Computer-Assisted versus Oral-and-Written History Taking for the Prevention and Management of Cardiovascular Disease: a Systematic Review of the Literature

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ABSTRACT

Background and objectives: CVD is an important global healthcare issue; it is the leading cause of global mortality, with an increasing incidence identified in both developed and developing countries. It is also an extremely costly disease for healthcare systems unless managed effectively. In this review we aimed to:

– Assess the effect of computer-assisted versus oral-and-written history taking on the quality of collected information for the prevention and management of CVD.

– Assess the effect of computer-assisted versus oral-and-written history taking on the prevention and management of CVD.

Methods: A systematic review of randomised controlled trials that included participants of 16 years or older at the beginning of the study, who were at risk of CVD (prevention) or were either previously diagnosed with CVD (management). We searched all major databases. We assessed risk of bias using the Cochrane Collaboration tool.

Results: Two studies met the inclusion criteria. One comparing the two methods of history-taking for the prevention of cardiovascular disease n = 75.

The study shows that generally the patients in the experimental group underwent more laboratory procedures, had more biomarker readings recorded and/or were given (or had reviewed), more dietary changes than the control group. The other study compares the two methods of history-taking for the management of cardiovascular disease (n = 479). The study showed that the computerized decision aid appears to increase the proportion of patients who responded to invitations to discuss CVD prevention with their doctor. The Computer-Assisted History Taking Systems (CAHTS) increased the proportion of patients who discussed CHD risk reduction with their doctor from 24% to 40% and increased the proportion who had a specific plan to reduce their risk from 24% to 37%.

Discussion: With only one study meeting the inclusion criteria, for prevention of CVD and one study for management of CVD we did not gather sufficient evidence to address all of the objectives of the review. We were unable to report on most of the secondary patient outcomes in our protocol.

Conclusions: We tentatively conclude that CAHTS can provide individually-tailored information about CVD prevention. However, further primary studies are needed to confirm these findings. We cannot draw any conclusions in relation to any other clinical outcomes at this stage. There is a need to develop an evidence base to support the effective development and use of CAHTS in this area of practice. In the absence of evidence on effectiveness, the implementation of computer-assisted history taking may only rely on the clinicians' tacit knowledge, published monographs and viewpoint articles.

KEYWORDS

history-taking; computer; cardiovascular disease; CVD; prevention; management

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BACKGROUND

Cardiovascular Disease (CVD) is caused by a disorder of the heart and circulatory system. In this review we are specifically looking at atherosclerotic cardiovascular disease which includes coronary heart disease, cerebrovascular disease (stroke) and peripheral artery disease. CVD is a leading cause of mortality globally. Chronic diseases, including cardiovascular disease, were estimated to cause more than 60% (35 million) of all deaths in 2005; more than 80% of these deaths occurred in low-income and middle-income countries (31). According to the 2010 Global Burden of Disease Study (58) ischaemic heart disease and stroke killed 12.9 million people in 2010, or one in four deaths worldwide, compared with one in five in 1990. The World Health Organisation projects that by 2030, almost 23.6 million people will die from CVD (10). The risk of developing vascular disease and the rate of its progression is determined by certain 'fixed' risk factors: age, sex, family history of vascular disease and ethnic groups, as well as by certain 'modifiable' risk factors: hypertension, hypercholesterolaemia, physical inactivity, obesity, tobacco consumption and diabetes (51). Ineffective management of CVD associated modifiable risk factors can lead to an increased risk of an adverse cardiovascular event. People with established CVD (such as angina pectoris, CHD, myocardial infarction, transient Ischaemic attacks, stroke or peripheral vascular disease) are at high risk of developing recurrent cardiovascular events; it is possible to prevent this by reducing a patient's cardiovascular risk by modification of adverse lifestyle behaviours and adhering to treatment, thus enabling effective management of their chronic condition (59, 33).

CAHTS facilitate automations of history taking approaches; hence aiding the collection of information in a timely manner by drastically reducing the time spent on dictating and collating written records, while being able to present relevant data in an easily accessible format (50, 4). They can also be administered at a time that is convenient to the patient and practitioner, saving resources, such as additional time and space (57, 30). Additionally, CAHTS can promote inter-operability between systems and compatibility with electronic health record templates (40). This offers the benefit that the information collected could be linked to a computerized decision support system which can offer patients personalized feedback on their lifestyle choices and advice on how to modify these to reduce their risk of developing or redeveloping cardiovascular related complications.

Clinician and patient-operated CAHTS may help to improve data quality through:

- data entry forms with data validation checks (for example erroneously entered information, such as age of 300, may lead to a prompt for the person to correct this;
- coding of data;
- eliminate transcription errors as the information is not dictated;
- legibility;
- easier access to past records; attribution of entries;
- greater availability;
- facilitating patient verification of their personal information.

Patients can also administer the CAHTS online and on lifestyle and self-generated biomarker readings (for example, blood pressure or blood cholesterol) can be shared with their clinician and assessed without the need for a face to face consultation. Additionally, collected information from gathered histories can generate data sets that may facilitate future epidemiological research (34).

CVD is an important global healthcare issue; it is the leading cause of global mortality, with an increasing incidence identified in both developed and developing countries. CVD is an extremely costly disease for healthcare systems and unless managed effectively, will continue to pose serious challenges to these systems and to the allocation of scarce resources (9). Evidence suggests that current programmes for cardiovascular management offer feasible, cost-effective ways to reduce CVD mortality and morbidity in both developed and developing country populations (10, 23); implementation of such programmes should thus be a priority for health policy-makers. With the move from hospital care to community-based care in many parts of the world, staff become increasingly mobile, thus require access to data input facilities at the point of care. If a patient's history were taken by a CAHTS, the information could be more accessible to the entire, multi-disciplinary, healthcare team and assist in the planning of an appropriate care package for the patient.

Most of the computer-assisted technologies are presently supported by limited empirical evidence. This impedes widespread adoption in the management and prevention of CVD, hence necessitating more evaluations of CAHTS. There is also a need for regular evaluations, analogous to techniques used in continuous quality improvement in healthcare (36, 1, 11). Unless these systems are adequately studied, they may not 'mature' to the extent that is needed to realise their full potential when deployed in every-day clinical settings (18, 15). Because only a few randomised controlled trials involving CATHS have been performed so far, it has been speculated that the improvements in the volume and accuracy of the answers seen in studies (34, 57, 24) may not accurately reflect the intervention. It has been suggested that the effects may be attributed to novelty and performance biases whereby the behaviour of researchers and patients was influenced (24).

CAHTS are frequently promoted as being 'cost-saving' (26, 45), yet cost-effectiveness and efficiency was rarely evaluated rigorously (37), therefore comprehensive cost-effectiveness analyses will be required to assess the financial rationale for choosing one CAHTS over another history taking tool, especially within disease management (45, 28). Although CAHTS have been available for around 50 years, successful use in routine healthcare remains variable. This review aims to establish whether these systems could be effective for the management of CVD, by assisting patient adoption of lifestyle modification behaviour and assisting treatment adherence, and identify any gaps in the research surrounding this. This systematic review involves an up-to-date literature search and detailed description of the studies on CAHTS to provide the framework for a comprehensive evaluation that will lead to an evidence base to inform policy and practice.

METHODS

TYPES OF STUDIES AND PARTICIPANTS

We considered RCT studies that included participants 16 years or older at the beginning of the study, who were at risk of CVD (prevention) and those who were previously diagnosed with CVD (management).

TYPES OF INTERVENTIONS

We considered the following six types of CAHTS:

1. Computer-assisted self-interviewing;
2. Audio computer-assisted self-administered interviewing;
3. Computer-assisted face-to-face interviewing;
4. Computer-assisted telephone interviewing;
5. Interactive voice response telephone interviewing;
6. Internet-based computer-assisted history taking.

CONTROL

Oral and written history taking for people with modifiable CVD risk factors (prevention) and those diagnosed with CVD (management).

OUTCOMES

Primary outcomes:

- Response rates to invitations for (lifestyle) assessment for CVD.
- Quality of data recorded (Composite outcome including: error rates, accuracy, reliability, completeness).
- Lifestyle modifications (Composite outcome including: changes in tobacco consumption (pack years), weight (kg), dietary intake (self-reported intake), physical activity level (number of days a week patient participates in physical activity); Biomarker reading modifications (Composite outcome including: changes in blood cholesterol levels (total cholesterol in mg/dl), blood pressure readings (mmHg), glycosylated haemoglobin A1c level (mm/mol)).

Secondary outcomes

- Cost effectiveness.
- Patient and provider satisfaction with the methods.
- Adverse events (Composite outcome including: CVD mortality and morbidity).
- Response rates to invitations for (lifestyle) assessment or CVD; Patient compliance with treatment.
- Biomarker readings (Composite outcome: includes changes in blood cholesterol levels, blood pressure readings and glycosylated haemoglobin A1c level).
- Cost effectiveness.
- Patient and provider satisfaction with the methods.
- Adverse events (Composite outcome: includes cardiovascular-related mortality (i.e. death due to CHD or stroke), increased cardiovascular-related morbidity (i.e. increased recurrence of a cardiovascular event) and hospitalisation due to a cardiovascular event).

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

We searched electronically the following sources for the identification of trials on 18 June 2016:

- CENTRAL (Issue 5 of 12, 2016) on The Cochrane Library,
- MEDLINE (OVID, 1946 to June 2016 week 1),
- EMBASE (OVID, 1980 to 2016 week 24),
- Web of Science Core Collection (Thomson Reuters, 1970 to 13 June 2016),
- DARE, HTA and EED (Issue 2 of 4, 2016) on The Cochrane Library.

We imposed no language limits. The Cochrane precision-maximising RCT filter was used for MEDLINE and terms as suggested as a RCT filter for EMBASE (14).

We also used the following other resources for the identification of trials:

- 'Current Controlled Trials' (www.controlledtrials.com),
- Clinical Trials.gov (www.clinicaltrials.gov),
- WHO ICTRP Portal (apps.who.int/trialsearch).

We tried to identify additional studies by searching the reference lists of included trials, related (systematic) reviews and meta-analyses. Authors of included studies were contacted for further details (if required) and authors and experts in the field were asked for information about unpublished/ongoing trials.

DATA COLLECTION AND DATA EXTRACTION

To determine the studies to be assessed further, three authors (SP, JV and YP) independently scanned the abstract, title or both sections of every record retrieved. All potentially relevant articles were investigated as full text. Where differences in opinion existed, they were resolved by a third party. If resolving disagreement was not possible, the article were added to those 'awaiting assessment' and authors were been contacted for clarification. An adapted PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow-charts of study selection is attached (19) see Figures 1 and 2.

For studies that fulfilled inclusion criteria, two authors (SP and PT) independently abstracted relevant population and intervention characteristics using standard data extraction templates with any disagreements resolved by discussion, or if required by a third party. Any relevant missing information on the trial was sought from the original author(s) of the article, if required. Authors and experts in the field were asked for information about unpublished/ongoing trials.

ASSESSMENT OF RISK OF BIAS IN INCLUDED STUDIES

Two authors assessed each trial and performed assessment of bias independently. Disagreement was resolved by consensus, or with consultation of a third party.

We assessed risk of bias using the Cochrane Collaboration's tool. We used the following criteria:

- Was the allocation sequence adequately generated? Was the allocation adequately concealed?
- Was knowledge of the allocated intervention adequately prevented during the study? Were incomplete outcome data adequately addressed?

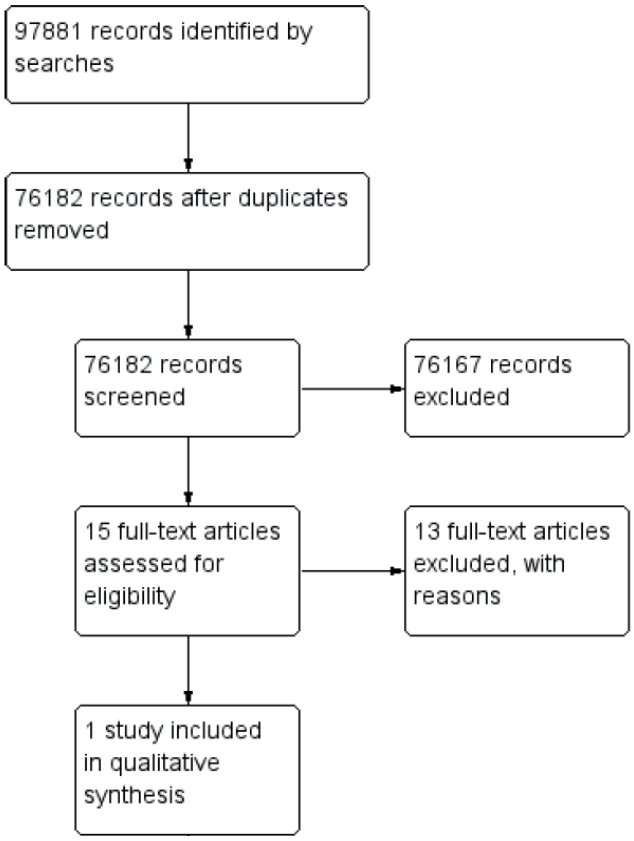

Fig. 1: Flowchart of studies in CVD prevention.

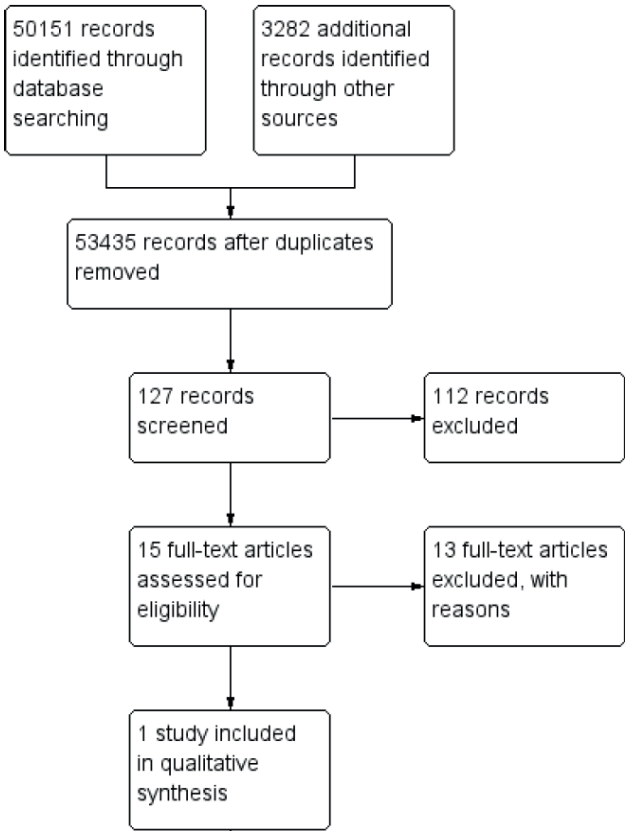

Fig. 2: Flowchart of studies in CVD management.

- Were reports of the study free of suggestion of selective outcome reporting?
- Was the study apparently free of other problems that could put it at a high risk of bias?

We assessed the risk of bias as high, low or unclear. We used the criteria described in the Cochrane Handbook for Systematic Reviews of Interventions (19). Funnel plots were to be used to assess for the potential existence of small study bias. As a number of explanations for the asymmetry of a funnel plot (27) exist, we planned to carefully interpret results (13).

MEASURES OF TREATMENT EFFECT

We collected endpoint scores, as change standard deviations may not be available for many studies. If both endpoint and change scores are available for the same outcomes, only the former was reported in this review. If endpoint scores are not available, but change scores are, we reported the latter in the tables and text of the review. However, for inclusion of a study reporting change score in the meta-analysis, we calculated the endpoint mean from the change score given and assumed that the endpoint standard deviation is equal to the baseline standard deviation. We also took into account the level at which randomisation occurred, such as cross-over trials, cluster-randomised trials and multiple observations for the same outcome.

There were no missing data in the included studies. Evaluation of important numerical data such as screened, randomised patients as well as intention-to-treat and per-protocol population was carefully performed. Attrition rates, for example drop-outs, losses to follow-up and withdrawals were investigated. Issues of missing data and techniques to handle these (for example, last-observation-carried-forward) was critically appraised.

ASSESSMENT OF HETEROGENEITY

The review included two studies one on the prevention of CVD and one on the management of CVD and no assessment of heterogeneity was needed. Results of the studies included were presented in narrative form.

RESULTS

Results were divided into two categories according the main use of CAHTS:

- CVD Prevention,
- CVD Management.

These two categories are reflected in the objectives of the review and the search strategy.

PREVENTION

Results of the search

The search identified 97881 records for screening; 76182 after removing duplicates. The titles of the records were screened by two authors. 127 records were further screened by abstract and 15 were retrieved in full text. One record met the inclusion criteria of the review. Reasons for excluding the abstracts included: participants not having

pre-existing cardiovascular disease, no computer-assisted history taking systems being used as intervention, or the studies were not randomized controlled trials. See Figure 1 for a detailed search strategy.

For included studies see Table 1. One study (43) met our inclusion criteria, the details of which can be found in Characteristics of included studies. For excluded studies see Table 3.

Tab. 1: Characteristics of included studies (CVD prevention).

Author	Reasons for inclusion
Sheridan et al. (2006)	This study was used to test the effectiveness of an individually-tailored, computerized decision aid about CHD on patients' discussions with their doctor and their plans for CHD prevention. Participants were identified from daily clinician schedules and after obtaining clinician's permission, they were approached about the study in the waiting room or in the exam room as they waited for their scheduled visit. 75 adults were enrolled. 41 received decision aid, 34 usual care. After assessing baseline characteristics, all patients in the intervention group were asked to review the computerized decision aid, Heart to Heart. Heart to Heart 1) calculates a patient's global risk of CHD events (e.g. angina, myocardial infarction, and death) in the next 10 years by combining information about their age, sex, blood pressure, total and HDL cholesterol, smoking, diabetes and left ventricular hypertrophy status using a continuous Framingham equation. 2) provides patients with individualized information about their global CHD risk, their personal risk factors, the pros and cons of pertinent CHD risk-reducing therapies (e.g. hypertension medication, cholesterol medication, smoking cessation and aspirin), and the risk reduction achievable after one or more therapeutic interventions 3) encourages patients to choose therapies that are acceptable and feasible for long-term CHD risk reduction.It also provides a summary print-out that can be taken to one's visit with his or her doctor. The patients navigated the decision aid at their own speed. A research assistant was available at all times to answer any questions.

Tab. 1.1: Risk of bias.

Sheridan et al. (2006)		
Type of bias	**Severity of bias**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Quote: We used a computerized random number generator to randomize patients to receive either the Heart to Heart decision aid or a list of their CHD risk factors that they could present to their doctor.
Allocation concealment (selection bias)	Low risk	Quote: Intervention assignments were sealed in security envelopes until after subjects agreed to participate in the study. The research assistant then broke the seal to determine intervention assignment.
Blinding (performance bias and detection bias)	Low risk	Participants were blinded.
Blinding of outcome assessment (detection bias)	High risk	The research team weren't blinded
Incomplete outcome data (attrition bias)	Low risk	Twelve patients (8 in the decision aid group and 4 in the control group) were subsequently determined to be ineligible with those in the decision aid group being slightly more likely to be male and younger. These individuals were excluded from further analyses
Selective reporting (reporting bias)	Low risk	No selective reporting was detected.
Other bias	Low risk	None identified

Effects of interventions in CVD prevention

75 adults were enrolled. 41 patients received the decision aid and 34 received usual care The main effect of the decision aid on decision making was measured in 2 ways: 1) by the proportion of patients who reported they discussed CHD risk with their doctor, and 2) by the proportion of patients that talked with their doctor who reported they had a specific plan for CHD risk reduction at the post-visit survey. Sheridan et al. (2006) measured patient discussions with their doctor through a single question: "Did you and your doctor discuss a plan to lower your chances of having a heart attack?" Sheridan et al. (2006) measured plans for CHD risk reduction through a single question: "At the end of your visit, what did you decide to do, if anything, to lower your chances of heart disease?" Sheridan et al. (2006) considered stated intent to adopt any CHD risk reducing behaviour (i.e. aspirin, lipid lowering medication, antihypertensive medication, smoking cessation medications, dietary change, or exercise) in the next 6 months as sufficient evidence of a plan for CHD risk reduction.

In unadjusted analysis, the decision aid increased the proportion of patients who discussed CHD risk reduction with their doctor from 24% to 40% (absolute difference 16%; 95% CI –4% to +37%). In pre-post testing, the decision aid also appeared to increase the proportion of patients with plans to intervene on their CHD risk through initiating aspirin, lipid lowering medication, antihypertensive medication, smoking cessation medication, dietary change or exercise. The study did not look at the other outcome measures included in our protocol including quality of the data recorded, life-

style modifications, biomarker reading modifications, cost effectiveness, patient and provider satisfaction or adverse events.

MANAGEMENT

Results of the search

The search identified 50151 records from databases and 3282 from other resources, giving a total of 53433 records for screening. The titles of the records were screened by two authors (YP, SP). 127 records were further screened by abstract and 14 were retrieved in full text. One record met the inclusion criteria of the review. Reasons for excluding the abstracts included: participants not having pre-existing cardiovascular disease, no computer-assisted history taking systems being used as intervention, or the studies were not randomized controlled trials. See Figure 2 for more detailed flow of our searches.

For included studies see Table 2. One study, Rogers et al. met the inclusion criteria. Details of the study can be found in Characteristics of included studies. For excluded studies see Table 3.

Tab. 2: Characteristics of included studies (CVD management).

Author	Reasons for inclusion
Rogers et al. (1982)	This study describes the influence of a computerized medical record summary system in three disease areas (hypertension, obesity and renal disease) observed in the course of a controlled, randomized and prospective study of 479 Northwestern University Cardiac, Pulmonary and Renal Clinic (NUCPRC) patients. From 1,200 eligible patients, 484 were randomly selected and assigned to either the experimental or control group. 241 participants were assigned to the experimental group and 238 in the control group. Five participants withdrew from the study before it began. The NUCPRC developed a computerized medical record system (NUCRSS) to provide physicians with concise and current information on patients' problems, to identify omissions in recording of observations and treatment recommendations, to show ordered procedures that were not carried out, to record deficiencies in medical reasoning and, most importantly, to recommend corrective actions according to selected criteria. In the experimental group, patients had available a computer printout of a current NUCRSS summary in addition to the traditional medical record, while the control group had available only the handwritten, traditional medical record. Hypertension: examination of the renal function occurred more frequently during both years of the study I n the experimental group (120 times in experimental group and 93 times in control group). There was little difference in distributions across conditions for either the fundusopic examination (14 vs 9) or the intravenous pyelogram (78 vs 59). Obesity: failure to give or review a diet at any time during the two-year study period clearly occurred less often among experimental patients (number of diets given or reviewed: 23 in experimental group and 16 in control group). Renal disease: there were fewer experimental patients who had not had a urine analysis performed either year, while more experimental patients had tests performed both years (30 vs 14).

Tab. 2.1: Risk of bias.

Type of bias – Rogers et al. (1982)	Severity of bias	Author
Random sequence generation (selection bias)	High risk	Rogers et al. (1982) stated the randomization process was performed as follows: From 1,200 eligible patients, 484 were selected and assigned to either an experimental or control group. It is not clear whether the participants were randomly selected or assigned to a group.
Allocation concealment (selection bias)	High risk	As above
Blinding (performance bias and detection bias)	Unclear risk	In the experimental group, patients had a computer printout of a current North wester University computerized medical record system summary (NUCRSS) in addition to the traditional medical record, while the control group had only the handwritten, traditional medical record. Physicians participating in the study were randomly divided into three groups: 1) those that were only to see patients with automated records available; 2) those who were to see patients without automated records; and 3) those whose patient load was approximately half with and half without automated records. It would therefore not have been possible to blind participants or physicians to their allocation. Blind retrospective chart reviews were done one and two years after the entry of patients into the study for both experimental and control patients by trained personnel using a standardised evaluation form.
Incomplete outcome data (attrition bias)	Unclear risk	Rogers et al. (1982) reported the number and percentage of patients who died by the end of the two-year study period or were transferred to another clinic, moved or left for unknown reasons. Differential dropout rates across conditions due to death or other reasons were not presented.
Selective reporting (reporting bias)	Low risk	None identified
Other bias	Low risk	None identified

EFFECTS OF INTERVENTIONS IN CVD MANAGEMENT

The effects of the interventions in the Rogers et al. (1982) study were measured according to the performance of selected annual medical tests and procedures that were considered to be essential for the care of patients with hypertension, obesity and renal disease. These were blood tests for renal function, electrolytes, fundoscopy and intravenous pyelogram for hypertension. Urine analysis and culture was also checked for the renal patients. Obese patients were given diet information or had their diet reviewed. The details of the diet were not reported.

Tab. 3: Characteristics of excluded studies.

Author	Reason for exclusion
Baer et al. (2012)	Full text of this study was not available, even after contacting the authors.
Bulpitt et al. (1976)	Investigation results not often present in the notes.
Davis et al. (2010)	Experimental group not computer-assisted history-taking.
Gill et al. (2009)	Electronic health records used in both groups.
Khambatta et al. (2011)	Not RCT.
Lowensteyn et al. (1988)	Control group only received cardiovascular risk profile if the patient was clinically re-evaluated during a 3 month follow-up visit.
Ruffin et al. (2011)	Familial risk assessed only.
Sequist et al. (2011)	Electronic health records used in both groups.
Sequist et al. (2012)	The aim is to identify subsequent actions following a risk alert. This outcome is not included in our protocol.
Sheridan et al. (2006)	Study participants did not have a history of cardiovascular disease.
Sheridan et al. (2011)	Study participants did not have a history of cardiovascular disease.
Van Wyck et al. (2003)	Abstract prospective, full article not located.
Wakefield et al. (2012)	Study does not compare electronically gathered data to data gathered in oral and/or written form.

PRIMARY OUTCOMES FOR PREVENTION AND MANAGEMENT

Quality of data recorded (Composite outcome: includes error rates, completeness, accuracy, reliability) and lifestyle modifications (Composite outcome: includes changes in tobacco consumption, weight, dietary intake and physical activity levels): the results of the study show that generally the patients in the experimental group underwent more laboratory procedures, and/or were given (or had reviewed), more diets than the control group. There was a statistically significant difference in the number of hypertensive patients who had their renal function checked, the number of diets given or reviewed for obese patients, and the number of urine cultures checked for patients with renal disease. These are all tests that are considered essential for high quality, routine care of patients with cardiovascular disease. The results therefore suggest that computer-assisted methods of history-taking are more effective for the management of cardiovascular disease.

The paper does not comment on adverse effects but does describe mortality rates. About a third of patients died of hypertension (28% in the experimental group and 33% in the control group). 10% died in the renal group (10% of both the experimental and control group). 8% died in the obesity group (1% of the experimental group and 7% of the control group).

RISK OF BIAS IN INCLUDED STUDIES (TABLE 2.1)

Overall the risk of bias for Sheridan et al. was low. The risk of bias for Rogers et al. (1982) was high.

DISCUSSION

Discussion is divided into two categories according to the aims and initial searches. The two categories are:

- CAHTS for CVD Prevention,
- CAHTS for CVD Management.

CAHTS FOR CVD PREVENTION

The comprehensive search strategy for studies on the use of CAHTS for CVD prevention yielded 97881 results, of which one met our inclusion criteria. A randomized trial was carried out to test the effectiveness of an individually-tailored, computerized decision aid about CHD on patients' discussions with their doctor and their plans for CHD prevention. A computerized random number generator was used to randomize patients to receive the intervention, the computerised Heart to Heart decision aid, or the control which was a list of their chronic heart disease (CHD) risk factors that they could present to their doctor. This list included qualitative identification of the risk factors and, where appropriate, a quantitative value for the following risk factors: blood pressure, total and HDL cholesterol, smoking, diabetes, and left ventricular hypertrophy (LVH) status. The computerized decision aid allows computer-assisted history-taking of patients' CVD risk factors. For more information on how it uses this information see Table 1. 75 adults were enrolled. 41 patients received the decision aid and 34 received usual care. The main effect of the decision aid on decision making was measured in 2 ways: 1) by the proportion of patients who reported they

discussed CHD risk with their doctor, and 2) by the proportion of patients that talked with their doctor who reported they had a specific plan for CHD risk reduction at the post-visit survey. Sheridan et al. (2006) measured patient discussions with their doctor through a single question: "Did you and your doctor discuss a plan to lower your chances of having a heart attack?" Similarly, Sheridan et al. (2006) measured plans for CHD risk reduction through a single question: "At the end of your visit, what did you decide to do, if anything, to lower your chances of heart disease?" Sheridan et al. (2006) considered stated intent to adopt any CHD risk reducing behaviour (i.e. aspirin, lipid lowering medication, antihypertensive medication, smoking cessation medications, dietary change, or exercise) in the next 6 months as sufficient evidence of a plan for CHD risk reduction. In unadjusted analysis, the decision aid increased the proportion of patients who discussed CHD risk reduction with their doctor from 24% to 40% (absolute difference 16%; 95% CI −4% to +37%). In pre-post testing, the decision aid also appeared to increase the proportion of patients with plans to intervene on their CHD risk through initiating aspirin, lipid lowering medication, antihypertensive medication, smoking cessation medication, dietary change or exercise. Overall assessment of risk of bias was low. There are no other reviews on the use of CAHTS for the prevention of cardiovascular disease. Other studies (43, 53, 41, 32, 54, 7) assessed the use of CAHTS on cardiovascular disease prevention and management, but these either did not compare oral to written history taking processes or were conducted in participants who did have pre-existing cardiovascular disease. In agreement with our findings they generally found that computer-assisted methods improved the prevention or management of patients with cardiovascular disease or with risk factors for cardiovascular disease.

CAHTS FOR CVD MANAGEMENT

The comprehensive search strategy for studies on the use of CAHTS for CVD management yielded 50151 results, of which one met our inclusion criteria (39) This study is a randomized, controlled prospective study looking at the influence of a computerized medical record summary system in three disease areas (hypertension, obesity and renal disease) in 479 Northwestern University Clinic patients. Patients in the experimental group had computerised record summaries whilst patients in the control group had only a hard copy medical record. They were compared on several medical tests and procedures whose yearly occurrence was considered good medical practice for this patient population. These were blood tests for renal function, electrolytes, fundoscopy and intravenous pyelogram for hypertension. Urine analysis and culture was also checked for the renal patients. Obese patients were given diet information or had their diet reviewed. The details of the diet were not reported. For more detailed information please see Table 2. The results of the study show that generally the patients in the experimental group underwent more laboratory procedures, and/or were given (or had reviewed), more diets than the control group. These laboratory procedures give the biomarker readings which are stated in our protocol as appropriate outcome measures for our review.

Rogers et al. (1982) also reports that the traditional non-computerised records used in the clinics contained an average of 1.5 pounds of notes, laboratory test outcomes, diagnoses and other information not entered over long periods of time by the physicians. This may have affected continuity of care, especially as patients were not necessarily seen by the same physician from visit to visit. The same authors further noted that the computerised information system condensed the records to items that were current and relevant, providing physicians with warnings and reminders about good medical practices. These comments regarding the medical records provide evidence for quality of data, a further outcome measure stated in our protocol.

Traditionally a patient's history is taken by oral-and-written methods; however, it can also be taken using computers. Although computer-assisted history taking systems (CAHTS) have been available (in various forms) since the 1960s (2), wide and systematic adoption in routine delivery of healthcare remains variable. CAHTS, such as a web-based questionnaire or interactive touch screen monitors, are tools used to aid clinicians in gathering information from patients. They can be used by healthcare professionals, or directly by patients, as in the case of pre- or post-consultation interviews (34, 38, 52). CAHTS can be used remotely, for example via the Internet, telephone or mobile phone messaging or on-site. Bowling (2005) describes that the various CAHTS typologies depend on three interrelated factors: a) the information technology used to collect the information (e.g. personal computer, personal digital assistant, Internet, telephone); b) the mode of administration (e.g. administered by an interviewer or self-administered); c) the channel of presentation (e.g. auditory, oral or visual). The CAHTS typologies can be classified as computer-assisted self-administering interviewing and audio computer-assisted self-administered interviewing, computer-assisted face-to-face interviewing, computer-assisted telephone interviewing, interactive voice response telephone interviewing and Internet-based computer-assisted history taking. Given the social and psychological value ascribed to lifestyle choices, asking a person about these in general practice makes responses vulnerable to social desirability bias (a tendency to behave in a way that is believed to be socially acceptable and desirable). Computer interviewing is effective for obtaining personal information that many people find difficult to discuss face-to-face as the systems can collect patient data without the need for a face-to-face interviewer (46); CAHTS may therefore help to reduce the social desirability bias in patient-reporting of harmful lifestyle choices or behaviors. Computers cannot however detect non-verbal communication, which may be important or relevant for a patient's treatment plans that could be identified in a face-to-face consultation (34).

There are no other reviews on the use of CAHTS for the management of cardiovascular disease. Other studies (17, 43, 53, 41, 54, 7, 55) assessed the use of CAHTS on cardiovascular disease prevention and management, but these either did not compare oral to written history taking

processes or were conducted in participants who did not have pre-existing cardiovascular disease. In line with our review they generally commented that computer-assisted methods improved the management of patients with cardiovascular disease or with risk factors for cardiovascular disease.

Bulpitt et al. (1976) found that in three hypertension clinics, certain symptoms and risk factors for cardiovascular disease were recognised more often when computer-held records were used instead of standard hospital notes. Davis et al. (2010) found a reduction in glycated Haemoglobin in diabetic patients when a remote comprehensive diabetes self-management education intervention was used. LDL cholesterol was also reduced when compared with usual care. Davis et al. (2010) also cites Hivert et al. (2009) who tested the effects of a web-based decision support tool, the diabetes Disease Management Application (DMA), developed to improve evidence-based management of type 2 diabetes. The number of HbA(1c) tests obtained per year increased significantly in the intervention group compared with the control group, as did the number of LDL cholesterol tests and the proportions of patients undergoing at least one foot examination per year. Levels of HbA(1c) decreased by 0.2 in the intervention group and increased by 0.1 in the control group, proportions of patients with LDL cholesterol levels <130 mg/dl increased by 20.3% in the intervention group and 10.5% in the control group. These results suggest that web-based patient-specific decision support has the potential to improve the parameters of diabetes care, which is relevant to our research question due to their use of computer-assisted decision support tools and the importance of diabetes as a risk factor for cardiovascular disease. If the diabetes can be improved with computer-assisted history taking this consequently impacts on the prevention of cardiovascular disease.

Gill et al. (2009) found improved outcomes in patients at high-risk of cardiovascular disease when an electronic form containing prompts regarding sub optimal care was integrated into the electronic medical record. The 3 main outcome variables were defined accordingly: the proportion of patients tested adequately for hyperlipidaemia, the proportion of patients whose most recent low-density lipoprotein cholesterol (LDL-C) was at goal, and the proportion of patients at high risk of cardiovascular disease with an LDL-C > 130 who were prescribed lipid-lowering medications. The study showed improvements in the quality of lipid management after implementing an electronic disease management intervention in primary care. Lowensteyn et al. (1988) found improved identification of patients at high-risk of cardiovascular disease when computer-generated risk profiles were used. Their use was also associated with a significantly greater improvement in serum lipid profiles and overall coronary risks. Ruffin et al. (2011) found that a self-administered web-based tool that assesses familial risk for 6 common diseases including cardiovascular disease and provides personalised risk-tailored messages, increased self-reporting of physical activity and healthy eating. This is consistent with the findings of the current study which found that experimental patients had their diets reviewed more frequently and evidenced greater weight loss on average than control patients. Evidence of improvement in weight loss is relevant to our research question due to the importance of obesity as a risk factor for cardiovascular disease. The use of computer-assisted tools to increase weight loss may consequently help to improve cardiovascular disease prevention and management. Rogers et al. (1982) also found that the traditional record used in the clinics contained on average 1.5 pounds of notes, laboratory test outcomes, diagnoses and other information entered over long periods of time by different physicians. The computerized system, in addition to condensing the medical information to items that were current, legible and relevant, also provided physicians with warnings and reminders concerning good medical practices.

Our findings are consistent with other reviews on the use of computer-assisted history taking systems (CAHTS) for diabetes such as Pappas et al. (2011) which found that CAHTS can save professionals' time, improve delivery of care to those with special needs and also facilitate the collection of information, especially potentially sensitive information (e.g. sexual history, alcohol consumption). The findings are consistent with another systematic review, Wei et al. (2011) that found computer-assisted diet history taking to be as accurate as the oral-and-written method. However, this systematic review only included one study so we are unable to make robust conclusions.

LIMITATIONS

Biases in the review process were prevented by involving three reviewers in the data extraction and assessment of bias processes. All studies that met the initial inclusion criteria and were not in English were reviewed by colleagues who were either native speakers of the respective languages or bilingual. Although CAHTS can facilitate the history taking in several languages, it is possible that some patients speak none of the languages offered by the system.

CONCLUSIONS

In this review of the literature, we aimed to assess the effect of computer-assisted versus oral-and written history taking on the quality of collected information for the prevention and management of CVD. Also, to assess the effect of computer-assisted versus oral-and written history taking on the prevention and management of CVD. We searched all major databases. We identified two studies. The limited evidence in this review shows that an individually-tailored computerized decision aid about cardiovascular disease prevention appears to increase the proportion of patients who discuss cardiovascular disease prevention with their doctors and the proportion of patients who have a specific plan for CHD risk reduction. These findings were corroborated by within group differences that showed an increase in the perception that cardiovascular disease requires a personal decision and a specific plan for risk reduction. This might be clinical-

ly relevant but further research evidence is needed. We tentatively conclude that CAHTS can provide individually-tailored information about CVD prevention. However, further primary studies are needed to confirm these findings. There is a need to develop an evidence base to support the effective development and use of CAHTS in this area of practice.

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