of 0.05. The protocol for this research project was approved with the code of ethics IR.ZBMU.REC.1401.152 by the Ethics Committee of Zabul University of Medical Sciences. The research proposal was also registered in the Iranian Registry of

Clinical Trials with the code IRCT20231108059996N1.

Results

The average age of patients in the control group was (45.6+11.76), aloe vera (47.46+16.85), chlorhexidine (45.19+19.73). One-way analysis of variance did not show a statistically significant difference in the average age between the three groups (p=0.762) and most of the participants in the chlorhexidine group were male (50%) and the aloe vera group were female (66.7%). The K square test did not show a statistically significant difference between the groups in terms of gender. Therefore, these three groups were the same in terms of the gender variable.Table 2. The distribution of the participants in the three groups by employment. As can be seen, most of the participants in the chlorhexidine, aloe vera, and control groups were housewives. The chi-square test did not show a statistically significant difference between the three groups in terms of occupation. The results show that most of the participants in the chlorhexidine and control groups had high blood pressure. However, the chi-square test did not show a statistically significant difference between the three groups in terms of blood pressure.

As shown in the table below, the chi-square test did not show a statistically significant difference in the frequency of phlebitis between the chlorhexidine group and the control group. However, there was a statistically significant difference between the frequency of phlebitis in the control group and aloe vera. The highest and lowest frequency of phlebitis was observed in the control group and the aloe vera group, respectively, while there was no significant difference between the control group. Aloe vera group and control group before the intervention. Also, there was no statistically significant difference between the chlorhexidine and aloe vera groups in terms of the frequency of phlebitis (Table 4).

Table 1. The frequency of phlebitis in the three groups

Stage	Phlebitis	Control group	Aloe vera group	Chlorhexidine group	Z-score	P-value
Pre-intervention 12, 24, and 36 hours after the intervention	No	30 (100%)	30 (100%)	30 (100%)		
48 hours after the intervention	Yes	4 (13.3%)	1 (3.3%)	1 (3.3%)	2.63	0.357
	No	26 (86.7%)	29 (96.7%)	29 (96.7%)		
60 hours after the intervention	Yes	18 (60%)	9 (30%)	13 (43.3%)	5.49	0.064
	No	12 (40%)	21 (70%)	17 (56.7%)		
72 hours after the intervention	Yes	28 (93.3%)	18 (60%)	25 (83.3%)	10.54	0.005
	No	2 (6.7%)	12 (40%)	5 (16.7%)		

Discussion

This interventional study compared the effectiveness of aloe vera gel and 2% chlorhexidine gluconate solution in preventing phlebitis caused by peripheral vein catheters in hospitalized patients. The findings suggested that both aloe

vera gel and chlorhexidine solution support treatments are effective in reducing the incidence of phlebitis in the intervention and control groups, but the frequency of phlebitis in the aloe vera group was significantly higher compared to the control group.

The data from the present study also revealed that chlorhexidine solution is effective in reducing the incidence of phlebitis, but there was no statistically significant difference. Likewise, Pourmohammadi et al. (2016) examined the effect of 2% chlorhexidine gluconate solution on the prevention of phlebitis caused by peripheral vein catheters and found no statistically significant difference [5]. In a similar vein, Kolahdouzipour. et al. (2009) also found no statistically significant difference between the chlorhexidine and alcohol solutions in the prevention of phlebitis. However, phlebitis symptoms were less severe in the chlorhexidine group compared to the alcohol group [25]. In addition, Tayebimianeh et al (2020) compared the effectiveness of chlorhexidine, povidone-iodine solution, and alcohol in the incidence of phlebitis in infants. Contrary to the present study, the findings showed that the participants who used chlorhexidine solution showed a statistically significant difference compared to the control group and the incidence of phlebitis was lower in the chlorhexidine group [26]. Abdulahi et al. (2015) also compared the effectiveness of chlorhexidine disinfectant solution and 70% alcohol in the prevention of phlebitis. Out of 100 patients, 59 patients (17 patients in the chlorhexidine group and 32 patients in the alcohol group) had phlebitis. The findings indicated that the use of chlorhexidine solution was associated with a lower frequency and severity of phlebitis than alcohol [27]. Sarani et al. (2018) compared the effects of alcohol, chlorhexidine, and alcohol-chlorhexidine on the frequency of local infections related to the catheter and found that the frequency of local infections in the alcohol-chlorhexidine group decreased significantly [10].

The present study also showed that aloe vera gel is effective on the frequency of phlebitis in the long term. Accordingly, the frequency of phlebitis in the aloe vera group was significantly lower compared to the control. Various studies have examined the effect of aloe vera gel support treatments on phlebitis. In their meta-analysis study, Gao et al. (2016) highlighted that aloe vera has potential clinical value in the prevention and treatment of chemotherapy-induced phlebitis, as confirmed in the present study [28]. Another study by Leuchamine et al. (2016) examined the clinical effect of aloe vera in the treatment of phlebitis caused by levofloxacin. The participants in the intervention group were treated with aloe vera and the patients in the control group were treated with moist magnesium sulfate. The findings showed phlebitis was treated better in the intervention group than in the control group, and aloe vera was more effective than magnesium sulfate, as reported in the present study [29]. Haji Abadi et al. (2021) compared the impact of aloe vera compress and warm compress on the intensity of phlebitis and pain caused by venous catheter in hospitalized children and found that the average severity of phlebitis and pain intensity in the aloe vera intervention group decreased more significantly than the warm compress group [24], which is in line with the present study. The effectiveness of aloe vera compress can be attributed to the compounds hidden in aloe vera including anthraquinone, carbohydrates, enzymes, inorganic compounds such as iron, copper, and potassium, non-essential amino acids such as alanine, proteins, and vitamins such as thiamine, which have many therapeutic and medicinal properties [30][31]. As confirmed in the present study, the most important factor in the occurrence of phlebitis is time, and the incidence of phlebitis increases over time. Accordingly, Kardak et al. (2000) reported that the incidence of phlebitis increased with increasing catheter placement hours [32]. The present study found that the incidence of phlebitis was lower in the aloe vera group compared to the chlorhexidine and control groups,

which could be due to the effect of aloe vera gel. The findings also revealed that the impact of aloe vera on the occurrence of phlebitis is demonstrated in the long term. Accordingly, since angiocath in patients is replaced once every 72 hours, the use of aloe vera for preventing phlebitis can delay the time of replacing the angiocath. The underlying diseases, vascular latency and fragility, and lack of continuous catheter monitoring were some of the limitations of the present study. Similar studies can focus on finding the best and least complicated nursing methods as one of the constant concerns of nurses [33].

Conclusion

The findings from the present study revealed that the frequency of phlebitis in both chlorhexidine and aloe vera groups decreased. However, compared to chlorhexidine, aloe vera gel had a greater effect in reducing the incidence of phlebitis in patients in the long term. Accordingly, traditional and cost-effective methods including aloe vera gel can be used as a non-complicated and accessible method to reduce the incidence of phlebitis during catheterization.

Statements and Declarations

Conflict of Interest Disclosure: The authors declare no conflict of interest.

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References

1. a, b *Avazeh A, Elahi N, Asadi Zaker M, Rasekh A, Haji hosseini F. Effect of Topical Nitroglycerin on the Occurence and Severity of phlebitis due to Indwelling Intravenous Catheter in Hospitalized Patients. J Adv Med Biomed Res 2004; 12 (47):15-23*
2. ^ *Zheng GH, Yang L, Chen HY, Chu JF, Mei L. Aloe vera for prevention and treatment of infusion phlebitis. The Cochrane Database Syst. Rev. 2014; 4(6):CD009162.*
3. ^ *Borzou S, Salavati M, Zandyeh M, Zamanparvar A, Torckman B.The effect of sterile gauze bandage on preventing of phlebitis and local infections due to using intravenous catheter]. J Gorgan Univ Med Sci. 2003;5(2):71-6.*
4. ^ *Bayati A. A study about Predisposing Factor of Phelebitis in Hospitalized Children that Managed by Intravenous Fluid Therapy. Journal of Arak University of Medical Sciences.1999;2(9):1-5*
5. a, b, c, d *M P, Z F, N R. The Effect of 2% Chlorhexidine Gluconate Solution on Prevention of Phlebitis Related to Peripheral Venous Catheter in Patients Hospitalized in Cardiac Care Units of a Military Hospital. MCS 2017; 4 (1):19-29*
6. ^ *Hadaway L. Short peripheral intravenous catheters and infections. J Infus Nurs. 2012;35(4):230-40.*
7. ^ *Uslusony Esin, Meta Samiye. Pre disposing factor to phlebitis in patients with peripheral. intravenous catheter: A descriptive study JAm Acad Nurs Practitioners. 2008; 20(4): 172.*

8. [a, b, c, d, e, f]*Mohammadyan S, seidi J, Nouri B, fathi M. A Comparative Study on the Effect of Aloe Vera and Nitroglycerin Ointment on the Incidence and Severity of Phlebitis Caused by the Peripheral Catheter. SJKU 2020; 25 (2):44-53*
9. ^*Panadero A, Iohom G, Taj J, Mackay N, Shorten G. A dedicated intravenous cannula for postoperative use effect on incidence and severity of phlebitis. Anaesthesia. 2002.921-5(9)57;*
10. [a, b, c]*Sarani H, Ahmadi F, Dabiri S. Comparison of Alcohol, Betadineand Alcohol-Iodine in the Incidence of Complications Venous Catheter. J Arak Nurs Sci. 2000;3:11-7.*
11. ^*Cokmez A, Gur S, Genc H, Deniz S, Tarcan E. Effect of transdermal glyceryl trinitrate and anti-inflammatory gel in infusion phlebitis. ANZ J Surg. 2003;73(10):794-6.*
12. [a, b]*O›Grady NP, Alexander M, Burns LA, Dellinger EP, Garland J, Heard SO, et al. Guidelines for the prevention of intravascular catheter-related infections. Clin Infect Dis. 2011;52(9):e162-93.*
13. ^*Bagheri-Nesami M, Khodadadian-Miri J, Tabiban S, Ala S. The comparison of 2% nitroglycerin ointment and 2% chlorhexidine solution effect in preventing catheter-related phlebitis. Journal of Babol University of Medical Sciences. 2014;16(6):7-15.*
14. ^*Larypoor M, Frsad S. [Evaluation of nosocomial infections in one of hospitals of Qom, 2008]. Iranian J Med Microbiol. 2011;5(3):7-17.*
15. ^*Alaee Karahroudy F, Naeimi N, Khanali Mojan L, Nasiri M. The Audit of Nursing Cares Related to the Treatment of Extravasation in Neonatal Intensive Care Units. Journal of Hayat 2016; 22 (1):79-89*
16. ^*Tetarour P, Salemi S, Maqsoodi S, Atrkar Roshan. EVALUATION OF QUALITY CARE OF INTRAVENOUS LINE BY NURSES. IJN 2001; 14 (28):25-30*
17. ^*Karadag A, Gorgulu S. Devising an intravenous fluid therapy protocol and compliance of nurses with the protocol. J Intraven Nurs 2000; 23 (4): 232-8.*
18. ^*Slaughter SE. Intravascular catheter-related infection: Intravascular catheter-related infections. Strategies for combating this common foe. Postgrad Med J 2004;116(5):59-66.*
19. ^*Zitella L. Centeral venous catheter site cart for blood and marrow transplant recipients. Clin J Oncol Nurs 2003; 7(3):289-98.*
20. ^*Brunner L, Suddarth D. Textbook of Medical Surgical Nursing. Philadelphia: Lippincott Co 2012. 2033-60 p.*
21. ^*Marino P. The ICU Book. Philadelphia: Lippincott Williams & Wilkins; 2007.*
22. ^*Surjushe A, Vasani R, Saple D. Aloe vera: a short review. Indian J.Dermatol. 2008;53(4):163*
23. ^*Ahmadi Ashtiani H, Noori Garmroodi A. A review of the role of aloe vera in the management of skin diseases. Journal of Dermatology and Cosmetic. 2020;11(2):132-41*
24. [a, b]*Hajiabadi F, Mahmoodi N, Kermansaravi F, Naderifar M. Comparison of the Effect of Aloe vera and Warm Compresses on Pain Due to Phlebitis in Hospitalized Children. Med Surg Nurs J. 2023;12(2):e141101.*
25. ^*Kolahdoozipour J, Abdollahzadeh F, Zamanzadeh V, Vahedi A, Lotfi M, Heidarzadeh M.] The comparison of the effect of chlorhexidine gloconate 2% and alcohol ethylic 70% in prevention of phlebitis[. Horiz Med Sci. 2009;14(4):48-54*
26. ^*Zahra Tayebi Myaneh, Fariba Abdolahi, Seyedeh Soghra Taher Harikandeie, Zeynab Kamipoor. Chlorhexidie or*

povidone-iodine and alcohol: A pilot study for evaluating the incidence of phlebitis in neonates. Journal of Neonatal Nursing. 2023;29(1): 105-107

27. ^*Foroozan Abdollahi, Azizolallah Arababisarjou. Comparing the Effect of Disinfectant Solution of 2% Chlorhexidine Gluconate and 70% Alcohol on Prevention of Phlebitis. Der Pharmacia Lettre. 2016;8(6):129-134*
28. ^*Gao Y, Jiang T, Mei S, Zhang S, Zhu C, Sun Y. Metaanalysis of Aloe vera for the prevention and treatment of chemotherapy-induced phlebitis. Int J Clin Exp Med. 2016;9(6):9642-50.*
29. ^*Chaomin L. Analysis of curative effect of aloe and topical treatment of phlebitis caused by Levofloxacine Injection. China Journal of Pharmaceutical Economics.2017.*
30. ^*Chelu, M.; Musuc, A.M.; Popa, M.; Calderon Moreno, J. Aloe vera-Based Hydrogels for Wound Healing: Properties and Therapeutic Effects. Gels. 2023;9:539.*
31. ^*Moghaddam S, Rahnama M, Abdollahimohammad A, Naderifar M) 2022). Comparison of rinsing with chlorhexidine and matrica mouthwashes on the ventilatorassociated pneumonia.Romanian Journal of Military Medicine No. 2: Vol 5. 213-219. doi: 10.55453/rjmm.2022.125.2.6*
32. ^*Karadage A, Gorgulu S. Devising an intravenous fluid therapy protocol and compliance of nurses with the protocol. JIntraven Nurs 2000;23(4):232-8.*
33. ^*Balouchi A, Rafsanjani MHAP, Al-Mutawaa K, Naderifar M, Rafiemanesh H, Ebadi A, Ghezeljeh TN, Shahraki-Mohammadi A, Al-Mawali A. Hypertension and Pre-Hypertension in Middle East and North Africa (MENA): A Meta-Analysis of Prevalence, Awareness, Treatment, and Control. Curr Probl Cardiol. 2022 Jul;47(7):101069. doi: 10.1016/j.cpcardiol.2021.101069. Epub 2021 Nov 26. PMID: 34843808.*