Effective components of nurse-coordinated care to prevent recurrent coronary events: a systematic review and meta-analysis

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ABSTRACT
Current guidelines on secondary prevention of cardiovascular disease recommend nurse-coordinated care (NCC) as an effective intervention. However, NCC programmes differ widely and the efficacy of NCC components has not been studied. To investigate the efficacy of NCC and its components in secondary prevention of coronary heart disease by means of a systematic review and meta-analysis of randomised controlled trials. 18 randomised trials (11 195 patients in total) using 15 components of NCC met the predefined inclusion criteria. These components were placed into three main intervention strategies: (1) risk factor management (13 studies); (2) multidisciplinary consultation (11 studies) and (3) shared decision making (10 studies). Six trials combined NCC components from all three strategies. In total, 30 outcomes were observed. We summarised observed outcomes in four outcome categories: (1) risk factor levels (16 studies); (2) clinical events (7 studies); (3) patient-perceived health (7 studies) and (4) guideline adherence (3 studies). Comparing with usual care, NCC lowered systolic blood pressure (weighted mean difference (WMD) 2.96 mm Hg; 95% CI 1.53 to 4.40 mm Hg) and low-density lipoprotein cholesterol (WMD 0.23 mmol/L; 95% CI 0.10 to 0.36 mmol/L). NCC also improved smoking cessation rates by 25% (risk ratio 1.25; 95% CI 1.08 to 1.43). NCC demonstrated to have an effect on a small number of outcomes. NCC that incorporated blood pressure monitoring, cholesterol control and smoking cessation has an impact on the improvement of secondary prevention. Additionally, NCC is a heterogeneous concept. A shared definition of NCC may facilitate better comparisons of NCC content and outcomes.

INTRODUCTION
Coronary heart disease (CHD) remains a major cause of morbidity and mortality worldwide. Important determinants are the ageing of populations and unhealthy lifestyles. 1, 2 Patients with established CHD are at very high risk for recurrent cardiovascular events and mortality and are therefore considered the first priority in secondary prevention. 3 Although adequate risk factor control to guideline-recommended target levels is highly effective in the secondary prevention setting, recent surveys have shown that risk factor control in clinical practice is far from ideal, leaving substantial room for improvement. 4-6 Secondary prevention provided and coordinated by nurses, that is, nurse-coordinated care (NCC), has the potential to improve patient compliance and risk factor control in patients with CHD, although previous reports on the effect of NCC have not shown clear and convincing results. 7 8 A previous review concluded that NCC in secondary prevention has a beneficial effect on quality of life. 9 However, no consistent relationships were observed between NCC interventions and other outcomes; in another review, almost half of the interventions had no significant effect on study outcomes. 10 Heterogeneity in intervention strategies and outcomes hinders comparison between the various studies. 10 The European guidelines on cardiovascular disease prevention state that NCC prevention programmes are effective, based on two trials. 11, 12 Available research is, however, more extensive and the overall findings appeared less conclusive. In the present study, we therefore systematically reviewed the available evidence on the efficacy of NCC in secondary prevention of CHD.

METHODS
Search strategy and selection
Using a comprehensive search strategy, we searched MEDLINE, the Cochrane Central Register of Controlled Trials and CINAHL from 1990 up to January 2015, with no language restriction. Since evidence for NCC has evolved after the 1990s, the review was limited to studies published after 1990. The following search terms were entered as independent terms, text words or medical subject headings (MeSH) terms: (1) coronary heart disease or cardiovascular patient or cardiovascular diseases and (2) nurse led or case manage* or nurse practitioner or managed care programs/organization and administration. In addition, reference lists of existing reviews were manually searched to identify additional relevant studies. Our MEDLINE search strategy is described in detail in online supplement 1.

Two reviewers independently screened all titles and abstracts identified by the search. Studies that were classified as possibly relevant by at least one reviewer were retrieved in full text and assessed for inclusion using a standardised inclusion form. Multiple publications reporting on the same study were included only when additional relevant outcomes were presented; they were counted as one study. Disagreements were solved by discussion between the two reviewing authors. We conducted our systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement. 13
Selection criteria
Studies were included only if (a) they were designed as a randomised controlled trial (RCT); (b) patients were hospitalised or being treated by a general practitioner (GP) for secondary prevention of CHD; (c) Trials were included as at least 70% of their included study population had cardiovascular disease (CVD) or reported data separately on a secondary prevention group; (d) a registered nurse was involved as a ‘nurse coordinator’, using Krumholz’s description of coordinated care: the development and implementation of a therapeutic plan to integrate the efforts of multiple health professionals and (e) the outcomes reported included risk factors, health behaviours, clinical events, patient-perceived health or guideline adherence. For studies meeting these criteria, all other outcomes, except costs, were taken into account in our analysis.

Quality assessment
Two reviewers independently assessed the risk of bias in the included studies using the Cochrane Collaboration’s risk of bias tool, which requires critical evaluation of the following domains: sequence generation, allocation concealment, blinding of outcome assessment, incomplete outcome data, selective outcome reporting and other source of bias. After this evaluation, each domain of the studies was classified as having low, high or unclear risk of bias.

Data extraction
Data were extracted about the setting and study population, NCC intervention components and both primary and secondary outcomes of included studies. Two reviewers independently extracted all relevant information using a data extraction form. Due to heterogeneity of the data, a descriptive approach was used to summarise components of NCC and their effect on outcomes. Based on consensus, we distinguished three intervention strategies: (1) risk factor management, (2) multidisciplinary consultation and (3) shared decision making. We rated the intensity of the intervention as high (>4 visits plus more than one NCC strategy used), intermediate (3–4 visits) or low (1–2 visits). We defined a multidisciplinary team as a team with >2 disciplines. Furthermore, we classified the observed outcomes into four categories: (1) risk factor levels, (2) clinical events, (3) patient-perceived health and (4) guideline adherence. In our meta-analysis, we pooled the sufficiently homogeneous outcomes to determine the effectiveness of the NCC intervention.

Statistical analysis
We used forest plots to visualise the effects of NCC on systolic blood pressure (SBP), low-density lipoprotein (LDL) cholesterol and smoking cessation compared with usual care, stratified for treatment intensity (high, intermediate, low, unknown). To indicate the differences between these methods, random effects and fixed effects models were used to pool treatment effects. Mantel–Haenszel fixed effect pooling assumes a single true treatment effect and ignores between-study heterogeneity. DerSimonian–Laird random effects pooling takes between-study heterogeneity into account and leads to wider CIs. However, in random effects pooling, small studies receive more weight and this may affect the pooled treatment estimates. If no between-study heterogeneity exists, both methods yield identical results. Heterogeneity was expressed using the I² statistic. (Pooled) risk ratios were calculated from 2x2 tables, which were derived from the publications, using the metan command (V.3.04, 21 September 2010) in Stata V.13.1.

RESULTS
Study selection
A total of 3524 publications were initially identified (figure 1). Screening the references in these publications yielded another four potentially relevant studies. After two reviewers reviewed titles and abstracts, 44 publications were retrieved in full text. We excluded 25 of these publications after reading the full text (see online supplement 2). To prevent double counting, only Voogdt-Pruis’ primary care study (2010) was included, as it matched our review purpose best.16 Campbell et al reported different outcomes of the same study in two publications. We counted these as one study.17 18 In total, we included 18 studies in our systematic review.

Trial characteristics
Total sample sizes ranged from 138 to 2142 participants in 12 countries of four continents (see online supplement 3). Patients with CHD were recruited during hospital admission11 19–26 or at outpatient clinics,27 28 a community health clinic,29 a secondary prevention unit30 or general practices.16 18 31 32 The study participants’ mean age ranged from 54 to 75 years.22 29 ‘Usual care’ generally consisted of routine aftercare by a GP or cardiologist (see online supplement 3). In six of the trials, routine care was more intensive and included a cardiac rehabilitation programme.21 25 26 28 30 33

Risk of bias in included studies
Online supplement 4 presents the risk of bias across the included studies; 13 of 18 studies (72%) were considered to have a high risk of bias for one or more domains. In general, there was a low risk of selection bias; all studies, except two,30 33 used a valid method for random sequence generation and 4 of 18 trials (22%) used non-individual randomisation methods.11 24 31 32 Allocation concealment was unsatisfactory or not reported in five trials (28%).11 18 24 30 33 In one trial, ‘the patients were randomised by the researchers’,18 which resulted in a high risk of bias. Blinding of intervention is not possible in this type of studies, which increases the possibility of performance bias. Four trials (22%) blinded the outcome assessors using an independent research assistant to carry out the clinical assessments,21 24 28 32 and in three additional trials, outcome data were independently retrieved from hospital records.22 23 24 The risk of detection bias in the other trials was classified as either unclear or high. Six trials collected outcome data incompletely,11 16 21 24 27 30 and had many missing values19 or unclear exclusions from the analysis.11 Seven studies (39%) did not report prespecified outcomes19–21 26 27 30 33 in the primary publication or in a trial registry or design paper, if available. Of 18 trials in total, five recent trials (28%) were registered in a trial registry.11 17 25 28 29 Eleven studies (61%) used one or more self-reported outcomes for lifestyle-related risk factors, which may have introduced bias.34

Description of the intervention by strategy
The NCC programmes varied in components and intensity (see online supplement 3). We identified 15 components of the NCC intervention and grouped them into three strategies (figure 2): (1) risk factor management, for example, lifestyle counselling, blood pressure and lipid control; (2) multidisciplinary consultation, for example, consultation and referral and (3) shared decision making, for example, goal setting and family support.

Risk factor management
Risk factor management was the most commonly used NCC strategy and was reported in 13 studies (72%). In six studies
(33%), nurses were authorised to prescribe or titrate medication.\textsuperscript{20} 26–29 31 In two of these studies, this was done according to prespecified algorithms.\textsuperscript{26} 29 To encourage a more active lifestyle, NCC interventions consisted of ‘instruction to participate in a home-based exercise programme’,\textsuperscript{29} ‘Stepping Out’ programmes to promote physical activity,\textsuperscript{18} starting a physical training programme in the first 3 months of the intervention,\textsuperscript{30} recommendation to walk briskly for 20 min daily\textsuperscript{26} or referral to a physiotherapist.\textsuperscript{11}

Multidisciplinary consultation

The second strategy, multidisciplinary consultation, was assessed in 11 studies (61%). ‘Involvement of a multidisciplinary team’ was part of this strategy in four trials (22%).\textsuperscript{11} 26 28 29 Seven trials\textsuperscript{11} 16 20 23 25 28 31 (39%) incorporated ‘referral to more specialised disciplines’ as needed.

Shared decision making

The third strategy, ‘shared decision making’, was incorporated in 10 studies (56%). This strategy refers to implementing family support,\textsuperscript{11} 21 40 goal setting for cardiac risk factor control\textsuperscript{11} 18 19 21 28 29 33 and a personalised action plan.\textsuperscript{11} 18 20 27 29 33

The included studies varied in terms of the duration of the intervention (2–24 months), frequency of visits (3–14 contacts) and follow-up time (3–24 months). The majority used a 12-month follow-up period (see online supplement 6). In eight studies (44%), telephone follow-up was used.\textsuperscript{19} 21 22 25–27 25 33
and in six studies (33%) home visits were part of the intervention (see online supplement 3). Six trials included four or more visits plus more than one NCC strategy (high intensity). Six trials were rated as intermediate intensity, three trials were rated as low intensity, and three studies were rated as unclear intensity (see online supplement 3).19–24

### Description of outcomes by category

Outcomes of NCC varied considerably (see online supplement 5a,b). In total, 30 NCC outcomes were measured. We grouped observed outcomes into four categories: (1) risk factor levels; (2) clinical events; (3) patient-perceived health and (4) guideline adherence.

#### Risk factor levels

In 14 studies (78%), outcomes of NCC studies were measured as improvement of risk factor levels with heterogeneous treatment effects (see online supplement 6). One study used SCORE, a comprehensive cardiovascular risk algorithm designed for the primary prevention setting, as the study outcome. Figures 3–5 present our meta-analyses of weighted mean differences and relative risk (RR) calculations of trials reporting on SBP, LDL cholesterol and smoking cessation, respectively.

Seven studies reported on SBP outcomes. The NCC intervention decreased SBP by 2.96 mm Hg (95% CI 1.53 to 4.40 mm Hg) compared with usual care with low-to-moderate between-study heterogeneity (I²=37.1%). Eight trials reported on LDL cholesterol outcomes. The effect of NCC compared with usual care on LDL cholesterol was −0.23 mmol/L (95% CI −0.36 to −0.10 mmol/L), with substantial heterogeneity (I²=74.3%). Trials incorporating prescription and/or titration of drug therapy by nurses were associated with a significant reduction in LDL cholesterol and SBP compared with usual care. Meta-analysis of eight trials comparing smoking cessation rates, generally self-reported (75%), between NCC and usual care yielded a pooled RR of 1.25 (95% CI 1.08 to 1.43). Random effects and fixed effects models showed no between-study heterogeneity in treatment effects (I²=0.0%). Six studies reported smoking cessation rates at 12 months, one study at 6 months and one study at 12 weeks of follow-up.

#### Clinical events

In total, seven studies reported on clinical events (see online supplement 5b) and five studies reported on recurrent events and the duration of hospitalisation or readmission rates at assessment time >6 months. In four of these studies, a reduction was shown for all-cause and cardiovascular readmission rates or the duration of hospitalisation and other CVD rates or recurrent coronary events. A disease management programme significantly reduced the secondary outcome emergency department encounters (incidence density ratio −2.08, p<0.001), claims for diagnostic or therapeutic services (830 vs 1208 claims, p=0.012) and the use of laboratory services (1481 vs 2401, p=0.007) in favour of the NCC intervention. The trials that assessed the outcomes all-cause mortality, time to readmission or death or event-free survival all showed no effect of NCC versus usual care on these outcomes.

#### Patient-perceived health

Six publications reported patient-perceived health outcomes with different instruments and showed small effects (see online supplement 5b and 6). Three studies showed a statistically significant improvement on the following questionnaires (or one of their subscales): the short form 36 (SF-36), chest pain, perception of chronic illness care and the Seattle Angina Questionnaire. Snaterse M, et al. Heart 2016;102:50–56. doi:10.1136/heartjnl-2015-308050

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**Figure 3** Forest plot of seven randomised trials on the effect of nurse-coordinated care (NCC) on systolic blood pressure. Trials are ordered by treatment intensity and year. Medication indicates trials using medication-titration; I-V, inverse-variance (fixed effects); D+L, DerSimonian–Laird (random effects). Random effects estimates in the subgroups are identical to the fixed effects estimates, no between-trial heterogeneity. Except for two trials (Gorden et al, Jiang et al), all trials used a 12-month follow-up period.

| Author     | Year | Difference, mmHg (95% CI) | Medication |
|------------|------|---------------------------|------------|
| High Intensity |      |                           |            |
| Allen      | 2011 | -6.20 (-10.20, -2.20)     | Medication |
| Jorstad    | 2013 | -4.30 (-7.02, -1.58)      | Medication |
| Intermediate Intensity | |       |                           |            |
| Gordon     | 2002 | -0.90 (-4.91, 3.11)       |            |
| Jiang      | 2007 | -1.49 (-3.84, 0.88)       |            |
| Voogdt-Pruis| 2010| -1.10 (-4.02, 1.82)       |            |
| Low Intensity |     |                           |            |
| Khunti     | 2007 | -4.58 (-6.86, -2.28)      | Medication |
| Unknown Intensity | |       |                           |            |
| Jolly      | 1999 | -2.20 (-5.90, 1.50)       |            |

Heterogeneity between groups: p = 0.331

I-V Overall (I-squared = 37.1%, p = 0.146) -2.98 (-4.09, -1.88)

D+L Overall -2.96 (-4.40, -1.53)
Figure 4  Forest plot of eight randomised trials on the effect of nurse-coordinated care (NCC) on serum low-density lipoprotein cholesterol concentrations. Trials are ordered by treatment intensity and year. Medication indicates trials using medication-titration; I–V, inverse-variance (fixed effects); D+L, DerSimonian–Laird (random effects). Except for three trials (Allison et al, Gorden et al, Jiang et al), all trials used a 12-month follow-up period.

| Author    | Year | Difference, mmol/L (95% CI) | Medication |
|-----------|------|-----------------------------|------------|
| High Intensity |
| DeBusk    | 1994 | -0.64 (-1.02, -0.26)        | Medication |
| Allen     | 2002 | -0.39 (-0.64, -0.14)        | Medication |
| Allen     | 2011 | -0.41 (-0.59, -0.23)        | Medication |
| Jonkelaan | 2013 | -0.13 (-0.26, 0.00)         | Medication |
| Intermediate intensity |
| I–V Subtotal (I-squared = 73.2%, p = 0.011) | -0.29 (-0.37, -0.18) | D+L Subtotal (-0.35 (-0.56, -0.15)) |
| D+L Overall | -0.23 (-0.36, -0.10) |

Figure 5  Forest plot of eight randomised trials on the effect of nurse-coordinated care (NCC) on smoking cessation rates. Trials are ordered by treatment intensity and year. M–H indicates Mantel–Haenszel (fixed effects), D+L indicates DerSimonian–Laird (random effects). The trial by Wood et al was excluded since only the absolute cessation risk difference (of 10.4% (−0.30 to 21.20) in favour of NCC) was reported and pooling of absolute risk differences caused much heterogeneity in the stratum with the intermediate intensity trials. NCC_nN and Usual_Care_nN denote the number of quitters (n) of the total number of smokers at baseline (N) in the NCC intervention groups and usual care groups, respectively. Except for one trial (Jiang et al), all trials used a 12-month follow-up period.

| Author    | Year | Relative Risk of Quitting (95% CI) | NCC_nN | Usual_Care_nN |
|-----------|------|-----------------------------------|--------|---------------|
| High intensity |
| DeBusk    | 1994 | 1.33 (1.09, 1.62)                | 92/131 | 64/121        |
| Allen     | 2011 | 1.12 (0.89, 1.40)                | 86/169 | 71/156        |
| Intermediate intensity |
| Allen     | 1996 | 2.36 (0.83, 6.66)                | 9/14   | 3/11          |
| Carleson  | 1997 | 1.94 (1.01, 3.77)                | 15/32  | 9/25          |
| Gorden    | 2002 | 0.40 (0.29, 5.98)                | 1/5    | 2/4           |
| Jiang     | 2007 | 1.31 (0.78, 2.38)                | 17/33  | 15/38         |
| Voogd-Prijs | 2010 | 1.52 (0.39, 5.88)                | 4/68   | 4/102         |
| Unknown intensity |
| Jolly     | 1999 | 0.92 (0.50, 1.70)                | 18/89  | 17/87         |
| M–H Overall (I-squared = 0.0%, p = 0.459) | 1.26 (1.08, 1.43) | D+L Overall (1.25 (1.08, 1.43)) |

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Guideline adherence
Three trials reported better results for the NCC intervention compared with the usual care group on the outcome category ‘guideline adherence’, which implies assessment of risk factors according to secondary prevention guidelines.18 31 32

Summary of effective interventions and their NCC components
We found that interventions that include independent prescription and/or titration of drug therapy by nurses and a high-intensity strategy appeared to be effective in reducing SBP and LDL cholesterol (figures 3 and 4).20 26–29 31 Effective components regarding behavioural interventions were goal setting for cardiac risk factor control plus identification of barriers, an approach that positively affected the risk factor profile in several studies.11 18 19 21 29

Of 11 trials with prespecified primary outcomes, eight trials demonstrated positive outcomes for NCC compared with usual care: for the outcome category risk factor levels: total cholesterol,16 29 31 LDL cholesterol,29 triglycerides,29 pharmacological treatment,31 SCORE28 blood pressure,24 25 and diet;11 clinical events: all-cause and cardiovascular readmission (days)53 and guideline adherence.18 32 Half of these studies were classified as high intensity, including >4 face-to-face contacts11 18 28 29 and frequent telephone follow-up in one of them.29

DISCUSSION
The evidence summarised in this review suggests that prescription and/or titration of drug therapy by nurses, in combination with a high-intensity strategy, can decrease SBP and LDL cholesterol. NCC also improved smoking cessation substantially by 25%, but, although nurses’ attention for lifestyle-related risk factors was a common component in the reviewed studies, this did not result in weight loss. Evidence from cardiac rehabilitation studies with exercise and multimodal interventions showed an effect on mortality.15 This effect might have been achieved through improved adherence to lifestyle modification and medication, which may be a result of frequent follow-up visits by nurses. The intervention components and outcome measures were very heterogeneous. This indicates that NCC is not yet a clearly defined concept, as well as a complex intervention. Complex interventions, including several components, are made up of various interconnecting parts and it is therefore difficult to evaluate the contribution of individual components. Furthermore, breaking down these complex interventions into separate components does not take into account the synergistic effects of combining these components. In most studies, NCC interventions were multifaceted, broadly structured and therefore lacked focus. As there is a variation in the selection of outcomes in the included studies, it is important to answer the question what should be appropriate goals for NCC. Consensus about NCC content and reporting of outcome measurements for RCTs would facilitate a better evidence base for future. In 2006, the American Heart Association Disease Management Taxonomy Writing Group published a statement about defining and classifying different care models, in particular disease management.14 The interdisciplinary writing group designed a conceptual model and its proposed components to allow comparisons across interventions of disease management trials. This statement forms an ideal starting point to compare diverse disease management programmes and to assess specific components associated with effectiveness. Such an initiative would also be valuable for the development of NCC programmes.

Limitations
We encountered heterogeneity in our meta-analyses. We also observed between-study differences that we could not explain. Although the composition of NCC programmes was heterogeneous, this was not always the case for their relative effects on outcomes. The overall quality of the RCTs in this review was moderate. At the same time, it was encouraging that more recent studies had better methodological quality and clinical trial registration. One older study was deemed to be of low or unclear quality since it did not describe critical components for assessing the risk of bias.38 We nevertheless included this study in the meta-analysis of smoking cessation. Many studies were at risk of selective reporting. In several studies, no prespecified primary and secondary endpoints were stated. Self-reported outcomes were used as well, so the observed effects could be overestimated or underestimated. The results should therefore be interpreted with caution.

Overweight and smoking remained persistent and prevalent risk factors in many of the studies. A recent review on the efficacy of lifestyle modification programmes to support behaviour change in patients with CHD found that comprehensive lifestyle modification programmes reduced mortality by 34% and cardiac readmissions by 35%.36 Interventions incorporating four self-regulation techniques (ie, goal setting, planning, self-monitoring, feedback) were associated with greater lifestyle benefits. This is in line with our finding that goal setting is a successful component for both behavioural counselling and medication-regulated risk factors. Community-based comprehensive lifestyle programmes take this approach and this might be a new opportunity to achieve weight reduction in patients with CHD.37–40

Despite clinical heterogeneity, we conclude that effective NCC interventions consist of these components: (i) prescription and/or titration of drug therapy by nurses;26–29 31 particularly with predefined algorithms;26 29 (ii) tailored behavioural counselling with goal setting11 18 19 21 29 33 and (iii) frequent follow-up visits and telephone contacts.26 27 29

Our review shows that when NCC incorporates blood pressure monitoring, cholesterol control and smoking cessation, it may improve secondary prevention. Finding effective interventions to achieve weight reduction in patients with CHD remains an important challenge for future. Additionally, NCC has shown to be a heterogeneous concept. We recommend a shared definition of NCC to facilitate better comparisons of NCC content and outcomes.

Acknowledgements The authors thank Ms Faridi van Etten-Jamaludin, clinical librarian at AMC, University of Amsterdam, for her valuable contribution in developing the search strategy.

Contributors MS, RJGP, BMB and WJMSOr participated in the design of the systematic review. MS, JD and PJ performed study selection, quality assessment and extraction of data. MS, GtR, PJ and JD were involved in the data analyses. MS, GtR, JD, RJGP, WJMSOr were involved in the interpretation and discussion of results. MS drafted the manuscript. JD, PJ and WJMSOr contributed to the drafting of the review. GtR, SMB, BMB and WJMSOr provided critical revision for important intellectual content. All authors approved the final version of the manuscript.

Funding MS is supported by a research grant from the Netherlands Organisation for Scientific Research (NWO).

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

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41. Gordon NF, English CD, Contractor AS, et al. Effectiveness of three models for comprehensive cardiovascular disease risk reduction. Am J Cardiol 2002;89:1263–8.
42. Muller-Riemenschneider F, Damm K, Meinhard C, et al. Evaluation of medical and health economic effectiveness of non-pharmacological secondary prevention of coronary heart disease. GMS Health Technol Assess 2009;5:16.
43. Janssens V, De Gucht V, Dusseldorp E, et al. Lifestyle modification programmes for patients with coronary heart disease: a systematic review and meta-analysis of randomized controlled trials. Eur J Prev Cardiol 2015;20:620–40.
44. McEwen A, West R, McRobbie H. Effectiveness of specialist group treatment for smoking cessation vs. one-to-one treatment in primary care. Addict Behav 2006;31:1650–60.
45. Jebb SA, Ahern AL, Olson AD, et al. Primary care referral to a commercial provider for weight loss treatment versus standard care: a randomised controlled trial. Lancet 2011;378:1489–92.
46. Jolly K, Lewis A, Beach J, et al. Comparison of range of commercial or primary care led weight reduction programmes with minimal intervention control for weight loss in obesity: lighten up randomised controlled trial. BMJ 2011;343:d6500.
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Online supplement 1 MEDLINE search strategy

(systematic[sb] OR (Therapy/Broad[filter])) AND ("Coronary Disease"[Majr] OR coronary disease*[tiab] OR coronary heart disease*[tiab] OR cardiovascular patient*[tiab] OR "Cardiovascular Diseases"[Majr] OR cardiovascular disease*[tiab] OR "Coronary Artery Disease"[Majr] OR "Heart Diseases"[Majr] OR cardiac disease*[tiab] OR "Coronary Disease"[Mesh:noexp] OR coronary risk*[tiab] OR "Myocardial Infarction"[Majr] OR cardiovascular[ti] OR coronary[ti] OR cardiac[ti] OR Myocardial Infarction[ti]) AND ("Disease Management"[Mesh] OR Disease Management*[tiab] OR Diseases Management*[tiab] OR "Patient Education as Topic"[Mesh] OR nurse led*[tiab] OR nursing management*[tiab] OR nurse case management*[tiab] OR case manage*[tiab] OR registered nurse*[tiab] OR "Nurse Practitioners"[Mesh] OR nurse practitioner*[tiab] OR nurse coordinat*[tiab] OR nurse delivered*[tiab] OR "Nurse's Role"[MAJR] OR "Models, Nursing"[MAJR] OR "Nurse Clinicians"[Mesh] OR "Managed Care Programs/organization and administration"[Majr] OR "Case Management"[Majr] OR nurse counselor*[tiab] OR advanced practice nurse*[tiab] OR ((led) AND (nurse*)) OR ((clinic) AND (nurse*)))
### Online supplement 2 Excluded studies and reasons for exclusion

| Study | Reason/ selection criterion |
|-------|-----------------------------|
| Allison TG, Squires RW, Johnson BD, et al. Achieving national cholesterol education program goals for low-density lipoprotein cholesterol in cardiac patients: Importance of diet, exercise, weight control, and drug therapy. *Mayo Clin Proc* 1999;74:466-473. | No nurse-coordinated care |
| Broers CJM, Smulders J, van der Ploeg TJ, et al. Nurse practitioner equally as good as a resident in the treatment of stable patients after myocardial infarction, but with more patient satisfaction. *Ned Tijdschr Geneesk* 2006;150:2544-8. | No secondary prevention |
| Coburn KD, Marcantonio S, Lazansky R, et al. Effect of a community-based nursing intervention on mortality in chronically ill older adults: a randomized controlled trial. *PloS Med.* 2012;9(7). | No CHD patients |
| Giannuzzi P, Temporelli PL, Maggioni AP, et al. Global Secondary Prevention strategies to Limit event recurrence after myocardial infarction: the GOSPEL study. A trial rom the Italian Cardiac Rehabilitation Network. *Arch Intern Med.* 2008;168:2194-2204. | No nurse-coordinated care |
| Goessens BM. A Randomised, controlled trial for risk factor reduction in patients with symptomatic vascular disease: the multidisciplinary Vascular Prevention by Nurses Study (VENUS). *Eur J Cardiovasc Prev Rehabil.* 2006;13:996-1003. | No CHD patients |
| Goldie CL, Prodan-Bhalla N, Mackay M. Nurse practitioners in postoperative cardiac surgery: Are they effective? *Can J Cardiovasc Nurs.* 2012;22: 8-15. | No secondary prevention |
| Gould, KA. A Randomized controlled trial of a discharge nursing intervention to promote self-regulation of care for early discharge interventional cardiology patients. *Dimens Crit Care Nurs* 2011;30:117-25. | No nurse-coordinated care |
| Johnston M, Foullkes J, Johnston DW, et al. Impact on patients and partners of inpatient and extended cardiac counseling and rehabilitation: a controlled trial. *Psychosomatic medicine* 1999;61:225-233. | No nurse-coordinated care |
| Study                                                                 | Patients or Care                                                                 | Evidence Type |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------|
| Jun M. Case management to reduce risk of cardiovascular disease in a county health care system. *Arch Intern Med.* 2009;169:1988-1995. | No CHD patients                                                                  |               |
| Lapointe F, Lepage S, Larrivee L, et al. Surveillance and treatment of dyslipidemia in the post-infarct patient: can a nurse-led management approach make a difference? *Can J Cardiol* 2006 Jul;22:761-767. | No nurse-coordinated care                                                         |               |
| Leemrijse CJ, vanDijk L, Jorstad HT, et al. The effects of Hartcoach, a lifestyle intervention provided by telephone on the reduction of coronary risk factors: a randomised trial. *BMC Cardiovasc Disord.* 2012;12:47. | No RCT                                                                           |               |
| Mainie PM. To examine the effectiveness of a hospital-based nurse-led secondary prevention clinic. *Eur J Cardiovasc Nurs.* 2005;4:308-13. | No RCT                                                                           |               |
| McHugh F. Nurse led share care for patients on the waiting list for coronary artery bypass surgery: a randomised controlled trial. *Heart* 2001;86:317-23. | No nurse-coordinated care                                                         |               |
| Miller P. Regimen compliance two years after myocardial infarction. *Nursing Research* 1990;39:33-6. | No nurse-coordinated care                                                         |               |
| Mills M, Loney P, Jamieson E, et al. A primary care cardiovascular risk reduction clinic in Canada was more effective and no expensive than usual on demand primary care - a randomised controlled trial. *Health and Soc Care in the Community* 2010;18:30-40. | No CHD patients                                                                  |               |
| Patja K, Absetz P, Auvinen A, et al. Health coaching by telephony to support self-care in chronic diseases: clinical outcomes from The TERVERA randomized controlled trial. *BMC Health Services Research.* 2012;12:147. | No nurse-coordinated care                                                         |               |
| Roderick P, Ruddock V, Hunt P, et al. A randomized trial to evaluate the effectiveness of dietary advice by practice nurses in lowering diet-related coronary heart disease risk. *Br J Gen Pract* 1997;47:7-12. | No nurse-coordinated care                                                         |               |
| Selvaraj FJ, Mohamed M, Omar K, et al. DISSEMINATE study group. The impact of a disease management program (COACH) on the attainment of better cardiovascular risk control in dyslipidaemic patients at primary care centers (The DISSEMINATE Study): a randomised controlled trial. *BMC Fam Pract.* 2012;13:97. | No nurse-coordinated care                                                         |               |
| Author(s)                                                                 | Title                                                                                     | Type of Care                                      |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------|
| Shah BR, Adams M, Peterson ED, et al.                                    | Secondary prevention risk interventions via telemedicine and tailored patient education (SPRITE): a randomized trial to improve post-myocardial infarction management. *Circ Cardiovasc Qual Outcomes* 2011;4:235-242. | No RCT                                           |
| Taylor CB, Housten N, Smith PM, et al.                                   | The effect of a home-based, case managed, multifactorial risk-reduction program on reducing psychological distress in patients with cardiovascular disease. *J of Cardiopulm Rehab.* 1997;17:157-162. | No nurse-coordinated care                        |
| Vale MJ, Jelinek MV, Best JD, et al.                                     | For the COACH Study Group. Coaching patients On Achieving Cardiovascular Health (COACH). *Arch Intern Med.* 2003;163:2775-2783. | No nurse-coordinated care                        |
| Voogdt-Pruis HR, Van Ree JW, Gorgels AP, et al.                         | Adherence to a guideline on cardiovascular prevention: a comparison between general practitioners and practice nurses. *Int J Nurs Stud* 2011;48:798-807. | Double publication                               |
| Woollard J.                                                               | Effects of general practice-based nurse-counselling on ambulatory blood pressure and antihypertensive drug prescription in patients at increased risk of cardiovascular disease. *J Hum Hypertens* 2003;17:689-95 | No CHD patients                                  |
| Woollard J.                                                               | Effects of a general practice-based intervention on diet, body mass index and blood lipids in patients at cardiovascular risk. *J Cardiovasc Risk* 2003;10:31-40 | No CHD patients                                  |
| Zhao Y, Wong FK.                                                         | Effects of a post-discharge transitional care programme for patients with coronary heart disease in China: a randomised controlled trial. *J Clin Nurs* 2009;18:2444-2455. | No nurse-coordinated care                        |
Characteristics of included studies.

| Study           | Sample size (n) | Study population, setting, usual care                                                                 | Mean age in years | Men (%) | Intervention content and coordinating activities                                                                                                                                                                                                                   | Intensity |
|-----------------|-----------------|---------------------------------------------------------------------------------------------------------|------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Allen et al.    | 138             | Women after CABG. Hospital (start pre-discharge) and outpatient clinic, USA. Usual care by primary provider, standard discharge teaching and physical therapy instructions, pre-discharge group class. | 64               | 0%      | I: Nurse-directed behavioural interventions with elements of self-efficacy construct, starting the day before hospital discharge with a videotape and workbook. Hospital-based smoking cessation counselling. Feedback on food questionnaire, short-term goals for diet, exercise and smoking cessation. | Consultation: first visit before hospital discharge, 1 follow-up counselling after one month. Home visits: 1 visit, after 2 weeks. Telephone follow-up: 1 phone call, after 2 months. **Intensity: intermediate** |
| Allen et al.    | 228             | Hypercholesterolemia and CHD patients. Outpatient clinic, USA. Usual care by primary provider cardiologist enhanced with feedback on lipids. | 60               | 72%     | I: NP (case manager) + cardiologist/primary provider participated in managing patient’s lipids. NP had permission to prescribe and monitor lipid-lowering drug therapy. One outpatient visit 4-6 weeks after discharge to initiate a lipid management plan. Lipid testing, medication and lifestyle modifications were an integral part of lipid management. Nutritional counselling, physical activity, smoking cessation counselling and relapse prevention. | Consultation: first visit 4-6 weeks after discharge. 7 contacts per patient within 12 months. Home visits: 1 visit. Telephone follow-up: yes. Duration: average of 4.5 hours per patient **Intensity: high** |
| Allen et al.    | 525             | African American or Caucasians CVD patients. Community health clinics, USA. Usual care from primary provider with enhanced feedback regarding CVD risk factors. | 54               | 29%     | I: Behavioural interventions to effect lifestyle changes. Aggressive pharmacologic management, lifestyle modification, identification of barriers to attainment of goals by a NP functioning as a case coordinator. Pre-appointment reminders. Specific algorithms for drug treatment were developed; a low-literacy Wellness Guide was developed specially for the study as a behavioural tool to promote lifestyle changes. Instructions to participate in a home-based exercise program. | Consultation: 7 visits within 12 months. Telephone follow-up: 6 contacts between the consultations. **Intensity: high** |
| Study          | Sample size (=n) | Study population, setting, usual care                                                                 | Mean age in years | Men (%) | Intervention content and coordinating activities                                                                 | Intensity       |
|---------------|------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------|---------------------------------------------------------------------------------------------------------------------|-----------------|
| Allison et al. (2000) | 326   | Instable AP or elective PCI patients without myocardial infarction from chest pain unit. Cardiovascular health clinic, USA. | 58                | 56%     | I: Risk factor modification plan by a nurse interventionist, pharmacologic lipid management, referrals, and additional follow-up as indicated (check lipids). | Consultation: 3 one-hour visits or more if indicated within 6 months after discharge. Duration: 3 hours or more Intensity: intermediate |
| Campbell et al. (1998) | 1343 | CHD patients, 19 general practices. North Scotland. Usual care from general practitioner. | 66                | 58%     | I: Nurse clinic visits contains (1) symptoms reviewing to identify poor control and referral, (2) assessing drug treatment, (3) blood pressure and lipid control, (4) behavioural risk factors were assessed. Feedback, goal planning and an agreed action plan were outlined on a take home form. Leaflets to help with dietary modifications and Stepping Out programmes to promote physical activity were available. Health visitors, district nurses or practice nurses run the clinics. A clinic coordinator provided support by phone. | Consultation: 2 to 6 visits within 12 months. Duration: first visit around 45 min., follow-up visits around 20 minutes. Intensity: high |
| Carlsson et al. (1997) | 168   | Acute myocardial infarction patients. Secondary prevention unit, Sweden. Usual care from general practitioner, 2 or 3 visits in one year. | 62                | 75%     | I: 3-month period education program, individually and in group sessions: counselling for smoking cessation, dietary education -information orally and in writing- and physical activity. Continued with 2-3 times weekly exercise training sessions for 10-12 weeks (40 min.) | Consultation: 4 visits within ten months. Duration: total of 9 hours per patient. Intensity: intermediate |

*Before randomization:* The first five weeks all patients were scheduled for two visits: at a nurse and one visit at a cardiologist. They were informed about CAD risk factors and the effect of lifestyle changes on the prognosis. All patients were invited to join an exercise program, with extra information about the positive effects of physical activity.
| Study                        | Sample size (n) | Study population, setting, usual care | Mean age in years | Men (%) | Intervention content and coordinating activities                                                                                                                                                                                                                                                                                                                                 | Intensity |
|-----------------------------|----------------|---------------------------------------|-------------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Carrington et al. (2013)    | 602            | Elective and emergency patients with any cardiac diagnosis requiring ongoing management. Home visits, Australia. | 70                | 72%     | I: Home visit within 7-14 post index hospitalization according to GARDIAN system. Intensity of management by the cardiac nurse including repeat home visits, telephone coaching, and referral was adjusted accordingly. Detailed clinical report and recommendations were sent to the patient's specialist and family physician. Patients were able to contact the cardiac nurse for continued advice and support.                                                                 | Home visits: 1 or more Telephone follow-up: average of 3.3 calls per patient (duration of 7.5 minutes) Intensity: low |
| DeBusk et al. (1994)        | 585            | Acute myocardial infarction patients. Hospital (start pre-discharge) and outpatient clinic, USA. | 57                | 79%     | I: (1) Nurse-initiated telephone contacts, (2) Computer-generated progress reports mailed to the patients, (3) visits for treadmill exercise testing, nutritional counselling, lipid lowering drug therapy (algorithms), or smoking relapse counselling by nurses. Nurses obtained permission to add a new drug; changes in dosage did not require permission.                                                                 | Consultations: 4 visits to nurse case manager within 6 months. Telephone follow-up: max. 14 calls. Duration: 9 hours. Intensity: high |
| Study          | Sample size (n) | Study population, setting, usual care                                                                 | Mean age in years | Men (%) | Intervention content and coordinating activities                                                                                                                                                                                                 | Intensity |
|---------------|----------------|----------------------------------------------------------------------------------------------------|-------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Gordon et al. (2002) | 155           | Diagnosed CAD patients. Cardiac rehabilitation clinic (I1), outpatient clinic (I2), and shopping mall kiosk/hospital outpatient complex (I3), USA. | 60                | 75%     | All patients received a computer-generated cardiac risk factor report, goal level based on guidelines and an individualized action plan. Usual care by physicians. I1: Cardiac rehabilitation program. 3 days/week, additionally education on CAD disease, risk factors and lifestyle modification. Included written materials, audiotapes, group education, one-on-one counselling. Referral for medication changes. I2: Physician-supervised, nurse-care-managed program. Education on CAD disease, risk factors and lifestyle modification. Included written materials, audiotapes, one-on-one counselling. Home-based exercise plan, nutrition, weight, stress management, smoking cessation program. Supervising physician made medication changes or referral. I3: Community-based program at a shopping mall kiosk or hospital outpatient complex. Administered by exercise physiologists. Counselling on site or via telephone, 1-2/week. Education on CAD disease, risk factors and lifestyle modification, ca. 15 min. Included written materials, audiotapes, one-on-one counselling. Home-based exercise plan, nutrition, weight, stress management, smoking cessation program. Referral for medication changes. | Consultation: 2 visits with the physician and nurse. Telephone follow-up: 4 calls
Intensity: intermediate |
| Study            | Sample size (=n) | Study population, setting, usual care                                                                 | Mean age in years | Men (%) | Intervention content and coordinating activities                                                                                                                                                                                                 | Intensity          |
|-----------------|------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Jiang et al. (2007) | 167              | First hospitalization with AP or myocardial infarction. Hospital (start pre-discharge) and home visits, China. Usual care unclear. | 62                | 71%     | I: Cardiac rehabilitation program: *Phase I: Hospital based patient/family education on seven topics:* (1) CHD and self-management principles, (2) medication management (3) angina prevention and management (4) physical exercise (5) dietary management (6) smoking cessation and (7) family support. *Phase II: Home-based rehabilitative care* (1) setting of daily behavioural goals (2) setting of goals for cardiac physiological risk control (3) goal directed self-management (4) log record (5) participated family members (6) follow-up care through home visits and telephone calls for monitoring, facilitating and reinforcing the self-management practice of the patients and supportive behaviours of family members. | Consultation: 3 months, intensity unclear Home visits: yes Telephone follow-up: yes *Intensity: intermediate* |
| Jolly et al. (1999) | 597              | Newly diagnosed patients with myocardial infarction and angina. General practices, United Kingdom. Usual care unclear. | 64                | 71%     | I: An undefined program to coordinate preventive care from hospital-home led by three specialist liaison nurses. Coaching of practice nurses to provide structured follow-up care and seek advice. Responsibility for coordinating follow-up care. Each patient received a record, which prompted and guided follow up at standard intervals. | Consultations: visit practice staff every 3-6 months Telephone follow-up: yes, support of practice staff by phone *Intensity: unclear* |
| Jorstad et al. (2013) | 754              | ACS patients. 11 outpatients clinic, The Netherlands. Usual care by cardiologist and cardiac rehabilitation programme. | 58                | 80%     | I: Nurse-coordinated prevention program in addition to UC based on guidelines. Focus on (1) healthy lifestyles (2) biometric risk factors (3) medication adherence. This included medication titration as needed. Referral to other health professions or treating physician for diabetes as needed. | Consultations: 4 visits in six months *Intensity: high* |
| Khunti et al. (2007) | 1316             | CHD and CHF patients from 20 general practices, United Kingdom. Usual care from primary healthcare team, also open access to ECG and secondary care clinic. | 70                | 62%     | I: In addition to UC, two peripatetic nurse specialists trained in the management of CHD and CHF travelled between practices, where they held weekly clinics. Including assessment, conformation of diagnosis by investigations, medication management and titration and liaison between primary and secondary care. | Consultations: Weekly clinics, intensity unclear Home visits: only for housebound patients with CHF *Intensity: low* |
| Study                        | Sample size (=n) | Study population, setting, usual care | Mean age in years | Men (%) | Intervention content and coordinating activities | Intensity                      |
|------------------------------|------------------|---------------------------------------|-------------------|---------|---------------------------------------------------|--------------------------------|
| Meisinger et al. (2013)      | 340              | MI patients of ≥65 years. Hospital (start pre-discharge) and home visits, Germany. | 75                | 62%     | I: Intervention combining (1) case management and (2) disease management components: (1) identification of individual care problems, the facilitation of care coordination, (2) management of cardiac risk factors and the provision of information and individual education, including medication and medication adherence. | Home visits: Varying number of home visits (0-4), dependent on patients' needs and risk level. First consultation before discharge. Telephone follow-up: at least every 3 months, average of 19 minutes per phone call. Duration: Average of 117 minutes per home visit. **Intensity: low** |
| Moher et al. (2011)          | 2142             | CHD patients from 21 general practices, United Kingdom. | 66                | 68%     | 3 methods of promoting secondary prevention. I₁: Audit group. Audit of summary feedback by primary health care team at a practice meeting; amount of patients with CHD, proportion of patients with adequate assessment, data from other practices for comparison. I₂: GP group. Same information as audit group. Recall to general practitioner for patient assessment according to guidelines. Setting up a disease register and systematic recall of patients. I₃: Nurse group. Same information as GP group. Recall to nurse-clinic for patient assessment according to guidelines of secondary prevention. Nurses received education to implement it. Setting up a disease register and systematic recall of patients in a nurse led clinic. | Consultations: unclear **Intensity: unclear** |
| Voogdt-Pruis et al. (2010)   | 701              | Patients with high risk for or documented CVD. Primary care, The Netherlands. | 64                | 64%     | I: Nurse consultation for cardiovascular risk management according to Dutch guideline with referral to other professions (dietician). Lifestyle and medical advice. | Consultations: 3 to 4 consultations within 12 months. **Intensity: intermediate** |
| Study                                | Sample size (=n) | Study population, setting, usual care                                                                 | Mean age in years | Men (%) | Intervention content and coordinating activities                                                                                                                                                                                                 | Intensity       |
|-------------------------------------|------------------|------------------------------------------------------------------------------------------------------|-------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Wood et al. (2008)                  | 946              | ACS or high-risk patients and their partners. Only hospital arm taken, 12 hospitals in Europe. Usual care unclear.                                        | 63                | 70%    | I: Initial assessment of risk factors, lifestyle, drug treatment of patients and partners. Reassessment of patient and partner at 16 weeks, reassessment at one year. Medication titration by cardiologist. Dieticians (hospital) gave advice in terms of food and patterns and set realistic goals for patient and families. Nurse smoking cessation, quit date+ plan. Blood pressure cholesterol and glucose monitoring, education to improve medication compliance. Physiotherapist patterns, capacity, plan+ goals, step counter, 7-day activity recall diary. | Consultations: at least 8 sessions, plus a group workshop and exercise class in 4 months. Intensity: high |
| Young et al. (2003)                 | 162              | MI patients at hospital discharge, home visits. Canada. Usual care consists of follow-up by own cardiologist, information in cardiac teaching class and cardiac rehabilitation programme. | 69                | 60%    | I: Disease management program. A standardized pathway ‘the nursing checklist’, referral criteria for specialty care, communication system with the family physician and patient education.                                                                                             | Home visits: minimum of 6 home visits within 8 weeks. Intensity: unclear |

Abbreviations: ACS: Acute Coronary Syndrome, AP: Angina pectoris, C: Control, CABG: Coronary arterial bypass graft, CHD: Coronary heart disease, CHF: Coronary heart failure, CVD: Cardiovascular disease, ECG: Electrocardiogram, GP: General practitioner, I: Intervention, MI: myocardial infarct, NP: Nurse practitioner, PCI: Percutaneous coronary intervention.
### Risk of bias in included studies

| Study                  | Random sequence generation (selection bias) | Allocation concealment (selection bias) | Blinding of outcome assessment (detection bias) | Incomplete outcome data (attrition bias) | Selective reporting (reporting bias) | Other bias |
|------------------------|---------------------------------------------|-----------------------------------------|-------------------------------------------------|----------------------------------------|--------------------------------------|-----------|
| 1994, DeBusk           | +                                           | +                                       | -                                               | +                                      | +                                    | +         |
| 1996, Allen            | +                                           | +                                       | -                                               | +                                      | -                                    | +         |
| 1997, Carlsson         | ?                                            | ?                                       | +                                               | +                                      | -                                    | +         |
| 1998a, Campbell        | +                                           | -                                       | ?                                               | +                                      | +                                    | +         |
| 1999, Jolly            | +                                           | ?                                       | +                                               | -                                      | +                                    | +         |
| 2000, Allison          | +                                           | +                                       | -                                               | ?                                      | +                                    | ?         |
| 2001, Moher            | +                                           | +                                       | +                                               | +                                      |                                      |           |
| 2002, Allen            | +                                           | +                                       | ?                                               | +                                      | ?                                    | ?         |
| 2002, Gordon           | ?                                            | ?                                       | ?                                               | +                                      | +                                    |           |
| 2003, Young            | +                                           | +                                       | +                                               | +                                      |                                      | ?         |
| 2007, Jiang            | +                                           | +                                       | +                                               | -                                      | +                                    | ?         |
| 2007, Khunti           | +                                           | +                                       | -                                               | +                                      | +                                    | ?         |
| 2008, Wood             | +                                           | +                                       | +                                               | -                                      | -                                    | +         |
| 2010, Voogdt-Pruis     | +                                           | +                                       | ?                                               | +                                      | +                                    |           |
| 2011, Allen            | +                                           | +                                       | ?                                               | +                                      | +                                    | +         |
| 2013, Carrington       | +                                           | +                                       | +                                               | +                                      |                                      |           |
| 2013, Jorstad          | +                                           | +                                       | +                                               | +                                      |                                      |           |
| 2013, Meisinger        | +                                           | +                                       | +                                               | +                                      |                                      |           |
5a. Assessed outcomes of nurse-coordinated care by category in 18 studies
Presented numbers in figure are study references.
Abbreviations: NCC nurse-coordinated care.
### CLINICAL EVENTS
- All-cause/cardiovascular readmission (rates, days)
- Time to readmission or death
- All-cause mortality
- Event free survival
- Number of ED/cardiology visits
- Diagnostic and therapeutic services/rehabilitation
- Health care costs

### PATIENT PERCEIVED HEALTH OUTCOMES
- SCL-90 symptom checklist
- Social isolation questionnaire
- Hospital Anxiety and Depression Scale
- QoL/Health status
- PACIC chronic illness care
- Shortness of breath
- Chest pain

### GUIDELINE ADHERENCE
- Adequate assessment

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5b. Assessed outcomes of nurse-coordinated care by category in 18 studies
Presented numbers in figure are study references.
Abbreviations: ED emergency department; NCC nurse-coordinated care; SCL-90 Symptom Check List; QoL quality of life; PACIC Patient Assessment of Chronic Illness Care.
## Online supplement Description of outcomes

| Study           | Outcome category   | Outcomes          | Unit of measurement                  | Results: difference between I and C          | Follow-up |
|-----------------|--------------------|-------------------|--------------------------------------|---------------------------------------------|-----------|
| Allen et al.    | Risk factor levels | Smoking           | Self-reported                        | NS                                          | 12 months |
| (1996)          |                    | BMI               | Kg/m²                                | NS                                          |           |
|                 |                    | Weight loss       | Not reported                         | NS                                          |           |
|                 |                    | Dietary intake    | Questionnaire: dietary intake of previous month | Fat(%) p=0.008, saturated fat (%) p=0.02 |           |
|                 |                    | Physical activity | Questionnaire: 7-day activity recall  | NS                                          |           |
| Allen et al.    | Risk factor levels | Lipids            | Total Cholesterol (mmol/L)            | -0.4 mmol/L, p=0.008                        | 12 months |
| (2002)          |                    | LDL-C (mmol/L)    |                                      | -0.39 mmol/L, p=0.001                       |           |
|                 |                    | HDL-C (mmol/L)    |                                      | NS                                          |           |
|                 |                    | Triglycerides (mmol/L) |                                   | NS                                          |           |
|                 |                    | LDL-C<2.59 mmol/L, n (%) |                                  | NR                                          |           |
|                 |                    | Smoking           | Exhaled carbon monoxide + self-reported | NR                                          |           |
|                 |                    | Dietary intake    | Questionnaire: fat intake (%)        | -3.7%, p=0.004                              |           |
|                 |                    | Questionnaire: saturated fat intake (%) |                              | -1.4%, p=0.004                              |           |
|                 |                    | Questionnaire: cholesterol intake (mg) |                              | -62.5 mg, p=0.017                           |           |
|                 |                    | Questionnaire: fiber intake |                                  | NS                                          |           |
|                 |                    | Physical activity | Questionnaire: physical activity      | 18 METS, p=0.05                             |           |
| Allen et al.    | Risk factor levels | Lipids            | Total Cholesterol (mmol/L)            | -0.51 mmol/L, p<0.001                        | 12 months |
| (2011)          |                    | LDL-C (mmol/L)    |                                      | -0.41 mmol/L, p<0.001                        |           |
|                 |                    | HDL-C (mmol/L)    |                                      | NS                                          |           |
|                 |                    | Triglycerides (mmol/L) |                                  | -0.18 mmol/L, p=0.003                        |           |
|                 |                    | Blood pressure    | Systolic BP (mmHg)                   | -6.2 mmHg, p=0.013                          |           |
|                 |                    | Diastolic BP (mmHg) |                                  | -3.1 mmHg, p=0.013                          |           |
|                 |                    | HbA1c             | Mean HbA1c                           | -0.5%, p=0.034                              |           |
|                 |                    | Smoking cessation | Not reported                         | NR                                          |           |
| Study | Outcome category | Outcomes | Unit of measurement | Results: difference between I and C | Follow-up |
|-------|------------------|----------|---------------------|-----------------------------------|-----------|
| BMI   |                  |          | Kg/m²               | NS                                |           |
| Dietary intake | Questionnaire: Habits and History Food Frequency |          | NS                                |           |
| Physical activity | Questionnaire: Stanford 7-Day Physical Activity |          | NS                                |           |
| Perceived health outcomes | Quality of life | Questionnaire: EQ-5D |           | Reported elsewhere |           |
| Perceived health outcomes | Perception of chronic illness care | Questionnaire: PACIC |           | 1.2 points, p<0.001 |           |
| **Allison et al.** (2000) | Risk factor levels | **Lipids** | Total Cholesterol (mmol/L) | NS | 6 months |
| | | LDL-C (mmol/L) |          | NS                                |           |
| | | HDL-C (mmol/L) |          | NS                                |           |
| | | Triglycerides (mmol/L) | 0.37 mmol/L, p<0.01 |           |
| | Blood pressure | Systolic BP (mmHg) |          | NS                                |           |
| | | Diastolic BP (mmHg) |          | NS                                |           |
| | Glucose | Fasting blood glucose (mg/dL) |          | NS                                |           |
| | Pharmacological treatment | Pharmacological treatment rates |          | NS                                |           |
| | Smoking | Exhaled carbon monoxide + self-reported | NS data not applicable for meta-analysis |           |
| | Weight loss | Kg | -1.0 kg, p=0.007 |           |
| | Low fat diet | Questionnaire: no data |          | p=0.012                          |           |
| | Regular exercise | Questionnaire (in min.) |          | 25 min, p=0.049 |           |
| **Clinical events** | **Recurrent events** |          | Rate | -8%, p=0.002 |           |
| | Recurrent coronary event | Rate |          | NS                                |           |
| | Rehospitalization | Rate |          | NS                                |           |
| | Death | All causes |          | NS                                |           |
| | Perceived health outcomes | Psychosocial evaluation | Questionnaire: SCL-90-R |          | NS                                |           |
| | Chest pain | Reporting episodes (%) |          | NS                                |           |
| Study                  | Outcome category     | Outcomes                                  | Unit of measurement                  | Results: difference between I and C            | Follow-up |
|-----------------------|----------------------|-------------------------------------------|---------------------------------------|------------------------------------------------|-----------|
| Campbell et al. (1998)| Risk factor levels   | Aspirin management                         | On target (%)                         | NS                                             | 12 months |
|                       |                      | Blood pressure management                 | On target (%): ≤ 160/90 mmHg          | RR=1.09 (1.06-1.13)                             |           |
|                       |                      | Lipid management                           | On target (%): ≤ 5.2 mmol/L           | RR=1.9 (1.59-2.29)                              |           |
|                       |                      | Smoking cessation                          | On target (self-reported) (%)         | NS data not applicable for meta-analysis       |           |
|                       |                      | Low fat diet                               | On target (DINE-score) (%)            | RR=1.16 (1.03-1.31)                             |           |
|                       |                      | Physical activity                          | On target (%)                         | RR=1.35 (1.16-1.58)                             |           |
|                       | Clinical events      | Use of health service                      | Difference in length of stay (days)   | NS                                             |           |
|                       |                      | Hospital admissions (OR)                   |                                       | OR=0.64 (0.48-0.86), p=0.003                   |           |
|                       | Perceived health outcomes | Anxiety and depression               | Questionnaire: HADS                   | NS                                             |           |
|                       |                      | Health status                              | Questionnaire: SF-36 score             |                                                |           |
|                       |                      | Physical domain                           |                                       | 4.32, p<0.001                                   |           |
|                       |                      | Social domain                              |                                       | 3.51, p=0.007                                   |           |
|                       |                      | Role domain                                |                                       | 8.52, p<0.001                                   |           |
|                       |                      | Role emotional domain                      |                                       | 4.66, p=0.045                                   |           |
|                       |                      | Mental domain                              |                                       | NS                                             |           |
|                       |                      | Energy domain                              |                                       | NS                                             |           |
|                       |                      | Pain domain                                |                                       | 2.50, p=0.035                                   |           |
|                       |                      | General domain                             |                                       | 2.34, p=0.013                                   |           |
|                       |                      | Chest pain                                 |                                       | worsening                                       |           |
|                       |                      |                                          |                                       | *UK=B.59 (U.S.-94), p=0.026*                   |           |
|                       |                      |                                          |                                       | Reporting chest pain                            | NS        |
| Carlsson et al. (1997)| Risk factor levels   | Smoking habits                             | Questionnaire, self-reported           | NS                                             | 12 months |
|                       |                      | Food habits                                | Questionnaire                          | Unclear, p=0.008                                |           |
|                       |                      | Physical activity                          | Questionnaire                          | NS                                             |           |
| Carrington et al. (2013)| Risk factor levels | Clinical status                            | GARDIAN risk status (effect sizes unknown) |                                               |           |
|                       | Clinical events      | All-cause and cardiovascular hospitalization | Rate                                   |                                                |           |
| Study | Outcome category | Outcomes | Unit of measurement | Results: difference between I and C | Follow-up |
|-------|------------------|----------|---------------------|-------------------------------------|-----------|
| DeBusk et al. (1994) | Risk factor levels | Lipids | Total Cholesterol (mmol/L) | -0.63 mmol/L, p<0.001 | 12 months |
| | | | LDL-C (mmol/L) | -0.64 mmol/L, p<0.001 | |
| | | | HDL-C (mmol/L) | NS | |
| | | | Triglycerides (mmol/L) | NS | |
| | Smoking cessation | Biochemically + self-reported (%) | 17%, p=0.03 | |
| | Nutritional management | Questionnaire, food frequency | Unclear | |
| | Functional capacity | Treadmill exercise test (METs) | 0.9 METS, p=0.001 | |
| Gordon et al. (2002) | Risk factor levels | Lipids | Total Cholesterol (mmol/L) | NS | 12 weeks |
| | | | LDL-C (mmol/L) | NS | |
| | | | HDL-C (mmol/L) | NS | |
| | | | Triglycerides (mmol/L) | NS | |
| | Blood pressure | Systolic BP (mmHg) | NS | |
| | | Diastolic BP (mmHg) | NS | |
| | Medication use | Change in % | NS | |
| | Smoking | Self-reported | NS | |
| | Weight loss | LBS | NS | |
| | VO2 max | VO2 max (ml/kg/min) | NS | |
| Jiang et al. (2007) | Risk factor levels | Lipids | Total Cholesterol (mmol/L) | -0.33 mmol/L, p<0.001 | 6 months |
| | | | LDL-C (mmol/L) | -0.30 mmol/L, p<0.001 | |
| Study               | Outcome category               | Outcomes                               | Unit of measurement                  | Results: difference between I and C            | Follow-up |
|--------------------|--------------------------------|----------------------------------------|--------------------------------------|-----------------------------------------------|-----------|
| Jolly et al.       | Risk factor levels             | Lipids                                 | Total Cholesterol (mmol/L)           | NS                                            | 12 months |
| (1999)             |                                | Blood pressure                        | Systolic and diastolic differences (mmHg) | NS                                            |           |
|                    |                                | Pharmacological treatment             | Difference in prescribed drugs (%)   | NS                                            |           |
|                    |                                | Smoking cessation                      | Biochemically + self-reported (%)    | NS                                            |           |
|                    |                                | BMI                                    | Kg/m²                                | NS                                            |           |
|                    |                                | Diet                                   | Mean difference in score for intake (self-reported) | NS                                            |           |
|                    |                                | Exercise                               | Distance walked in 6 min. [test]     | NS                                            |           |
|                    | Clinical events                | Practice attendance                    | Difference in mean no. of visits     | NS                                            |           |
|                    | Perceived health outcomes      | Anxiety                                | Questionnaire: HADS subscale        | NS                                            |           |
|                    |                                | Depression                             | Questionnaire: HADS subscale        | NS                                            |           |
|                    |                                | Quality of life                        | Questionnaire: EuroQol               | NS                                            |           |
|                    |                                | Shortness of breath                    | Self-reported (%)                    | NS                                            |           |
|                    |                                | Chest pain                             | Self-reported (%)                    | NS                                            |           |
| Jorstad et al.     | Risk factor levels             | 10-year cardiovascular mortality (SCORE)| Estimation of SCORE risk reduction (%) | -17.4%, p=0.021                                 | 12 months |
| (2013)             |                                | Reduction of 10-year incidence of coronary mortality and morbidity | Framingham Coronary Risk Score (FCRS) | -12.5%, p=0.017                                 |           |
| Study            | Outcome category | Outcomes                      | Unit of measurement          | Results: difference between I and C | Follow-up |
|------------------|------------------|-------------------------------|------------------------------|------------------------------------|-----------|
|                  |                  | Lipids                        |                              |                                    |           |
|                  |                  | Outcomes                      | Unit of measurement          | Results: difference between I and C | Follow-up |
|                  |                  |                                |                              | NS                                 |           |
|                  |                  |                                |                              | NS                                 |           |
|                  |                  |                                |                              | NS                                 |           |
|                  |                  |                                |                              | NS                                 |           |
|                  |                  |                                |                              | NS                                 |           |
|                  |                  | Blood pressure                |                              |                                    |           |
|                  |                  | Systolic BP (mmHg)            |                              | -4.3 mmHg, p=0.002                 |           |
|                  |                  | Diastolic BP (mmHg)           |                              | NS                                 |           |
|                  |                  | Smoking                       |                              | NS                                 |           |
|                  |                  | Self-reported                 |                              | NS                                 |           |
|                  |                  | BMI                           | Kg/m2                        | NS                                 |           |
|                  |                  | Weight                        | Kg                           | NS                                 |           |
|                  |                  | Waist circumference           | Cm                            | -2.1 cm, p=0.048                  |           |
|                  |                  | Clinical events              |                              |                                    |           |
|                  |                  | Total number of readmissions  | N (%)                        | -22%, p=0.023                      |           |
|                  |                  | Readmissions for ACS          | N (%)                        | NS                                 |           |
|                  |                  | Other CVD readmissions        | N (%)                        | -48%, p=0.001                      |           |
|                  |                  | Elective interventions        | N (%)                        | NS                                 |           |
| Khunti et al.   | Risk factor levels|                              |                              |                                    | 12 months |
| (2007)           |                  | Total cholesterol             | Total Cholesterol (mmol/L)    | -0.18 mmol/L (-0.30, -0.05)        |           |
|                  |                  | Systolic BP                   | mmHg                         | -4.58 mmHg (-6.88, -2.28)          |           |
|                  |                  | Diastolic BP                  | mmHg                         | -3.53 mmHg (-4.78, -2.29)          |           |
|                  |                  | ACE inhibitor                 | Prescribed drugs (OR)        | NS                                 |           |
|                  |                  | Aspirin                       | Prescribed drugs (OR)        | NS                                 |           |
|                  |                  | Beta-blocker                  | Prescribed drugs (OR)        | 1.43 (1.19-1.99)                   |           |
|                  |                  | Lipid lowering medication     | Prescribed drugs (OR)        | 1.99 (1.06-3.74)                   |           |
|                  | Risk factor management| BMI                           | Kg/m2                        | NS                                 |           |
|                  | Process of care   | Cholesterol measured          | OR                            | NS                                 |           |
|                  |                  | Cholesterol < 5mmol/L         | OR                            | 1.58 (1.05-2.37)                   |           |
|                  |                  | BP measured                   | OR                            | 22.61 (6.47-70.13)                 |           |
|                  |                  | BP < 140/85 mmHg              | OR                            | 1.61 (1.22-2.37)                   |           |
|                  |                  | Smoking status recorded       | OR                            | 33.96 (14.49-79.62)                |           |
|                  |                  | BMI/weight measured           | OR                            | 10.14 (4.99-20.55)                 |           |
| Study                          | Outcome category     | Outcomes                                      | Unit of measurement                        | Results: difference between I and C | Follow-up |
|-------------------------------|----------------------|-----------------------------------------------|--------------------------------------------|-----------------------------------|-----------|
| Meisinger et al. (2013)       | Clinical events      | First unplanned readmission or death          | Time-to-event from initial discharge (HR)  | NS                                | 12 months |
|                               |                      | Intervention costs                            |                                            | Reported elsewhere                |           |
| Meisinger et al. (2013)       | Perceived health outcomes | Functional ability                           | Questionnaires: the Barthel Index, HAQ-DI, IADL | Not yet been published           |           |
|                               |                      | Social support                                | Questionnaire: F-sozU                       |                                   |           |
|                               |                      | Depressive symptoms                           | Questionnaire: GDS                         |                                   |           |
|                               |                      | Emotional well-being                          | Questionnaire: WHO-5                       |                                   |           |
|                               |                      | Cognitive function                            | MMSE                                       |                                   |           |
| Moher et al. (2001)           | Risk factor levels   | Pharmacological treatment                     |                                            |                                   | 18 months |
|                               |                      | Antiplatelets                                  | Mean (range percentage)                    | Nurse-Audit: 10%, p=0.009         |           |
|                               |                      | Hypotensive                                    | Mean (range percentage)                    | NS                                |           |
|                               |                      | Lipid lowering                                 | Mean (range percentage)                    | NS                                |           |
|                               |                      | Process of care                                | Overall adequate assessment                | Nurse: 85%, GP:76%, Audit: 52%    |           |
|                               |                      |                                               |                                            | Nurse vs. audit p<0.001           |           |
|                               |                      |                                               |                                            | GP vs. Audit p=0.002             |           |
| Study            | Outcome category | Outcomes                   | Unit of measurement                  | Results: difference between I and C                  | Follow-up |
|------------------|------------------|----------------------------|--------------------------------------|---------------------------------------------------|-----------|
| **Adequate assessment of:** |                  | Blood pressure             | Mean (range percentage)              | GP:97%, Audit:86%, p<0.001                        |           |
|                  |                  | Cholesterol                | Mean (range percentage)              | Nurse:88%, Audit:67%, p=0.001                      |           |
|                  |                  | Smoking status             | Mean (range percentage)              | Nurse:95%, Audit:78%, p=0.001                      |           |
| Voogdt-Pruis et al. (2010) | Risk factor levels | Lipids                     | Total Cholesterol (mmol/L)           | -0.2 mmol/L, p=0.009                              | 12 months |
|                  |                  | Blood pressure             | LDL-C (mmol/L)                       | NS                                                |           |
|                  |                  | Smoking cessation          | Self-reported                        | NS                                                |           |
|                  |                  | BMI                         | BMI (kg/m2)                          | NS                                                |           |
| Wood et al. (2008) | Risk factor levels | Lipids                     | Total Cholesterol <5 mmol/L          | NS                                                | 12 months |
|                  |                  | Blood pressure             | BP < 140/90 mmHg                     | 10.4%, p=0.04                                     |           |
|                  |                  | HbA1C                       | Difference (%)                       | NS                                                |           |
|                  |                  | ACE inhibitor               | Difference (%)                       | NS                                                |           |
|                  |                  | Antiplatelet drug          | Difference (%)                       | NS                                                |           |
|                  |                  | Beta-blocker               | Difference (%)                       | NS                                                |           |
|                  |                  | Statin                     | Difference (%)                       | NS                                                |           |
|                  |                  | Not smoking                | Exhaled carbon monoxide + self-reported | NS data not incorporated in meta-analysis       |           |
|                  |                  | BMI                         | BMI < 25 kg/m2                       | NS                                                |           |
|                  |                  | Weight loss                | Weight loss ≥5% in patients          | NS                                                |           |
|                  |                  | Waist circumference        | Women <80cm, men <94cm               | NS                                                |           |
| **Hospital arm** |                  | Blood pressure             | BP < 140/90 mmHg                     | 10.4%, p=0.04                                     |           |
| Diet             | Questionnaire: food habits | Saturated fat <10% of total energy (table 3) (%) | 17.4%, p=0.009                         |                                                   |           |
|                  |                  | Saturated fat <10% of total energy (p.2003) (%) | NS                                  |                                                   |           |
|                  |                  | Eating oily fish ≥3 times per week (%) | 8.9%, p=0.04                         |                                                   |           |
|                  |                  | Eating fruit/vegetables >400 gr per day (table 3) (%) | 37.3%, p=0.004                      |                                                   |           |
|                  |                  | Eating fruit/vegetables >400 gr per day (p.2003) (%) | 15.8%, p=0.03                      |                                                   |           |
|                  |                  | Physical activity          | Physical activity ≥30 min. ≥ 4 times per week (%) | 35.6%, p=0.002                                |           |
| Study          | Outcome category | Outcomes                                      | Unit of measurement                              | Results: difference between I and C | Follow-up |
|---------------|------------------|-----------------------------------------------|-------------------------------------------------|------------------------------------|-----------|
| Young et al.  | Clinical events  | All-cause readmission days                    | Days per 1000 follow-up days (IDR)              | 1.53, p<0.001                      | 454 days  |
| (2003)        |                  | Readmission days for angina, CHF and COPD     | Days per 1000 follow-up days (IDR)              | 1.59, p<0.001                      |           |
|               |                  | ED visits                                     | Number of ED visits                              | 2.08, p<0.001                      |           |
|               |                  | Physician visits                              |                                                  | NS                                 |           |
|               |                  | Diagnostic and therapeutic services           | Absolute numbers (≤225 days of discharge)       | -378, p=0.012                      |           |
|               |                  | Laboratory services                           | Absolute numbers (≤225 days of discharge)       | -920, p=0.007                      |           |

**Abbreviations:**

A: Audit group, ACE: Angiotensin converting enzyme, ACS: Acute Coronary Syndrome, BMI: Body mass index, BP: Blood pressure, C: Control, CHF: Chronic Heart Failure, Cm: Centimeters, ED: Emergency Department EQ-5D: 5 item EuroQol questionnaire, GP: General practitioner, HDL-C: High density lipoprotein cholesterol, I: Intervention, kg: Kilograms, LDL: Low density lipoprotein, Mg: Milligram, MET(S): Metabolic Equivalent Task, NR: Not reported, NS: Non-significant, OR: Odds ratio, PACIC: Patient assessment of chronic illness care, QoL: Quality of life, RR: Relative Risk.