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Task Shifting Interventions for Cardiovascular Risk Reduction in Low-and Middle-Income Countries: A Systematic Review of the Evidence

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ABSTRACT

Objective : To evaluate evidence from published randomized controlled trials (RCTs), for the use of task-shifting strategies for cardiovascular disease (CVD) risk reduction in low- and middle-income countries (LMICs).

Design: Systematic review of RCTs that utilized task-shifting strategy in management of CVD in LMICs.

Data Sources: We searched the following databases for relevant RCTs: PubMed from 1940s, Embase from 1974, Global Health from 1910, Ovid Health Star from 1966, Web of Knowledge from 1900, Scopus from 1823, CINAHL from 1937, and RCTs from ClinicalTrials.gov.

Eligibility criteria for selecting studies: We focused on RCTs published in English but without publication year. We included RCTs in which the intervention used task-shifting (non-physician healthcare workers involved in either prescribing of medications, treatment and/or medical testing), use of non-physician healthcare providers in management of CV risk factors and diseases (hypertension, diabetes, hyperlipidemia, stroke, coronary artery disease, or heart failure), and RCTs that were conducted in LMICs. We excluded studies that are not RCTs.

Results: Of the 2771 articles identified, only four met predefined criteria. All four trials were conducted in practice-based settings among patients with hypertension (2 studies) and diabetes (2 studies), with one study also incorporating home visits. The duration of the studies ranged from three months to 12 months; and the task-shifting strategies included provision of medication prescriptions by nurses, community health workers, and pharmacists; and telephone follow up post-hospital discharge. Both hypertension studies reported mean significant blood pressure reduction (2/1 mm Hg and 30/15 mm Hg); and both diabetes trials reported reduction in HbA1c levels of 0·5-1·87%.

Conclusions: There is a dearth of evidence on the implementation of task-shifting strategies to reduce the burden of CVD in LMICs. Effective task-shifting interventions targeted at reducing global CVD epidemic in LMICs are urgently needed.

Strengths and limitations of this study

- This systematic review evaluates effectiveness of existing task-shifting strategies in management of cardiovascular (CV) risk factors in low-and middle-income countries (LMICs).
- Analysis of four randomized controlled trials (the only studies meeting our eligibility criteria), where non-physician healthcare workers were involved in either prescribing of medications, treatment and/or medical testing showed significant improvement in blood pressure and glucose levels.
- The studies indicate some evidence of the effectiveness of task-shifting strategies for hypertension and diabetes management using nurses in LMICs.
- Our findings highlight the lack of data on widespread implementation and effectiveness of task-shifting strategies for CVD other than the one large trial conducted by Mendis and colleagues at the WHO which showed that task shifting is effective at primary care healthcare facilities in Nigeria and China.
- The small number of studies and heterogeneity in terms of the various CVD makes it not feasible to conduct a meta-analysis.

Key Words: Task-shifting, Cardiovascular disease, Hypertension, Diabetes, Low-and middle-income countries, systematic review

INTRODUCTION

The prevalence of cardiovascular diseases (CVD) and diabetes, and their attendant complications is high in low- and middle-income countries (LMICs).[1] According to the World Health Organization (WHO), 80% of the mortality attributable to non-communicable diseases (NCDs) occurs in LMICs; and cardiovascular diseases (CVD) account for the greatest burden.[2] For example, the mortality attributable to CVD in Africa, South-East Asia, and Eastern Mediterranean regions is projected to increase from 20 to 35% by the year 2020.[2] It is estimated that more than 30 million adults in Africa have hypertension, and 75% of all deaths in Africa may be attributable to hypertension by the year 2020.[3] Stroke deaths attributable to hypertension in sub-Saharan Africa (SSA) account for a total disability of 2.6 million Disability Adjusted Life Years.[4] Even more troubling is the fact that the growing NCD burden [in most LMICs] occurs in the context of high levels of infectious diseases such as malaria, HIV/AIDS and tuberculosis, thus indicating a rapid epidemiologic transition.[5] This makes the urgency of addressing the epidemic of CVDs in LMICs imminent.

Although barriers to management of CVD exist at multiple levels of care, systems-level barriers [particularly acute shortage of healthcare providers] limit the capacity of LMICs to manage CVD at the primary care level.[1, 6-9] For example, although SSA has 11% of the world's population and bears over 24% of the global disease burden, it harbors only 3% of the global health workforce.[1] There are 2.4 million doctors and nurses in SSA, which translate to 2 doctors and 11 nursing / midwifery personnel per 10,000 people compared to 19 doctors and 49 nursing/midwifery personnel per 10,000 in North America.[10] Given such limited resources, cost-effective approaches are urgently needed to mitigate systems-level barriers to management of CVD in LMICs. One such approach is a task-shifting strategy, defined as the rational distribution of primary care duties from physicians to non-physician healthcare providers.[11] In fact the idea of task shifting is not entirely new. Task shifting was to be the hallmark of the WHO-led primary health care movement of the 1980s. It was behind the declaration of what became known as health for all by the year 2000. For this purpose, and in order to maximize the efficient use of health workforce resources, primary care tasks are shifted from higher-trained health workers such as physicians to less highly trained health workers. According to the WHO and later echoed by the World Medical Association, task shifting is particularly useful in low-resource settings facing healthcare human resource crisis,[12] and is therefore proposed as a viable method for primary and secondary prevention at the primary care level.[13] The benefits of task shifting are well documented in management of HIV/AIDS.[14] It utilizes multiple strategies to address the CVD

epidemic including screening, counseling on lifestyle modification, initiation of treatment, and referral to specialist care. [11-13, 15]

Despite the global call for task shifting for management of non-communicable diseases, and the potential for task-shifting strategies to mitigate the systems-level barriers to implementation of primary and secondary prevention of CVD in LMICs, their effectiveness has not been widely evaluated. In this systematic review, we evaluated the evidence from published randomized controlled trials (RCTs), for the use of task-shifting strategies for CVD risk reduction in LMICs.

METHODS

Search Strategy

We identified published trials that met predefined inclusion criteria using standard Cochrane Collaboration systematic review techniques,[16] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[17] statement. We searched the following databases: PubMed from 1940s, Embase from 1974, Global Health from 1910, Ovid Health Star from 1966, Web of Knowledge from 1900, Scopus from 1823, CINAHL from 1937, and RCTs from ClinicalTrials.gov. The search strategy included terms from three subject categories: those related to cardiovascular disease; those related to the concept of task-shifting; and those related to low- and middle-income countries, as defined by the World Bank [using a variety of factors including gross domestic product (GDP), population, economic policy and external debt, health, environment, and education].[18] All concepts were then combined using both keywords and controlled vocabularies such as, "*task shift*" AND "balance of care OR nonphysician clinician OR substitute health worker OR community care giver OR primary health care team OR cadres OR nurs*" AND "CVD"*. The search terms used were similar to the ones used by Callaghan et al in their systematic review of task-shifting in HIV treatment.[14]

We adopted the following definition of task-shifting by Callaghan et al,:[14] "the process of shifting tasks to a variety of health workers; including nurses or new cadres in prescribing of medications and medical testing, as long as it is a streamlined, rationalized chain of care." As depicted in Figure 1, the process of task shifting should involve ongoing training from higher-level health professionals, delegation, and continuous supervision. Also, patients with complicated disease cases should always be referred for specialist care.

Eligibility Criteria for Inclusion of Studies

We limited our search to only RCTs published in English but without publication year. We included RCTs in which the intervention used task-shifting (non-physician healthcare workers involved in either prescribing of medications, treatment and/or medical testing), use of non-physician healthcare providers in management of CV risk factors and diseases (hypertension, diabetes, hyperlipidemia, stroke, coronary artery disease, or heart failure), and RCTs that were conducted in LMICs. We excluded studies that are not RCTs. We then reviewed the identified RCTs in their entirety to determine their eligibility.

Data Extraction

Each of the authors assessed all retrieved lists of citations and abstracts independently. Initially, we determined the relevance of the articles by title and abstract. Discrepancies between the authors about eligibility of retrieved studies were resolved by discussion. We then obtained printed copies of all relevant articles for extensive examination to ensure that the articles met all eligibility criteria. Information from potentially eligible articles including study country, study design, methods, participant characteristics, retention rates, and study outcomes were extracted into the Cochrane Review Manager.[19]

RESULTS

Full search strategies for each of the databases are provided in Appendix 1 (online supplementary). We retrieved and screened 2771 articles (Figure 2), and conducted full paper review on 32 articles that initially met the inclusion criteria including study location in LMICs, the use of non-physician providers to provide health services, CVD, and use of task-shifting strategies. After further review, we excluded 16 articles including: studies that were not conducted in LMICs (3); studies that were missing important details about intervention strategies (4); protocol papers that were missing main trial outcomes (4); studies that referred to the same study protocol conducted in the same populations (3); studies whose primary outcome did not include major cardiovascular risk factors or CVD (1); and studies that only provided abstracts (1). A total of 16 articles met the eligibility criteria.[20-35] The 16 articles were further screened based on whether or not the intervention fulfilled the definition of task shifting used for this review [use of non-physician clinicians in prescribing medications or performing medical testing in the treatment or

management of CVD]. This final review led to further elimination of 12 additional articles, leaving only four RCTs, which were included in this systematic review. [20, 22, 29, 30] The characteristics of the studies included in this systematic review are presented in Tables 1 and 2. One trial was conducted in Nigeria,[20] another is a multi-center trial conducted in Nigeria and China,[29] one in South Korea,[22] and the last one was conducted in Iran.[30] The study populations were patients with hypertension (two studies),[20, 29] and type 2 diabetes (two studies).[22, 30] (Table 2). The sample size of the interventions varied, with a range of 71 - 2397 patients (Table 1): the sample size for the two diabetes trials were 71,[22] and 61;[30] while the those of the two hypertension trials were 544, [20] and 2397.[29] The duration of these studies ranged from one month to 3 months for the diabetes trials and 6 to 12 months for the hypertension trials. The quality of all four trials were rated 73% using the Jadad quality measure.[36] Below, we summarize the findings from all four studies.

Hypertension Trials

Both studies evaluated the effect of task shifting on hypertension control using various forms of task- shifting strategies including interventions led by nurses, pharmacists, and community health workers (Table 2). The studies were conducted in Nigeria, and China.[20, 29] In addition to nurses or pharmacists prescribing antihypertensive medications, the interventions included health education emphasizing lifestyle modifications such as diet, physical activity, and medication adherence. The interventions were effective at improving blood pressure (BP) control in both studies.[20, 29]

The first hypertension trial, by Adeyemo and colleagues, examined the effectiveness of the use of nurses to deliver hypertension management in a primary care practice versus usual care plus home visits on medication adherence, and BP control at 6 months among 544 patients (mean age~63 years, mean BP~168/92 mmHg) in Nigeria.[20] The intervention included the following components: 1) a nurse-led treatment program with physician backup, 2) clinic visits and health education by nurses, 3) the use of diuretics and a ß blocker prescribed by nurses with physician backup. The primary outcome of BP control (BP<140/90mm Hg) was achieved in 66% of the study participants (66.7% in clinic only group, 65.4% in clinic plus home visit; p=0.584 and p=0.891).[20] The overall decline in mean systolic and diastolic BP over the six-month period was 30 mmHg and 15 mmHg respectively (p<0.001and p<0.0001).[20] Overall, medication adherence was high among study participants with 77% of participants taking >98 of their prescribed pills.

The second hypertension trial was the largest in this review. In this cluster RCT, Mendis and colleagues evaluated the effectiveness of the WHO Cardiovascular Disease (CVD) package using task-shifting strategies to improve BP control among 2397 hypertensive patients from forty primary care facilities (20 intervention sites, 20 control sites) in Nigeria and China.[29] Non-physician healthcare workers provided patients at the intervention sites with the WHO CVD package protocol while those at the control sites received usual care for a period of 12 months. The WHO CVD package was designed as an adaptable, cost-effective tool for systematic case management at all healthcare levels, and consequently for scaling up in health systems in LMICs. The program provides clinical decision support for the assessment and management of CV risk through easy-to-follow risk-assessment algorithms, lifestyle counseling, drug treatment protocols, and referral pathways.[15] The protocol consists of four basic steps: inquiry about patient's history (heart attack, angina, stroke, transient ischemic attack, diabetes and lifestyle behaviors); physical and laboratory examination (including BP measurements, anthropometrics, urine dip stick, fasting glucose, and plasma cholesterol); estimation of patient's CVD risk based on the WHO risk charts (low, medium or high); and subsequent initiation of drug therapy and lifestyle counseling during follow-up visits.[29] Depending on the patient's CVD risk, the treatment decisions include either 1) immediate referral to a specialist in the case of patents with high CVD risk; or 2) lifestyle counseling on diet, physical activity and tobacco cessation; prescription of an antihypertensive medication; and follow-up with a provider. The primary outcome was change in systolic BP from baseline to 12 months. Systolic and diastolic BP decreased significantly in favor of the intervention group at both study sites (P<0.0001) and ((P<0.0002), but BP control rate was abysmally low at only 20%. The intervention resulted in significantly greater reduction in systolic and diastolic BP for the treatment group (2 mmHg and 1 mmHg) than the control group in both countries.[29]

Diabetes Trials

The two diabetes trials evaluated whether nurse-led care could improve diabetes management compared to usual care.[22, 30] The first study was a 12-week study by Cho et al. that was conducted in six primary healthcare posts in rural South Korea with 71 patients with diabetes.[21] In the intervention group (n=36), the nurses measured patients' glucose levels with a PDA-type glucometer, then uploaded patient information such as diet, physical activity, and medications to a diabetes telehealth center. A physician then analyzed the information and sent weekly

recommendations to the patients via the internet and responded to patients' questions within a 24-hour period. The nurse also followed up with the patients to answer additional disease management questions, and provided in-person health education based on the physician's recommendation. The control group received general diabetes education and had their glucose measured, but this group did not receive feedback on their blood tests or any physician recommendations. At the 12-week follow- up, HbA1c was significantly lower in the intervention group (8.0% vs. 7.5%; P< 0.01) but not in the control group (8.0% vs. 7.8%, p<0.01; P = 0.11).[22]

The second diabetes trial was conducted by Nesari and colleagues in Iran among 61 patients with diabetes, who received either telephone-based nurse follow-up care for 3 months or usual care.[30] Both groups received health education on diet, physical activity, foot-care, blood glucose self-monitoring, management of medication side effects and hypoglycemia. Additionally, in the intervention group, the nurse adjusted the patients' medications according to the patients' reported glycemic level, with back up from an endocrinologist. The reported decline in HbA1c was higher in the intervention group compared to the usual care group (1.87% in the intervention group, p<0.001; and 0.42% in the usual care group, p<0.15).[30] Similarly, the mean levels of HbA1c was significantly lower in the intervention group than in the usual care group at 3 months (mean HbA1c of 7.04% ± 1.18 in the intervention group versus 8.64% ± 1.88 for the control group; P< 0.001).[30]

DISCUSSION

In this review, we examined the evidence for task shifting of primary care duties for management of CVD in low- and middle-income countries. We reviewed four clinical trials that utilized task-shifting strategies for management of CVD in LMICs.[20, 22, 29, 30] Two of the four trials were hypertension studies,[20, 29] and the other two were diabetes.[22, 30] The outcomes of the four trials were positive with significant improvement in BP and HbA1c.[20, 22, 29, 30] The studies show some evidence of the effectiveness of task-shifting strategies for management of hypertension and diabetes using nurses.

The concept of tasking shifting is not new because task shifting strategies have proven effective in the battle against the HIV/AIDs epidemic in LMICs;[14] and thus may be potentially effective for chronic disease management, provided adequate and sustainable training is afforded to the health professionals involved. Considering the barriers and challenges that task shifting may pose if non-physician healthcare workers are not equipped with the expertise to efficiently manage HIV/AIDS, the WHO launched the treat, train, retrain plan in

2006,[37] to ensure competency and aid in capacity building of these providers. As a result, many LMICs have adopted task-shifting strategies for HIV/AIDS management in LMICs. In this regard, Callaghan et al. conducted a systematic review of 84 articles on HIV treatment and care in SSA and their findings suggest that that task-shifting strategies led to improved efficiency in delivery of healthcare services, enhanced access to care, better team dynamics, and improved quality of care and health outcomes for patients with HIV/AIDS.[14]

Task shifting is a potentially viable and low-cost strategy for reducing the growing CVD epidemic in LMICs because it utilizes multiple strategies that are amenable to management of CVDs including screening, counseling on lifestyle modification, initiation of treatment, and referral to specialist care.[11-15] We are not aware of any rigorous evaluation of task-shifting strategies for management of CVDs in LMICs. To our knowledge, our study was the first systematic review to evaluate effectiveness of existing task-shifting strategies in management of CV risk factors in LMICs. Our findings highlight the lack of data on widespread implementation and effectiveness of task-shifting strategies for CVD other than the one large trial conducted by Mendis and colleagues at the WHO which showed that task shifting is effective at primary care healthcare facilities in Nigeria and China.[29] The other studies reviewed had numerous weaknesses. First, the quality of the trials was low given their very small sample sizes, poor definition of study outcomes, and short duration of the trials [only 3 months for both diabetes trials[22, 30] and 6 months for one of the hypertension trials[20]], making it difficult to ascertain the effect of regression to mean on the study outcomes. Second, the authors provided very scanty description of the non-physician healthcare providers who delivered the task shifting duties: only three of the studies identified that nurses provided the task shifting duties. [20, 22, 30] Unfortunately, the largest trial with the best quality did not provide any information on the level of training of the task shifting healthcare provider.[29] Third, there was no data on the cost-effectiveness of these studies and finally, none of the trials integrated their intervention into existing healthcare systems making evaluation of the implementation and dissemination of the study findings problematic. Future studies should focus on the cost-effectiveness of task-shifting interventions for CVD risk reduction as part of the larger healthcare system. In addition, these studies should compare the cost effectiveness of the use of nurses versus other allied healthcare workers.

In order for task shifting strategies to be considered effective, evidence of its implementation for addressing the CVD epidemic as part of existing healthcare systems in LMICs are paramount. Thus, in 2001, the Global Alliance for Chronic Diseases (GACD) funded 15 implementation trials targeting hypertension control. Five of these

studies are evaluating the role of task-shifting strategies to reduce overall CV risk and improve hypertension control in Ghana, India, Kenya, Tanzania, and South Africa.[38] Such studies integrated into existing healthcare systems will guarantee subsequent adoption of interventions if proven successful.

In conclusion and based on our findings, task-shifting strategies are applicable and feasible in many LMICs, who are burdened with infectious and chronic diseases, compounded with limited material and healthcare personnel resources. With proper training and continuous feedback, lower level health professionals can be instrumental in managing CVDs efficiently. Future studies should address their implementation as part of existing healthcare systems as well as their cost-effectiveness in LMICs.

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Conflicting Interests

None

Authors' Contributions

GO conceived of the review, participated in the design and article selections and helped to draft the manuscript. JG conducted supplementary literature review, participated in the article selections, and drafted the manuscript. AS conducted the primary literature review and helped to draft the manuscript. DMR participated in the article selection process and helped to draft the manuscript. JPR, CA, JI, and RC all contributed to the article selection process and edited the manuscript for critical content. All authors have read and approved the final manuscript.

Data Sharing Statement

No additional data available

Legend

Figure 1: Referral Pathway for CVD Management using Task Shifting

Figure 2: Flow diagram showing citations retrieved from literature searches and number of trials included in the analysis

Table 1. Characteristics of Studies Included in the Systematic Review

Table 2. Characteristics of Studies Included in the Systematic Review (Cont'd)

Appendix 1: Search strategy

REFERENCES

1. Anyangwe SC, Mtonga C. Inequities in the global health workforce: the greatest impediment to health in sub-Saharan Africa. *Int J Environ Res Public Health* 2007; **4**(2): 93-100.
2. WHO. Global Status Report on Noncommunicable Diseases 2010. http://www.who.int/nmh/publications/ncd_report_full_en.pdf (accessed April 15 2013).
3. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005; **365**(9455): 217-23.
4. Mensah GA. Epidemiology of stroke and high blood pressure in Africa. *Heart* 2008; **94**(6): 697-705.
5. BeLue R, Okoror TA, Iwelunmor J, et al. An overview of cardiovascular risk factor burden in sub-Saharan African countries: a socio-cultural perspective. *Globalization and health* 2009; **5**: 10.
6. Beaglehole R, Epping-Jordan J, Patel V, et al. Improving the prevention and management of chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet* 2008; **372**(9642): 940-9.
7. Dussault G, Dubois CA. Human resources for health policies: a critical component in health policies. *Hum Resour Health* 2003; **1**(1): 1.
8. Hagopian A, Thompson MJ, Fordyce M, Johnson KE, Hart LG. The migration of physicians from sub-Saharan Africa to the United States of America: measures of the African brain drain. *Hum Resour Health* 2004; **2**(1): 17.
9. Pang T, Lansang MA, Haines A. Brain drain and health professionals. *Bmj* 2002; **324**(7336): 499-500.
10. Mayosi B. The 10 'Best Buys' to combat heart disease, diabetes and stroke in Africa. http://heart.bmj.com/content/early/2013/05/16/heartjnl-2013-304130.full.pdf+htm (accessed 27 February 2013).
11. WMA Resolution on Task Shifting from the Medical Profession. http://www.wma.net/en/30publications/10policies/t4/ (accessed March 18 2013).
12. Lekoubou A, Awah P, Fezeu L, Sobngwi E, Kengne AP. Hypertension, diabetes mellitus and task shifting in their management in sub-Saharan Africa. *Int J Environ Res Public Health* 2010; **7**(2): 353-63.
13. Zachariah R, Ford N, Philips M, et al. Task shifting in HIV/AIDS: opportunities, challenges and proposed actions for sub-Saharan Africa. *Trans R Soc Trop Med Hyg* 2009; **103**(6): 549-58.
14. Callaghan M, Ford N, Schneider H. A systematic review of task- shifting for HIV treatment and care in Africa. *Hum Resour Health* 2010; **8**: 8.
15. WHO. WHO CVD risk management package for low-and med-resource settings. 2002. http://whqlibdoc.who.int/publications/2002/9241545852.pdf?ua=1 (accessed April 15 2013).
16. Higgins JPT GS, editors. Cochrane Handbook for Systematic Reviews of Interventions 4.2.6 [updated September 2006]. Chichester, UK: John Wiley & Sons, Ltd.; 2006.

17. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine* 2009; **6**(7): e1000097.
18. Countries and Economies. http://data.worldbank.org/country (accessed October 20 2013).
19. Review Manager (RevMan). Version 5.0. Copenhagen: The Nordic Cochrane Centre: The Cochrane Collaboration; 2008.
20. Adeyemo A, Tayo BO, Luke A, Ogedegbe O, Durazo-Arvizu R, Cooper RS. The Nigerian antihypertensive adherence trial: a community-based randomized trial. *Journal of hypertension* 2013; **31**(1): 201-7.
21. Andryukhin A, Frolova E, Vaes B, Degryse J. The impact of a nurse-led care programme on events and physical and psychosocial parameters in patients with heart failure with preserved ejection fraction: a randomized clinical trial in primary care in Russia. *Eur J Gen Pract* 2010; **16**(4): 205-14.
22. Cho JH, Kwon HS, Kim HS, Oh JA, Yoon KH. Effects on diabetes management of a health-care provider mediated, remote coaching system via a PDA-type glucometer and the Internet. *J Telemed Telecare* 2011; **17**(7): 365-70.
23. DePue JD, Dunsiger S, Seiden AD, et al. Nurse-community health worker team improves diabetes care in American Samoa: results of a randomized controlled trial. *Diabetes Care* 2013; **36**(7): 1947-53.
24. Hacihasanoglu R, Gozum S. The effect of patient education and home monitoring on medication compliance, hypertension management, healthy lifestyle behaviours and BMI in a primary health care setting. *J Clin Nurs* 2011; **20**(5-6): 692-705.
25. Jafar TH, Hatcher J, Poulter N, et al. Community-based interventions to promote blood pressure control in a developing country: a cluster randomized trial. *Annals of internal medicine* 2009; **151**(9): 593-601.
26. Jafar TH, Islam M, Hatcher J, et al. Community based lifestyle intervention for blood pressure reduction in children and young adults in developing country: cluster randomised controlled trial. *Bmj* 2010; **340**: c2641.
27. Jiang X, Sit JW, Wong TK. A nurse-led cardiac rehabilitation programme improves health behaviours and cardiac physiological risk parameters: evidence from Chengdu, China. *J Clin Nurs* 2007; **16**(10): 1886-97.
28. Kim HS, Oh JA. Adherence to diabetes control recommendations: impact of nurse telephone calls. *J Adv Nurs* 2003; **44**(3): 256-61.
29. Mendis S, Johnston SC, Fan W, Oladapo O, Cameron A, Faramawi MF. Cardiovascular risk management and its impact on hypertension control in primary care in low-resource settings: a cluster-randomized trial. *Bull World Health Organ* 2010; **88**(6): 412-9.
30. Nesari M, Zakerimoghadam M, Rajab A, Bassampour S, Faghihzadeh S. Effect of telephone follow-up on adherence to a diabetes therapeutic regimen. *Jpn J Nurs Sci* 2010; **7**(2): 121-8.
31. Selvaraj FJ, Mohamed M, Omar K, et al. The impact of a disease management program (COACH) on the attainment of better cardiovascular risk control in dyslipidaemic patients at primary care centres (The DISSEMINATE Study): a randomised controlled trial. *BMC Fam Pract* 2012; **13**: 97.

32. Sit JW, Yip VY, Ko SK, Gun AP, Lee JS. A quasi-experimental study on a community-based stroke prevention programme for clients with minor stroke. *J Clin Nurs* 2007; **16**(2): 272-81.
33. Wong FK, Chow SK, Chan TM. Evaluation of a nurse-led disease management programme for chronic kidney disease: a randomized controlled trial. *Int J Nurs Stud* 2010; **47**(3): 268-78.
34. Wong FK, Mok MP, Chan T, Tsang MW. Nurse follow-up of patients with diabetes: randomized controlled trial. *J Adv Nurs* 2005; **50**(4): 391-402.
35. Zhao Y, Wong FK. Effects of a postdischarge transitional care programme for patients with coronary heart disease in China: a randomised controlled trial. *J Clin Nurs* 2009; **18**(17): 2444-55.
36. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials* 1996; **17**(1): 1-12.
37. WHO. Task shifting to tackle health worker shortages. http://www.who.int/healthsystems/task_shifting_booklet.pdf (accessed October 20 2013).
38. Global Alliance for Chronic Diseases (GACD) http://www.gacd.org/projects/current-projects (accessed December 14 2013).

Figure 1: Referral Pathway for CVD Management using Task Shifting

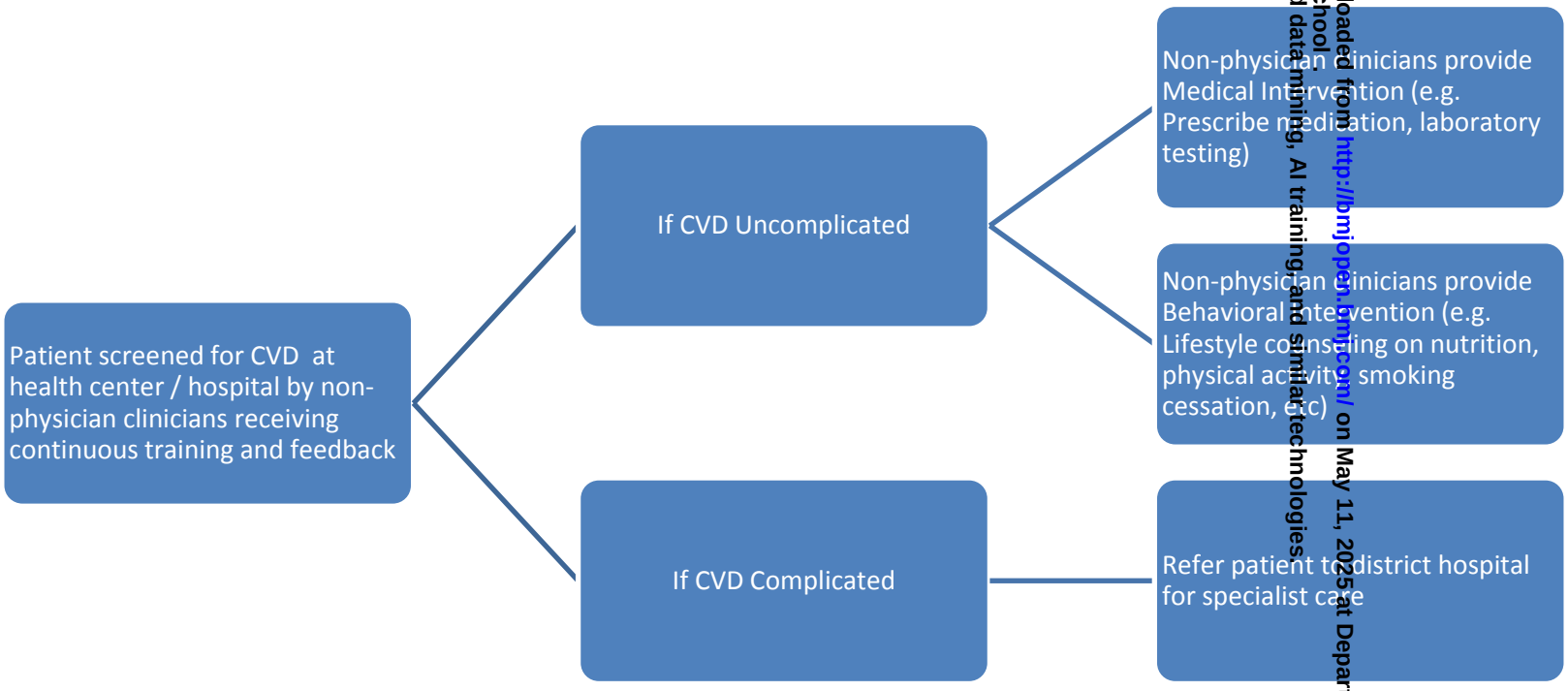

Figure 2: Flow diagram showing citations retrieved from literature searches and number of trials included in the analysis

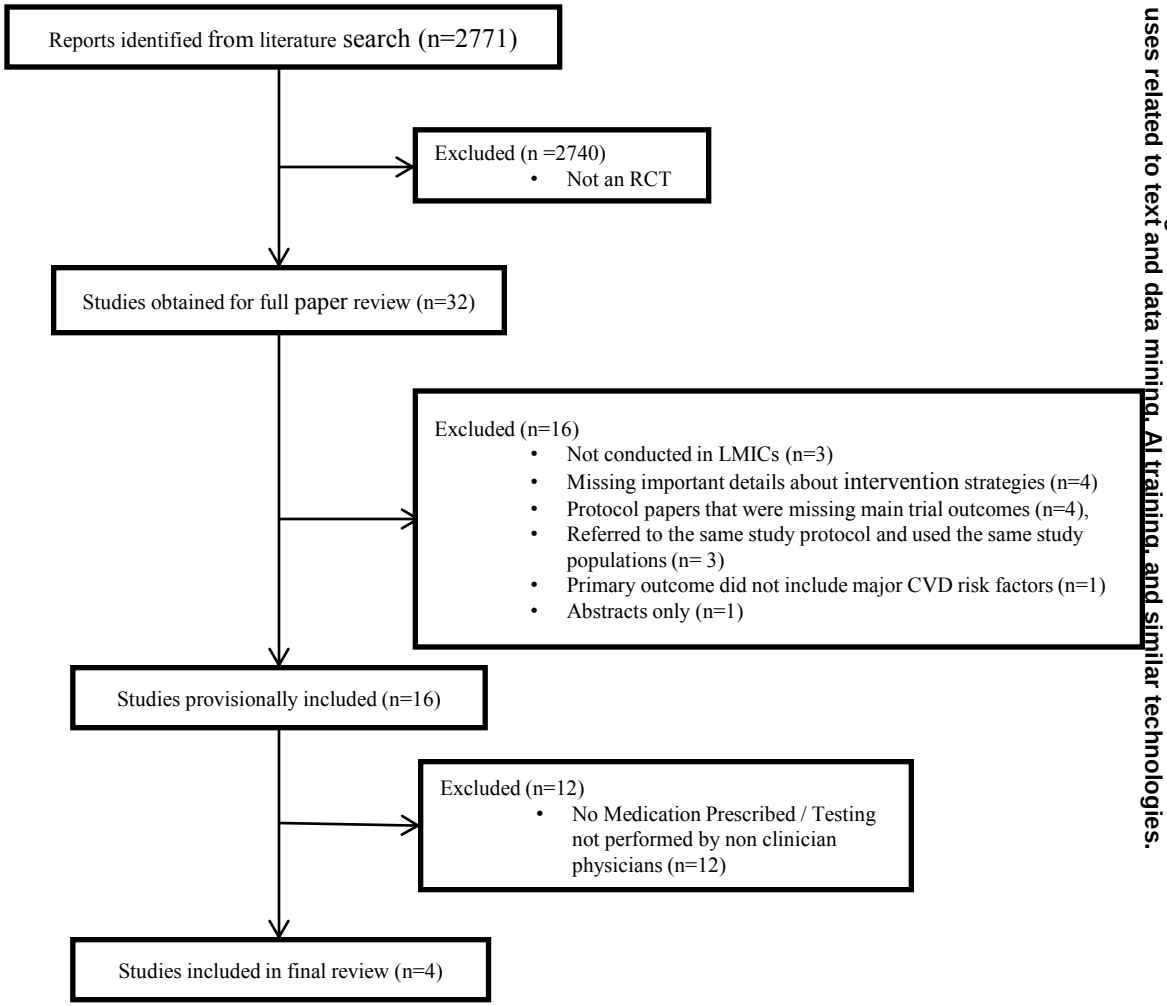

Table 1. Characteristics of Studies Included in the Systematic Review

Study (Year)	Duration of Interventions	Sample size	Completed Follow-up % Intervention	Completed Follow-up % Control	Primary Outcome Measures	Statistical Improvement in CVD
Adeyemo et al. (2013) [20]	6 months	544	88	72	Medication adherence BP Control	Yes
Mendis et al. (2010) [29]	12 months	2397	93.5	86.4	Systolic BP change from Baseline to 12 months	Yes
Cho et al. (2011) [22]	12 weeks	71	88.9	91.4	Reduction in HbA_{1c} levels Reduction in Total Cholesterol	Yes
Nesari et al. (2010) [30]	3 months	61	100	96.8	Adherence to diabetes regimen Reduction in HbA_{1c} levels	Yes

Table 2. Characteristics of Studies Included in the Systematic Review (Cont'd)

Study (Year)	Cardiovascular Disease	Country	Task Shifting Professional	Intervention Components	Intervention Setting
Adeyemo et al. (2013)[20]	Hypertension	Nigeria	Nurses	***Intervention 1*:** Clinic-based care management- a community based, nurse-led treatment program with physician backup; facilitation of clinic visits and health education; and the use of diuretics and a beta-blocker as needed. ***Intervention 2*:** Clinic-based care management plus home visits by nurses	Two clinics and/or Patient Home
Mendis et al. (2010)[29]	Hypertension	Nigeria and China	Non-physician healthcare workers	***Control*:** Usual care by physicians ***Intervention*:** Received WHO cardiovascular risk management package, patient education, initiation of hydrochlorothiazide	Forty primary health-care facilities
Cho et al. (2011)[22]	Type II Diabetes	South Korea	Nurses	***Control*:** Usual care ***Intervention*:** Specialized diabetes care using PDA-type blood glucose monitoring with a bar code detector,; in-person diabetes health education	Six primary health-care posts
Nesari et al. (2010))[30]	Type II Diabetes	Iran	Nurses	***Control*:** Usual care ***Both Groups***: Patient education on diet, exercise, foot-care, medication-taking, hypoglycemia management; blood glucose self-monitoring,; medication adjustment ***Intervention*:** In addition to above, patients received telephone follow-up by nurses 1-2 times per week	Community-based setting and health center

APPENDIX 1: SEARCH STRATEGY

For all searches, the three sets of terms were combined as follows:
CVD search AND task-shifting search AND low- and middle-income countries search

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PubMed search

CVD: "Hyperlipidemias"[MeSH] OR "hyperlipidemias"[All Fields] OR "hyperlipidemia"[All Fields] OR "hyperlipidaemia"[All Fields] OR "hyperlipidaemias"[All Fields] OR "hyperlipemia"[All Fields] OR "hyperlipemias"[All Fields] OR "hyperlipaemia"[All Fields] OR "hyperlipaemias"[All Fields] OR "lipidemia"[All Fields] OR "lipidaemia"[All Fields] OR "high cholesterol"[All Fields] OR "hypercholesterolemia"[All Fields] OR "hypercholesterolemias"[All Fields] OR "hypercholesteremia"[All Fields] OR "hypercholesteremias"[All Fields] OR "hypercholesterolaemia"[All Fields] OR "hypercholesterolaemias"[All Fields] OR "hypercholesteraemia"[All Fields] OR "Diabetes"[All Fields] OR "diabetic"[All fields] OR "Diabetes Mellitus"[Mesh] OR "proteinuria"[Mesh] OR "proteinuria"[All Fields] OR "Albuminuria"[All Fields] OR "Hemoglobinuria"[All Fields] OR "Kidney Failure, Chronic"[Mesh] OR "chronic kidney disease"[All Fields] OR "chronic renal disease"[All Fields] OR "chronic renal insufficiency"[All Fields] OR "CKD"[All Fields] OR "end-stage renal disease"[All Fields] OR "chronic kidney failure"[All Fields] OR "chronic renal failure"[All Fields] OR "chronic kidney diseases"[All Fields] OR "chronic renal diseases"[All Fields] OR "chronic renal insufficiencies"[All Fields] OR "end-stage renal diseases"[All Fields] OR "chronic kidney failures"[All Fields] OR "chronic renal failures"[All Fields] OR "stroke"[Mesh] OR "stroke"[All Fields] OR "strokes"[All Fields] OR "brain vascular accident"[All Fields] OR "brain vascular accidents"[All Fields] OR "apoplexy"[All Fields] OR "cerebrovascular accident"[All Fields] OR "cerebrovascular accidents"[All Fields] OR "cardiomyopathies"[Mesh] OR "cardiomyopathy"[All Fields] OR "cardiomyopathies"[All Fields] OR "myocardial disease"[All Fields] OR "myocardial diseases"[All Fields] OR "myocardiopathy"[All Fields] OR "myocardiopathies"[All Fields] OR "heart neoplasms"[Mesh] OR "heart neoplasm"[All Fields] OR "heart neoplasms"[All Fields] OR "cardiac tumor"[All Fields] OR "cardiac tumors"[All Fields] OR "myocardial tumor"[All Fields] OR "myocardial tumors"[All Fields] OR "cardiac carcinoma"[All Fields] OR "cardiac carcinomas"[All Fields] OR "heart cancer"[All Fields] OR "cardiac cancers"[All Fields] OR "cardiac cancer"[All Fields] OR "heart tumor"[All Fields] OR "heart tumors"[All Fields] OR "myocardial ischemia"[Mesh] OR "myocardial ischemia"[All Fields] OR "myocardial ischemias"[All Fields] OR "ischemic heart disease"[All Fields] OR "ischemic heart diseases"[All Fields] OR "myocardial ischaemia"[All Fields] OR "myocardial ischaemias"[All Fields] OR "ischaemic heart disease"[All Fields] OR "ischaemic heart diseases"[All Fields] OR "acute coronary syndrome"[All Fields] OR "acute coronary syndromes"[All Fields] OR "coronary disease"[All Fields] OR "coronary diseases"[All Fields] OR "coronary artery disease"[All Fields] OR "coronary artery diseases"[All Fields] OR "coronary arteriosclerosis"[All Fields] OR "Coronary atherosclerosis"[All Fields] OR "coronary stenosis"[All Fields] OR "coronary stenoses"[All Fields] OR "coronary restenosis"[All Fields] OR "coronary restenoses"[All Fields] OR "coronary heart disease"[All Fields] OR "coronary heart diseases"[All Fields] OR "coronary thrombosis"[All Fields] OR "coronary thromboses" OR "coronary occlusion"[All Fields] OR "coronary occlusions"[All Fields] OR "myocardial infarction"[All Fields] OR "myocardial infarctions"[All Fields] OR "heart attack"[All Fields] OR "heart attacks"[All Fields] OR "myocardial infarct"[All Fields] OR "myocardial infarcts"[All Fields] OR "heart arrest"[Mesh] OR "heart arrest"[All Fields] OR "heart arrests"[All Fields] OR "cardiac arrest"[All Fields] OR "cardiac arrests"[All Fields] OR "asystole"[All Fields] OR "asystoles"[All Fields] OR "cardiopulmonary arrest"[All Fields] OR "cardiopulmonary arrests"[All Fields] OR
"heart failure"[Mesh] OR "heart failure"[All Fields] OR "heart failures"[All Fields] OR "cardiac failure"[All Fields] OR "cardiac failures"[All Fields] OR "myocardial failure"[All Fields] OR "myocardial failures"[All Fields] OR "heart decompensation"[All Fields] OR "hypertension"[Mesh] OR "hypertension"[All Fields] OR "hypertensions"[All Fields] OR "high blood pressure"[All Fields] OR "high blood pressures"[All Fields] OR "cardiovascular diseases"[Mesh] OR "cardiovascular disease"[All Fields] OR "cardiovascular diseases"[All Fields] OR "cardiovascular risk"[All Fields] OR "cardiovascular risks"[All Fields]

Task-Shifting: ((“Task”[All Fields] OR "tasks"[all fields]) AND ("shift"[All fields] OR "shifted"[all fields] OR "shifts"[all fields] OR "shifting"[all fields])) OR (shortage*[All Fields] AND ("physicians"[MeSH] OR “health personnel”[Mesh] OR "physicians"[All Fields] OR "doctors"[All Fields] OR "trained personnel"[All Fields] OR "health workforce"[All Fields] OR “health care workforce"[All Fields] OR “healthcare workforce"[All Fields] OR "health workers"[All Fields] OR "health care workers"[All Fields] OR “healthcare workers"[All Fields] OR "health care providers"[All Fields] OR “health providers"[All Fields] OR “healthcare providers"[All Fields])) OR ("nurse led"[All Fields] OR "primary health care nurse"[All Fields] OR "primary health care nurses"[All Fields] OR "primary health care nursing"[All Fields]) OR "nonphysician clinicians"[All Fields] OR "non-physician clinicians"[All Fields] OR “non physician health care workers"[All Fields] OR “nonphysician health care workers"[All Fields] OR “non physician healthcare workers"[All Fields] OR “nonphysician healthcare workers"[All Fields] OR “nonphysician health workers"[All Fields] OR “non physician health workers"[All Fields] OR ("role"[All Fields] AND ("nurse"[All Fields] OR "nurses"[all fields] OR "nursing"[all fields])) OR “community health aides”[mesh] OR “community health centers”[mesh] OR “lay health workers"[All Fields] OR “lay health care workers"[All Fields] OR “lay healthcare workers"[All Fields] OR “community health workers"[All Fields] OR “community health care workers"[All Fields] OR “community healthcare workers"[All Fields] OR “community health center”[All Fields] OR “community Health centers”[all fields] OR “community health centre”[All fields] OR “community health centres”[All Fields] OR “extended scope practitioner”[all fields] OR “extended scope practitioners”[all fields] OR “extended scope practice”[all fields] OR “enhanced role”[all fields] OR “role enhancement”[all fields] OR ((“substitution”[All Fields] OR “substituted”[All Fields] OR “substitute”[All Fields] OR “substituting”[All Fields] OR “substitutes”[All Fields] OR “delegate”[All Fields] OR “delegating”[All Fields] OR “delegates”[All Fields] OR “delegation”[All Fields] OR “delegated”[All Fields]) AND (“physicians”[mesh] OR “physician”[All Fields] OR “physicians”[All Fields] OR “doctor”[All Fields] OR “doctors”[All Fields]))

Low-and Middle-income countries: "developing countries"[all fields] OR "developing country"[all fields] OR "developing countries"[mesh] OR “medically underserved area”[mesh] OR “medically underserved area”[all fields] OR “medically underserved areas”[all fields] OR “low income countries”[all fields] OR “low income country”[all fields] OR “middle income countries”[all fields] OR “middle income country”[all fields] OR “global”[all fields] OR “resource poor”[all fields] OR “low resource”[all fields] OR “Africa”[Mesh] OR “Asia, Central”[Mesh] OR “Asia, Western”[Mesh] OR “Asia, Southeastern”[Mesh] OR “Indian Ocean Islands”[Mesh] OR “Central America”[Mesh] OR “South America”[Mesh] OR “Europe, Eastern”[Mesh] OR “Transcaucasia”[Mesh] OR “China”[Mesh] OR “Korea”[Mesh] OR “Mongolia”[Mesh] OR “Mexico”[Mesh] OR “Caribbean Region”[Mesh] OR “Pacific Islands”[Mesh] OR “Africa”[all fields] OR “Central Asia”[all fields] OR “western Asia”[all fields] OR “southeastern Asia”[all fields] OR “Indian Ocean Islands”[all fields] OR “Central America”[all fields] OR “South America”[all fields] OR “eastern Europe”[all fields] OR “Transcaucasia”[all fields] OR “Caribbean”[all fields] OR “Pacific Islands”[all fields] OR “Afghan”[all fields] OR “afghani”[all fields] OR “afghanistan”[all fields] OR “Bangladesh”[all fields] OR “bangladeshi”[all fields] OR “Benin”[all fields] OR “Beninese”[all fields] OR “Burkina Faso”[all fields] OR “Burkinabe”[all fields] OR “Burundi”[all fields] OR “burundian”[all fields] OR “Cambodia”[all fields] OR “cambodian”[all fields] OR “Central African Republic”[all fields] OR “central African”[all fields] OR “Chad”[all fields] OR “chadian”[all fields] OR “Comoros”[all fields] OR “comoran”[all fields] OR “Congo”[all fields] OR “congolese”[all fields] OR “Eritrea”[all fields] OR “eritrean”[all fields] OR “Ethiopia”[all fields] OR “ethiopian”[all fields] OR “Gambia”[all fields] OR “gambian”[all fields] OR “Guinea”[all fields] OR “guinean”[all fields] OR “Haiti”[all fields] OR “haitian”[all fields] OR “Kenya”[all fields] OR “Kenyan” OR “Korea”[all fields] OR “korean”[all fields] OR “Kyrgyz”[all fields] OR "kyrgyzstan"[all fields] OR “Liberia”[all fields] OR “liberian”[all fields] OR “Madagascar”[all fields] OR “malagasy”[all fields] OR “Malawi”[all fields] OR “malawian”[all fields] OR “mali”[all fields] OR “malian”[all fields] OR “mozambique”[all fields] OR “mozambican”[all fields] OR “Myanmar”[all fields] OR “myanmarese”[all fields] OR “burmese”[all fields] OR “Nepal”[all fields] OR “Nepalese”[all fields] OR “Niger”[all fields] OR “nigerian”[all fields] OR “Rwanda”[all fields] OR “rwandan”[all fields] OR “Sierra Leone”[all fields] OR “sierra leonean”[all fields] OR “Somalia”[all fields] OR “somalian”[all fields] OR “Tajikistan”[all fields] OR “tajik”[all fields] OR “tadzhik”[all fields] OR” Tanzania”[all fields] OR “tanzanian”[all fields] OR

"Togo"[all fields] OR "togolese"[all fields] OR "Uganda"[all fields] OR "ugandan"[all fields] OR "Zimbabwe"[all fields] OR "zimbabwean"[all fields] OR "Angola"[all fields] OR "angolan"[all fields] OR "Armenia"[all fields] OR "armenian"[all fields] OR "Belize"[all fields] OR "belizean"[all fields] OR "Bhutan"[all fields] OR "bhutanese"[all fields] OR "Bolivia"[all fields] OR "bolivian"[all fields] OR "Cameroon"[all fields] OR "cameroonian"[all fields] OR "Cape Verde"[all fields] OR "cape verdian"[all fields] OR "cape verdean"[all fields] OR "Côte d'Ivoire" [all fields] OR "ivory coast"[all fields] "ivorian"[all fields] OR "Djibouti"[all fields] OR "Egypt"[all fields] OR "egyptian"[all fields] OR "El Salvador"[all fields] OR "salvadoran"[all fields] OR "Fiji"[all fields] OR "fijian"[all fields] OR "Georgia"[all fields] OR "georgian"[all fields] OR "Ghana"[all fields] OR "ghanaian"[all fields] OR "Guatemala"[all fields] OR "Guatemalan"[all fields] OR "Guyana"[all fields] OR "guyanese"[all fields] OR "Honduras" OR "honduran"[all fields] OR "Indonesia"[all fields] OR "indonesian"[all fields] OR "India"[all fields] OR "indian"[all fields] OR "Iraq"[all fields] OR "iraqi"[all fields] OR "Kiribati"[all fields] OR "Kosovo"[all fields] OR "kosovar"[all fields] OR "Laos"[all fields] OR "lao"[all fields] OR "laotian"[all fields] OR "Lesotho"[all fields] OR "Marshall Islands"[all fields] OR "marshallese"[all fields] OR "Mauritania"[all fields] OR "mauritanian"[all fields] OR "Micronesia"[all fields] OR "micronesian"[all fields] OR "Moldova"[all fields] OR "moldovan"[all fields] OR "Mongolia"[all fields] OR "mongolian"[all fields] OR "Morocco"[all fields] OR "moroccan"[all fields] OR "Nicaragua"[all fields] OR "nicaraguan"[all fields] OR "Nigeria"[all fields] OR "nigerian"[all fields] OR "Pakistan"[all fields] OR "pakistani"[all fields] OR "Papua New Guinea"[all fields] OR "papua new guinean"[all fields] OR "Paraguay"[all fields] OR "paraguayan"[all fields] OR "Philippines"[all fields] OR "filipino"[all fields] OR "Samoa"[all fields] OR "samoan"[all fields] OR "Sao Tome and Principe"[all fields] OR "São Tomé and Príncipe"[all fields] OR "santomean"[all fields] OR "Senegal"[all fields] OR "senegalese"[all fields] OR "Solomon Islands"[all fields] OR "Solomon islander"[all fields] OR "Sri Lanka"[all fields] OR "sri lankan"[all fields] OR "Sudan"[all fields] OR "sudanese"[all fields] OR "Swazi"[all fields] OR "swaziland"[all fields] OR "Syria"[all fields] OR "syrian"[all fields] OR "east Timor"[all fields] OR "east timorese"[all fields] OR "Tonga"[all fields] OR "tongan"[all fields] OR "Turkmenistan"[all fields] OR "turkmen"[all fields] OR "Tuvalu"[all fields] OR "tuvaluan"[all fields] OR "Ukraine"[all fields] OR "ukrainian"[all fields] OR "Uzbekistan"[all fields] OR "uzbek"[all fields] OR "Vanuatu"[all fields] OR "Vietnam"[all fields] OR "vietnamese"[all fields] OR "West Bank"[all fields] OR "Gaza"[all fields] OR "Yemen"[all fields] OR "yemeni"[all fields] OR "yemenite"[all fields] OR "Zambia"[all fields] OR "zambian"[all fields] OR "Albania"[all fields] OR "albanian"[all fields] OR "Algeria"[all fields] OR "algerian"[all fields] OR "Antigua and Barbuda"[all fields] OR "antiguan"[all fields] OR "barbudan"[all fields] OR "Argentina"[all fields] OR "argentinian"[all fields] OR "Azerbaijan"[all fields] OR "azerbaijani"[all fields] OR "Belarus"[all fields] OR "belarusian"[all fields] OR "Bosnia"[all fields] OR "bosnian"[all fields] OR "Botswana"[all fields] OR "Brazil"[all fields] OR "brazilian"[all fields] OR "Bulgaria"[all fields] OR "bulgarian"[all fields] OR "Chile"[all fields] OR "chilean"[all fields] OR "China"[all fields] OR "Chinese"[all fields] OR "Colombia"[all fields] OR "colombian"[all fields] OR "Costa Rica"[all fields] OR "costa rican"[all fields] OR "Cuba"[all fields] OR "Cuban"[all fields] OR "Dominica"[all fields] OR "dominican"[all fields] OR "Ecuador"[all fields] OR "ecuadorean"[all fields] OR "Gabon"[all fields] OR "gabonese"[all fields] OR "Grenada"[all fields] OR "grenadian"[all fields] OR "Iran"[all fields] OR "iranian"[all fields] OR "Jamaica"[all fields] OR "jamaican"[all fields] OR "Jordan"[all fields] OR "jordanian"[all fields] OR "Kazakhstan"[all fields] OR "kazakhstani"[all fields] OR "Latvia"[all fields] OR "latvian"[all fields] OR "Lebanon"[all fields] OR "lebanese"[all fields] OR "Libya"[all fields] OR "libyan"[all fields] OR "Lithuania"[all fields] OR "lithuanian"[all fields] OR "Macedonia"[all fields] OR "macedonian"[all fields] OR "Malaysia"[all fields] OR "malaysian"[all fields] OR "Maldives"[all fields] OR "maldivian"[all fields] OR "mauritius"[all fields] OR "mauritian"[all fields] OR "Mexico"[all fields] OR "mexican"[all fields] OR "Montenegro"[all fields] OR "montenegrin"[all fields] OR "Namibia"[all fields] OR "namibian"[all fields] OR "Palau"[all fields] OR "palauan"[all fields] OR "Panama"[all fields] OR "panamanian"[all fields] OR "Peru"[all fields] OR "peruvian"[all fields] OR "Romania"[all fields] OR "romanian"[all fields] OR "Russia"[all fields] OR "russian"[all fields] OR "Serbia"[all fields] OR "serbian"[all fields] OR "Seychelles"[all fields] OR "seychellois"[all fields] OR "South Africa"[all fields] OR "south african"[all fields] OR "Saint Kitts"[all fields] OR "saint Lucia"[all fields] OR "Saint Vincent"[all fields] OR "Suriname"[all fields] OR "surinamer"[all fields] OR "thailand"[all fields] OR "Thai"[all fields] OR "Tunisia"[all fields] OR "tunisian"[all fields] OR "Turkey"[all fields] OR "turkish"[all fields] OR "Uruguay"[all fields] OR "uruguayan"[all fields] OR "Venezuala"[all fields] OR "venezualan"[all fields]

Web of Knowledge search:

CVD: (hyperlip*emia* OR lipid*emia* OR "high cholesterol" OR hypercholester*emia*) OR (diabetes OR diabetic) OR (proteinuria$ OR albuminuria$ OR hemoglobinuria$) OR ("chronic kidney disease*" OR "chronic renal disease*" Or "chronic renal insufficienc*" OR CKD OR "end-stage renal disease*" OR "chronic kidney failure*" OR "chronic renal failure*") OR (stroke$ OR "brain vascular accident*" OR apoplexy OR "cerebrovascular accident*") OR (cardiomyopath* OR "myocardial disease*" OR myocardiopath*) OR ("heart neoplasm" OR "cardiac tumor*" OR "myocardial tumor*" OR "cardiac carcinoma*" OR "heart cancer*" OR "cardiac cancer*" OR "heart tumor*") OR ("myocardial isch*emia*" OR "isch*emic heart disease*" OR "acute coronary syndrome*" OR "coronary disease*" OR "coronary artery disease*" OR "coronary arterioscleros*" or "coronary atheroscleros*" OR "coronary stenos*" OR "coronary restenos*" OR "coronary heart disease*" OR "coronary thrombos*" OR "coronary occlusion*" OR "myocardial infarct*" OR "heart attack*" OR "heart arrest*" OR "cardiac arrest*" OR asystole$ OR "cardiopulmonary arrest*" OR "heart failure*" OR "cardiac failure*" OR "myocardial failure*" OR "heart decompensation*") OR (hypertension$ OR "high blood pressure*") OR (cardiovascular NEAR/5 disease$ OR cardiovascular NEAR/5 risk$)

Task-Shifting: (shortage$ NEAR/5 (doctor$ OR physician$ OR "trained personnel" OR (health* NEAR/3 workforce) OR (health* NEAR/3 worker$) OR (health* NEAR/3 provider$))) OR (task$ NEAR/5 shift*) OR ("nurse led") OR ("non*physician clinician*") OR (non*physician NEAR/2 health* NEAR/2 workers) OR ("primary health care nurs*") OR (role NEAR/5 nurs*) OR (lay NEAR/2 health* NEAR/2 worker$) OR (community NEAR/2 health* NEAR/2 aide*) OR (community NEAR/2 health* NEAR/2 worker$) OR ((substitut* OR delegat*) NEAR/10 (physician$ OR doctor$ OR nurse$)) OR (community NEAR/2 health* NEAR/2 cent*) OR ("extended scope practi*") OR (role$ NEAR/3 enhance*)

Low-and Middle-income countries: "developing countr*" OR "medically underserved area*" OR "low income countr*" OR "middle income countr*" OR Africa* OR Caribbean OR “central America*” OR “south America*” OR “central asia*” OR “southeastern asia*” OR “western asia*” OR “Indian ocean islands” OR “eastern Europe*” OR global OR “low resource” OR “resource poor” OR Transcaucasia$ OR “pacific islands” OR Afghan* OR Bangladesh* OR Benin* OR “burkina Faso*” or burkinabe OR Burundi* OR Cambodia* OR “Central African” OR Chad* OR Comor* OR Congo* OR Eritrea* OR Ethiopia* OR Gambia* OR Guinea* OR Haiti* OR Kenya* OR Korea* OR Kyrgyz* OR Liberia* OR Madagascar OR Malagasy OR Malawi* OR mali OR mozambi* OR Myanmar* OR Nepal* OR Niger* OR Rwanda* OR Sierra Leon* OR Somalia* OR Tajik* OR Tanzania* OR Togo* OR Uganda* OR Zimbabw* OR Angola* OR Armenia* OR Belize* OR Bhutan* OR Bolivia* OR Cameroon* OR Cape Verd* OR Congo* OR “Côte d'Ivoire” OR "ivory coast" OR ivorian OR Djibouti OR Egypt* OR “El Salvador” OR salvadoran OR Fiji* OR Georgia* OR Ghana* OR Guatemala* OR Guyan* OR Hondura* OR Indonesia* OR India* OR Iraq* OR Kiribati OR Kosov* OR Lao* OR Lesotho OR “Marshall Islands” OR marshallese OR Mauritania* OR Micronesia* OR Moldova* OR Mongolia* OR Morocc* OR Nicaragua* OR Nigeria* OR Pakistan* OR “Papua New Guinea*” OR Paraguay* OR Philippines OR Filipino OR Samoa* OR “Sao Tome*” OR Senegal* OR “Solomon Island*” OR Sri Lanka* OR Sudan* OR Swazi* OR Syria* OR Timor* OR Tonga* OR Turkmen* OR Tuvalu* OR Ukrain* OR Uzbek* OR Vanuat* OR Vietnam* OR “West Bank” OR Gaza OR Yemen* OR Zambia* OR Albania* OR Algeria* OR “Antigua and Barbuda” OR antiguan OR barbudan OR Argentin* OR Azerbaijan* OR Belarus* OR Bosnia* OR Botswana OR Brazil* OR Bulgaria* OR Chile* OR China OR Chinese OR Colombia* OR Costa Rica* OR Cuba* OR Dominic* OR Ecuador* OR Gabon* OR Grenad* OR Iran* OR Jamaica* OR Jordan* OR Kazakhstan* OR Latvia* OR Leban* OR Libya* OR Lithuania* OR Macedonia* OR Malaysia* OR Maldiv* OR mauriti* OR Mayott* OR Mexic* OR Montenegr* OR Namibia* OR Palau* OR Panama* OR Peru* OR Romania* OR Russia* OR Serbia* OR Seychell* OR “South Africa*” OR “Saint Kitts” OR “Saint Lucia” OR “Saint Vincent” OR Surinam* OR Thai* OR Tunisia* OR Turk* OR Uruguay* OR Venezuala*

Scopus search:

CVD: hyperlip*emia* OR lipid*emia* OR ("high cholesterol") OR hypercholester*emia* OR diabetes OR diabetic OR proteinuria* OR albuminuria* OR hemoglobinuria* OR ("chronic kidney disease*") OR ("chronic renal disease*") Or ("chronic renal insufficienc*") OR CKD OR ("end-stage renal disease*") OR ("chronic kidney failure*") OR ("chronic renal failure*") OR stroke* OR ("brain vascular accident*") OR apoplexy OR ("cerebrovascular accident*") OR cardiomyopath* OR ("myocardial disease*") OR myocardiopath* OR ("heart neoplasm") OR ("cardiac tumor*") OR ("myocardial tumor*") OR ("cardiac carcinoma*") OR ("heart cancer*") OR ("cardiac cancer*") OR ("heart tumor*") OR ("myocardial isch*emia*") OR ("isch*emic heart disease*") OR ("acute coronary syndrome*") OR ("coronary disease*") OR ("coronary artery disease*") OR ("coronary arterioscleros*") or ("coronary atheroscleros*") OR ("coronary stenos*") OR ("coronary restenos*") OR ("coronary heart disease*") OR ("coronary thrombos*") OR ("coronary occlusion*") OR ("myocardial infarct*") OR ("heart attack*") OR ("heart arrest*") OR ("cardiac arrest*") OR asystole* OR ("cardiopulmonary arrest*") OR ("heart failure*") OR ("cardiac failure*") OR ("myocardial failure*") OR ("heart decompensation*") OR hypertension* OR ("high blood pressure*") OR (cardiovascular W/5 disease*) OR (cardiovascular W/5 risk*)

Task-Shifting: (shortage* W/5 doctor*) OR (shortage* W/5 physician*) OR (shortage* W/5 "trained personnel") OR (shortage* W/5 health* W/5 work*) OR (shortage* W/5 health* W/5 provider*) OR (task* W/5 shift*) OR ("nurse led") OR ("non*physician clinician*") OR (non*physician W/2 health* W/2 workers) OR ("primary health care nurs*") OR (role W/5 nurs*) OR (lay W/2 health* W/2 worker*) OR (community W/2 health* W/2 aide*) OR (community W/2 health* W/2 worker*) OR (community W/2 health* W/2 cent*) OR ("extended scope practi*") OR (role W/3 enhance*) OR (substitut* W/10 physician*) OR (substitut* W/10 doctor*) or (substitut* W/10 nurs*) OR (delegat* W/10 physician*) OR (delegat* W/10 doctor*) OR (delegat* W/10 nurs*)

Low-and Middle-income countries: ("developing countr*") or ("medically underserved area*") or ("low income countr*") or ("middle income countr*") or Africa* or Caribbean or ("central america*") or ("south america*") or ("central asia*") or ("southeastern asia*") or ("western asia*") or ("indian ocean islands") or ("pacific islands") or ("eastern europe") or global or ("low resource") or ("resource poor") OR Afghan* or Bangladesh* OR Benin* or ("burkina Faso*") or burkinabe OR Burundi* OR Cambodia* OR ("Central African") OR Chad* OR Comor* OR Congo* OR Eritrea* OR Ethiopia* OR Gambia* OR Guinea* OR Haiti* OR Kenya* OR Korea* OR Kyrgyz* OR Liberia* OR Madagascar OR Malagasy OR Malawi* OR mali OR mozambi* OR Myanmar* OR Nepal* OR Niger* OR Rwanda* OR ("Sierra Leon*") OR Somalia* OR Tajik* OR Tanzania* OR Togo* OR Uganda* OR Zimbabw* OR Angola* OR Armenia* OR Belize* OR Bhutan* OR Bolivia* OR Cameroon* OR ("Cape Verd*") OR Congo* OR ("Côte d'Ivoire") OR ("ivory coast") OR ivorian OR Djibouti OR Egypt* OR ("El Salvador") OR salvadoran OR Fiji* OR Georgia* OR Ghana* OR Guatemala* OR Guyan* OR Hondura* OR Indonesia* OR India* OR Iraq* OR Kiribati OR Kosov* OR Lao* OR Lesotho OR ("Marshall Islands") OR marshallese OR Mauritania* OR Micronesia* OR Moldova* OR Mongolia* OR Morocc* OR Nicaragua* OR Nigeria* OR Pakistan* OR ("Papua New Guinea*") OR Paraguay* OR Philippines OR Filipino OR Samoa* OR ("Sao Tome*") OR Senegal* OR ("Solomon Island*") OR ("Sri Lanka*") OR Sudan* OR Swazi* OR Syria* OR Timor* OR Tonga* OR Turkmen* OR Tuvalu* OR Ukrain* OR Uzbek* OR Vanuat* OR Vietnam* OR ("West Bank") OR Gaza OR Yemen* OR Zambia* OR Albania* OR Algeria* OR ("Antigua and Barbuda") OR antiguan OR barbudan OR Argentin* OR Azerbaijan* OR Belarus* OR Bosnia* OR Botswana OR Brazil* OR Bulgaria* OR Chile* OR China OR Chinese OR Colombia* OR ("Costa Rica*") OR Cuba* OR Dominic* OR Ecuador* OR Gabon* OR Grenad* OR Iran* OR Jamaica* OR Jordan* OR Kazakhstan* OR Latvia* OR Leban* OR Libya* OR Lithuania* OR Macedonia* OR Malaysia* OR Maldiv* OR mauriti* OR Mayott* OR Mexic* OR Montenegr* OR Namibia* OR Palau* OR Panama* OR Peru* OR Romania* OR Russia* OR Serbia* OR Seychell* OR ("South Africa*") OR ("Saint Kitts") OR ("Saint Lucia") OR ("Saint Vincent") OR Surinam* OR Thai* OR Tunisia* OR Turk* OR Uruguay* OR Venezuala*

CINAHL Search
Results limited to Academic Journals and Dissertations

CVD: (MH “cardiovascular diseases+”) OR (TX cardiovascular N5 disease#) OR (MH “cardiovascular risk factors+”) OR (TX cardiovascular N5 risk#) OR (MH “Hyperlipidemia+”) OR (TX hyperlipid#emia#) OR (TX hyperlip#emia#) OR (TX lipid#emia#) OR (TX "high cholesterol") OR (TX hypercholesterol#emia#) OR (TX hypercholester#emia#) OR (TX diabetes) OR (TX diabetic) OR (MH “Diabetes Mellitus+”) OR (MH “proteinuria+”) OR (TX proteinuria#) OR (TX albuminuria#) OR (TX hemoglobinuria#) OR (MH "Kidney Failure, Chronic") OR (TX “chronic kidney disease#”) OR (TX “chronic renal disease#”) OR (TX “chronic renal insufficienc*”) OR (TX "CKD") OR (TX “end-stage renal disease#”) OR (TX “chronic kidney failure#”) OR (TX “chronic renal failure#”) OR (TX stroke#) OR (TX "brain vascular accident#") OR (TX apoplexy*) OR (TX "cerebrovascular accident#") OR (TX cardiomyopath*) OR (TX “myocardial disease#”) OR (TX myocardiopath*) OR (TX "heart neoplasm#") OR (TX "cardiac tumor#") OR (TX "myocardial tumor#") OR (TX "cardiac carcinoma#") OR (TX "heart cancer#") OR (TX "cardiac cancer#") OR (TX "heart tumor#") OR (TX "myocardial isch#emia#") OR (TX "isch#emic heart disease#") OR (TX “acute coronary syndrome#”) OR (TX “coronary disease#”) OR (TX “coronary artery disease#”) OR (TX “coronary arterioscleros*”) OR (TX “coronary atheroscleros*”) OR (TX “coronary stenos*”) OR (TX “coronary restenos*”) OR (TX “coronary heart disease*”) OR (TX “coronary thrombos*”) OR (TX “coronary occlusion#”) OR (TX “myocardial infarct*”) OR (TX “heart attack#") OR (TX "heart arrest#") OR (TX "cardiac arrest#") OR (TX asystole#) OR (TX "cardiopulmonary arrest#") OR (TX "heart failure#") OR (TX "cardiac failure#") OR (TX "myocardial failure#") OR (TX "heart decompensation#") OR (TX hypertension#) OR (TX "high blood pressure#")

Task-Shifting: (MH “Personnel Shortage+”) OR (TX shortage# N5 doctor#) OR (TX shortage# N5 physician#) OR (TX shortage# N5 “trained personnel”) OR (TXshortage# N5 “health* * workforce”) OR (TX shortage# N5 “health* * worker#”) OR (TX shortage# N5 “health* * provider#”) OR (TX task# N5 shift*) OR (TX "nurse led") OR (TX "non*physician clinicians") OR (TX “non*physician health* * worker#”) OR (TX "primary health* * nurs*") OR (TX role N5 nurs*) OR (MH “community health workers+”) OR (MH “community health centers+”) OR (TX "lay health* * worker#") OR (TX community N2 “health* * aide#”) OR (TX community N2 “health* * worker#”) OR (TX community N2 “health* * cent*") OR (TX "extended scope practi*") OR (TX role N3 enhance*) OR (TX substitut* N10 physician#) OR (TX substitut* N10 doctor#) OR (TX substitute* N10 nurse#) OR (TX delegat* N10 physician#) OR (TX delegat * N10 doctor#) OR (TX delegat * N10 nurse#)

Low-and Middle-income countries: (MH “developing countries+”) OR (MH “medically underserved area+”) OR (TX "developing countr*") OR (TX "medically underserved area#") OR (TX "low income countr *") OR (TX "middle income countr*") OR (MH “Africa+”) OR (TX Africa#) OR (TX Caribbean) OR (MH “west indies+”) OR (TX “central America#”) OR (MH “Central America+”) OR (TX “south America#”) OR (MH “south America+”) OR (TX global) OR (TX “low resource”) OR (TX “resource poor”) OR (TX “central asia#”) OR (MH “asia, central+”) OR (TX “southeastern asia#”) OR (MH "asia, southeastern+”) OR (TX “western asia#”) OR (MH “asia, western+”) OR (TX “Indian ocean islands”) OR (MH “Indian ocean islands+”) OR (TX “eastern Europe*”) OR (MH “europe, eastern”) OR (TX Transcaucasia#) OR (TX “pacific islands”)OR (MH “pacific islands+”) OR (TX Afghan*) OR (TX Bangladesh#) OR (TX Benin*) OR (TX “Burkina Faso”) OR (TX burkinabe) OR (TX Burundi*) OR (TX Cambodia#) OR (TX “Central African”) OR (TX Chad*) OR (TX Comor*) OR (TX Congo*) OR (TX Eritrea#) OR (TX Ethiopia#) OR (TX Gambia#) OR (TX Guinea#) OR (TX Haiti*) OR (TX Kenya#) OR (TX Korea#) OR (TX Kyrgyz*) OR (TX Liberia#) OR (TX Madagascar) OR (TX malagasy) OR (TX Malawi*) OR (TX mali*) OR (TX mozambi*) OR (TX Myanmar*) OR (TX Nepal*) OR (TX Niger*) OR (TX Rwanda#) OR (TX “Sierra Leon*”) OR (TX Somalia#) OR (TX Tajik*) OR (TX tadzhik) OR (TX Tanzania#) OR (TX Togo*) OR (TX Uganda#) OR (TX Zimbabwe*) OR (TX Angola#) OR (TX Armenia#) OR (TX Belize*) OR (TX Bhutan*) OR (TX Bolivia#) OR (TX Cameroon*) OR (TX Cape Verd*) OR (TX Congo*) OR (TX “Côte d'Ivoire”) OR (TX "ivory coast") OR (TX ivorian) OR (TX Djibouti) OR (TX Egypt#) OR (TX “El Salvador”) OR (TX “Salvadoran”) OR (TX Fiji*) OR (TX Georgia#) OR (TX Ghana*) OR (TX Guatemala#) OR (TX Guyan*) OR (TX Hondura#) OR (TX Indonesia#) OR (TX India#) OR (TX Iraq#) OR (TX Kiribati) OR (TX Kosov*) OR (TX Lao*) OR (TX Lesotho) OR (TX (“Marshall Islands”)) OR (TX marshallese) OR (TX Mauritania#) OR (TX Micronesia#) OR (TX Moldova#) OR (TX Mongolia#) OR (TX Morocc*) OR (TX Nicaragua#) OR (TX Nigeria#) OR (TX Pakistan#) OR (TX “Papua New

Guinea*") OR (TX Paraguay*) OR (TX Philippines) OR (TX Filipino) OR (TX Samoa#) OR (TX "Sao Tome*") OR (TX Senegal*) OR (TX "Solomon Island*") OR (TX "sri lanka#") OR (TX Sudan*) OR (TX Swazi*) OR (TX Syria#) OR (TX Timor*) OR (TX Tonga#) OR (TX Turkmen*) OR (TX Tuvalu*) OR (TX Ukrain*) OR (TX Uzbek*) OR (TX Vanuat*) OR (TX Vietnam*) OR (TX ("West Bank")) OR (TX Gaza) OR (TX Yemen*) OR (TX Zambia#) OR (TX Albania#) OR (TX Algeria#) OR (TX "Antigua and Barbuda") OR (TX antiguan) OR (TX barbudan) OR (TX Argentin*) OR (TX Azerbaijani*) OR (TX Belarus*) OR (TX Bosnia#) OR (TX Botswana) OR (TX Brazil*) OR (TX Bulgaria#) OR (TX Chile*) OR (TX China) OR (TX Chinese) OR (MH "China+") OR (TX Colombia#) OR (TX "Costa Rica#") OR (TX Cuba#) OR (TX Dominica#) OR (TX Ecuador*) OR (TX Gabon*) OR (TX Grenad*) OR (TX Iran*) OR (TX Jamaica#) OR (TX Jordan*) OR (TX Kazakhstan#) OR (TX Latvia#) OR (TX Leban*) OR (TX Libya#) OR (TX Lithuania#) OR (TX Macedonia#) OR (TX Malaysia#) OR (TX Maldiv*) OR (TX mauriti*) OR (TX Mexic*) OR (TX Montenegr*) OR (TX Namibia#) OR (TX Palau*) OR (TX Panama*) OR (TX Peru*) OR (TX Romania#) OR (TX Russia#) OR (TX Serbia#) OR (TX Seychell*) OR (TX "South Africa#") OR (TX "Saint Kitts") OR (TX "Saint Lucia") OR (TX "Saint Vincent") OR (TX Suriname#) OR (TX Thai*) OR (TX Tunisia#) OR (TX Turk*) OR (TX Uruguay*) OR (TX Venezuala#)

EMBASE Search

CVD: exp hyperlipidemia/ or hyperlipid?emia$1.mp. or hyperlip?emia$1.mp. or lipid?emia$1.mp. or high cholesterol.mp. or hypercholesterol?emia$1.mp. or hypercholester?emia$1.mp. or exp Diabetes mellitus/ or diabetes.mp. OR exp diabetic angiopathy/ or diabetic.mp. or exp proteinuria/ or proteinuria$1.mp. or albuminuria$1.mp. or hemoglobinuria$1.mp. or exp chronic kidney disease/ or chronic kidney disease$1.mp. or chronic renal disease$1.mp. or chronic renal insufficienc$.mp. OR CKD.mp. OR end-stage renal disease$1.mp. or chronic kidney failure$1.mp. or chronic renal failure$1.mp. or exp stroke/ or stroke$1.mp. or brain vascular accident$1.mp. or apoplexy.mp. or cerebrovascular accident$1.mp. or exp myocardial disease/ or cardiomyopath$.mp. or myocardial disease$1.mp. or myocardiopath$.mp. or heart muscle isch?emia$1.mp. or myocardial isch?emia$1.mp. or isch?emic heart disease$1.mp. or acute coronary syndrome$1.mp. or coronary disease$1.mp. or coronary artery disease$1.mp. or coronary arterioscleros$.mp. or coronary atheroscleros$.mp. or coronary stenos$.mp. or coronary restenos$.mp. or coronary heart disease$1.mp. or coronary thrombos$.mp. or coronary occlusion$1.mp. or myocardial infarct$.mp. or heart attack$1.mp. or exp heart tumor/ or heart neoplasm$1.mp. or cardiac tumor$1.mp. or myocardial tumor$1.mp. or cardiac carcinoma$1.mp. or heart cancer$1.mp. or cardiac cancer$1.mp. or heart tumor$1.mp. or exp heart failure/ or heart arrest$1.mp. or cardiac arrest$1.mp. or asystole$1.mp. or cardiopulmonary arrest$1.mp. or heart failure$1.mp. or cardiac failure$1.mp. or myocardial failure$1.mp. or heart decompensation$1.mp. or exp hypertension/ or hypertension$1.mp. or high blood pressure$1.mp. or exp cardiovascular disease/ or exp cardiovascular risk/ or (cardiovascular ADJ5 disease$1).mp. or (cardiovascular ADJ5 risk$1).mp.

Task-Shifting: exp personnel shortage/ or (shortage$1 ADJ5 doctor$1).mp. or (shortage$1 ADJ5 physician$1).mp. or (shortage$1 ADJ5 trained ADJ5 personnel).mp. or (shortage$1 ADJ5 health ADJ5 workforce).mp. or (shortage$1 ADJ5 health ADJ5 worker$1).mp. or (shortage$1 ADJ5 health ADJ5 provider$1).mp. or (task$1 ADJ5 shift$).mp. or nurse led.mp. or non$1physician clinician$1.mp. or non$1physician health$ worker$1.mp. or primary health care nurs$.mp. or (role ADJ5 nurs$).mp. or exp community health nursing/ or exp health auxiliary/ or community health$ worker$1.mp. or community health cent$.mp. or lay health$ worker$1.mp. or community health$ aide$1.mp. or (community ADJ2 health ADJ5 worker$1).mp. or extended scope practi$.mp. or (role ADJ3 enhance$).mp. or (substitute$ ADJ10 physician$1).mp. or (substitute$ ADJ10 doctor$1).mp. or (substitute$ ADJ10 nurse$1).mp. or (delegat$ ADJ10 physician$1).mp. or (delegat$ ADJ10 doctor$1).mp. or (delegat$ ADJ10 nurse$1).mp.

Low-and Middle-income countries: exp developing country/ or exp medically underserved/ or developing countr$.mp. or medically underserved area$1.mp. or low income countr$.mp. or middle income

country.mp. or low resource.mp. or resource poor.mp. or global.mp. or exp Africa/ or exp "South and Central America"/or exp asia/ or exp Caribbean islands/ or exp pacific islands/ or exp eastern Europe/ or exp Indian Ocean/or south america$1.mp. or Africa$1.mp. or Caribbean.mp. or central America$1.mp. or south America$1.mp. or eastern Europe$1.mp. or pacific island$.mp. or Indian ocean island$.mp. or asia.mp. or Afghan$.mp. or Bangladesh$1.mp. or Benin$.mp. or Burkina Faso.mp. or Burkinabe.mp. or Burundi$.mp. or Cambodia$1.mp. or Central African.mp. or Chad$.mp. or Comor$.mp. or Congo$.mp. or Eritrea$1.mp. or Ethiopia$1.mp. or Gambia$1.mp. or Guinea$1.mp. or Haiti$.mp. or Kenya$1.mp. or Korea$1.mp. or exp North Korea/ or Kyrgyz$.mp. or Liberia$1.mp. or Madagascar.mp. or Malagasy.mp. or Malawi$.mp. or mali$.mp. or mozambi$.mp. or Myanmar$.mp. or Nepal$.mp. or Niger$.mp. or Rwanda$1.mp. or Sierra Leone$.mp. or Somalia$1.mp. or Tajik$.mp. or Tanzania$1.mp. or Togo$.mp. or Uganda$1.mp. or Zimbabwe$.mp. or Angola$1.mp. or Armenia$1.mp. or Beliz$.mp. or Bhutan$.mp. or Bolivia$1.mp. or Cameroon$.mp. or Cape Verde$.mp. or Congo$.mp. or "Côte d'Ivoire".mp. or Ivory Coast.mp. or Ivorian.mp. or Djibouti.mp. or Egypt$.mp. or El Salvador.mp. or Salvadoran.mp. or Fiji$.mp. or Georgia$1.mp. or Ghana$.mp. or Guatemala$1.mp. or Guyan$.mp. or Hondura$.mp. or Indonesia$1.mp. or India$1.mp. or Iraq$1.mp. or Kiribati.mp. or Kosov$.mp. or Lao$.mp. or Lesotho.mp. or Marshall Islands.mp. or Marshallese.mp. or Mauritania$1.mp. or Micronesia$1.mp. or Moldov$.mp. or Mongolia$1.mp. or Morocc$.mp. or Nicaragua$1.mp. or Nigeria$1.mp. or Pakistan$1.mp. or Papua New Guinea$1.mp. or Paraguay$.mp. or Philippines.mp. or Filipino.mp. or Samoa$1.mp. or sao tome$.mp. or Senegal$.mp. or Solomon Island$.mp. or sri lanka$1.mp. or Sudan$.mp. or Swazi$.mp. or Syria$1.mp. or Timor$.mp. or Tonga$1.mp. or Turkmen$.mp. or Tuvalu$.mp. or Ukrain$.mp. or Uzbek$.mp. or Vanuat$1.mp. or Vietnam$.mp. or West Bank.mp. or Gaza.mp. or Yemen$.mp. or Zambia$1.mp. or Albania$1.mp. or Algeria$1.mp. or "Antigua and Barbuda".mp. or antiguan.mp. or barbudan.mp. or Argentin$.mp. or Azerbaijan$1.mp. or Belarus$.mp. or Bosnia$1.mp. or Botswana.mp. or Brazil$.mp. or Bulgaria$1.mp. or Chile$.mp. or China.mp. or Chinese.mp. or Colombia$1.mp. or Costa Rica$1.mp. or Cuba$1.mp. or Dominica$1.mp. or Ecuador$.mp. or Gabon$.mp. or Grenad$.mp. or Iran$.mp. or Jamaica$1.mp. or Jordan$.mp. or Kazakhstan$1.mp. or Latvia$1.mp. or Leban$.mp. or Libya$1.mp. or Lithuania$1.mp. or Macedonia$1.mp. or Malaysia$1.mp. or Maldiv$.mp. or mauriti$.mp. or Mexic$.mp. or Montenegr$.mp. or Namibia$1.mp. or Palau$.mp. or Panama$.mp. or Peru$.mp. or Romania$1.mp. or Russia$1.mp. or Serbia$1.mp. or Seychell$.mp. or South Africa$1.mp. or Saint Kitts.mp. or Saint Lucia.mp. or Saint Vincent.mp. or Suriname$1.mp. or Thai$.mp. or Tunisia$1.mp. or Turk$.mp. or Uruguay$.mp. or Venezuala$1.mp.

Global Health Search

CVD: exp hyperlipaemia/ or hyperlipid?emia$1.mp. or hyperlip?emia$1.mp. or lipid?emia$1.mp. or high cholesterol.mp. or hypercholesterol?emia$1.mp. or hypercholester?emia$1.mp. or exp Diabetes mellitus/ or diabetes.mp. or diabetic.mp. or exp proteinuria/ or proteinuria$1.mp. or albuminuria$1.mp. or hemoglobinuria$1.mp. or chronic kidney disease$1.mp. or chronic renal disease$1.mp. or chronic renal insufficienc$.mp. OR CKD.mp. OR end-stage renal disease$1.mp. or chronic kidney failure$1.mp. or chronic renal failure$1.mp. or exp stroke/ or stroke$1.mp. or brain vascular accident$1.mp. or apoplexy.mp. or cerebrovascular accident$1.mp. or exp cardiomyopathy/ or cardiomyopath$.mp. or myocardial disease$1.mp. or myocardiopath$.mp. or exp myocardial ischaemia/ or heart muscle isch?emia$1.mp. or myocardial isch?emia$1.mp. or isch?emic heart disease$1.mp. or acute coronary syndrome$1.mp. or coronary disease$1.mp. or coronary artery disease$1.mp. or coronary arterioscleros$.mp. or coronary atheroscleros$.mp. or coronary stenos$.mp. or coronary restenos$.mp. or coronary heart disease$1.mp. or coronary thrombos$.mp. or coronary occlusion$1.mp. or myocardial infarct$.mp. or heart attack$1.mp. or heart neoplasm$1.mp. or cardiac tumor$1.mp. or myocardial tumor$1.mp. or cardiac carcinoma$1.mp. or heart cancer$1.mp. or cardiac cancer$1.mp. or heart tumor$1.mp. or heart arrest$1.mp. or cardiac arrest$1.mp. or asystole$1.mp. or cardiopulmonary arrest$1.mp. or heart failure$1.mp. or cardiac failure$1.mp. or myocardial failure$1.mp. or heart decompensation$1.mp. or exp hypertension/ or hypertension$1.mp. or high blood pressure$1.mp. or exp cardiovascular diseases/ or (cardiovascular ADJ5 disease$1).mp. or (cardiovascular ADJ5 risk$1).mp.

Task-Shifting: (shortage$1 ADJ5 doctor$1).mp. or (shortage$1 ADJ5 physician$1).mp. or (shortage$1 ADJ5 trained ADJ5 personnel).mp. or (shortage$1 ADJ5 health* ADJ5 workforce).mp. or (shortage$1

ADJ5 health ADJ5 worker$1).mp. or (shortage$1 ADJ5 health ADJ5 provider$1).mp. or (task$1 ADJ5 shift$).mp. or nurse led.mp. or non$1physician clinician$1.mp. or non$1physician health$ worker$1.mp. or primary health care nurs$.mp. or (role ADJ5 nurs$).mp. or exp community health services/ or exp medical auxiliaries/ or exp barefoot doctors/ or community health$ worker$1.mp. or community health cent$.mp. or lay health$ worker$1.mp. or community health$ aide$1.mp. or community health nurs$.mp. or (community ADJ2 health ADJ5 worker$1).mp. or extended scope practi$.mp. or (role ADJ3 enhance$).mp. or (substitute$ ADJ10 physician$1).mp. or (substitute$ ADJ10 doctor$1).mp. or (substitute$ ADJ10 nurse$1).mp. or (delegat$ ADJ10 physician$1).mp. or (delegat$ ADJ10 doctor$1).mp. or (delegat$ ADJ10 nurse$1).mp.

Low-and Middle-income countries: exp developing countries/ or developing countr$.mp. or medically underserved area$1.mp. or low income countr$.mp. or middle income country.mp. or low resource.mp. or resource poor.mp. or global.mp. or exp Africa/ or exp South America/ or exp Central America/or Africa$1.mp. or Caribbean.mp. or central America$1.mp. or south America$1.mp. or exp south asia/ or exp southeast asia/ or exp Caribbean/ or exp pacific islands/ or Afghan$.mp. or Bangladesh$1.mp. or Benin$.mp. or Burkina Faso.mp. or Burkinabe.mp. or Burundi$.mp. or Cambodia$1.mp. or Central African.mp. or Chad$.mp. or Comor$.mp. or Congo$.mp. or Eritrea$1.mp. or Ethiopia$1.mp. or Gambia$1.mp. or Guinea$1.mp. or Haiti$.mp. or Kenya$1.mp. or Korea$1.mp. or exp North Korea/ or Kyrgyz$.mp. or Liberia$1.mp. or Madagascar.mp. or Malagasy.mp. or Malawi$.mp. or mali$.mp. or mozambi$.mp. or Myanmar$.mp. or Nepal$.mp. or Niger$.mp. or Rwanda$1.mp. or Sierra Leone$.mp. or Somalia$1.mp. or Tajik$.mp. or Tanzania$1.mp. or Togo$.mp. or Uganda$1.mp. or Zimbabwe$.mp. or Angola$1.mp. or Armenia$1.mp. or Beliz$.mp. or Bhutan$.mp. or Bolivia$1.mp. or Cameroon$.mp. or Cape Verde$.mp. or Congo$.mp. or "Côte d'Ivoire".mp. or Ivory Coast.mp. or Ivorian.mp. or Djibouti.mp. or Egypt$.mp. or El Salvador.mp. or Salvadoran.mp. or Fiji$.mp. or Georgia$1.mp. or Ghana$.mp. or Guatemala$1.mp. or Guyan$.mp. or Hondura$.mp. or Indonesia$1.mp. or India$1.mp. or Iraq$1.mp. or Kiribati.mp. or Kosov$.mp. or Lao$.mp. or Lesotho.mp. or Marshall Islands.mp. or Marshallese.mp. or Mauritania$1.mp. or Micronesia$1.mp. or Moldov$.mp. or Mongolia$1.mp. or Morocc$.mp. or Nicaragua$1.mp. or Nigeria$1.mp. or Pakistan$1.mp. or Papua New Guinea$1.mp. or Paraguay$.mp. or Philippines.mp. or Filipino.mp. or Samoa$1.mp. or sao tome$.mp. or Senegal$.mp. or Solomon Island$.mp. or sri lanka$1.mp. or Sudan$.mp. or Swazi$.mp. or Syria$1.mp. or Timor$.mp. or Tonga$1.mp. or Turkmen$.mp. or Tuvalu$.mp. or Ukrain$.mp. or Uzbek$.mp. or Vanuat$1.mp. or Vietnam$.mp. or West Bank.mp. or Gaza.mp. or Yemen$.mp. or Zambia$1.mp. or Albania$1.mp. or Algeria$1.mp. or "Antigua and Barbuda".mp. or antiguan.mp. or barbudan.mp. or Argentin$.mp. or Azerbaijan$1.mp. or Belarus$.mp. or Bosnia$1.mp. or Botswana.mp. or Brazil$.mp. or Bulgaria$1.mp. or Chile$.mp. or China.mp. or Chinese.mp. or Colombia$1.mp. or Costa Rica$1.mp. or Cuba$1.mp. or Dominica$1.mp. or Ecuador$.mp. or Gabon$.mp. or Grenad$.mp. or Iran$.mp. or Jamaica$1.mp. or Jordan$.mp. or Kazakhstan$1.mp. or Latvia$1.mp. or Leban$.mp. or Libya$1.mp. or Lithuania$1.mp. or Macedonia$1.mp. or Malaysia$1.mp. or Maldiv$.mp. or mauriti$.mp. or Mexic$.mp. or Montenegr$.mp. or Namibia$1.mp. or Palau$.mp. or Panama$.mp. or Peru$.mp. or Romania$1.mp. or Russia$1.mp. or Serbia$1.mp. or Seychell$.mp. or South Africa$1.mp. or Saint Kitts.mp. or Saint Lucia.mp. or Saint Vincent.mp. or Suriname$1.mp. or Thai$.mp. or Tunisia$1.mp. or Turk$.mp. or Uruguay$.mp. or Venezuala$1.mp.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5,6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	n/a
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	n/a

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	n/a
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6-7
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	7-9
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	n/a
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	7-9
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	n/a
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9-10
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	10
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	11
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	n/a

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

BMJ Open

Task Shifting Interventions for Cardiovascular Risk Reduction in Low-and Middle-Income Countries: A Systematic Review of Randomized Controlled Trials

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Primary Subject Heading:	Cardiovascular medicine
Secondary Subject Heading:	Global health, Health services research
Keywords:	Task shifting, Cardiovascular diseases, Hypertension < CARDIOLOGY, Diabetes, Low-and middle-income countries, Systematic review

Task Shifting Interventions for Cardiovascular Risk Reduction in Low-and Middle-Income Countries: A Systematic Review of Randomized Controlled Trials

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ABSTRACT

Objective: To evaluate evidence from published randomized controlled trials (RCTs), for the use of task-shifting strategies for cardiovascular disease (CVD) risk reduction in low- and middle-income countries (LMICs).

Design: Systematic review of RCTs that utilized task-shifting strategy in management of CVD in LMICs.

Data Sources: We searched the following databases for relevant RCTs: PubMed from 1940s, Embase from 1974, Global Health from 1910, Ovid Health Star from 1966, Web of Knowledge from 1900, Scopus from 1823, CINAHL from 1937, and RCTs from ClinicalTrials.gov.

Eligibility criteria for selecting studies: We focused on RCTs published in English but without publication year. We included RCTs in which the intervention used task-shifting (non-physician healthcare workers involved in either prescribing of medications, treatment and/or medical testing), use of non-physician healthcare providers in management of CV risk factors and diseases (hypertension, diabetes, hyperlipidemia, stroke, coronary artery disease, or heart failure), and RCTs that were conducted in LMICs. We excluded studies that are not RCTs.

Results: Of the 2771 articles identified, only three met predefined criteria. All three trials were conducted in practice-based settings among patients with hypertension (2 studies) and diabetes (1 study), with one study also incorporating home visits. The duration of the studies ranged from three months to 12 months; and the task-shifting strategies included provision of medication prescriptions by nurses, community health workers, and pharmacists; and telephone follow up post-hospital discharge. Both hypertension studies reported mean significant blood pressure reduction (2/1 mm Hg and 30/15 mm Hg); and the diabetes trial reported reduction in HbA1c levels of 1.87%.

Conclusions: There is a dearth of evidence on the implementation of task-shifting strategies to reduce the burden of CVD in LMICs. Effective task-shifting interventions targeted at reducing global CVD epidemic in LMICs are urgently needed.

Strengths and limitations of this study

- This systematic review evaluates the effectiveness of existing task-shifting strategies in management of cardiovascular (CV) risk factors in low-and middle-income countries (LMICs).
- Analysis of three randomized controlled trials (the only studies meeting our eligibility criteria), where non-physician healthcare workers were involved in either prescribing of medications, treatment and/or medical testing, showed significant improvement in blood pressure and glucose levels.
- The studies indicate some evidence of the effectiveness of task-shifting strategies for hypertension and diabetes management using nurses in LMICs.
- Our findings highlight the lack of data on widespread implementation and effectiveness of task-shifting strategies for CVD other than the one large trial conducted by Mendis and colleagues at the WHO which showed that task shifting is effective at primary care healthcare facilities in Nigeria and China.
- The small number of studies and heterogeneity in terms of the various CVDs did not allow for a meta-analysis to be conducted.

Key Words: Task-shifting, Cardiovascular disease, Hypertension, Diabetes, Low-and middle-income countries, Systematic review, Randomized Controlled Trials

INTRODUCTION

The prevalence of cardiovascular diseases (CVD) and diabetes, and their attendant complications is high in low- and middle-income countries (LMICs).[1] According to the World Health Organization (WHO), 80% of the mortality attributable to non-communicable diseases (NCDs) occurs in LMICs; and cardiovascular diseases (CVD) account for the greatest burden.[2] For example, the mortality attributable to CVD in Africa, South-East Asia, and Eastern Mediterranean regions is projected to increase from 20 to 35% by the year 2020.[2] It is estimated that more than 30 million adults in Africa have hypertension, and 75% of all deaths in Africa may be attributable to hypertension by the year 2020.[3] Stroke deaths attributable to hypertension in sub-Saharan Africa (SSA) account for a total disability of 2.6 million Disability Adjusted Life Years.[4] Even more troubling is the fact that the growing NCD burden [in most LMICs] occurs in the context of high levels of infectious diseases such as malaria, HIV/AIDS and tuberculosis, thus indicating a rapid epidemiologic transition.[5] This makes the urgency of addressing the epidemic of CVDs in LMICs imminent.

Although barriers to management of CVD exist at multiple levels of care, systems-level barriers [particularly acute shortage of healthcare providers] limit the capacity of LMICs to manage CVD at the primary care level.[1, 6-9] For example, although SSA has 11% of the world's population and bears over 24% of the global disease burden, it harbors only 3% of the global health workforce.[1] There are 2.4 million doctors and nurses in SSA, which translate to 2 doctors and 11 nursing / midwifery personnel per 10,000 people compared to 19 doctors and 49 nursing/midwifery personnel per 10,000 in North America.[10] Given such limited resources, cost-effective approaches are urgently needed to mitigate systems-level barriers to management of CVD in LMICs. One such approach is a task-shifting strategy, defined as the rational distribution of primary care duties from physicians to non-physician healthcare providers.[11] In fact the idea of task shifting is not entirely new. Task shifting was to be the hallmark of the WHO-led primary health care movement of the 1980s. It was behind the declaration of what became known as health for all by the year 2000. For this purpose, and in order to maximize the efficient use of health workforce resources, primary care tasks are shifted from higher-trained health workers such as physicians to less highly trained health workers. According to the WHO and later echoed by the World Medical Association, task shifting is particularly useful in low-resource settings facing healthcare human resource crisis,[12] and is therefore proposed as a viable method for primary and secondary prevention at the primary care level.[13] The benefits of task shifting are well documented in management of HIV/AIDS.[14] It utilizes multiple strategies to address the CVD

epidemic including screening, counseling on lifestyle modification, initiation of treatment, and referral to specialist care. [2, 11-13, 15-18]

Despite the global call for task shifting for management of non-communicable diseases, and the potential for task-shifting strategies to mitigate the systems-level barriers to implementation of primary and secondary prevention of CVD in LMICs, their effectiveness has not been widely evaluated. In this systematic review, we evaluated the evidence from published randomized controlled trials (RCTs), for the use of task-shifting strategies for CVD risk reduction in LMICs.

METHODS

Search Strategy

We identified published trials that met predefined inclusion criteria using standard Cochrane Collaboration systematic review techniques,[19] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[20] statement. We searched the following databases: PubMed from 1940s, Embase from 1974, Global Health from 1910, Ovid Health Star from 1966, Web of Knowledge from 1900, Scopus from 1823, CINAHL from 1937, and RCTs from ClinicalTrials.gov. The search strategy included terms from three subject categories: those related to cardiovascular disease; those related to the concept of task-shifting; and those related to low- and middle-income countries, as defined by the World Bank [using a variety of factors including gross domestic product (GDP), population, economic policy and external debt, health, environment, and education].[21] All concepts were then combined using both keywords and controlled vocabularies such as, "*task shift*" AND "balance of care OR nonphysician clinician OR substitute health worker OR community care giver OR primary health care team OR cadres OR nurs*" AND "CVD"*. The search terms used were similar to the ones used by Callaghan et al in their systematic review of task-shifting in HIV treatment.[14] Searches were undertaken in October 2011 and repeated in March 2013 before the final write up.

We adopted the following definition of task-shifting by Callaghan et al,:[14] "the process of shifting tasks to a variety of health workers; including nurses or new cadres in prescribing of medications and medical testing, as long as it is a streamlined, rationalized chain of care." As depicted in Figure 1, the process of task shifting should involve ongoing training from higher-level health professionals, delegation, and continuous supervision. Also, patients with complicated disease cases should always be referred for specialist care.

Eligibility Criteria for Inclusion of Studies

We limited our search to only RCTs published in English but without publication year. We included RCTs in which the intervention used task-shifting (non-physician healthcare workers involved in either prescribing of medications, treatment and/or medical testing), use of non-physician healthcare providers in management of CV risk factors and diseases (hypertension, diabetes, hyperlipidemia, stroke, coronary artery disease, or heart failure), and RCTs that were conducted in LMICs. We excluded studies that are not RCTs. We then reviewed the identified RCTs in their entirety to determine their eligibility.

Data Extraction

Each of the authors assessed all retrieved lists of citations and abstracts independently. Initially, we determined the relevance of the articles by title and abstract. Discrepancies between the authors about eligibility of retrieved studies were resolved by discussion. We then obtained printed copies of all relevant articles for extensive examination to ensure that the articles met all eligibility criteria. Information from potentially eligible articles including study country, study design, methods, participant characteristics, retention rates, and study outcomes were extracted into the Cochrane Review Manager.[22]

Quality Assessment

The quality of available RCTs was assessed using the Cochrane criteria[23] adapted from previous suggestions.[24, 25] Specifically, the risk of bias in generation of the randomization sequence, allocation concealment, and blinding (participants and outcome assessors), incomplete outcome data and selective reporting were assessed as adequate, uncertain, or inadequate.[24, 25] Two authors (JG and JI) assessed the risk of bias in the individual studies that met the inclusion criteria. Disagreements were resolved by consensus, and a third reviewer was consulted if disagreements persisted.

RESULTS

Full search strategies for each of the databases are provided in Appendix 1 (online supplementary). We retrieved and screened 2771 articles (Figure 2), and conducted full paper review on 32 articles that initially met the inclusion criteria including study location in LMICs, the use of non-physician providers to provide health services, CVD, and use of task-shifting strategies. After further review, we excluded 18 articles including: studies that were not conducted in LMICs (5); studies that were missing important details about intervention strategies (4); protocol papers that were missing main trial outcomes (4); studies that referred to the same study protocol conducted in the same populations (3); studies whose primary outcome did not include major cardiovascular risk factors or CVD (1); and studies that only provided abstracts (1). A total of 14 articles met the initial eligibility criteria.[21, 26-38] The 14 articles were further screened based on whether or not the intervention fulfilled the definition of task shifting used for this review [use of non-physician clinicians in prescribing medications or performing medical testing in the treatment or management of CVD]. This final review led to further elimination of 11 additional articles,[27-32, 34-38] leaving only three RCTs, which were included in this systematic review.[21, 26, 33] The characteristics of the studies included in this systematic review are presented in Tables 1 and 2. One trial was conducted in Nigeria,[26] another is a multi-center trial conducted in Nigeria and China,[33] and the last one was conducted in Iran.[21] The study populations were patients with hypertension (two studies),[26, 33] and type 2 diabetes (one study).[21] (Table 2). The sample size of the interventions varied, with a range of 61 - 2397 patients (Table 1): the sample size for the diabetes trial was 61;[21] while those of the two hypertension trials were 544,[26] and 2397.[33] The duration of these studies ranged 3 months for the diabetes trial and 6 to 12 months for the hypertension trials. The reporting quality of all three trials were rated 73% using the Jadad quality measure.[39]

Overall risk of bias was moderate; random sequence generation was adequate in 67% (2/3) of the studies, and allocation concealment in 67% (2/3), however blinding of data collection (participants) was not possible in any of the study due to the nature of the intervention, as well as with blinding of the outcomes except for one study.[21] All the studies described the methods used to collect outcomes, although we could not assess blinding of the researchers collecting the outcome data. Overall, incomplete data was reported in all of the studies; however selective reporting was poor with very minimal information in all the studies on whether the interventions were implemented with

fidelity *"that is whether each of the components of the intervention were delivered in a comparable manner to all participants and is true to the objectives of the underlying research."* [40]

Hypertension Trials

Both studies evaluated the effect of task shifting on hypertension control using various forms of task- shifting strategies including interventions led by nurses, pharmacists, and community health workers (Table 2). The studies were conducted in Nigeria, and China.[26, 33] In addition to nurses or pharmacists prescribing antihypertensive medications, the interventions included health education emphasizing lifestyle modifications such as diet, physical activity, and medication adherence. The interventions were effective at improving blood pressure (BP) control in both studies.[26, 33]

The first hypertension trial, by Adeyemo and colleagues, examined the effectiveness of the use of nurses to deliver hypertension management in a primary care practice versus usual care plus home visits on medication adherence, and BP control at 6 months among 544 patients (mean age~63 years, mean BP~168/92 mmHg) in Nigeria.[26] The intervention included the following components: 1) a nurse-led treatment program with physician backup, 2) clinic visits and health education by nurses, 3) the use of diuretics and a ß blocker prescribed by nurses with physician backup. The primary outcome of BP control (BP<140/90mm Hg) was achieved in 66% of the study participants (66.7% in clinic only group, 65.4% in clinic plus home visit; p=0.584 and p=0.891).[26] The overall decline in mean systolic and diastolic BP over the six-month period was 30 mmHg and 15 mmHg respectively (p<0.001and p<0.0001).[26] Overall, medication adherence was high among study participants with 77% of participants taking >98 of their prescribed pills.

The second hypertension trial was the largest in this review. In this cluster RCT, Mendis and colleagues evaluated the effectiveness of the WHO Cardiovascular Disease (CVD) package using task-shifting strategies to improve BP control among 2397 hypertensive patients from forty primary care facilities (20 intervention sites, 20 control sites) in Nigeria and China.[33] Non-physician healthcare workers provided patients at the intervention sites with the WHO CVD package protocol while those at the control sites received usual care for a period of 12 months. The WHO CVD package was designed as an adaptable, cost-effective tool for systematic case management at all healthcare levels, and consequently for scaling up in health systems in LMICs. The program provides clinical

decision support for the assessment and management of CV risk through easy-to-follow risk-assessment algorithms, lifestyle counseling, drug treatment protocols, and referral pathways.[41] The protocol consists of four basic steps: inquiry about patient's history (heart attack, angina, stroke, transient ischemic attack, diabetes and lifestyle behaviors); physical and laboratory examination (including BP measurements, anthropometrics, urine dip stick, fasting glucose, and plasma cholesterol); estimation of patient's CVD risk based on the WHO risk charts (low, medium or high); and subsequent initiation of drug therapy and lifestyle counseling during follow-up visits.[33] Depending on the patient's CVD risk, the treatment decisions include either 1) immediate referral to a specialist in the case of patents with high CVD risk; or 2) lifestyle counseling on diet, physical activity and tobacco cessation; prescription of an antihypertensive medication; and follow-up with a provider. The primary outcome was change in systolic BP from baseline to 12 months. Systolic and diastolic BP decreased significantly in favor of the intervention group at both study sites (P<0.0001) and ((P<0.0002), but BP control rate was abysmally low at only 20%. The intervention resulted in significantly greater reduction in systolic and diastolic BP for the treatment group (2 mmHg and 1 mmHg) than the control group in both countries.[33]

Diabetes Trial

The diabetes trial evaluated whether nurse-led care could improve diabetes management compared to usual care.[21] This trial was conducted by Nesari and colleagues in Iran among 61 patients with diabetes, who received either telephone-based nurse follow-up care for 3 months or usual care.[21] Both groups received health education on diet, physical activity, foot-care, blood glucose self-monitoring, management of medication side effects and hypoglycemia. Additionally, in the intervention group, the nurse adjusted the patients' medications according to the patients' reported glycemic level, with back up from an endocrinologist. The reported decline in HbA1c was higher in the intervention group compared to the usual care group (1.87% in the intervention group, p<0.001; and 0.42% in the usual care group, p<0.15).[21] Similarly, the mean levels of HbA1c was significantly lower in the intervention group than in the usual care group at 3 months (mean HbA1c of 7.04% ± 1.18 in the intervention group versus 8.64% ± 1.88 for the control group; P< 0.001).[21]

DISCUSSION

In this review, we examined the evidence for task shifting of primary care duties for management of CVD in low- and middle-income countries. We reviewed three clinical trials that utilized task-shifting strategies for management of CVD in LMICs.[21, 26, 33] Two of the three trials were hypertension studies,[26, 33] and one diabetes trial.[21] The outcomes of the three trials were positive with significant improvement in BP and HbA1c.[21, 26, 33] The studies show some evidence of the effectiveness of task-shifting strategies for management of hypertension and diabetes using nurses.

Some of the common task shifting enablers among the studies are as follows: continuous educational training and feedback from higher level health professionals; bridging hospital care to home care in order to ensure continuity of patient care; and providing explicit training tools including medication/ treatment algorithms. Nonetheless, barriers to task-shifting in LMICs that currently do not utilize task-shifting strategies include the lack of policy on ability of non-physician providers to prescribe medications for common disorders; the lack of referral system as backup for complicated cases; the lack of organizational structure to accommodate non-physician provider as a primary care provider; and the lack of competence of the non-physician provider in their ability to manage uncomplicated cardiovascular risk factors; and finally the lack of infrastructure for data collection and monitoring of clinical information on a periodic basis.

The concept of tasking shifting is not new because task shifting strategies have proven effective in the battle against the HIV/AIDs epidemic in LMICs;[14] and thus may be potentially effective for chronic disease management, provided adequate and sustainable training is afforded to the health professionals involved. Considering the barriers and challenges that task shifting may pose if non-physician healthcare workers are not equipped with the expertise to efficiently manage HIV/AIDS, the WHO launched the treat, train, retrain plan in 2006,[42] to ensure competency and aid in capacity building of these providers. As a result, many LMICs have adopted task-shifting strategies for HIV/AIDS management in LMICs. In this regard, Callaghan et al. conducted a systematic review of 84 articles on HIV treatment and care in SSA and their findings suggest that task-shifting strategies led to improved efficiency in delivery of healthcare services, enhanced access to care, better team dynamics, and improved quality of care and health outcomes for patients with HIV/AIDS.[14]

Task shifting is a potentially viable and low-cost strategy for reducing the growing CVD epidemic in LMICs because it utilizes multiple strategies that are amenable to management of CVDs including screening, counseling on lifestyle modification, initiation of treatment, and referral to specialist care.[11-14, 41] We are not aware of any rigorous evaluation of task-shifting strategies for management of CVDs in LMICs. To our knowledge, our study was the first systematic review to evaluate effectiveness of existing task-shifting strategies in management of CV risk factors in LMICs. Our findings highlight the lack of data on widespread implementation and effectiveness of task-shifting strategies for CVD other than the one large trial conducted by Mendis and colleagues at the WHO which showed that task shifting is effective at primary care healthcare facilities in Nigeria and China.[33] The other studies reviewed had numerous weaknesses. First, the quality of the trials was low given their very small sample sizes, poor definition of study outcomes, and short duration of the trials [only 3 months for the diabetes trial[21] and 6 months for one of the hypertension trials[26]], making it difficult to ascertain the effect of regression to mean on the study outcomes. Second, the authors provided very scanty description of the non-physician healthcare providers who delivered the task shifting duties: only two of the studies identified that nurses provided the task shifting duties.[21, 26] Unfortunately, the largest trial with the best quality did not provide any information on the level of training of the task shifting healthcare provider.[33] Third, there was no data on the cost-effectiveness of these studies and finally, none of the trials integrated their intervention into existing healthcare systems making evaluation of the implementation and dissemination of the study findings problematic.

A possible limitation of our review is that we excluded 11 RCT studies which did not meet our criteria. These studies are shown in Table 3 and the majority of the reasons for exclusion are because they were studies that were largely patient education/health education interventions carried out by non-physicians. These duties readily fit in the nurses and other non-physician duties and hence were not considered task-shifting. Other reasons include the lack of randomization (2,739 studies) and although they measured outcomes of CVD, the lack of randomization makes them low quality. These studies were nevertheless effective as pre-post design that policy makers may find useful.

Future studies should focus on the cost-effectiveness of task-shifting interventions for CVD risk reduction as part of the larger healthcare system. In addition, these studies should compare the cost effectiveness of the use of nurses versus other allied healthcare workers. In order for task shifting strategies to be considered effective, evidence of its implementation for addressing the CVD epidemic as part of existing healthcare systems in LMICs

are paramount. Thus, in 2001, the Global Alliance for Chronic Diseases (GACD) funded 15 implementation trials targeting hypertension control. Five of these studies are evaluating the role of task-shifting strategies to reduce overall CV risk and improve hypertension control in Ghana, India, Kenya, Tanzania, and South Africa.[43] Such studies integrated into existing healthcare systems will guarantee subsequent adoption of interventions if proven successful.

In conclusion and based on our findings, task-shifting strategies are applicable and feasible in many LMICs, who are burdened with infectious and chronic diseases, compounded with limited material and healthcare personnel resources. With proper training and continuous feedback, lower level health professionals can be instrumental in managing CVDs efficiently. Future studies should address their implementation as part of existing healthcare systems as well as their cost-effectiveness in LMICs.

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Conflicting Interests

None

Authors' Contributions

GO conceived of the review, participated in the design and article selections and helped to draft the manuscript. JG conducted supplementary literature review, participated in the article selections, and drafted the manuscript. AS conducted the primary literature review and helped to draft the manuscript. DMR participated in the article selection process and helped to draft the manuscript. JPR, CA, JI, and RC all contributed to the article selection process and edited the manuscript for critical content. All authors have read and approved the final manuscript.

Data Sharing Statement

No additional data available

Legend

Figure 1: Referral Pathway for CVD Management using Task Shifting

Figure 2: Flow diagram showing citations retrieved from literature searches and number of trials included in the analysis

Table 1. Characteristics of Studies Included in the Systematic Review

Table 2. Characteristics of Studies Included in the Systematic Review (Cont'd)

Table 3. Excluded RCT studies not meeting final review criteria

Appendix 1: Search strategy

REFERENCES

1. Anyangwe SC, Mtonga C. Inequities in the global health workforce: the greatest impediment to health in sub-Saharan Africa. *Int J Environ Res Public Health* 2007; **4**(2): 93-100.
2. WHO. Global Status Report on Noncommunicable Diseases 2010. http://www.who.int/nmh/publications/ncd_report_full_en.pdf (accessed April 15 2013).
3. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005; **365**(9455): 217-23.
4. Mensah GA. Epidemiology of stroke and high blood pressure in Africa. *Heart* 2008; **94**(6): 697-705.
5. BeLue R, Okoror TA, Iwelunmor J, et al. An overview of cardiovascular risk factor burden in sub-Saharan African countries: a socio-cultural perspective. *Globalization and health* 2009; **5**: 10.
6. Beaglehole R, Epping-Jordan J, Patel V, et al. Improving the prevention and management of chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet* 2008; **372**(9642): 940-9.
7. Dussault G, Dubois CA. Human resources for health policies: a critical component in health policies. *Hum Resour Health* 2003; **1**(1): 1.
8. Hagopian A, Thompson MJ, Fordyce M, Johnson KE, Hart LG. The migration of physicians from sub-Saharan Africa to the United States of America: measures of the African brain drain. *Hum Resour Health* 2004; **2**(1): 17.
9. Pang T, Lansang MA, Haines A. Brain drain and health professionals. *Bmj* 2002; **324**(7336): 499-500.
10. Mayosi B. The 10 'Best Buys' to combat heart disease, diabetes and stroke in Africa. http://heart.bmj.com/content/early/2013/05/16/heartjnl-2013-304130.full.pdf+htm (accessed 27 February 2013).
11. WMA Resolution on Task Shifting from the Medical Profession. http://www.wma.net/en/30publications/10policies/t4/ (accessed March 18 2013).
12. Lekoubou A, Awah P, Fezeu L, Sobngwi E, Kengne AP. Hypertension, diabetes mellitus and task shifting in their management in sub-Saharan Africa. *Int J Environ Res Public Health* 2010; **7**(2): 353-63.
13. Zachariah R, Ford N, Philips M, et al. Task shifting in HIV/AIDS: opportunities, challenges and proposed actions for sub-Saharan Africa. *Trans R Soc Trop Med Hyg* 2009; **103**(6): 549-58.
14. Callaghan M, Ford N, Schneider H. A systematic review of task- shifting for HIV treatment and care in Africa. *Hum Resour Health* 2010; **8**: 8.
15. Labhardt ND, Balo JR, Ndam M, Manga E, Stoll B. Improved retention rates with low-cost interventions in hypertension and diabetes management in a rural African environment of nurse-led care: a cluster-randomised trial. *Tropical medicine & international health : TM & IH* 2011; **16**(10): 1276-84.
16. Kim HS, Oh JA. Adherence to diabetes control recommendations: impact of nurse telephone calls. *J Adv Nurs* 2003; **44**(3): 256-61.

17. Joshi R, Chow C, Raju P, et al. The Rural Andhra Pradesh Cardiovascular Prevention Study (RAPCAPS): A Cluster Randomized Trial. *JACC* 2012; **59**(13): 1188-96.
18. Cho JH, Kwon HS, Kim HS, Oh JA, Yoon KH. Effects on diabetes management of a health-care provider mediated, remote coaching system via a PDA-type glucometer and the Internet. *J Telemed Telecare* 2011; **17**(7): 365-70.
19. Higgins JPT GS, editors. Cochrane Handbook for Systematic Reviews of Interventions 4.2.6 [updated September 2006]. Chichester, UK: John Wiley & Sons, Ltd.; 2006.
20. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine* 2009; **6**(7): e1000097.
21. Nesari M, Zakerimoghadam M, Rajab A, Bassampour S, Faghihzadeh S. Effect of telephone follow-up on adherence to a diabetes therapeutic regimen. *Jpn J Nurs Sci* 2010; **7**(2): 121-8.
22. Review Manager (RevMan). Version 5.0. Copenhagen: The Nordic Cochrane Centre: The Cochrane Collaboration; 2008.
23. Higgins J. Green S. Cochrane handbook for systematic reviews of interventions Version 5.1. 0 [updated March 2011]. The Cochrane Collaboration, 2011. *www cochrane-handbook org* 2012.
24. Clark CE, Smith LF, Taylor RS, Campbell JL. Nurse led interventions to improve control of blood pressure in people with hypertension: systematic review and meta-analysis. *Bmj* 2010; **341**.
25. De Simoni A, Hardeman W, Mant J, Farmer A, Kinmonth A. Trials to improve blood pressure through adherence to antihypertensives in stroke/TIA: systematic review and meta-analysis. *Journal of the American Heart Association* 2013; **2**(4): e000251-e.
26. Adeyemo A, Tayo BO, Luke A, Ogedegbe O, Durazo-Arvizu R, Cooper RS. The Nigerian antihypertensive adherence trial: a community-based randomized trial. *Journal of hypertension* 2013; **31**(1): 201-7.
27. Andryukhin A, Frolova E, Vaes B, Degryse J. The impact of a nurse-led care programme on events and physical and psychosocial parameters in patients with heart failure with preserved ejection fraction: a randomized clinical trial in primary care in Russia. *Eur J Gen Pract* 2010; **16**(4): 205-14.
28. DePue JD, Dunsiger S, Seiden AD, et al. Nurse-community health worker team improves diabetes care in American Samoa: results of a randomized controlled trial. *Diabetes Care* 2013; **36**(7): 1947-53.
29. Hacihasanoglu R, Gozum S. The effect of patient education and home monitoring on medication compliance, hypertension management, healthy lifestyle behaviours and BMI in a primary health care setting. *J Clin Nurs* 2011; **20**(5-6): 692-705.
30. Jafar TH, Hatcher J, Poulter N, et al. Community-based interventions to promote blood pressure control in a developing country: a cluster randomized trial. *Annals of internal medicine* 2009; **151**(9): 593-601.
31. Jafar TH, Islam M, Hatcher J, et al. Community based lifestyle intervention for blood pressure reduction in children and young adults in developing country: cluster randomised controlled trial. *Bmj* 2010; **340**: c2641.

32. Jiang X, Sit JW, Wong TK. A nurse-led cardiac rehabilitation programme improves health behaviours and cardiac physiological risk parameters: evidence from Chengdu, China. *J Clin Nurs* 2007; **16**(10): 1886-97.
33. Mendis S, Johnston SC, Fan W, Oladapo O, Cameron A, Faramawi MF. Cardiovascular risk management and its impact on hypertension control in primary care in low-resource settings: a cluster-randomized trial. *Bull World Health Organ* 2010; **88**(6): 412-9.
34. Selvaraj FJ, Mohamed M, Omar K, et al. The impact of a disease management program (COACH) on the attainment of better cardiovascular risk control in dyslipidaemic patients at primary care centres (The DISSEMINATE Study): a randomised controlled trial. *BMC Fam Pract* 2012; **13**: 97.
35. Sit JW, Yip VY, Ko SK, Gun AP, Lee JS. A quasi-experimental study on a community-based stroke prevention programme for clients with minor stroke. *J Clin Nurs* 2007; **16**(2): 272-81.
36. Wong FK, Chow SK, Chan TM. Evaluation of a nurse-led disease management programme for chronic kidney disease: a randomized controlled trial. *Int J Nurs Stud* 2010; **47**(3): 268-78.
37. Wong FK, Mok MP, Chan T, Tsang MW. Nurse follow-up of patients with diabetes: randomized controlled trial. *J Adv Nurs* 2005; **50**(4): 391-402.
38. Zhao Y, Wong FK. Effects of a postdischarge transitional care programme for patients with coronary heart disease in China: a randomised controlled trial. *J Clin Nurs* 2009; **18**(17): 2444-55.
39. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials* 1996; **17**(1): 1-12.
40. Dumas JE, Lynch AM, Laughlin JE, Phillips Smith E, Prinz RJ. Promoting intervention fidelity: Conceptual issues, methods, and preliminary results from the EARLY ALLIANCE prevention trial. *American journal of preventive medicine* 2001; **20**(1): 38-47.
41. WHO. WHO CVD risk management package for low-and med-resource settings. 2002. http://whqlibdoc.who.int/publications/2002/9241545852.pdf?ua=1 (accessed April 15 2013).
42. WHO. Task shifting to tackle health worker shortages. http://www.who.int/healthsystems/task_shifting_booklet.pdf (accessed October 20 2013).
43. Global Alliance for Chronic Diseases (GACD) http://www.gacd.org/projects/current-projects (accessed December 14 2013).

Table 1. Characteristics of Studies Included in the Systematic Review

Study (Year)	Duration of Interventions	Sample size	Completed Follow-up % Intervention	Completed Follow-up % Control	Primary Outcome Measures	Statistical Improvement in CVD
Adeyemo et al. (2013) [26]	6 months	544	88	72	Medication adherence BP Control	Yes
Mendis et al. (2010) [33]	12 months	2397	93.5	86.4	Systolic BP change from Baseline to 12 months	Yes
Nesari et al. (2010) [21]	3 months	61	100	96.8	Adherence to diabetes regimen Reduction in HbA_{1c} levels	Yes

Table 2. Characteristics of Studies Included in the Systematic Review (Cont'd)

Study (Year)	Cardiovascular Disease	Country	Task Shifting Professional	Intervention Components	Intervention Setting
Adeyemo et al. (2013)[26]	Hypertension	Nigeria	Nurses	***Intervention 1*:** Clinic-based care management- a community based, nurse-led treatment program with physician backup; facilitation of clinic visits and health education; and the use of diuretics and a beta-blocker as needed. ***Intervention 2*:** Clinic-based care management plus home visits by nurses	Two clinics and/or Patient Home
Mendis et al. (2010)[33]	Hypertension	Nigeria and China	Non-physician healthcare workers	***Control*:** Usual care by physicians ***Intervention*:** Received WHO cardiovascular risk management package, patient education, initiation of hydrochlorothiazide	Forty primary health-care facilities
Nesari et al. (2010))[21]	Type II Diabetes	Iran	Nurses	***Control*:** Usual care ***Both Groups***: Patient education on diet, exercise, foot-care, medication-taking, hypoglycemia management; blood glucose self-monitoring,; medication adjustment ***Intervention*:** In addition to above, patients received telephone follow-up by nurses 1-2 times per week	Community-based setting and health center

Table 3. Excluded RCT studies not meeting final review criteria

Study (Year)	Country	Reason for Exclusion
Andryukhin et al.(2010)[27]	Russia	Educational program for patients with heart failure
DePue et al.(2013)[28]	American Samoa	Diabetes management support program
Hacihasanoglu et al.(2011)[29]	Turkey	Hypertension health education
Jafar et al.(2009)[30]	Pakistan	Home-based hypertension health education
Jafar et al.(2010)[31]	Pakistan	Home-based hypertension health education
Jiang et al.(2007)[32]	China	Cardiac Rehabilitation Program
Selvaraj et al. (2012)[34]	Malaysia	Telephone intervention for dyslipidemia patients
Sit et al.(2007) [35]	China	Educational intervention for self-care management of stroke
Wong et al.(2010)[36]	China	Health education for patients with end stage renal disease
Wong et al.(2005)[37]	China	Telephone intervention for diabetic patients
Zhao et al.(2010)[38]	China	Telephone follow-up for patients with coronary heart disease

Task Shifting Interventions for Cardiovascular Risk Reduction in Low-and Middle-Income Countries: A Systematic Review of Randomized Controlled Trials

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ABSTRACT

~~Objective :~~Objective: To evaluate evidence from published randomized controlled trials (RCTs), for the use of task-shifting strategies for cardiovascular disease (CVD) risk reduction in low- and middle-income countries (LMICs).

Design: Systematic review of RCTs that utilized task-shifting strategy in management of CVD in LMICs.

Data Sources: We searched the following databases for relevant RCTs: PubMed from 1940s, Embase from 1974, Global Health from 1910, Ovid Health Star from 1966, Web of Knowledge from 1900, Scopus from 1823, CINAHL from 1937, and RCTs from ClinicalTrials.gov.

Eligibility criteria for selecting studies: We focused on RCTs published in English but without publication year. We included RCTs in which the intervention used task-shifting (non-physician healthcare workers involved in either prescribing of medications, treatment and/or medical testing), use of non-physician healthcare providers in management of CV risk factors and diseases (hypertension, diabetes, hyperlipidemia, stroke, coronary artery disease, or heart failure), and RCTs that were conducted in LMICs. We excluded studies that are not RCTs.

Results: Of the 2771 articles identified, only three met predefined criteria. All three trials were conducted in practice-based settings among patients with hypertension (2 studies) and diabetes (1 study), with one study also incorporating home visits. The duration of the studies ranged from three months to 12 months; and the task-shifting strategies included provision of medication prescriptions by nurses, community health workers, and pharmacists; and telephone follow up post-hospital discharge. Both hypertension studies reported mean significant blood pressure reduction (2/1 mm Hg and 30/15 mm Hg); and the diabetes trial reported reduction in HbA1c levels of 1.87%.

Conclusions: There is a dearth of evidence on the implementation of task-shifting strategies to reduce the burden of CVD in LMICs. Effective task-shifting interventions targeted at reducing global CVD epidemic in LMICs are urgently needed.

Strengths and limitations of this study

- This systematic review evaluates the effectiveness of existing task-shifting strategies in management of cardiovascular (CV) risk factors in low-and middle-income countries (LMICs).
- Analysis of three randomized controlled trials (the only studies meeting our eligibility criteria), where non-physician healthcare workers were involved in either prescribing of medications, treatment and/or medical testing, showed significant improvement in blood pressure and glucose levels.
- The studies indicate some evidence of the effectiveness of task-shifting strategies for hypertension and diabetes management using nurses in LMICs.
- Our findings highlight the lack of data on widespread implementation and effectiveness of task-shifting strategies for CVD other than the one large trial conducted by Mendis and colleagues at the WHO which showed that task shifting is effective at primary care healthcare facilities in Nigeria and China.
- The small number of studies and heterogeneity in terms of the various CVD makes it not feasible to conduct a meta-analysis.

Key Words: Task-shifting, Cardiovascular disease, Hypertension, Diabetes, Low-and middle-income countries, Systematic review, Randomized Controlled Trials

INTRODUCTION

The prevalence of cardiovascular diseases (CVD) and diabetes, and their attendant complications is high in low- and middle-income countries (LMICs).[1] According to the World Health Organization (WHO), 80% of the mortality attributable to non-communicable diseases (NCDs) occurs in LMICs; and cardiovascular diseases (CVD) account for the greatest burden.[2] For example, the mortality attributable to CVD in Africa, South-East Asia, and Eastern Mediterranean regions is projected to increase from 20 to 35% by the year 2020.[2] It is estimated that more than 30 million adults in Africa have hypertension, and 75% of all deaths in Africa may be attributable to hypertension by the year 2020.[3] Stroke deaths attributable to hypertension in sub-Saharan Africa (SSA) account for a total disability of 2.6 million Disability Adjusted Life Years.[4] Even more troubling is the fact that the growing NCD burden [in most LMICs] occurs in the context of high levels of infectious diseases such as malaria, HIV/AIDS and tuberculosis, thus indicating a rapid epidemiologic transition.[5] This makes the urgency of addressing the epidemic of CVDs in LMICs imminent.

Although barriers to management of CVD exist at multiple levels of care, systems-level barriers [particularly acute shortage of healthcare providers] limit the capacity of LMICs to manage CVD at the primary care level.[1, 6-9] For example, although SSA has 11% of the world's population and bears over 24% of the global disease burden, it harbors only 3% of the global health workforce.[1] There are 2.4 million doctors and nurses in SSA, which translate to 2 doctors and 11 nursing / midwifery personnel per 10,000 people compared to 19 doctors and 49 nursing/midwifery personnel per 10,000 in North America.[10] Given such limited resources, cost-effective approaches are urgently needed to mitigate systems-level barriers to management of CVD in LMICs. One such approach is a task-shifting strategy, defined as the rational distribution of primary care duties from physicians to non-physician healthcare providers.[11] In fact the idea of task shifting is not entirely new. Task shifting was to be the hallmark of the WHO-led primary health care movement of the 1980s. It was behind the declaration of what became known as health for all by the year 2000. For this purpose, and in order to maximize the efficient use of health workforce resources, primary care tasks are shifted from higher-trained health workers such as physicians to less highly trained health workers. According to the WHO and later echoed by the World Medical Association, task shifting is particularly useful in low-resource settings facing healthcare human resource crisis,[12] and is therefore proposed as a viable method for primary and secondary prevention at the primary care level.[13] The benefits of task shifting are well documented in management of HIV/AIDS.[14] It utilizes multiple strategies to address the CVD

epidemic including screening, counseling on lifestyle modification, initiation of treatment, and referral to specialist care. [2, 11-13, 15-18]

Despite the global call for task shifting for management of non-communicable diseases, and the potential for task-shifting strategies to mitigate the systems-level barriers to implementation of primary and secondary prevention of CVD in LMICs, their effectiveness has not been widely evaluated. In this systematic review, we evaluated the evidence from published randomized controlled trials (RCTs), for the use of task-shifting strategies for CVD risk reduction in LMICs.

METHODS

Search Strategy

We identified published trials that met predefined inclusion criteria using standard Cochrane Collaboration systematic review techniques,[19] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[20] statement. We searched the following databases: PubMed from 1940s, Embase from 1974, Global Health from 1910, Ovid Health Star from 1966, Web of Knowledge from 1900, Scopus from 1823, CINAHL from 1937, and RCTs from ClinicalTrials.gov. The search strategy included terms from three subject categories: those related to cardiovascular disease; those related to the concept of task-shifting; and those related to low- and middle-income countries, as defined by the World Bank [using a variety of factors including gross domestic product (GDP), population, economic policy and external debt, health, environment, and education].[21] All concepts were then combined using both keywords and controlled vocabularies such as, "*task shift*" AND "balance of care OR nonphysician clinician OR substitute health worker OR community care giver OR primary health care team OR cadres OR nurs*" AND "CVD"*. The search terms used were similar to the ones used by Callaghan et al in their systematic review of task-shifting in HIV treatment.[14] Searches were undertaken in October 2011 and repeated in March 2013 before the final write up.

We adopted the following definition of task-shifting by Callaghan et al,:[14] "the process of shifting tasks to a variety of health workers; including nurses or new cadres in prescribing of medications and medical testing, as long as it is a streamlined, rationalized chain of care." As depicted in Figure 1, the process of task shifting should involve ongoing training from higher-level health professionals, delegation, and continuous supervision. Also, patients with complicated disease cases should always be referred for specialist care.

Eligibility Criteria for Inclusion of Studies

We limited our search to only RCTs published in English but without publication year. We included RCTs in which the intervention used task-shifting (non-physician healthcare workers involved in either prescribing of medications, treatment and/or medical testing), use of non-physician healthcare providers in management of CV risk factors and diseases (hypertension, diabetes, hyperlipidemia, stroke, coronary artery disease, or heart failure), and RCTs that were conducted in LMICs. We excluded studies that are not RCTs. We then reviewed the identified RCTs in their entirety to determine their eligibility.

Data Extraction

Each of the authors assessed all retrieved lists of citations and abstracts independently. Initially, we determined the relevance of the articles by title and abstract. Discrepancies between the authors about eligibility of retrieved studies were resolved by discussion. We then obtained printed copies of all relevant articles for extensive examination to ensure that the articles met all eligibility criteria. Information from potentially eligible articles including study country, study design, methods, participant characteristics, retention rates, and study outcomes were extracted into the Cochrane Review Manager.[22]

Quality Assessment

The quality of available RCTs was assessed using the Cochrane criteria[23] adapted from previous suggestions.[24, 25] Specifically, the risk of bias in generation of the randomization sequence, allocation concealment, and blinding (participants and outcome assessors), incomplete outcome data and selective reporting were assessed as adequate, uncertain, or inadequate.[24, 25] Two authors (JG and JI) assessed the risk of bias in the individual studies that met the inclusion criteria. Disagreements were resolved by consensus, and a third reviewer was consulted if disagreements persisted.

RESULTS

Full search strategies for each of the databases are provided in Appendix 1 (online supplementary). We retrieved and screened 2771 articles (Figure 2), and conducted full paper review on 32 articles that initially met the inclusion criteria including study location in LMICs, the use of non-physician providers to provide health services, CVD, and use of task-shifting strategies. After further review, we excluded 18 articles including: studies that were not conducted in LMICs (5); studies that were missing important details about intervention strategies (4); protocol papers that were missing main trial outcomes (4); studies that referred to the same study protocol conducted in the same populations (3); studies whose primary outcome did not include major cardiovascular risk factors or CVD (1); and studies that only provided abstracts (1). A total of 14 articles met the initial eligibility criteria.[21, 26-38] The 14 articles were further screened based on whether or not the intervention fulfilled the definition of task shifting used for this review [use of non-physician clinicians in prescribing medications or performing medical testing in the treatment or management of CVD]. This final review led to further elimination of 11 additional articles,[27-32, 34-38] leaving only three RCTs, which were included in this systematic review.[21, 26, 33] The characteristics of the studies included in this systematic review are presented in Tables 1 and 2. One trial was conducted in Nigeria,[26] another is a multi-center trial conducted in Nigeria and China,[33] and the last one was conducted in Iran.[21] The study populations were patients with hypertension (two studies),[26, 33] and type 2 diabetes (one study).[21] (Table 2). The sample size of the interventions varied, with a range of 61 - 2397 patients (Table 1): the sample size for the diabetes trial was 61;[21] while those of the two hypertension trials were 544, [26] and 2397.[33] The duration of these studies ranged 3 months for the diabetes trial and 6 to 12 months for the hypertension trials. The reporting quality of all three trials were rated 73% using the Jadad quality measure.[39]

Overall risk of bias was moderate; random sequence generation was adequate in 67% (2/3) of the studies, and allocation concealment in 67% (2/3), however blinding of data collection (participants) was not possible in any of the study due to the nature of the intervention, as well as with blinding of the outcomes except for one study.[21] All the studies described the methods used to collect outcomes, although we could not assess blinding of the researchers collecting the outcome data. Overall, incomplete data was reported in all of the studies; however selective reporting was poor with very minimal information in all the studies on whether the interventions were implemented with

fidelity *"that is whether each of the components of the intervention were delivered in a comparable manner to all participants and is true to the objectives of the underlying research."* [40]

Hypertension Trials

Both studies evaluated the effect of task shifting on hypertension control using various forms of task- shifting strategies including interventions led by nurses, pharmacists, and community health workers (Table 2). The studies were conducted in Nigeria, and China.[26, 33] In addition to nurses or pharmacists prescribing antihypertensive medications, the interventions included health education emphasizing lifestyle modifications such as diet, physical activity, and medication adherence. The interventions were effective at improving blood pressure (BP) control in both studies.[26, 33]

The first hypertension trial, by Adeyemo and colleagues, examined the effectiveness of the use of nurses to deliver hypertension management in a primary care practice versus usual care plus home visits on medication adherence, and BP control at 6 months among 544 patients (mean age~63 years, mean BP~168/92 mmHg) in Nigeria.[26] The intervention included the following components: 1) a nurse-led treatment program with physician backup, 2) clinic visits and health education by nurses, 3) the use of diuretics and a ß blocker prescribed by nurses with physician backup. The primary outcome of BP control (BP<140/90mm Hg) was achieved in 66% of the study participants (66.7% in clinic only group, 65.4% in clinic plus home visit; p=0.584 and p=0.891).[26] The overall decline in mean systolic and diastolic BP over the six-month period was 30 mmHg and 15 mmHg respectively (p<0.001and p<0.0001).[26] Overall, medication adherence was high among study participants with 77% of participants taking >98 of their prescribed pills.

The second hypertension trial was the largest in this review. In this cluster RCT, Mendis and colleagues evaluated the effectiveness of the WHO Cardiovascular Disease (CVD) package using task-shifting strategies to improve BP control among 2397 hypertensive patients from forty primary care facilities (20 intervention sites, 20 control sites) in Nigeria and China.[33] Non-physician healthcare workers provided patients at the intervention sites with the WHO CVD package protocol while those at the control sites received usual care for a period of 12 months. The WHO CVD package was designed as an adaptable, cost-effective tool for systematic case management at all healthcare levels, and consequently for scaling up in health systems in LMICs. The program provides clinical

decision support for the assessment and management of CV risk through easy-to-follow risk-assessment algorithms, lifestyle counseling, drug treatment protocols, and referral pathways.[41] The protocol consists of four basic steps: inquiry about patient's history (heart attack, angina, stroke, transient ischemic attack, diabetes and lifestyle behaviors); physical and laboratory examination (including BP measurements, anthropometrics, urine dip stick, fasting glucose, and plasma cholesterol); estimation of patient's CVD risk based on the WHO risk charts (low, medium or high); and subsequent initiation of drug therapy and lifestyle counseling during follow-up visits.[33] Depending on the patient's CVD risk, the treatment decisions include either 1) immediate referral to a specialist in the case of patents with high CVD risk; or 2) lifestyle counseling on diet, physical activity and tobacco cessation; prescription of an antihypertensive medication; and follow-up with a provider. The primary outcome was change in systolic BP from baseline to 12 months. Systolic and diastolic BP decreased significantly in favor of the intervention group at both study sites (P<0.0001) and ((P<0.0002), but BP control rate was abysmally low at only 20%. The intervention resulted in significantly greater reduction in systolic and diastolic BP for the treatment group (2 mmHg and 1 mmHg) than the control group in both countries.[33]

Diabetes Trial

The diabetes trial evaluated whether nurse-led care could improve diabetes management compared to usual care.[21] This trial was conducted by Nesari and colleagues in Iran among 61 patients with diabetes, who received either telephone-based nurse follow-up care for 3 months or usual care.[21] Both groups received health education on diet, physical activity, foot-care, blood glucose self-monitoring, management of medication side effects and hypoglycemia. Additionally, in the intervention group, the nurse adjusted the patients' medications according to the patients' reported glycemic level, with back up from an endocrinologist. The reported decline in HbA1c was higher in the intervention group compared to the usual care group (1.87% in the intervention group, p<0.001; and 0.42% in the usual care group, p<0.15).[21] Similarly, the mean levels of HbA1c was significantly lower in the intervention group than in the usual care group at 3 months (mean HbA1c of 7.04% ± 1.18 in the intervention group versus 8.64% ± 1.88 for the control group; P< 0.001).[21]

DISCUSSION

In this review, we examined the evidence for task shifting of primary care duties for management of CVD in low- and middle-income countries. We reviewed three clinical trials that utilized task-shifting strategies for management of CVD in LMICs.[21, 26, 33] Two of the three trials were hypertension studies,[26, 33] and one diabetes trial.[21] The outcomes of the three trials were positive with significant improvement in BP and HbA1c.[21, 26, 33] The studies show some evidence of the effectiveness of task-shifting strategies for management of hypertension and diabetes using nurses.

Some of the common task shifting enablers among the studies are as follows: continuous educational training and feedback from higher level health professionals; bridging hospital care to home care in order to ensure continuity of patient care; and providing explicit training tools including medication/ treatment algorithms. Nonetheless, barriers to task-shifting in LMICs that currently do not utilize task-shifting strategies include the lack of policy on ability of non-physician providers to prescribe medications for common disorders; the lack of referral system as backup for complicated cases; the lack of organizational structure to accommodate non-physician provider as a primary care provider; and the lack of competence of the non-physician provider in their ability to manage uncomplicated cardiovascular risk factors; and finally the lack of infrastructure for data collection and monitoring of clinical information on a periodic basis.

The concept of tasking shifting is not new because task shifting strategies have proven effective in the battle against the HIV/AIDs epidemic in LMICs;[14] and thus may be potentially effective for chronic disease management, provided adequate and sustainable training is afforded to the health professionals involved. Considering the barriers and challenges that task shifting may pose if non-physician healthcare workers are not equipped with the expertise to efficiently manage HIV/AIDS, the WHO launched the treat, train, retrain plan in 2006,[42] to ensure competency and aid in capacity building of these providers. As a result, many LMICs have adopted task-shifting strategies for HIV/AIDS management in LMICs. In this regard, Callaghan et al. conducted a systematic review of 84 articles on HIV treatment and care in SSA and their findings suggest that task-shifting strategies led to improved efficiency in delivery of healthcare services, enhanced access to care, better team dynamics, and improved quality of care and health outcomes for patients with HIV/AIDS.[14]

Task shifting is a potentially viable and low-cost strategy for reducing the growing CVD epidemic in LMICs because it utilizes multiple strategies that are amenable to management of CVDs including screening, counseling on lifestyle modification, initiation of treatment, and referral to specialist care.[11-14, 41] We are not aware of any rigorous evaluation of task-shifting strategies for management of CVDs in LMICs. To our knowledge, our study was the first systematic review to evaluate effectiveness of existing task-shifting strategies in management of CV risk factors in LMICs. Our findings highlight the lack of data on widespread implementation and effectiveness of task-shifting strategies for CVD other than the one large trial conducted by Mendis and colleagues at the WHO which showed that task shifting is effective at primary care healthcare facilities in Nigeria and China.[33] The other studies reviewed had numerous weaknesses. First, the quality of the trials was low given their very small sample sizes, poor definition of study outcomes, and short duration of the trials [only 3 months for the diabetes trial[21] and 6 months for one of the hypertension trials[26]], making it difficult to ascertain the effect of regression to mean on the study outcomes. Second, the authors provided very scanty description of the non-physician healthcare providers who delivered the task shifting duties: only two of the studies identified that nurses provided the task shifting duties.[21, 26] Unfortunately, the largest trial with the best quality did not provide any information on the level of training of the task shifting healthcare provider.[33] Third, there was no data on the cost-effectiveness of these studies and finally, none of the trials integrated their intervention into existing healthcare systems making evaluation of the implementation and dissemination of the study findings problematic.

A possible limitation of our review is that we excluded 11 RCT studies which did not meet our criteria. These studies are shown in Table 3 and the majority of the reasons for exclusion are because they were studies that were largely patient education/health education interventions carried out by non-physicians. These duties readily fit in the nurses and other non-physician duties and hence were not considered task-shifting. Other reasons include the lack of randomization (2,739 studies) and although they measured outcomes of CVD, the lack of randomization makes them low quality. These studies were nevertheless effective as pre-post design that policy makers may find useful.

Future studies should focus on the cost-effectiveness of task-shifting interventions for CVD risk reduction as part of the larger healthcare system. In addition, these studies should compare the cost effectiveness of the use of nurses versus other allied healthcare workers. In order for task shifting strategies to be considered effective, evidence of its implementation for addressing the CVD epidemic as part of existing healthcare systems in LMICs

are paramount. Thus, in 2001, the Global Alliance for Chronic Diseases (GACD) funded 15 implementation trials targeting hypertension control. Five of these studies are evaluating the role of task-shifting strategies to reduce overall CV risk and improve hypertension control in Ghana, India, Kenya, Tanzania, and South Africa.[43] Such studies integrated into existing healthcare systems will guarantee subsequent adoption of interventions if proven successful.

In conclusion and based on our findings, task-shifting strategies are applicable and feasible in many LMICs, who are burdened with infectious and chronic diseases, compounded with limited material and healthcare personnel resources. With proper training and continuous feedback, lower level health professionals can be instrumental in managing CVDs efficiently. Future studies should address their implementation as part of existing healthcare systems as well as their cost-effectiveness in LMICs.

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Conflicting Interests

None

Authors' Contributions

GO conceived of the review, participated in the design and article selections and helped to draft the manuscript. JG conducted supplementary literature review, participated in the article selections, and drafted the manuscript. AS conducted the primary literature review and helped to draft the manuscript. DMR participated in the article selection process and helped to draft the manuscript. JPR, CA, JI, and RC all contributed to the article selection process and edited the manuscript for critical content. All authors have read and approved the final manuscript.

Data Sharing Statement

No additional data available

Legend

Figure 1: Referral Pathway for CVD Management using Task Shifting

Figure 2: Flow diagram showing citations retrieved from literature searches and number of trials included in the analysis

Table 1. Characteristics of Studies Included in the Systematic Review

Table 2. Characteristics of Studies Included in the Systematic Review (Cont'd)

Table 3. Excluded RCT studies not meeting final review criteria

Appendix 1: Search strategy

REFERENCES

1. Anyangwe SC, Mtonga C. Inequities in the global health workforce: the greatest impediment to health in sub-Saharan Africa. *Int J Environ Res Public Health* 2007; **4**(2): 93-100.
2. WHO. Global Status Report on Noncommunicable Diseases 2010. http://www.who.int/nmh/publications/ncd_report_full_en.pdf (accessed April 15 2013).
3. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005; **365**(9455): 217-23.
4. Mensah GA. Epidemiology of stroke and high blood pressure in Africa. *Heart* 2008; **94**(6): 697-705.
5. BeLue R, Okoror TA, Iwelunmor J, et al. An overview of cardiovascular risk factor burden in sub-Saharan African countries: a socio-cultural perspective. *Globalization and health* 2009; **5**: 10.
6. Beaglehole R, Epping-Jordan J, Patel V, et al. Improving the prevention and management of chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet* 2008; **372**(9642): 940-9.
7. Dussault G, Dubois CA. Human resources for health policies: a critical component in health policies. *Hum Resour Health* 2003; **1**(1): 1.
8. Hagopian A, Thompson MJ, Fordyce M, Johnson KE, Hart LG. The migration of physicians from sub-Saharan Africa to the United States of America: measures of the African brain drain. *Hum Resour Health* 2004; **2**(1): 17.
9. Pang T, Lansang MA, Haines A. Brain drain and health professionals. *Bmj* 2002; **324**(7336): 499-500.
10. Mayosi B. The 10 'Best Buys' to combat heart disease, diabetes and stroke in Africa. http://heart.bmj.com/content/early/2013/05/16/heartjnl-2013-304130.full.pdf+htm (accessed 27 February 2013).
11. WMA Resolution on Task Shifting from the Medical Profession. http://www.wma.net/en/30publications/10policies/t4/ (accessed March 18 2013).
12. Lekoubou A, Awah P, Fezeu L, Sobngwi E, Kengne AP. Hypertension, diabetes mellitus and task shifting in their management in sub-Saharan Africa. *Int J Environ Res Public Health* 2010; **7**(2): 353-63.
13. Zachariah R, Ford N, Philips M, et al. Task shifting in HIV/AIDS: opportunities, challenges and proposed actions for sub-Saharan Africa. *Trans R Soc Trop Med Hyg* 2009; **103**(6): 549-58.
14. Callaghan M, Ford N, Schneider H. A systematic review of task- shifting for HIV treatment and care in Africa. *Hum Resour Health* 2010; **8**: 8.
15. Labhardt ND, Balo JR, Ndam M, Manga E, Stoll B. Improved retention rates with low-cost interventions in hypertension and diabetes management in a rural African environment of nurse-led care: a cluster-randomised trial. *Tropical medicine & international health : TM & IH* 2011; **16**(10): 1276-84.
16. Kim HS, Oh JA. Adherence to diabetes control recommendations: impact of nurse telephone calls. *J Adv Nurs* 2003; **44**(3): 256-61.

17. Joshi R, Chow C, Raju P, et al. The Rural Andhra Pradesh Cardiovascular Prevention Study (RAPCAPS): A Cluster Randomized Trial. *JACC* 2012; **59**(13): 1188-96.
18. Cho JH, Kwon HS, Kim HS, Oh JA, Yoon KH. Effects on diabetes management of a health-care provider mediated, remote coaching system via a PDA-type glucometer and the Internet. *J Telemed Telecare* 2011; **17**(7): 365-70.
19. Higgins JPT GS, editors. Cochrane Handbook for Systematic Reviews of Interventions 4.2.6 [updated September 2006]. Chichester, UK: John Wiley & Sons, Ltd.; 2006.
20. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine* 2009; **6**(7): e1000097.
21. Nesari M, Zakerimoghadam M, Rajab A, Bassampour S, Faghihzadeh S. Effect of telephone follow-up on adherence to a diabetes therapeutic regimen. *Jpn J Nurs Sci* 2010; **7**(2): 121-8.
22. Review Manager (RevMan). Version 5.0. Copenhagen: The Nordic Cochrane Centre: The Cochrane Collaboration; 2008.
23. Higgins J. Green S. Cochrane handbook for systematic reviews of interventions Version 5.1. 0 [updated March 2011]. The Cochrane Collaboration, 2011. *www cochrane-handbook org* 2012.
24. Clark CE, Smith LF, Taylor RS, Campbell JL. Nurse led interventions to improve control of blood pressure in people with hypertension: systematic review and meta-analysis. *Bmj* 2010; **341**.
25. De Simoni A, Hardeman W, Mant J, Farmer A, Kinmonth A. Trials to improve blood pressure through adherence to antihypertensives in stroke/TIA: systematic review and meta-analysis. *Journal of the American Heart Association* 2013; **2**(4): e000251-e.
26. Adeyemo A, Tayo BO, Luke A, Ogedegbe O, Durazo-Arvizu R, Cooper RS. The Nigerian antihypertensive adherence trial: a community-based randomized trial. *Journal of hypertension* 2013; **31**(1): 201-7.
27. Andryukhin A, Frolova E, Vaes B, Degryse J. The impact of a nurse-led care programme on events and physical and psychosocial parameters in patients with heart failure with preserved ejection fraction: a randomized clinical trial in primary care in Russia. *Eur J Gen Pract* 2010; **16**(4): 205-14.
28. DePue JD, Dunsiger S, Seiden AD, et al. Nurse-community health worker team improves diabetes care in American Samoa: results of a randomized controlled trial. *Diabetes Care* 2013; **36**(7): 1947-53.
29. Hacihasanoglu R, Gozum S. The effect of patient education and home monitoring on medication compliance, hypertension management, healthy lifestyle behaviours and BMI in a primary health care setting. *J Clin Nurs* 2011; **20**(5-6): 692-705.
30. Jafar TH, Hatcher J, Poulter N, et al. Community-based interventions to promote blood pressure control in a developing country: a cluster randomized trial. *Annals of internal medicine* 2009; **151**(9): 593-601.
31. Jafar TH, Islam M, Hatcher J, et al. Community based lifestyle intervention for blood pressure reduction in children and young adults in developing country: cluster randomised controlled trial. *Bmj* 2010; **340**: c2641.

32. Jiang X, Sit JW, Wong TK. A nurse-led cardiac rehabilitation programme improves health behaviours and cardiac physiological risk parameters: evidence from Chengdu, China. *J Clin Nurs* 2007; **16**(10): 1886-97.
33. Mendis S, Johnston SC, Fan W, Oladapo O, Cameron A, Faramawi MF. Cardiovascular risk management and its impact on hypertension control in primary care in low-resource settings: a cluster-randomized trial. *Bull World Health Organ* 2010; **88**(6): 412-9.
34. Selvaraj FJ, Mohamed M, Omar K, et al. The impact of a disease management program (COACH) on the attainment of better cardiovascular risk control in dyslipidaemic patients at primary care centres (The DISSEMINATE Study): a randomised controlled trial. *BMC Fam Pract* 2012; **13**: 97.
35. Sit JW, Yip VY, Ko SK, Gun AP, Lee JS. A quasi-experimental study on a community-based stroke prevention programme for clients with minor stroke. *J Clin Nurs* 2007; **16**(2): 272-81.
36. Wong FK, Chow SK, Chan TM. Evaluation of a nurse-led disease management programme for chronic kidney disease: a randomized controlled trial. *Int J Nurs Stud* 2010; **47**(3): 268-78.
37. Wong FK, Mok MP, Chan T, Tsang MW. Nurse follow-up of patients with diabetes: randomized controlled trial. *J Adv Nurs* 2005; **50**(4): 391-402.
38. Zhao Y, Wong FK. Effects of a postdischarge transitional care programme for patients with coronary heart disease in China: a randomised controlled trial. *J Clin Nurs* 2009; **18**(17): 2444-55.
39. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials* 1996; **17**(1): 1-12.
40. Dumas JE, Lynch AM, Laughlin JE, Phillips Smith E, Prinz RJ. Promoting intervention fidelity: Conceptual issues, methods, and preliminary results from the EARLY ALLIANCE prevention trial. *American journal of preventive medicine* 2001; **20**(1): 38-47.
41. WHO. WHO CVD risk management package for low-and med-resource settings. 2002. http://whqlibdoc.who.int/publications/2002/9241545852.pdf?ua=1 (accessed April 15 2013).
42. WHO. Task shifting to tackle health worker shortages. http://www.who.int/healthsystems/task_shifting_booklet.pdf (accessed October 20 2013).
43. Global Alliance for Chronic Diseases (GACD) http://www.gacd.org/projects/current-projects (accessed December 14 2013).

Table 1. Characteristics of Studies Included in the Systematic Review

Study (Year)	Duration of Interventions	Sample size	Completed Follow-up % Intervention	Completed Follow-up % Control	Primary Outcome Measures	Statistical Improvement in CVD
Adeyemo et al. (2013) [26]	6 months	544	88	72	Medication adherence BP Control	Yes
Mendis et al. (2010) [33]	12 months	2397	93.5	86.4	Systolic BP change from Baseline to 12 months	Yes
Nesari et al. (2010) [21]	3 months	61	100	96.8	Adherence to diabetes regimen Reduction in HbA_{1c} levels	Yes

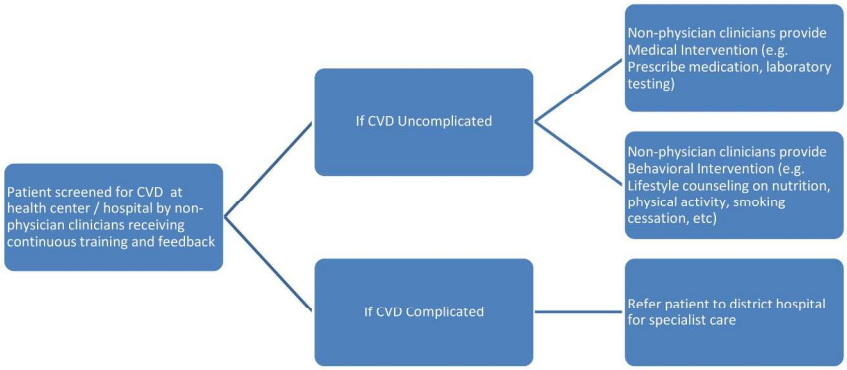
Table 2. Characteristics of Studies Included in the Systematic Review (Cont'd)

Study (Year)	Cardiovascular Disease	Country	Task Shifting Professional	Intervention Components	Intervention Setting
Adeyemo et al. (2013)[26]	Hypertension	Nigeria	Nurses	***Intervention 1*:** Clinic-based care management- a community based, nurse-led treatment program with physician backup; facilitation of clinic visits and health education; and the use of diuretics and a beta-blocker as needed. ***Intervention 2*:** Clinic-based care management plus home visits by nurses	Two clinics and/or Patient Home
Mendis et al. (2010)[33]	Hypertension	Nigeria and China	Non-physician healthcare workers	***Control*:** Usual care by physicians ***Intervention*:** Received WHO cardiovascular risk management package, patient education, initiation of hydrochlorothiazide	Forty primary health-care facilities
Nesari et al. (2010))[21]	Type II Diabetes	Iran	Nurses	***Control*:** Usual care ***Both Groups***: Patient education on diet, exercise, foot-care, medication-taking, hypoglycemia management; blood glucose self-monitoring,; medication adjustment ***Intervention*:** In addition to above, patients received telephone follow-up by nurses 1-2 times per week	Community-based setting and health center

Table 3. Excluded RCT studies not meeting final review criteria

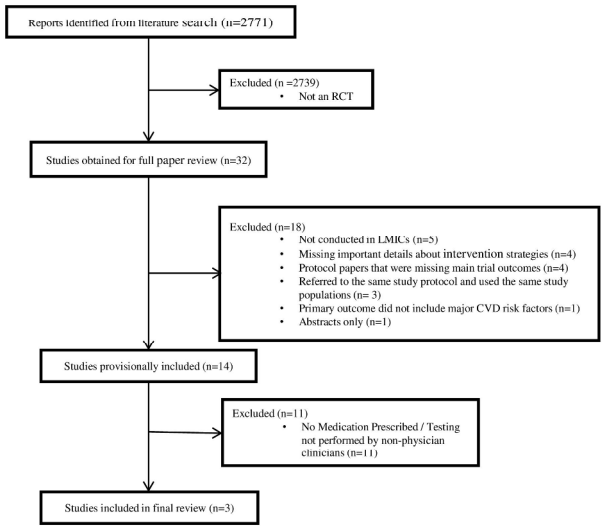
Study (Year)	Country	Reason for Exclusion
Andryukhin et al.(2010) [27]	Russia	Educational program for patients with heart failure
DePue et al. (2013)[28]	American Samoa	Diabetes management support program
Hacihasanoglu et al. (2011)[29]	Turkey	Hypertension health education
Jafar et al.(2009)[30]	Pakistan	Home-based hypertension health education
Jafar et al.(2010)[31]	Pakistan	Home-based hypertension health education
Jiang et al.(2007)[32]	China	Cardiac Rehabilitation Program
Selvaraj et al. (2012)[34]	Malaysia	Telephone intervention for dyslipidemia patients
Sit et al.(2007)[35]	China	Educational intervention for self-care management of stroke
Wong et al.(2010)-[36]	China	Health education for patients with end stage renal disease
Wong et al.(2005) [37]	China	Telephone intervention for diabetic patients
Zhao et al.(2010)[38]	China	Telephone follow-up for patients with coronary heart disease

Figure 1: Referral Pathway for CVD Management using Task Shifting



254x190mm (300 x 300 DPI)

Figure 2: Flow diagram showing citations retrieved from literature searches and number of trials included in the analysis



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APPENDIX 1: SEARCH STRATEGY

For all searches, the three sets of terms were combined as follows:
CVD search AND task-shifting search AND low- and middle-income countries search

PubMed search

CVD: "Hyperlipidemias"[MeSH] OR "hyperlipidemias"[All Fields] OR "hyperlipidemia"[All Fields] OR "hyperlipidaemia"[All Fields] OR "hyperlipidaemias"[All Fields] OR "hyperlipemia"[All Fields] OR "hyperlipemias"[All Fields] OR "hyperlipaemia"[All Fields] OR "hyperlipaemias"[All Fields] OR "lipidemia"[All Fields] OR "lipidaemia"[All Fields] OR "high cholesterol"[All Fields] OR "hypercholesterolemia"[All Fields] OR "hypercholesterolemias"[All Fields] OR "hypercholesteremia"[All Fields] OR "hypercholesteremias"[All Fields] OR "hypercholesterolaemia"[All Fields] OR "hypercholesterolaemias"[All Fields] OR "hypercholesteraemia"[All Fields] OR "Diabetes"[All Fields] OR "diabetic"[All fields] OR "Diabetes Mellitus"[Mesh] OR "proteinuria"[Mesh] OR "proteinuria"[All Fields] OR "Albuminuria"[All Fields] OR "Hemoglobinuria"[All Fields] OR "Kidney Failure, Chronic"[Mesh] OR "chronic kidney disease"[All Fields] OR "chronic renal disease"[All Fields] OR "chronic renal insufficiency"[All Fields] OR "CKD"[All Fields] OR "end-stage renal disease"[All Fields] OR "chronic kidney failure"[All Fields] OR "chronic renal failure"[All Fields] OR "chronic kidney diseases"[All Fields] OR "chronic renal diseases"[All Fields] OR "chronic renal insufficiencies"[All Fields] OR "end-stage renal diseases"[All Fields] OR "chronic kidney failures"[All Fields] OR "chronic renal failures"[All Fields] OR "stroke"[Mesh] OR "stroke"[All Fields] OR "strokes"[All Fields] OR "brain vascular accident"[All Fields] OR "brain vascular accidents"[All Fields] OR "apoplexy"[All Fields] OR "cerebrovascular accident"[All Fields] OR "cerebrovascular accidents"[All Fields] OR "cardiomyopathies"[Mesh] OR "cardiomyopathy"[All Fields] OR "cardiomyopathies"[All Fields] OR "myocardial disease"[All Fields] OR "myocardial diseases"[All Fields] OR "myocardiopathy"[All Fields] OR "myocardiopathies"[All Fields] OR "heart neoplasms"[Mesh] OR "heart neoplasm"[All Fields] OR "heart neoplasms"[All Fields] OR "cardiac tumor"[All Fields] OR "cardiac tumors"[All Fields] OR "myocardial tumor"[All Fields] OR "myocardial tumors"[All Fields] OR "cardiac carcinoma"[All Fields] OR "cardiac carcinomas"[All Fields] OR "heart cancer"[All Fields] OR "cardiac cancers"[All Fields] OR "cardiac cancer"[All Fields] OR "heart tumor"[All Fields] OR "heart tumors"[All Fields] OR "myocardial ischemia"[Mesh] OR "myocardial ischemia"[All Fields] OR "myocardial ischemias"[All Fields] OR "ischemic heart disease"[All Fields] OR "ischemic heart diseases"[All Fields] OR "myocardial ischaemia"[All Fields] OR "myocardial ischaemias"[All Fields] OR "ischaemic heart disease"[All Fields] OR "ischaemic heart diseases"[All Fields] OR "acute coronary syndrome"[All Fields] OR "acute coronary syndromes"[All Fields] OR "coronary disease"[All Fields] OR "coronary diseases"[All Fields] OR "coronary artery disease"[All Fields] OR "coronary artery diseases"[All Fields] OR "coronary arteriosclerosis"[All Fields] OR "Coronary atherosclerosis"[All Fields] OR "coronary stenosis"[All Fields] OR "coronary stenoses"[All Fields] OR "coronary restenosis"[All Fields] OR "coronary restenoses"[All Fields] OR "coronary heart disease"[All Fields] OR "coronary heart diseases"[All Fields] OR "coronary thrombosis"[All Fields] OR "coronary thromboses" OR "coronary occlusion"[All Fields] OR "coronary occlusions"[All Fields] OR "myocardial infarction"[All Fields] OR "myocardial infarctions"[All Fields] OR "heart attack"[All Fields] OR "heart attacks"[All Fields] OR "myocardial infarct"[All Fields] OR "myocardial infarcts"[All Fields] OR "heart arrest"[Mesh] OR "heart arrest"[All Fields] OR "heart arrests"[All Fields] OR "cardiac arrest"[All Fields] OR "cardiac arrests"[All Fields] OR "asystole"[All Fields] OR "asystoles"[All Fields] OR "cardiopulmonary arrest"[All Fields] OR "cardiopulmonary arrests"[All Fields] OR
"heart failure"[Mesh] OR "heart failure"[All Fields] OR "heart failures"[All Fields] OR "cardiac failure"[All Fields] OR "cardiac failures"[All Fields] OR "myocardial failure"[All Fields] OR "myocardial failures"[All Fields] OR "heart decompensation"[All Fields] OR "hypertension"[Mesh] OR "hypertension"[All Fields] OR "hypertensions"[All Fields] OR "high blood pressure"[All Fields] OR "high blood pressures"[All Fields] OR "cardiovascular diseases"[Mesh] OR "cardiovascular disease"[All Fields] OR "cardiovascular diseases"[All Fields] OR "cardiovascular risk"[All Fields] OR "cardiovascular risks"[All Fields]

Task-Shifting: ((“Task”[All Fields] OR "tasks"[all fields]) AND ("shift"[All fields] OR "shifted"[all fields] OR "shifts"[all fields] OR "shifting"[all fields])) OR (shortage*[All Fields] AND ("physicians"[MeSH] OR “health personnel”[Mesh] OR "physicians"[All Fields] OR "doctors"[All Fields] OR "trained personnel"[All Fields] OR "health workforce"[All Fields] OR “health care workforce"[All Fields] OR “healthcare workforce"[All Fields] OR "health workers"[All Fields] OR "health care workers"[All Fields] OR “healthcare workers"[All Fields] OR "health care providers"[All Fields] OR “health providers"[All Fields] OR “healthcare providers"[All Fields])) OR ("nurse led"[All Fields] OR "primary health care nurse"[All Fields] OR "primary health care nurses"[All Fields] OR "primary health care nursing"[All Fields]) OR "nonphysician clinicians"[All Fields] OR "non-physician clinicians"[All Fields] OR “non physician health care workers"[All Fields] OR “nonphysician health care workers"[All Fields] OR “non physician healthcare workers"[All Fields] OR “nonphysician healthcare workers"[All Fields] OR “nonphysician health workers"[All Fields] OR “non physician health workers"[All Fields] OR ("role"[All Fields] AND ("nurse"[All Fields] OR "nurses"[all fields] OR "nursing"[all fields])) OR “community health aides”[mesh] OR “community health centers”[mesh] OR “lay health workers"[All Fields] OR “lay health care workers"[All Fields] OR “lay healthcare workers"[All Fields] OR “community health workers"[All Fields] OR “community health care workers"[All Fields] OR “community healthcare workers"[All Fields] OR “community health center”[All Fields] OR “community Health centers”[all fields] OR “community health centre”[All fields] OR “community health centres”[All Fields] OR “extended scope practitioner”[all fields] OR “extended scope practitioners”[all fields] OR “extended scope practice”[all fields] OR “enhanced role”[all fields] OR “role enhancement”[all fields] OR ((“substitution”[All Fields] OR “substituted”[All Fields] OR “substitute”[All Fields] OR “substituting”[All Fields] OR “substitutes”[All Fields] OR “delegate”[All Fields] OR “delegating”[All Fields] OR “delegates”[All Fields] OR “delegation”[All Fields] OR “delegated”[All Fields]) AND (“physicians”[mesh] OR “physician”[All Fields] OR “physicians”[All Fields] OR “doctor”[All Fields] OR “doctors”[All Fields]))

Low-and Middle-income countries: "developing countries"[all fields] OR "developing country"[all fields] OR "developing countries"[mesh] OR “medically underserved area”[mesh] OR “medically underserved area”[all fields] OR “medically underserved areas”[all fields] OR “low income countries”[all fields] OR “low income country”[all fields] OR “middle income countries”[all fields] OR “middle income country”[all fields] OR “global”[all fields] OR “resource poor”[all fields] OR “low resource”[all fields] OR “Africa”[Mesh] OR “Asia, Central”[Mesh] OR “Asia, Western”[Mesh] OR “Asia, Southeastern”[Mesh] OR “Indian Ocean Islands”[Mesh] OR “Central America”[Mesh] OR “South America”[Mesh] OR “Europe, Eastern”[Mesh] OR “Transcaucasia”[Mesh] OR “China”[Mesh] OR “Korea”[Mesh] OR “Mongolia”[Mesh] OR “Mexico”[Mesh] OR “Caribbean Region”[Mesh] OR “Pacific Islands”[Mesh] OR “Africa”[all fields] OR “Central Asia”[all fields] OR “western Asia”[all fields] OR “southeastern Asia”[all fields] OR “Indian Ocean Islands”[all fields] OR “Central America”[all fields] OR “South America”[all fields] OR “eastern Europe”[all fields] OR “Transcaucasia”[all fields] OR “Caribbean”[all fields] OR “Pacific Islands”[all fields] OR “Afghan”[all fields] OR “afghani”[all fields] OR “afghanistan”[all fields] OR “Bangladesh”[all fields] OR “bangladeshi”[all fields] OR “Benin”[all fields] OR “Beninese”[all fields] OR “Burkina Faso”[all fields] OR “Burkinabe”[all fields] OR “Burundi”[all fields] OR “burundian”[all fields] OR “Cambodia”[all fields] OR “cambodian”[all fields] OR “Central African Republic”[all fields] OR “central African”[all fields] OR “Chad”[all fields] OR “chadian”[all fields] OR “Comoros”[all fields] OR “comoran”[all fields] OR “Congo”[all fields] OR “congolese”[all fields] OR “Eritrea”[all fields] OR “eritrean”[all fields] OR “Ethiopia”[all fields] OR “ethiopian”[all fields] OR “Gambia”[all fields] OR “gambian”[all fields] OR “Guinea”[all fields] OR “guinean”[all fields] OR “Haiti”[all fields] OR “haitian”[all fields] OR “Kenya”[all fields] OR “Kenyan” OR “Korea”[all fields] OR “korean”[all fields] OR “Kyrgyz”[all fields] OR "kyrgyzstan"[all fields] OR “Liberia”[all fields] OR “liberian”[all fields] OR “Madagascar”[all fields] OR “malagasy”[all fields] OR “Malawi”[all fields] OR “malawian”[all fields] OR “mali”[all fields] OR “malian”[all fields] OR “mozambique”[all fields] OR “mozambican”[all fields] OR “Myanmar”[all fields] OR “myanmarese”[all fields] OR “burmese”[all fields] OR “Nepal”[all fields] OR “Nepalese”[all fields] OR “Niger”[all fields] OR “nigerian”[all fields] OR “Rwanda”[all fields] OR “rwandan”[all fields] OR “Sierra Leone”[all fields] OR “sierra leonean”[all fields] OR “Somalia”[all fields] OR “somalian”[all fields] OR “Tajikistan”[all fields] OR “tajik”[all fields] OR “tadzhik”[all fields] OR” Tanzania”[all fields] OR “tanzanian”[all fields] OR

"Togo"[all fields] OR "togolese"[all fields] OR "Uganda"[all fields] OR "ugandan"[all fields] OR "Zimbabwe"[all fields] OR "zimbabwean"[all fields] OR "Angola"[all fields] OR "angolan"[all fields] OR "Armenia"[all fields] OR "armenian"[all fields] OR "Belize"[all fields] OR "belizean"[all fields] OR "Bhutan"[all fields] OR "bhutanese"[all fields] OR "Bolivia"[all fields] OR "bolivian"[all fields] OR "Cameroon"[all fields] OR "cameroonian"[all fields] OR "Cape Verde"[all fields] OR "cape verdian"[all fields] OR "cape verdean"[all fields] OR "Côte d'Ivoire" [all fields] OR "ivory coast"[all fields] "ivorian"[all fields] OR "Djibouti"[all fields] OR "Egypt"[all fields] OR "egyptian"[all fields] OR "El Salvador"[all fields] OR "salvadoran"[all fields] OR "Fiji"[all fields] OR "fijian"[all fields] OR "Georgia"[all fields] OR "georgian"[all fields] OR "Ghana"[all fields] OR "ghanaian"[all fields] OR "Guatemala"[all fields] OR "Guatemalan"[all fields] OR "Guyana"[all fields] OR "guyanese"[all 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Web of Knowledge search:

CVD: (hyperlip*emia* OR lipid*emia* OR "high cholesterol" OR hypercholester*emia*) OR (diabetes OR diabetic) OR (proteinuria$ OR albuminuria$ OR hemoglobinuria$) OR ("chronic kidney disease*" OR "chronic renal disease*" Or "chronic renal insufficienc*" OR CKD OR "end-stage renal disease*" OR "chronic kidney failure*" OR "chronic renal failure*") OR (stroke$ OR "brain vascular accident*" OR apoplexy OR "cerebrovascular accident*") OR (cardiomyopath* OR "myocardial disease*" OR myocardiopath*) OR ("heart neoplasm" OR "cardiac tumor*" OR "myocardial tumor*" OR "cardiac carcinoma*" OR "heart cancer*" OR "cardiac cancer*" OR "heart tumor*") OR ("myocardial isch*emia*" OR "isch*emic heart disease*" OR "acute coronary syndrome*" OR "coronary disease*" OR "coronary artery disease*" OR "coronary arterioscleros*" or "coronary atheroscleros*" OR "coronary stenos*" OR "coronary restenos*" OR "coronary heart disease*" OR "coronary thrombos*" OR "coronary occlusion*" OR "myocardial infarct*" OR "heart attack*" OR "heart arrest*" OR "cardiac arrest*" OR asystole$ OR "cardiopulmonary arrest*" OR "heart failure*" OR "cardiac failure*" OR "myocardial failure*" OR "heart decompensation*") OR (hypertension$ OR "high blood pressure*") OR (cardiovascular NEAR/5 disease$ OR cardiovascular NEAR/5 risk$)

Task-Shifting: (shortage$ NEAR/5 (doctor$ OR physician$ OR "trained personnel" OR (health* NEAR/3 workforce) OR (health* NEAR/3 worker$) OR (health* NEAR/3 provider$))) OR (task$ NEAR/5 shift*) OR ("nurse led") OR ("non*physician clinician*") OR (non*physician NEAR/2 health* NEAR/2 workers) OR ("primary health care nurs*") OR (role NEAR/5 nurs*) OR (lay NEAR/2 health* NEAR/2 worker$) OR (community NEAR/2 health* NEAR/2 aide*) OR (community NEAR/2 health* NEAR/2 worker$) OR ((substitut* OR delegat*) NEAR/10 (physician$ OR doctor$ OR nurse$)) OR (community NEAR/2 health* NEAR/2 cent*) OR ("extended scope practi*") OR (role$ NEAR/3 enhance*)

Low-and Middle-income countries: "developing countr*" OR "medically underserved area*" OR "low income countr*" OR "middle income countr*" OR Africa* OR Caribbean OR “central America*” OR “south America*” OR “central asia*” OR “southeastern asia*” OR “western asia*” OR “Indian ocean islands” OR “eastern Europe*” OR global OR “low resource” OR “resource poor” OR Transcaucasia$ OR “pacific islands” OR Afghan* OR Bangladesh* OR Benin* OR “burkina Faso*” or burkinabe OR Burundi* OR Cambodia* OR “Central African” OR Chad* OR Comor* OR Congo* OR Eritrea* OR Ethiopia* OR Gambia* OR Guinea* OR Haiti* OR Kenya* OR Korea* OR Kyrgyz* OR Liberia* OR Madagascar OR Malagasy OR Malawi* OR mali OR mozambi* OR Myanmar* OR Nepal* OR Niger* OR Rwanda* OR Sierra Leon* OR Somalia* OR Tajik* OR Tanzania* OR Togo* OR Uganda* OR Zimbabw* OR Angola* OR Armenia* OR Belize* OR Bhutan* OR Bolivia* OR Cameroon* OR Cape Verd* OR Congo* OR “Côte d'Ivoire” OR "ivory coast" OR ivorian OR Djibouti OR Egypt* OR “El Salvador” OR salvadoran OR Fiji* OR Georgia* OR Ghana* OR Guatemala* OR Guyan* OR Hondura* OR Indonesia* OR India* OR Iraq* OR Kiribati OR Kosov* OR Lao* OR Lesotho OR “Marshall Islands” OR marshallese OR Mauritania* OR Micronesia* OR Moldova* OR Mongolia* OR Morocc* OR Nicaragua* OR Nigeria* OR Pakistan* OR “Papua New Guinea*” OR Paraguay* OR Philippines OR Filipino OR Samoa* OR “Sao Tome*” OR Senegal* OR “Solomon Island*” OR Sri Lanka* OR Sudan* OR Swazi* OR Syria* OR Timor* OR Tonga* OR Turkmen* OR Tuvalu* OR Ukrain* OR Uzbek* OR Vanuat* OR Vietnam* OR “West Bank” OR Gaza OR Yemen* OR Zambia* OR Albania* OR Algeria* OR “Antigua and Barbuda” OR antiguan OR barbudan OR Argentin* OR Azerbaijan* OR Belarus* OR Bosnia* OR Botswana OR Brazil* OR Bulgaria* OR Chile* OR China OR Chinese OR Colombia* OR Costa Rica* OR Cuba* OR Dominic* OR Ecuador* OR Gabon* OR Grenad* OR Iran* OR Jamaica* OR Jordan* OR Kazakhstan* OR Latvia* OR Leban* OR Libya* OR Lithuania* OR Macedonia* OR Malaysia* OR Maldiv* OR mauriti* OR Mayott* OR Mexic* OR Montenegr* OR Namibia* OR Palau* OR Panama* OR Peru* OR Romania* OR Russia* OR Serbia* OR Seychell* OR “South Africa*” OR “Saint Kitts” OR “Saint Lucia” OR “Saint Vincent” OR Surinam* OR Thai* OR Tunisia* OR Turk* OR Uruguay* OR Venezuala*

Scopus search:

CVD: hyperlip*emia* OR lipid*emia* OR ("high cholesterol") OR hypercholester*emia* OR diabetes OR diabetic OR proteinuria* OR albuminuria* OR hemoglobinuria* OR ("chronic kidney disease*") OR ("chronic renal disease*") Or ("chronic renal insufficienc*") OR CKD OR ("end-stage renal disease*") OR ("chronic kidney failure*") OR ("chronic renal failure*") OR stroke* OR ("brain vascular accident*") OR apoplexy OR ("cerebrovascular accident*") OR cardiomyopath* OR ("myocardial disease*") OR myocardiopath* OR ("heart neoplasm") OR ("cardiac tumor*") OR ("myocardial tumor*") OR ("cardiac carcinoma*") OR ("heart cancer*") OR ("cardiac cancer*") OR ("heart tumor*") OR ("myocardial isch*emia*") OR ("isch*emic heart disease*") OR ("acute coronary syndrome*") OR ("coronary disease*") OR ("coronary artery disease*") OR ("coronary arterioscleros*") or ("coronary atheroscleros*") OR ("coronary stenos*") OR ("coronary restenos*") OR ("coronary heart disease*") OR ("coronary thrombos*") OR ("coronary occlusion*") OR ("myocardial infarct*") OR ("heart attack*") OR ("heart arrest*") OR ("cardiac arrest*") OR asystole* OR ("cardiopulmonary arrest*") OR ("heart failure*") OR ("cardiac failure*") OR ("myocardial failure*") OR ("heart decompensation*") OR hypertension* OR ("high blood pressure*") OR (cardiovascular W/5 disease*) OR (cardiovascular W/5 risk*)

Task-Shifting: (shortage* W/5 doctor*) OR (shortage* W/5 physician*) OR (shortage* W/5 "trained personnel") OR (shortage* W/5 health* W/5 work*) OR (shortage* W/5 health* W/5 provider*) OR (task* W/5 shift*) OR ("nurse led") OR ("non*physician clinician*") OR (non*physician W/2 health* W/2 workers) OR ("primary health care nurs*") OR (role W/5 nurs*) OR (lay W/2 health* W/2 worker*) OR (community W/2 health* W/2 aide*) OR (community W/2 health* W/2 worker*) OR (community W/2 health* W/2 cent*) OR ("extended scope practi*") OR (role W/3 enhance*) OR (substitut* W/10 physician*) OR (substitut* W/10 doctor*) or (substitut* W/10 nurs*) OR (delegat* W/10 physician*) OR (delegat* W/10 doctor*) OR (delegat* W/10 nurs*)

Low-and Middle-income countries: ("developing countr*") or ("medically underserved area*") or ("low income countr*") or ("middle income countr*") or Africa* or Caribbean or ("central america*") or ("south america*") or ("central asia*") or ("southeastern asia*") or ("western asia*") or ("indian ocean islands") or ("pacific islands") or ("eastern europe") or global or ("low resource") or ("resource poor") OR Afghan* or Bangladesh* OR Benin* or (“burkina Faso*”) or burkinabe OR Burundi* OR Cambodia* OR (“Central African”) OR Chad* OR Comor* OR Congo* OR Eritrea* OR Ethiopia* OR Gambia* OR Guinea* OR Haiti* OR Kenya* OR Korea* OR Kyrgyz* OR Liberia* OR Madagascar OR Malagasy OR Malawi* OR mali OR mozambi* OR Myanmar* OR Nepal* OR Niger* OR Rwanda* OR ("Sierra Leon*") OR Somalia* OR Tajik* OR Tanzania* OR Togo* OR Uganda* OR Zimbabw* OR Angola* OR Armenia* OR Belize* OR Bhutan* OR Bolivia* OR Cameroon* OR ("Cape Verd*") OR Congo* OR (“Côte d'Ivoire”) OR ("ivory coast") OR ivorian OR Djibouti OR Egypt* OR (“El Salvador”) OR salvadoran OR Fiji* OR Georgia* OR Ghana* OR Guatemala* OR Guyan* OR Hondura* OR Indonesia* OR India* OR Iraq* OR Kiribati OR Kosov* OR Lao* OR Lesotho OR (“Marshall Islands”) OR marshallese OR Mauritania* OR Micronesia* OR Moldova* OR Mongolia* OR Morocc* OR Nicaragua* OR Nigeria* OR Pakistan* OR (“Papua New Guinea*”) OR Paraguay* OR Philippines OR Filipino OR Samoa* OR (“Sao Tome*”) OR Senegal* OR (“Solomon Island*”) OR ("Sri Lanka*") OR Sudan* OR Swazi* OR Syria* OR Timor* OR Tonga* OR Turkmen* OR Tuvalu* OR Ukrain* OR Uzbek* OR Vanuat* OR Vietnam* OR (“West Bank”) OR Gaza OR Yemen* OR Zambia* OR Albania* OR Algeria* OR (“Antigua and Barbuda”) OR antiguan OR barbudan OR Argentin* OR Azerbaijan* OR Belarus* OR Bosnia* OR Botswana OR Brazil* OR Bulgaria* OR Chile* OR China OR Chinese OR Colombia* OR ("Costa Rica*") OR Cuba* OR Dominic* OR Ecuador* OR Gabon* OR Grenad* OR Iran* OR Jamaica* OR Jordan* OR Kazakhstan* OR Latvia* OR Leban* OR Libya* OR Lithuania* OR Macedonia* OR Malaysia* OR Maldiv* OR mauriti* OR Mayott* OR Mexic* OR Montenegr* OR Namibia* OR Palau* OR Panama* OR Peru* OR Romania* OR Russia* OR Serbia* OR Seychell* OR (“South Africa*”) OR (“Saint Kitts”) OR (“Saint Lucia”) OR (“Saint Vincent”) OR Surinam* OR Thai* OR Tunisia* OR Turk* OR Uruguay* OR Venezuala*

CINAHL Search
Results limited to Academic Journals and Dissertations

CVD: (MH “cardiovascular diseases+”) OR (TX cardiovascular N5 disease#) OR (MH “cardiovascular risk factors+”) OR (TX cardiovascular N5 risk#) OR (MH “Hyperlipidemia+”) OR (TX hyperlipid#emia#) OR (TX hyperlip#emia#) OR (TX lipid#emia#) OR (TX "high cholesterol") OR (TX hypercholesterol#emia#) OR (TX hypercholester#emia#) OR (TX diabetes) OR (TX diabetic) OR (MH “Diabetes Mellitus+”) OR (MH “proteinuria+”) OR (TX proteinuria#) OR (TX albuminuria#) OR (TX hemoglobinuria#) OR (MH "Kidney Failure, Chronic") OR (TX “chronic kidney disease#”) OR (TX “chronic renal disease#”) OR (TX “chronic renal insufficienc*”) OR (TX "CKD") OR (TX “end-stage renal disease#”) OR (TX “chronic kidney failure#”) OR (TX “chronic renal failure#”) OR (TX stroke#) OR (TX "brain vascular accident#") OR (TX apoplexy*) OR (TX "cerebrovascular accident#") OR (TX cardiomyopath*) OR (TX “myocardial disease#”) OR (TX myocardiopath*) OR (TX "heart neoplasm#") OR (TX "cardiac tumor#") OR (TX "myocardial tumor#") OR (TX "cardiac carcinoma#") OR (TX "heart cancer#") OR (TX "cardiac cancer#") OR (TX "heart tumor#") OR (TX "myocardial isch#emia#") OR (TX "isch#emic heart disease#") OR (TX “acute coronary syndrome#”) OR (TX “coronary disease#”) OR (TX “coronary artery disease#”) OR (TX “coronary arterioscleros*”) OR (TX “coronary atheroscleros*”) OR (TX “coronary stenos*”) OR (TX “coronary restenos*”) OR (TX “coronary heart disease*”) OR (TX “coronary thrombos*”) OR (TX “coronary occlusion#”) OR (TX “myocardial infarct*”) OR (TX “heart attack#") OR (TX "heart arrest#") OR (TX "cardiac arrest#") OR (TX asystole#) OR (TX "cardiopulmonary arrest#") OR (TX "heart failure#") OR (TX "cardiac failure#") OR (TX "myocardial failure#") OR (TX "heart decompensation#") OR (TX hypertension#) OR (TX "high blood pressure#")

Task-Shifting: (MH “Personnel Shortage+”) OR (TX shortage# N5 doctor#) OR (TX shortage# N5 physician#) OR (TX shortage# N5 “trained personnel”) OR (TXshortage# N5 “health* * workforce”) OR (TX shortage# N5 “health* * worker#”) OR (TX shortage# N5 “health* * provider#”) OR (TX task# N5 shift*) OR (TX "nurse led") OR (TX "non*physician clinicians") OR (TX “non*physician health* * worker#”) OR (TX "primary health* * nurs*") OR (TX role N5 nurs*) OR (MH “community health workers+”) OR (MH “community health centers+”) OR (TX "lay health* * worker#") OR (TX community N2 “health* * aide#”) OR (TX community N2 “health* * worker#”) OR (TX community N2 “health* * cent*") OR (TX "extended scope practi*") OR (TX role N3 enhance*) OR (TX substitut* N10 physician#) OR (TX substitut* N10 doctor#) OR (TX substitute* N10 nurse#) OR (TX delegat* N10 physician#) OR (TX delegat * N10 doctor#) OR (TX delegat * N10 nurse#)

Low-and Middle-income countries: (MH “developing countries+”) OR (MH “medically underserved area+”) OR (TX "developing countr*") OR (TX "medically underserved area#") OR (TX "low income countr *") OR (TX "middle income countr*") OR (MH “Africa+”) OR (TX Africa#) OR (TX Caribbean) OR (MH “west indies+”) OR (TX “central America#”) OR (MH “Central America+”) OR (TX “south America#”) OR (MH “south America+”) OR (TX global) OR (TX “low resource”) OR (TX “resource poor”) OR (TX “central asia#”) OR (MH “asia, central+”) OR (TX “southeastern asia#”) OR (MH "asia, southeastern+”) OR (TX “western asia#”) OR (MH “asia, western+”) OR (TX “Indian ocean islands”) OR (MH “Indian ocean islands+”) OR (TX “eastern Europe*”) OR (MH “europe, eastern”) OR (TX Transcaucasia#) OR (TX “pacific islands”)OR (MH “pacific islands+”) OR (TX Afghan*) OR (TX Bangladesh#) OR (TX Benin*) OR (TX “Burkina Faso”) OR (TX burkinabe) OR (TX Burundi*) OR (TX Cambodia#) OR (TX “Central African”) OR (TX Chad*) OR (TX Comor*) OR (TX Congo*) OR (TX Eritrea#) OR (TX Ethiopia#) OR (TX Gambia#) OR (TX Guinea#) OR (TX Haiti*) OR (TX Kenya#) OR (TX Korea#) OR (TX Kyrgyz*) OR (TX Liberia#) OR (TX Madagascar) OR (TX malagasy) OR (TX Malawi*) OR (TX mali*) OR (TX mozambi*) OR (TX Myanmar*) OR (TX Nepal*) OR (TX Niger*) OR (TX Rwanda#) OR (TX “Sierra Leon*”) OR (TX Somalia#) OR (TX Tajik*) OR (TX tadzhik) OR (TX Tanzania#) OR (TX Togo*) OR (TX Uganda#) OR (TX Zimbabwe*) OR (TX Angola#) OR (TX Armenia#) OR (TX Belize*) OR (TX Bhutan*) OR (TX Bolivia#) OR (TX Cameroon*) OR (TX Cape Verd*) OR (TX Congo*) OR (TX “Côte d'Ivoire”) OR (TX "ivory coast") OR (TX ivorian) OR (TX Djibouti) OR (TX Egypt#) OR (TX “El Salvador”) OR (TX “Salvadoran”) OR (TX Fiji*) OR (TX Georgia#) OR (TX Ghana*) OR (TX Guatemala#) OR (TX Guyan*) OR (TX Hondura#) OR (TX Indonesia#) OR (TX India#) OR (TX Iraq#) OR (TX Kiribati) OR (TX Kosov*) OR (TX Lao*) OR (TX Lesotho) OR (TX (“Marshall Islands”)) OR (TX marshallese) OR (TX Mauritania#) OR (TX Micronesia#) OR (TX Moldova#) OR (TX Mongolia#) OR (TX Morocc*) OR (TX Nicaragua#) OR (TX Nigeria#) OR (TX Pakistan#) OR (TX “Papua New

Guinea*") OR (TX Paraguay*) OR (TX Philippines) OR (TX Filipino) OR (TX Samoa#) OR (TX "Sao Tome*") OR (TX Senegal*) OR (TX "Solomon Island*") OR (TX "sri lanka#") OR (TX Sudan*) OR (TX Swazi*) OR (TX Syria#) OR (TX Timor*) OR (TX Tonga#) OR (TX Turkmen*) OR (TX Tuvalu*) OR (TX Ukrain*) OR (TX Uzbek*) OR (TX Vanuat*) OR (TX Vietnam*) OR (TX ("West Bank")) OR (TX Gaza) OR (TX Yemen*) OR (TX Zambia#) OR (TX Albania#) OR (TX Algeria#) OR (TX "Antigua and Barbuda") OR (TX antiguan) OR (TX barbudan) OR (TX Argentin*) OR (TX Azerbaijani*) OR (TX Belarus*) OR (TX Bosnia#) OR (TX Botswana) OR (TX Brazil*) OR (TX Bulgaria#) OR (TX Chile*) OR (TX China) OR (TX Chinese) OR (MH "China+") OR (TX Colombia#) OR (TX "Costa Rica#") OR (TX Cuba#) OR (TX Dominica#) OR (TX Ecuador*) OR (TX Gabon*) OR (TX Grenad*) OR (TX Iran*) OR (TX Jamaica#) OR (TX Jordan*) OR (TX Kazakhstan#) OR (TX Latvia#) OR (TX Leban*) OR (TX Libya#) OR (TX Lithuania#) OR (TX Macedonia#) OR (TX Malaysia#) OR (TX Maldiv*) OR (TX mauriti*) OR (TX Mexic*) OR (TX Montenegr*) OR (TX Namibia#) OR (TX Palau*) OR (TX Panama*) OR (TX Peru*) OR (TX Romania#) OR (TX Russia#) OR (TX Serbia#) OR (TX Seychell*) OR (TX "South Africa#") OR (TX "Saint Kitts") OR (TX "Saint Lucia") OR (TX "Saint Vincent") OR (TX Suriname#) OR (TX Thai*) OR (TX Tunisia#) OR (TX Turk*) OR (TX Uruguay*) OR (TX Venezuala#)

EMBASE Search

CVD: exp hyperlipidemia/ or hyperlipid?emia$1.mp. or hyperlip?emia$1.mp. or lipid?emia$1.mp. or high cholesterol.mp. or hypercholesterol?emia$1.mp. or hypercholester?emia$1.mp. or exp Diabetes mellitus/ or diabetes.mp. OR exp diabetic angiopathy/ or diabetic.mp. or exp proteinuria/ or proteinuria$1.mp. or albuminuria$1.mp. or hemoglobinuria$1.mp. or exp chronic kidney disease/ or chronic kidney disease$1.mp. or chronic renal disease$1.mp. or chronic renal insufficienc$.mp. OR CKD.mp. OR end-stage renal disease$1.mp. or chronic kidney failure$1.mp. or chronic renal failure$1.mp. or exp stroke/ or stroke$1.mp. or brain vascular accident$1.mp. or apoplexy.mp. or cerebrovascular accident$1.mp. or exp myocardial disease/ or cardiomyopath$.mp. or myocardial disease$1.mp. or myocardiopath$.mp. or heart muscle isch?emia$1.mp. or myocardial isch?emia$1.mp. or isch?emic heart disease$1.mp. or acute coronary syndrome$1.mp. or coronary disease$1.mp. or coronary artery disease$1.mp. or coronary arterioscleros$.mp. or coronary atheroscleros$.mp. or coronary stenos$.mp. or coronary restenos$.mp. or coronary heart disease$1.mp. or coronary thrombos$.mp. or coronary occlusion$1.mp. or myocardial infarct$.mp. or heart attack$1.mp. or exp heart tumor/ or heart neoplasm$1.mp. or cardiac tumor$1.mp. or myocardial tumor$1.mp. or cardiac carcinoma$1.mp. or heart cancer$1.mp. or cardiac cancer$1.mp. or heart tumor$1.mp. or exp heart failure/ or heart arrest$1.mp. or cardiac arrest$1.mp. or asystole$1.mp. or cardiopulmonary arrest$1.mp. or heart failure$1.mp. or cardiac failure$1.mp. or myocardial failure$1.mp. or heart decompensation$1.mp. or exp hypertension/ or hypertension$1.mp. or high blood pressure$1.mp. or exp cardiovascular disease/ or exp cardiovascular risk/ or (cardiovascular ADJ5 disease$1).mp. or (cardiovascular ADJ5 risk$1).mp.

Task-Shifting: exp personnel shortage/ or (shortage$1 ADJ5 doctor$1).mp. or (shortage$1 ADJ5 physician$1).mp. or (shortage$1 ADJ5 trained ADJ5 personnel).mp. or (shortage$1 ADJ5 health ADJ5 workforce).mp. or (shortage$1 ADJ5 health ADJ5 worker$1).mp. or (shortage$1 ADJ5 health ADJ5 provider$1).mp. or (task$1 ADJ5 shift$).mp. or nurse led.mp. or non$1physician clinician$1.mp. or non$1physician health$ worker$1.mp. or primary health care nurs$.mp. or (role ADJ5 nurs$).mp. or exp community health nursing/ or exp health auxiliary/ or community health$ worker$1.mp. or community health cent$.mp. or lay health$ worker$1.mp. or community health$ aide$1.mp. or (community ADJ2 health ADJ5 worker$1).mp. or extended scope practi$.mp. or (role ADJ3 enhance$).mp. or (substitute$ ADJ10 physician$1).mp. or (substitute$ ADJ10 doctor$1).mp. or (substitute$ ADJ10 nurse$1).mp. or (delegat$ ADJ10 physician$1).mp. or (delegat$ ADJ10 doctor$1).mp. or (delegat$ ADJ10 nurse$1).mp.

Low-and Middle-income countries: exp developing country/ or exp medically underserved/ or developing countr$.mp. or medically underserved area$1.mp. or low income countr$.mp. or middle income

country.mp. or low resource.mp. or resource poor.mp. or global.mp. or exp Africa/ or exp "South and Central America"/or exp asia/ or exp Caribbean islands/ or exp pacific islands/ or exp eastern Europe/ or exp Indian Ocean/or south america$1.mp. or Africa$1.mp. or Caribbean.mp. or central America$1.mp. or south America$1.mp. or eastern Europe$1.mp. or pacific island$.mp. or Indian ocean island$.mp. or asia.mp. or Afghan$.mp. or Bangladesh$1.mp. or Benin$.mp. or Burkina Faso.mp. or Burkinabe.mp. or Burundi$.mp. or Cambodia$1.mp. or Central African.mp. or Chad$.mp. or Comor$.mp. or Congo$.mp. or Eritrea$1.mp. or Ethiopia$1.mp. or Gambia$1.mp. or Guinea$1.mp. or Haiti$.mp. or Kenya$1.mp. or Korea$1.mp. or exp North Korea/ or Kyrgyz$.mp. or Liberia$1.mp. or Madagascar.mp. or Malagasy.mp. or Malawi$.mp. or mali$.mp. or mozambi$.mp. or Myanmar$.mp. or Nepal$.mp. or Niger$.mp. or Rwanda$1.mp. or Sierra Leone$.mp. or Somalia$1.mp. or Tajik$.mp. or Tanzania$1.mp. or Togo$.mp. or Uganda$1.mp. or Zimbabwe$.mp. or Angola$1.mp. or Armenia$1.mp. or Beliz$.mp. or Bhutan$.mp. or Bolivia$1.mp. or Cameroon$.mp. or Cape Verde$.mp. or Congo$.mp. or "Côte d'Ivoire".mp. or Ivory Coast.mp. or Ivorian.mp. or Djibouti.mp. or Egypt$.mp. or El Salvador.mp. or Salvadoran.mp. or Fiji$.mp. or Georgia$1.mp. or Ghana$.mp. or Guatemala$1.mp. or Guyan$.mp. or Hondura$.mp. or Indonesia$1.mp. or India$1.mp. or Iraq$1.mp. or Kiribati.mp. or Kosov$.mp. or Lao$.mp. or Lesotho.mp. or Marshall Islands.mp. or Marshallese.mp. or Mauritania$1.mp. or Micronesia$1.mp. or Moldov$.mp. or Mongolia$1.mp. or Morocc$.mp. or Nicaragua$1.mp. or Nigeria$1.mp. or Pakistan$1.mp. or Papua New Guinea$1.mp. or Paraguay$.mp. or Philippines.mp. or Filipino.mp. or Samoa$1.mp. or sao tome$.mp. or Senegal$.mp. or Solomon Island$.mp. or sri lanka$1.mp. or Sudan$.mp. or Swazi$.mp. or Syria$1.mp. or Timor$.mp. or Tonga$1.mp. or Turkmen$.mp. or Tuvalu$.mp. or Ukrain$.mp. or Uzbek$.mp. or Vanuat$1.mp. or Vietnam$.mp. or West Bank.mp. or Gaza.mp. or Yemen$.mp. or Zambia$1.mp. or Albania$1.mp. or Algeria$1.mp. or "Antigua and Barbuda".mp. or antiguan.mp. or barbudan.mp. or Argentin$.mp. or Azerbaijan$1.mp. or Belarus$.mp. or Bosnia$1.mp. or Botswana.mp. or Brazil$.mp. or Bulgaria$1.mp. or Chile$.mp. or China.mp. or Chinese.mp. or Colombia$1.mp. or Costa Rica$1.mp. or Cuba$1.mp. or Dominica$1.mp. or Ecuador$.mp. or Gabon$.mp. or Grenad$.mp. or Iran$.mp. or Jamaica$1.mp. or Jordan$.mp. or Kazakhstan$1.mp. or Latvia$1.mp. or Leban$.mp. or Libya$1.mp. or Lithuania$1.mp. or Macedonia$1.mp. or Malaysia$1.mp. or Maldiv$.mp. or mauriti$.mp. or Mexic$.mp. or Montenegr$.mp. or Namibia$1.mp. or Palau$.mp. or Panama$.mp. or Peru$.mp. or Romania$1.mp. or Russia$1.mp. or Serbia$1.mp. or Seychell$.mp. or South Africa$1.mp. or Saint Kitts.mp. or Saint Lucia.mp. or Saint Vincent.mp. or Suriname$1.mp. or Thai$.mp. or Tunisia$1.mp. or Turk$.mp. or Uruguay$.mp. or Venezuala$1.mp.

Global Health Search

CVD: exp hyperlipaemia/ or hyperlipid?emia$1.mp. or hyperlip?emia$1.mp. or lipid?emia$1.mp. or high cholesterol.mp. or hypercholesterol?emia$1.mp. or hypercholester?emia$1.mp. or exp Diabetes mellitus/ or diabetes.mp. or diabetic.mp. or exp proteinuria/ or proteinuria$1.mp. or albuminuria$1.mp. or hemoglobinuria$1.mp. or chronic kidney disease$1.mp. or chronic renal disease$1.mp. or chronic renal insufficienc$.mp. OR CKD.mp. OR end-stage renal disease$1.mp. or chronic kidney failure$1.mp. or chronic renal failure$1.mp. or exp stroke/ or stroke$1.mp. or brain vascular accident$1.mp. or apoplexy.mp. or cerebrovascular accident$1.mp. or exp cardiomyopathy/ or cardiomyopath$.mp. or myocardial disease$1.mp. or myocardiopath$.mp. or exp myocardial ischaemia/ or heart muscle isch?emia$1.mp. or myocardial isch?emia$1.mp. or isch?emic heart disease$1.mp. or acute coronary syndrome$1.mp. or coronary disease$1.mp. or coronary artery disease$1.mp. or coronary arterioscleros$.mp. or coronary atheroscleros$.mp. or coronary stenos$.mp. or coronary restenos$.mp. or coronary heart disease$1.mp. or coronary thrombos$.mp. or coronary occlusion$1.mp. or myocardial infarct$.mp. or heart attack$1.mp. or heart neoplasm$1.mp. or cardiac tumor$1.mp. or myocardial tumor$1.mp. or cardiac carcinoma$1.mp. or heart cancer$1.mp. or cardiac cancer$1.mp. or heart tumor$1.mp. or heart arrest$1.mp. or cardiac arrest$1.mp. or asystole$1.mp. or cardiopulmonary arrest$1.mp. or heart failure$1.mp. or cardiac failure$1.mp. or myocardial failure$1.mp. or heart decompensation$1.mp. or exp hypertension/ or hypertension$1.mp. or high blood pressure$1.mp. or exp cardiovascular diseases/ or (cardiovascular ADJ5 disease$1).mp. or (cardiovascular ADJ5 risk$1).mp.

Task-Shifting: (shortage$1 ADJ5 doctor$1).mp. or (shortage$1 ADJ5 physician$1).mp. or (shortage$1 ADJ5 trained ADJ5 personnel).mp. or (shortage$1 ADJ5 health* ADJ5 workforce).mp. or (shortage$1

ADJ5 health ADJ5 worker$1).mp. or (shortage$1 ADJ5 health ADJ5 provider$1).mp. or (task$1 ADJ5 shift$).mp. or nurse led.mp. or non$1physician clinician$1.mp. or non$1physician health$ worker$1.mp. or primary health care nurs$.mp. or (role ADJ5 nurs$).mp. or exp community health services/ or exp medical auxiliaries/ or exp barefoot doctors/ or community health$ worker$1.mp. or community health cent$.mp. or lay health$ worker$1.mp. or community health$ aide$1.mp. or community health nurs$.mp. or (community ADJ2 health ADJ5 worker$1).mp. or extended scope practi$.mp. or (role ADJ3 enhance$).mp. or (substitute$ ADJ10 physician$1).mp. or (substitute$ ADJ10 doctor$1).mp. or (substitute$ ADJ10 nurse$1).mp. or (delegat$ ADJ10 physician$1).mp. or (delegat$ ADJ10 doctor$1).mp. or (delegat$ ADJ10 nurse$1).mp.

Low-and Middle-income countries: exp developing countries/ or developing countr$.mp. or medically underserved area$1.mp. or low income countr$.mp. or middle income country.mp. or low resource.mp. or resource poor.mp. or global.mp. or exp Africa/ or exp South America/ or exp Central America/or Africa$1.mp. or Caribbean.mp. or central America$1.mp. or south America$1.mp. or exp south asia/ or exp southeast asia/ or exp Caribbean/ or exp pacific islands/ or Afghan$.mp. or Bangladesh$1.mp. or Benin$.mp. or Burkina Faso.mp. or Burkinabe.mp. or Burundi$.mp. or Cambodia$1.mp. or Central African.mp. or Chad$.mp. or Comor$.mp. or Congo$.mp. or Eritrea$1.mp. or Ethiopia$1.mp. or Gambia$1.mp. or Guinea$1.mp. or Haiti$.mp. or Kenya$1.mp. or Korea$1.mp. or exp North Korea/ or Kyrgyz$.mp. or Liberia$1.mp. or Madagascar.mp. or Malagasy.mp. or Malawi$.mp. or mali$.mp. or mozambi$.mp. or Myanmar$.mp. or Nepal$.mp. or Niger$.mp. or Rwanda$1.mp. or Sierra Leone$.mp. or Somalia$1.mp. or Tajik$.mp. or Tanzania$1.mp. or Togo$.mp. or Uganda$1.mp. or Zimbabwe$.mp. or Angola$1.mp. or Armenia$1.mp. or Beliz$.mp. or Bhutan$.mp. or Bolivia$1.mp. or Cameroon$.mp. or Cape Verde$.mp. or Congo$.mp. or "Côte d'Ivoire".mp. or Ivory Coast.mp. or Ivorian.mp. or Djibouti.mp. or Egypt$.mp. or El Salvador.mp. or Salvadoran.mp. or Fiji$.mp. or Georgia$1.mp. or Ghana$.mp. or Guatemala$1.mp. or Guyan$.mp. or Hondura$.mp. or Indonesia$1.mp. or India$1.mp. or Iraq$1.mp. or Kiribati.mp. or Kosov$.mp. or Lao$.mp. or Lesotho.mp. or Marshall Islands.mp. or Marshallese.mp. or Mauritania$1.mp. or Micronesia$1.mp. or Moldov$.mp. or Mongolia$1.mp. or Morocc$.mp. or Nicaragua$1.mp. or Nigeria$1.mp. or Pakistan$1.mp. or Papua New Guinea$1.mp. or Paraguay$.mp. or Philippines.mp. or Filipino.mp. or Samoa$1.mp. or sao tome$.mp. or Senegal$.mp. or Solomon Island$.mp. or sri lanka$1.mp. or Sudan$.mp. or Swazi$.mp. or Syria$1.mp. or Timor$.mp. or Tonga$1.mp. or Turkmen$.mp. or Tuvalu$.mp. or Ukrain$.mp. or Uzbek$.mp. or Vanuat$1.mp. or Vietnam$.mp. or West Bank.mp. or Gaza.mp. or Yemen$.mp. or Zambia$1.mp. or Albania$1.mp. or Algeria$1.mp. or "Antigua and Barbuda".mp. or antiguan.mp. or barbudan.mp. or Argentin$.mp. or Azerbaijan$1.mp. or Belarus$.mp. or Bosnia$1.mp. or Botswana.mp. or Brazil$.mp. or Bulgaria$1.mp. or Chile$.mp. or China.mp. or Chinese.mp. or Colombia$1.mp. or Costa Rica$1.mp. or Cuba$1.mp. or Dominica$1.mp. or Ecuador$.mp. or Gabon$.mp. or Grenad$.mp. or Iran$.mp. or Jamaica$1.mp. or Jordan$.mp. or Kazakhstan$1.mp. or Latvia$1.mp. or Leban$.mp. or Libya$1.mp. or Lithuania$1.mp. or Macedonia$1.mp. or Malaysia$1.mp. or Maldiv$.mp. or mauriti$.mp. or Mexic$.mp. or Montenegr$.mp. or Namibia$1.mp. or Palau$.mp. or Panama$.mp. or Peru$.mp. or Romania$1.mp. or Russia$1.mp. or Serbia$1.mp. or Seychell$.mp. or South Africa$1.mp. or Saint Kitts.mp. or Saint Lucia.mp. or Saint Vincent.mp. or Suriname$1.mp. or Thai$.mp. or Tunisia$1.mp. or Turk$.mp. or Uruguay$.mp. or Venezuala$1.mp.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5,6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	n/a

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	n/a
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6-7
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	7-9
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	7
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	7-9
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	n/a
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9-10
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	10
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	11
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	n/a

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