

Nutrition, Physical Activity Management Approaches Delivered by Nurse Practitioner-led Care Effect on the Outcomes of Care for Adult Subjects with Cardiovascular Disease: A Meta-analysis

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Abstract Background: Cardiovascular disease is the very common disease characterized. It may cause unpleasant symptoms as well as increases the person's risk of disability. With an ageing population, increasing rates of cardiovascular disease and limited access to specialists, new methods of care, like nurse practitioners need to be assessed to meet patient specific needs and provide sustainable care. We performed a meta-analysis to evaluate the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease. Methods: A systematic literature search up to October 2021 (between 2000 and 2021) was done and 8 studies included 4019 subjects with cardiovascular disease at the start of the study; 2064 of them were provided with nurse practitioner-led care and 1955 were standard care. They were reporting relationships about the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease. We calculated the odds ratio (OR) and mean difference (MD) with 95% confidence intervals (CIs) to assess the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease using the dichotomous and continuous methods with a random or fixed-effect model. Results: Nurse practitioner-led care had significantly lower 30-day readmission for cardiovascular disease (OR, 0.63; 95% CI, 0.47-0.86, $p=0.004$) compared to standard care in subjects with cardiovascular disease. However, nurse practitioner-led care had no significant difference in length of stay after cardiac surgery (MD, -1.27; 95% CI, -3.72-1.19, $p=0.31$), health-related quality of life: SF-36 physical composite score (MD, 0.21; 95% CI, -0.75-1.17, $p=0.67$), and health-related quality of life: SF-36 mental composite score (MD, -0.79; 95% CI, -2.65 -1.08, $p=0.41$) compared to standard care in subjects with cardiovascular disease. Conclusions: Nurse practitioner-led care had significantly lower 30-day readmission for cardiovascular disease; however, nurse practitioner-led care had no significant difference in length of stay after cardiac surgery, and health-related quality of life: SF-36 physical composite score, and SF-36 mental composite score compared to standard care in subjects with cardiovascular disease. Further studies are required to validate these findings.

Keywords: cardiovascular disease, nurse practitioner-led care, 30-day readmission for cardiovascular disease; length of stay after cardiac surgery, health-related quality of life: SF-36 physical composite score, and health-related quality of life: SF-36 mental composite score

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1. Background

Healthcare improvement is happening worldwide, due to its vital effects such as decreasing healthcare costs, appointments and procedures waiting times, and enhancing quality of care and patient safety. [1] Though healthcare

improvements in the last 20 years, 2 similar problems add to the barriers for instant and effective modification. Worldwide, most countries have an aging population and increasing growth of people living with chronic illnesses. [2] These two health problems continue to increase the use of additional need of the restricted healthcare resources in the world, increasing healthcare costs are also producing constant challenges to healthcare sustainability. [3] Thus,

healthcare providers are looking for new innovative techniques of care to provide safe and reasonable patient care. With restricted healthcare resources, healthcare providers have to define which technique of care to use. Healthcare leaders are encouraged to use healthcare data and outcomes to inform difficult decisions; such as the use of healthcare providers. [4] Advisory Panel on Healthcare Innovation and Institute for Healthcare Improvement [5,6,7,8] in different countries provided increasing support for healthcare providers working to their full scope of practice.

Nursing implications are the nursing-related consequences of something such as a disease, a medication, a procedure. It is not the medical side effects, but the things which may occur which are up to the nurse to resolve. They are very important in management of serious diseases and critically ill subjects. Worldwide nurse practitioners are graduate-level prepared registered nurses (in most countries), whose scope of practice comprises health maintenance and promotion from diagnosis, treatment, to follow-up of subjects with acute and chronic conditions in both the inpatient and outpatient setting. [5,9] Nurse practitioners are independent practitioners but frequently work in collaborative healthcare teams. Nurse practitioners are unique since they use certain chosen skills from medicine and advanced nursing skills that might outcome in great benefits to subjects and the healthcare system. Benefits of practitioner-led care include reduced costs, improved subjects engagement with their care, and enhanced quality of life. [10] Presently nurse practitioners-led cardiovascular care and the related results of care have not been properly assessed. [11] Thus, this meta-analysis study aimed to evaluate the effect of nurse

practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease.

2. Methods

The current study was completed following a reputable protocol that was based on the meta-analysis of studies in the epidemiology statement.

2.1. Study Selection

Comprised studies were that with statistical relationship (odds ratio [OR], mean difference [MD], frequency rate ratio, or relative risk, with 95% confidence intervals [CIs]) among the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease were included.

Only those human studies in any language were selected. Inclusion was not limited by study size or type. Studies excluded included review articles, commentaries, and studies that did not provide a level of association. Figure 1 shows the entire study procedure. The articles were combined into the meta-analysis when the next inclusion criteria were met:

1. The study was a randomized standard trial, prospective study, or retrospective study.
2. The target population is subjects with cardiovascular disease
3. The intervention program was nurse practitioner-led care
4. The study included comparisons between the nurse practitioner-led care and standard care.

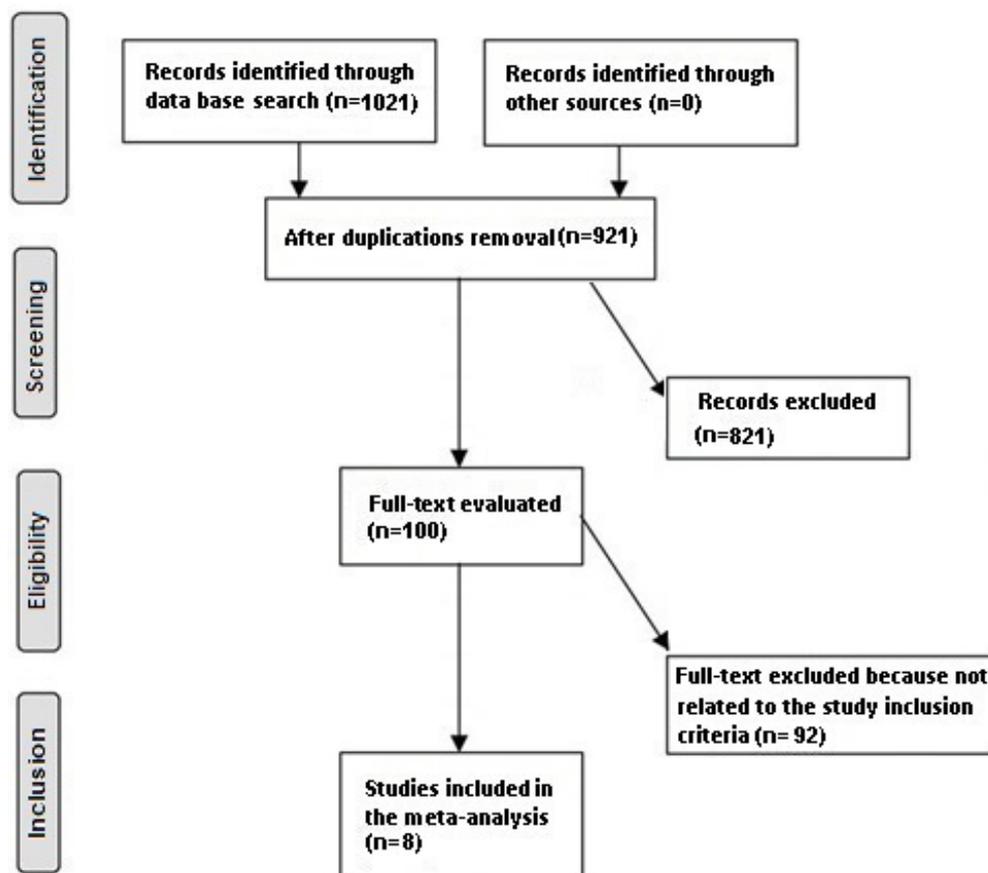


Figure 1. Schematic illustration of the study method

The exclusion criteria were:

1. Studies that did not determine the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease
2. Studies with adult subjects with cardiovascular disease care other than nurse practitioner-led care
3. Studies did not focus on the effect of comparative results.

2.2. Identification

A protocol of search plans was arranged based on the PICOS principle, and we defined it as follow: P (population): subjects with cardiovascular disease; I (intervention/exposure): nurse practitioner-led care; C (comparison): nurse practitioner-led care and standard care; O (outcome): 30-day readmission for cardiovascular disease, length of stay after cardiac surgery, health-related quality of life: SF-36 physical composite score, and health-related quality of life: SF-36 mental composite score; and S (study design): no limit. [12] First, we performed a systematic search of Embase, PubMed, Cochrane Library, OVID, and Google scholar till October 2021 (between 2000 and 2021), using a combination of keywords and related words for cardiovascular disease, nurse practitioner-led care, 30-day readmission for cardiovascular disease, length of stay after cardiac surgery, health-related quality of life: SF-36 physical composite score, and health-related quality of life: SF-36 mental composite score as shown in Table 1. All identified studies were grouped in an EndNote file, duplicates were omitted, and the title and abstracts were reviewed to remove studies that did not show any association about the effect of nurse practitioner-led care on the outcomes of care for adults subjects with cardiovascular disease. The remaining studies were studied for associated information.

Table 1. Search Strategy for Each Database

Database	Search strategy
Pubmed	#1 "cardiovascular disease"[MeSH Terms] OR "nurse practitioner-led care"[All Fields] OR "length of stay after cardiac surgery"[All Fields] #2 "SF-36 physical composite score"[MeSH Terms] OR "cardiovascular disease"[All Fields] OR "readmission within 30 days"[All Fields] OR "SF-36 mental composite score"[All Fields] #3 #1 AND #2
Embase	'cardiovascular disease'/exp OR 'nurse practitioner-led care'/exp OR 'length of stay after cardiac surgery'/exp #2 'SF-36 physical composite score'/exp OR 'ICBG'/exp OR 'readmission within 30 days'/exp OR 'SF-36 mental composite score'/exp #3 #1 AND #2
Cochrane library	#1 (cardiovascular disease):ti,ab,kw OR (nurse practitioner-led care):ti,ab,kw OR (length of stay after cardiac surgery):ti,ab,kw (Word variations have been searched) #2 (SF-36 physical composite score):ti,ab,kw OR (readmission within 30 days):ti,ab,kw OR (SF-36 mental composite score):ti,ab,kw (Word variations have been searched) #3 #1 AND #2

2.3. Screening

Data were abbreviated based on the following; study-related and subject-related features onto a homogeneous form as follow; the primary author last

name, study period, country, publication year, the studies region, and type of the population, design of the study; the total number of subjects, demographic data and clinical and treatment features. In addition to, the evaluation period is associated with measurement, quantitative method and qualitative method of assessment, source of information, and outcomes' assessment, and statistical analysis MD or relative risk, with 95% CI of relationship. [12] If a study fit for inclusion based on the abovementioned principles, data were extracted separately by two authors. In case of dissimilarity, the corresponding author gives a final choice. When there were different data from one study based on the evaluation of the relationship between the effects of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease, we extracted them separately. The risk of bias in these studies; individual studies were appraised using two authors who separately evaluated the methodological quality of the nominated studies. The "risk of bias tool" from the RoB 2: A revised Cochrane risk-of-bias tool for randomized trials was used to measure methodological quality. In terms of the evaluation criteria, each study was valued and consigned to one of the next three risks of bias: low: if all quality criteria were met, the study was considered to have a low risk of bias; unclear: if one or more of the quality criteria were partly met or unclear, the study was considered to have a moderate risk of bias; or high: if one or more of the criteria were not met, or not comprised, the study was considered to have a high risk of bias. Any discrepancies were addressed by reviewing the original article.

2.4. Eligibility

The chief result concentrated on the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease. An assessment of the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease was extracted forming a summary.

2.5. Inclusion

Sensitivity analyses were restricted only to studies showing the association of the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease. For subgroup and sensitivity analysis, we performed a comparison between the nurse practitioner-led care and standard care. It has to be noted that standard care differed from study to another according but most of them was physician led care.

2.6. Statistical Analysis

We computed the odds ratio (OR), mean difference (MD), and 95% confidence interval (CI) by the dichotomous or continuous technique with a random or fixed-effect model. We calculated the I^2 index and the I^2 index was between 0% and 100%. When the I^2 index was around 0%, 25%, 50%, and 75% that identifies no, low, moderate, and high heterogeneity, respectively. If the I^2 was > 50%, we used the random-effect; if it was < 50%, we used the fixed-effect. We used stratifying the original calculation per result category as defined before to do the

subgroup analysis. A p-value for differences amongst subgroups of <0.05 reflected statistically significant. Studies bias was measured quantitatively using the Egger regression test (studies bias is present if $p \geq 0.05$), and qualitatively, by visual examination of funnel plots of the logarithm of odds ratios against their standard errors. The entire p-values were 2 tailed. Reviewer manager version 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark) was used to perform all measurements and graphs.

3. Results

A total of 1021 distinctive studies were found, of which 8 studies (between 2004 and 2021) satisfied the inclusion criteria and were comprised in the study. [13-18]

The 8 studies included 4019 subjects with cardiovascular disease at the start of the study; 2064 of them were

provided with nurse practitioner-led care and 1955 were standard care. All studies evaluated the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease.

The study size ranged from 103 to 1240 subjects with cardiovascular disease at the beginning of the study. The information of the 8 studies is revealed in Table 2. Seven studies reported data stratified to the 30-day readmission for cardiovascular disease, 4 studies reported data stratified to the length of stay after cardiac surgery, 3 studies reported data stratified to health-related quality of life: SF-36 physical composite score and 3 studies reported data stratified to health-related quality of life: SF-36 mental composite score.

Nurse practitioner-led care had significantly lower 30-day readmission for cardiovascular disease (OR, 0.63; 95% CI, 0.47-0.86, $p=0.004$) with moderate heterogeneity ($I^2 = 64%$) compared to standard care in subjects with cardiovascular disease as shown in Figure 2.

Table 2. Characteristics of the selected studies for the meta-analysis

Study	Country	Total	Nurse practitioner-led care	Standard care
Lenz, 2004 [26]	USA	365	200	165
Goldie, 2012 [13]	Canada	103	22	81
Sawatzky, 2013 [14]	Canada	200	95	105
Blum, 2014 [15]	USA	203	102	101
David, 2015 [21]	USA	185	109	76
Smith, 2016 [16]	USA	676	532	144
van den Dries, 2020 [17]	Netherlands	1240	527	713
Dawson, 2021 [18]	USA	1047	477	570
	Total	4019	2064	1955

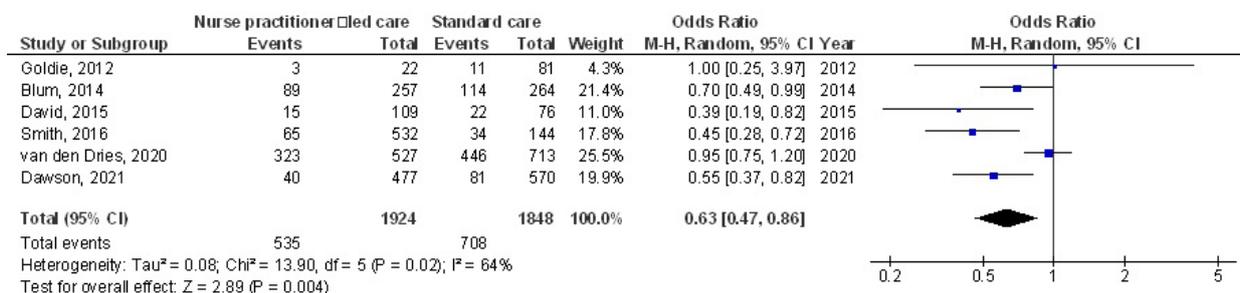


Figure 2. A forest plot of the 30-day readmission for cardiovascular disease in nurse practitioner-led care group compared to the standard care group

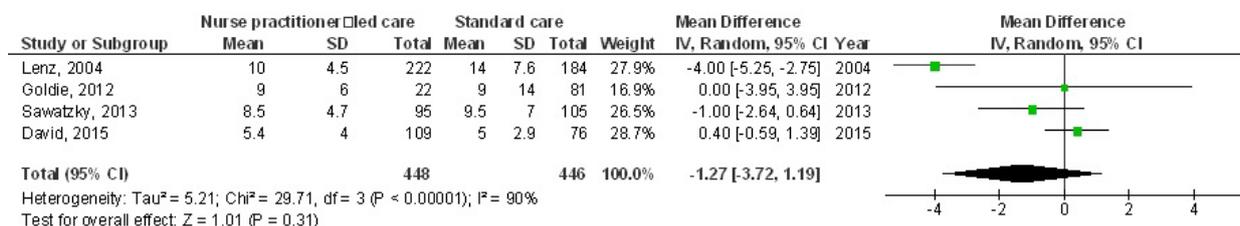


Figure 3. A forest plot of the length of stay after cardiac surgery in nurse practitioner-led care group compared to the standard care group

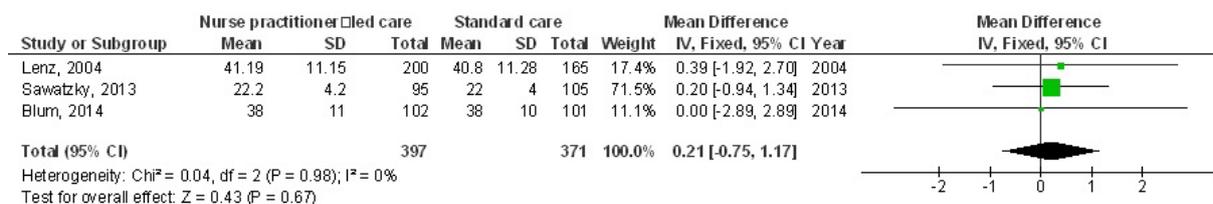


Figure 4. A forest plot of the health-related quality of life: SF-36 physical composite score in nurse, practitioner-led care group compared to the standard care group

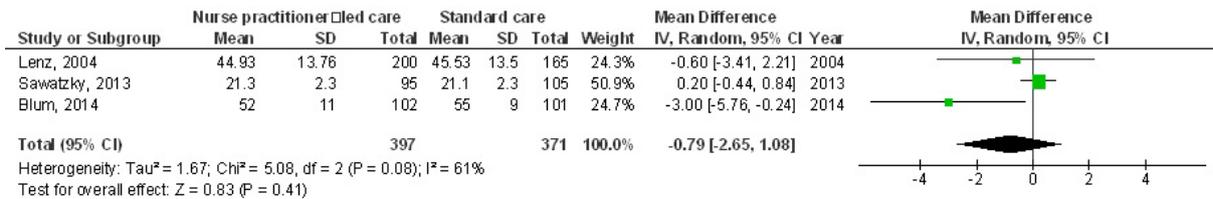


Figure 5. A forest plot of the health-related quality of life: SF-36 mental composite score in nurse, practitioner-led care group compared to the standard care group

However, nurse practitioner-led care had no significant difference in length of stay after cardiac surgery (MD, -1.27; 95% CI, -3.72-1.19, $p=0.31$) with high heterogeneity ($I^2 = 90\%$), health-related quality of life: SF-36 physical composite score (MD, 0.21; 95% CI, -0.75-1.17, $p=0.67$) with no heterogeneity ($I^2 = 0\%$), and health-related quality of life: SF-36 mental composite score (MD, -0.79; 95% CI, -2.65 - 1.08, $p=0.41$) with moderate heterogeneity ($I^2 = 61\%$) compared to standard care in subjects with cardiovascular disease as shown in Figure 3 – Figure 5.

Selected studies stratified analysis that adjusted for ethnicity, and age was not completed because no studies stated or adjusted for these influences.

Based on the visual assessment of the funnel plot as well as on quantitative measurement by the Egger regression test, there was no indication of publication bias ($p = 0.88$). Yet, the majority of the comprised studies were of low methodological quality because of their small sample size. All studies did not have selective reporting bias, and no articles had incomplete result data and selective reporting.

4. Discussion

Nurse practitioner-led care had significantly lower 30-day readmission for cardiovascular disease compared to standard care in subjects with cardiovascular disease. However, nurse practitioner-led care had no significant difference in length of stay after cardiac surgery, health-related quality of life: SF-36 physical composite score and health-related quality of life: SF-36 mental composite score compared to standard care in subjects with cardiovascular disease. Yet, the analysis of results must be done with attention due to the low number of studies found for the meta-analysis; recommending the necessity for additional studies to confirm these findings or perhaps to significantly impacts confidence in the effect assessment especially length of stay after cardiac surgery, health-related quality of life: SF-36 physical composite score and health-related quality of life: SF-36 mental composite score with their low number of studies found evaluation them.

Reducing 30-day readmission rates for cardiovascular disease and length of stay after cardiac surgery have been recognized as important healthcare improvement matters since the early 1970s. [3] Nurse practitioner roles have been applied to support accomplishing these health system objectives. Some studies have shown that cardiovascular nurse practitioners-led care is related to reducing 30-day readmission rates for cardiovascular disease. [15,19,20,21] Initially, they showed that cardiovascular

nurse practitioners-led care reduced 30-day cardiovascular disease readmission rates yet this was not sustained after one year.

Meyer and Miers [22] evaluated reducing the length of stay in postoperative cardiovascular surgery subjects with a retrospective chart review. They compared the earlier model of care to present nurse practitioners-led care and found a reduction of 1.91 days in the length of stay. The Goldie study [13] was not able to recruit to the full sample size however the Sawatzky study did not include the length of stay as one of their main results of care. [14] The variation in the findings might be because the sample sizes were not satisfactory to detect a length of stay. When the health-related quality of life is assessed as a result related to direct nurse practitioners-led care it was found to be related to higher levels of health-related quality of life scores. Though, when the health-related quality of life is assessed as a result of comparing nurse practitioners-led care with other healthcare providers, often no significant difference in the subjects' self-reported health status could be found. [23,24,25,26,27] One study showed that nurse practitioners-led care helped subjects to reduce their overall vascular risk by decreasing some vascular risk factors. [28] This could be due to that subjects in the nurse practitioners-led group had improved control of their cholesterol levels and other risk factors. [29,30,31,32] Though including nurse practitioners in cardiovascular care have been welcome, little is known about the results of care. Also, most of nurse practitioners studies are low-quality studies and few randomized controlled trials. [33,34] Several relevant studies of nurse practitioners-led care were not published. The assessment of medical and health-related studies is not being published and that could be due to the lack of time or value as a low priority for the nursing staff. [35] another meta-analysis study showed that nurse practitioners find it hard to balance their clinical roles and accompanying research studies. [36] Extra employer support or academic help and guidance can support nurse practitioners to balance loads of both roles and allow them to publish vital studies needed to guide practice.

This meta-analysis reported the association of the effect of nurse practitioner-led care on the outcomes of care for adult subjects with cardiovascular disease. Though, additional studies are required to confirm these probable relationships. Also, additional studies are required to provide a clinically meaningful difference in the outcomes. This was suggested also in previous similar meta-analysis studies which showed a similar effect of nurse practitioner-led care and standard care in subjects with cardiovascular disease. [6,37,38,39] The insignificant results of nurse practitioner-led care in the length of stay after cardiac surgery, health-related quality of life: SF-36

physical composite score and health-related quality of life: SF-36 mental composite score also needs additional study and clarification because no clear reasoning was found to clarify these outcomes. Well-conducted studies are also required to measure these factors and the blend of different ages, and ethnicity; because our meta-analysis study could not answer whether they are related to the outcomes. Most of the selected studies evaluated were designed and accompanied before 2013 when SPIRIT Statement was started as a protocol to assist in improving the quality of clinical trial protocols. [40] The CONSORT Statement (2010) is a 25-item checklist and flow diagram for authors to confirm transparent reporting of randomized trials. [41] Using the SPIRIT and CONSORT protocols and checklists when designing and reporting a randomized controlled trial will assist to confirm that all vital elements of the trial are reported. Therefore reduce the risk of bias which eventually will help increase the quality of nurse practitioner-led randomized controlled trials. [40,41] We suggest that well-designed, high-quality randomized controlled trials are required to be accomplished in cardiovascular nurse practitioner-led care. Nurse practitioners need to confirm completed studies be published to establish and document results related to cardiovascular nurse practitioners-led care since published evidence should be used to lead the clinical practice. [42]

In summary, nurse practitioner-led care had significantly lower 30-day readmission for cardiovascular disease, however, nurse practitioner-led care had no significant difference in length of stay after cardiac surgery, health-related quality of life: SF-36 physical composite score and health-related quality of life: SF-36 mental composite score compared to standard care in subjects with cardiovascular disease. Further studies are required to validate these findings.

5. Limitations

There might be selection bias in this study because so numerous of the studies found were excluded from our meta-analysis. Yet, the studies excluded did not fulfill the inclusion criteria of the meta-analysis. Also, we could not answer whether the outcomes were related to age and ethnicity or not. The study was intended to evaluate the association of the effect of nurse practitioner-led care on the outcomes of care for adult subjects with the cardiovascular disease based on data from earlier studies, which may originate bias brought by incomplete information. The meta-analysis was based on only 8 studies; variables like length of stay after cardiac surgery, health-related quality of life: SF-36 physical composite score, and health-related quality of life: SF-36 mental composite score were only analyzed using 4 or 3 studies. Variables such as age, ethnicity, and nutritional condition of subjects were also the probable bias-inducing influences.

6. Conclusions

Nurse practitioner-led care had significantly lower 30-day readmission for cardiovascular disease, however, nurse practitioner-led care had no significant difference in

length of stay after cardiac surgery, and health-related quality of life: SF-36 physical composite score and SF-36 mental composite score compared to standard care in subjects with cardiovascular disease. Further studies are required to validate these findings. More studies are essential to confirm these outcomes. Yet, the analysis of results must be done with attention due to the low number of studies found in the meta-analysis; recommending the necessity for additional studies to confirm these findings or perhaps to significantly impacts confidence in the effect assessment.

Fund

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